

PROJECT MANUAL FOR:

**Veterinary Science Building
Demolition**

PROJECT NO.: CP233041

AT:

**UNIVERSITY OF MISSOURI - COLUMBIA
COLUMBIA, MISSOURI**

FOR:

**THE CURATORS OF THE
UNIVERSITY OF MISSOURI**

PREPARED BY:

PWARCHITECTS, INC.

ATTN: ERIC ROSELLE, AIA

2120 FORUM BOULEVARD, SUITE 101

COLUMBIA, MISSOURI 65203

PHONE: (573) 449-2683

FAX: (573) 442-6213

**Issued for Bid
July 12, 2024**

ARCHITECT:

I hereby certify these Drawings and/or Specifications have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Drawings and/or Specifications are as required by and in compliance with Building Codes of the University of Missouri.

The below listed Drawings and/or Specification sections have been prepared by me, or under my supervision. Any Specification sections within this document, not listed below, are not certified under this statement and are the responsibility of other parties.



07.12.2024

Signature: _____

Eric S. Roselle – MO License No.: #A-2014036992

Certified Drawings:

G001 Cover Sheet
G002 Location Map, List of Drawings, Codes
D101 Building Demolition, Staging, &
Salvage Plan

Certified Specification Sections:

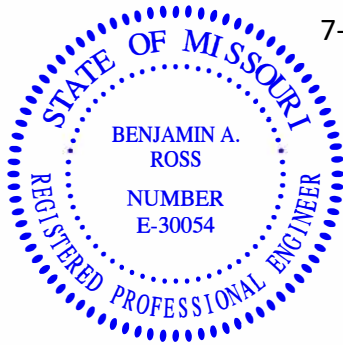
02 4100 Demolition
09 9000 Painting and Coating

CIVIL ENGINEER:

I hereby certify these Drawings and/or Specifications have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Drawings and/or Specifications are as required by and in compliance with Building Codes of the University of Missouri.

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7-12-2024



Signature: _____

Benjamin A. Ross, P.E.
Registered Professional Engineer
MO License No.: E-30054

Certified Drawings:

C0.01	General Notes
C1.01	Temporary Traffic Control Plan
C2.01	Erosion Control Plan
C3.01	Site Demolition Plan
C3.02	Utility Demolition Plan
C4.01	Site Plan
C5.01	Grading & Drainage Plan
C6.01	Utility Plan
C7.01	Site, Erosion Control, & Storm Sewer Details

Certified Specification Sections:

311000	Site Clearing
312000	Earth Moving
312333	Trenching and Backfilling
321216	Asphalt Paving
321313	Concrete Paving
321373	Concrete Paving Joint Sealants
331415	Site Water Distribution
334200	Stormwater Conveyance

MECHANICAL ELECTRICAL PLUMBING ENGINEER:

I hereby certify these Drawings and/or Specifications have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Drawings and/or Specifications are as required by and in compliance with Building Codes of the University of Missouri.

The below listed Drawings and/or Specification sections have been prepared by me, or under my supervision. Any Specification sections within this document, not listed below, are not certified under this statement and are the responsibility of other parties.

Signature: Gary Fischer

Gary Fisher – MO License No.: PE-2018021177

Certified Drawings:

- ME0.01 Mechanical/Electrical Symbols, Abbreviations, and Schedule
- ME3.01 Mechanical/Electrical Demolition Plan
- ME7.01 Mechanical/Electrical Details
- E4.01 Site Lighting Plan

Certified Specification Sections:

- 26 0500 Common Work Results for Electrical
- 26 0519 Conductors and Cables
- 26 0526 Grounding and Bonding
- 26 0529 Hangers and Supports
- 26 0533 Raceways
- 26 0534 Boxes Cabinets and Enclosures
- 26 0543 Underground Ducts and Raceways
- 26 0553 Identification for Electrical Systems
- 26 0600 Electrical Demolition
- 26 0923 Lighting Control Devices
- 26 0416 Panelboards



7/12/2024

MECHANICAL ENGINEER:

I hereby certify these Drawings and/or Specifications have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Drawings and/or Specifications are as required by and in compliance with Building Codes of the University of Missouri.

The below listed Drawings and/or Specification sections have been prepared by me, or under my supervision. Any Specification sections within this document, not listed below, are not certified under this statement and are the responsibility of other parties

Signature: _____

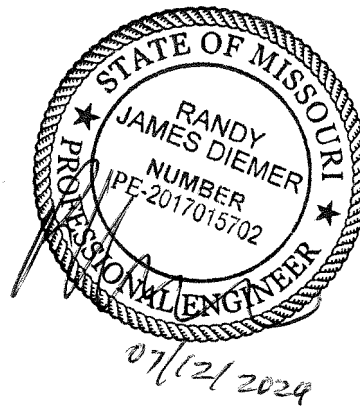
Randy Diemer , P.E.
Registered Professional Engineer

Certified Drawings:

ME0.01 Mechanical/Electrical Symbols,
Abbreviations, and Schedule
ME3.01 Mechanical/Electrical Demolition
Plan
ME7.01 Mechanical/Electrical Details

Certified Specification Sections:

23 0100 Basic Mechanical Requirements
23 0500 Basic Mechanical Materials and Methods
33 6313 Steam Energy Distribution Piping and Specialties
33 6321 Mechanical Insulation



SECTION 00 0110

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Project CP233041
Columbia, Missouri

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PLANNING DESIGN & CONSTRUCTION

900 E. Stadium, Ste. 130
Columbia, Missouri 65211
Telephone: (573) 882-6800

ADVERTISEMENT FOR BIDS

Sealed bids for:

VETERINARY SCIENCE BUILDING –
DEMOLITION

UNIVERSITY OF MISSOURI
COLUMBIA, MISSOURI

PROJECT NUMBER: CP233041

CONSTRUCTION ESTIMATE: \$1,395,000-\$1,555,000

will be received by the Curators of the University of Missouri, Owner, at Planning, Design & Construction, Room L100 (Front Reception Desk), General Services Building, University of Missouri, Columbia, Missouri 65211, until 1:30 p.m., C.T., August 13, 2024 and then immediately opened and publicly read aloud.

Drawings, specifications, and other related contract information may be obtained at <http://operations-webapps.missouri.edu/pdc/adsite/ad.html>. Electronic bid sets are available at no cost and may be printed as desired by the plan holders. No paper copies will be issued. If paper copies are desired, it is the responsibility of the user to print the files or have them printed.

Questions regarding the scope of work should be directed to Eric Roselle with PWArchitects at (573) 746-2574 or eroselle@pwarchitects.com. Questions regarding commercial conditions should be directed to Kenneth Keane at (573) 882-5382 or keaneke@missouri.edu.

A prebid meeting will be held at 10:00 a.m., C.T., August 1, 2024 in the General Services Bldg., Room 185, followed by a site walk-through.

A Diversity Participation goal of 10% MBE, 3% SDVE, 10% Combined WBE, DBE and Veteran Owned Business has been established for this contract.

The Owner reserves the right to waive informalities in bids and to reject any and all bids.

Individuals with special needs as addressed by the Americans with Disabilities Act may contact (573) 882-6800.

Advertisement Date: July 18, 2024

SECTION 1.A

BID FOR LUMP SUM CONTRACT

Date: _____

BID OF _____
(hereinafter called "Bidder") a corporation* organized and existing under laws of the State of _____

_____ ,
a partnership* consisting of _____ ,

an individual* trading as _____ ,

a joint venture* consisting of _____

*Insert Corporation(s), partnership or individual, as applicable.

TO: Curators of the University of Missouri
c/o Associate Vice Chancellor – Facilities
Room L100, General Services Building
University of Missouri – Columbia
Columbia, MO 65211

1. Bidder, in compliance with invitation for bids for construction work in accordance with Drawings and Specifications prepared by PWA Architects, Inc., entitled "Veterinary Science Building Demolition", project number CP233041, dated July 12, 2024, having examined Contract Documents and site of proposed work, and being familiar with all conditions pertaining to construction of proposed project, including availability of materials and labor, hereby proposes to furnish all labor, materials and supplies to construct project in accordance with Contract Documents, within time set forth herein at prices stated below. Prices shall cover all expenses, including taxes not covered by the University of Missouri's tax exemption status, incurred in performing work required under Contract documents, of which this Bid is a part.

Bidder acknowledges receipt of following addenda:

Addendum No. _____ Dated _____

Addendum No. _____ Dated _____

Addendum No. _____ Dated _____

Addendum No. _____ Dated _____

2. In following Bid(s), amount(s) shall be written in both words and figures. In case of discrepancy between words and figures, words shall govern.

3. **BID PRICING**

a. Base Bid:

The Bidder agrees to furnish all labor, materials, tools, and equipment required to 1) demolish the existing building(s) and related infrastructure, 2) to remove and modify any other indicated site elements, and 3) to restore the site and utility systems to the noted finish condition(s); all as indicated on the Drawings and described in these Specifications for sum of:

_____ DOLLARS (\$) _____).

b. Additive Alternate Bids:

Above Base Bid may be changed in accordance with following Alternate Bids as Owner may elect. Alternates are as described in Section 1.H of Project Manual. Alternates are written in a priority order, but Owner is not required to accept or reject in order listed. This is a one (1) contract project, therefore, Alternates shall be studied by each Bidder to determine effect on Bids of Contractor and each Subcontractor and/or Material supplier.

(1) Additive Alternate No. 1: Resurface and re-stripe existing parking lot as described on sheet C3.01. All for sum of:

_____ DOLLARS (\$_____).

c. Allowance:

Bidder shall include in the base bid sum an allowance of **Ten Thousand and 00/100 (\$10,000.00)** for additional abatement not included in the base bid scope identified in the bid documents. This allowance amount shall not include contractor's overhead and profit. The Contractor shall include overhead and profit on the allowance amount in his bid.

4. PROJECT COMPLETION

a. Contract Period - Contract period begins on the day the Contractor receives unsigned Contract, Performance Bond, Payment Bond, and "Instructions for Execution of Contract, Bonds, and Insurance Certificates." Bidder agrees to complete project within One-Hundred and Ninety-Nine (199) calendar days from receipt of aforementioned documents. Fifteen (15) calendar days have been allocated in construction schedule for receiving aforementioned documents from Bidder.

b. Commencement - Contractor agrees to commence work on this project after the "Notice to Proceed" is issued by the Owner. "Notice to Proceed" will be issued within seven (7) calendar days after Owner receives properly prepared and executed Contract documents listed in paragraph 4.a. above.

5. SUBCONTRACTOR LIST:

Bidder hereby certifies that the following subcontractors will be used in performance of Work:

NOTE: Failure to list subcontractors for each category of work identified on this form or listing more than one subcontractor for any category of work without designating the portion of work performed by each shall be grounds for rejection of bid. List name, city, and state of designated subcontractor, for each category of work listed in Bid For Lump Sum Contract. If work within a category will be performed by more than one subcontractor, Bidder shall provide name, city, and state of each subcontractor and specify exact portion of work to be performed by each. If acceptance/non-acceptance of Alternates will affect designation of a subcontractor, Bidder shall provide information, for each affected category, with this bid form. If Bidder intends to perform any designated subcontract work by using Bidder's own employees, then Bidder shall list their own name, city, and state. The bidder may petition the Owner to change a listed subcontractor only within 48 hours of the bid opening. See Information For Bidders Section 16 List of Subcontractors for requirements.

Work to be performed	Subcontractor Name,	City, State
Abatement	_____	_____
Demolition	_____	_____
Mechanical	_____	_____
Electrical	_____	_____

6. SUPPLIER DIVERSITY PARTICIPATION GOALS

- a. The Contractor shall have as a goal subcontracting with Minority Business Enterprise (MBE) of Ten Percent (10%), with Service-Disabled Veteran Owned Business (SDVE) of Three Percent (3%), and with Women Business Enterprise (WBE), Disadvantage Business Enterprise (DBE), and/or Veteran Owned Business of Ten Percent (10%); of awarded contract price for work to be performed.
- b. Requests for waiver of this goal shall be submitted on the attached Application For Waiver form. A determination by the Director of Facilities Planning & Development, UM, that a good faith effort has not been made by Contractor to achieve above stated goal may result in rejection of bid.
- c. The Undersigned proposes to perform work with following Supplier Diversity participation level:

MBE PERCENTAGE PARTICIPATION:

_____percent (____%)

SDVE PERCENTAGE PARTICIPATION:

_____percent (____%)

WBE, DBE, and/or VETERAN PERCENTAGE PARTICIPATION:

_____percent (____%)

- d. A Supplier Diversity Compliance Evaluation form shall be submitted with this bid for each diverse subcontractor to be used on this project.

7. BIDDER'S ACKNOWLEDGMENTS

- a. Bidder declares that he has had an opportunity to examine the site of the work and he has examined Contract Documents; therefore, that he has carefully prepared his bid upon the basis thereof; that he has carefully examined and checked bid, materials, equipment and labor required thereunder, cost thereof, and his figures therefore. Bidder hereby states that amount, or amounts,

set forth in bid is, or are, correct and that no mistake or error has occurred in bid or in Bidder's computations upon which this bid is based. Bidder agrees that he will make no claim for reformation, modifications, revisions, or correction of bid after scheduled closing time for receipt of bids.

b. Bidder agrees that bid shall not be withdrawn for a period of Sixty (60) days after scheduled closing time for receipt of bids.

c. Bidder understands that Owner reserves right to reject any or all bids and to waive any informalities in bidding.

d. Accompanying the bid is a bid bond, or a certified check, or an irrevocable letter of credit, or a cashier's check payable without condition to "The Curators of the University of Missouri" which is an amount at least equal to five percent (5%) of amount of largest possible total bid herein submitted, including consideration of Alternates.

e. Accompanying the bid is a Bidder's Statement of Qualifications. Failure of Bidder to submit the Bidder's Statement of Qualifications with the bid may cause the bid to be rejected. Owner does not maintain Bidder's Statements of Qualifications on file.

f. It is understood and agreed that bid security of two (2) lowest and responsive Bidders will be retained until Contract has been executed and an acceptable Performance Bond and Payment Bond has been furnished. It is understood and agreed that if the bid is accepted and the undersigned fails to execute the Contract and furnish acceptable Performance/Payment Bond as required by Contract Documents, accompanying bid security will be realized upon or retained by Owner. Otherwise, the bid security will be returned to the undersigned.

8. BIDDER'S CERTIFICATE

Bidder hereby certifies:

a. His bid is genuine and is not made in interest of or on behalf of any undisclosed person, firm or corporation, and is not submitted in conformity with any agreement or rules of any group, association or corporation.

b. He has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid.

c. He has not solicited or induced any person, firm, or corporation to refrain from bidding.

d. He has not sought by collusion or otherwise to obtain for himself any advantage over any other Bidder or over Owner.

e. He will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin in connection with performance of work.

f. By virtue of policy of the Board of Curators, and by virtue of statutory authority, a preference will be given to materials, products, supplies, provisions, and all other articles produced, manufactured, mined, or grown within the State of Missouri. By virtue of policy of the Board of Curators, preference will also be given to all Missouri firms, corporations, or individuals, all as more fully set forth in "Information For Bidders."

9. BIDDER'S SIGNATURE

Note: All signatures shall be original; not copies, photocopies, stamped, etc.

Authorized Signature	Date
Printed Name	Title
Company Name	
Mailing Address	
City, State, Zip	
Phone No.	Federal Employer ID No.
Fax No.	E-Mail Address
Circle one: Individual Partnership Corporation Joint Venture	
If a corporation, incorporated under the laws of the State of _____	
Licensed to do business in the State of Missouri? ____yes ____no	

(Each Bidder shall complete bid form by manually signing on the proper signature line above and supplying required information called for in connection with the signature. Information is necessary for proper preparation of the Contract, Performance Bond and Payment Bond. Each Bidder shall supply information called for in accompanying "Bidder's Statement of Qualifications.")

END OF SECTION

**UNIVERSITY OF MISSOURI
BIDDER'S STATEMENT OF QUALIFICATIONS**

Submit with Bid for Lump Sum Contract in separate envelope appropriately labeled. Attach additional sheet if necessary.

1. Company Name _____

Phone# _____ Fax #: _____

Address _____

2. Number of years in business _____. If not under present firm name, list previous firm names and types of organization.

3. List contracts on hand (complete the following schedule, include telephone number).

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed
-------------------	------------------------------	--------------	-----------	-------------------------	-------------------

4. General character of work performed by your company personnel.

5. List important projects completed in the last five (5) years on a type similar to the work now bid for, including approximate cost and telephone number.

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed
-------------------	------------------------------	--------------	-----------	-------------------------	-------------------

6. Other experience qualifying you for the work now bid.

7. No default has been made in any contract complete or incomplete except as noted below:

(a) Number of contracts on which default was made _____

(b) Description of defaulted contracts and reason therefor

8. (a) Have you or your company participated in any contract subject to an equal opportunity clause similar to that described in the General Conditions?

Yes _____ No _____

(b) Have you filed all required compliance reports?

Yes _____ No _____

- (c) Is fifty percent or more of your company owned by a minority?
Yes _____ No _____
- (d) Is fifty percent or more of your company owned by a woman?
Yes _____ No _____
- (e) Is fifty percent or more of your company owned by a service disabled veteran?
Yes _____ No _____
- (f) Is fifty percent or more of your company owned by a veteran?
Yes _____ No _____
- (g) Is your company a Disadvantaged Business Enterprise?
Yes _____ No _____

9. Have you or your company been suspended or debarred from working at any University of Missouri campus?
Yes _____ No _____ (If the answer is "yes", give details.)

10. Have any administrative or legal proceedings been started against you or your company alleging violation of any wage and hour regulations or laws?
Yes _____ No _____ (If the answer is "yes", give details.)

11. Workers Compensation Experience Modification Rates (last 3 yrs): _____ / _____ / _____
Incidence Rates (last 3 years): _____ / _____ / _____

12. List banking references.

- 13. (a) Do you have a current confidential financial statement on file with Owner?
Yes _____ No _____ (If not, and if desired, Bidder may submit such statement with bid, in a separate sealed and labeled envelope.)
- (b) If not, upon request will you file a detailed confidential financial statement within three (3) days?
Yes _____ No _____

Dated at _____ this _____ day of _____ 20_____

Name of Organization

Signature

Printed Name

Title of Person Signing

END OF SECTION

**UNIVERSITY OF MISSOURI
BIDDER'S STATEMENT OF QUALIFICATIONS FOR ASBESTOS ABATEMENT**

Submit with Bid for Lump Sum Contract in separate envelope appropriately labeled. Attach additional sheet if necessary.

1. Company Name _____ Phone# _____
Address _____

2. State of Missouri Registration number _____

3. Number of years in business _____. If not under present firm name, list previous firm names and types of organization.

4. List contracts on hand (complete the following schedule, include telephone number).

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed
-------------------	------------------------------	--------------	-----------	-------------------------	-------------------

5. General character of work performed by your company personnel.

6. List important projects completed in the last five (5) years on a type similar to the work now bid for, including approximate cost and telephone number.

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed
-------------------	------------------------------	--------------	-----------	-------------------------	-------------------

7. Other experience qualifying you for the work now bid.

8. No default has been made in any contract complete or incomplete except as noted below:

(a) Number of contracts on which default was made _____
(b) Description of defaulted contracts and reason therefor _____

9. (a) Have you or your company participated in any contract subject to an equal opportunity clause similar to that described in the General Conditions?

Yes _____ No _____

(b) Have you filed all required compliance reports?

Yes _____ No _____

- (c) Is fifty percent or more of your company owned by a minority?
Yes _____ No _____
- (d) Is fifty percent or more of your company owned by a woman?
Yes _____ No _____
- (e) Is fifty percent or more of your company owned by a service disabled veteran?
Yes _____ No _____
- (f) Is fifty percent or more of your company owned by a veteran?
Yes _____ No _____
- (g) Is your company a Disadvantaged Business Enterprise?
Yes _____ No _____

10. Have you or your company been suspended or debarred from working at any University of Missouri campus?
Yes _____ No _____ (If the answer is "yes", give details.)

11. Have any administrative or legal proceedings been started against you or your company alleging violation of any wage and hour regulations or laws?
Yes _____ No _____ (If the answer is "yes", give details.)

12. Workers Compensation Experience Modification Rates (last 3 yrs): _____ / _____ / _____
Incidence Rates (last 3 years): _____ / _____ / _____

13. List banking references.

- 14. (a) Do you have a current confidential financial statement on file with Owner?
Yes _____ No _____ (If not, and if desired, Bidder may submit such statement with bid, in a separate sealed and labeled envelope.)
- (b) If not, upon request will you file a detailed confidential financial statement within three (3) days?
Yes _____ No _____

Dated at _____ this _____ day of _____ 20_____

Name of Organization

Signature

Printed Name

Title of Person Signing

END OF SECTION

SUPPLIER DIVERSITY COMPLIANCE EVALUATION FORM

This form shall be completed by Bidders and submitted with the Bidder's Statement of Qualifications form for each diverse firm who will function as a subcontractor on the contract.

The undersigned submits the following data with respect to this firm's assurance to meet the goal for Supplier Diversity participation.

I. Project: _____

II. Name of General Contractor: _____

III. Name of Diverse Firm: _____
Address: _____

Phone No.: _____ Fax No.: _____

Status (check one) MBE _____ WBE _____ Veteran _____ Service Disabled Veteran _____ DBE _____

IV. Describe the subcontract work to be performed. (List Base Bid work and any Alternate work separately):

Base Bid: _____

V. Dollar amount of contract to be subcontracted to the Diverse firm:

Base Bid: _____

Alternate(s), (Identify separately): _____

VI. Is the proposed subcontractor listed in the Directory of M/W/DBE Vendors, Directory of Serviced Disabled Veterans and/or the Directory of Veterans maintained by the State of Missouri?

Yes _____ No _____

Is the proposed subcontractor certified as a diverse supplier by any of the following: federal government agencies, state agencies, State of Missouri city or county government agencies, Minority and/or WBE certifying agencies?

Yes _____

No _____

If yes, please provide details and attach a copy of the certification.

Does the proposed subcontractor have a signed document from their attorney certifying the Supplier as a Diverse and meeting the 51% owned and committed requirement?

Yes _____

No _____

If yes, please attach letter.

Signature:

Name:

Title:

Date:

APPLICATION FOR WAIVER

This form shall be completed and submitted with the Bidder's Statement of Qualifications. Firms wishing to be considered for award are required to demonstrate that a good faith effort has been made to include diverse suppliers. This form will be used to evaluate the extent to which a good faith effort has been made. The undersigned submits the following data with respect to the firm's efforts to meet the goal for Supplier Diversity Participation.

1. List pre-bid conferences your firm attended where Supplier Diversity requirements were discussed.

2. Identify advertising efforts undertaken by your firm which were intended to recruit potential diverse subcontractors for various aspects of this project. Provide names of newspapers, dates of advertisements and copies of ads that were run.

3. Note specific efforts to contact in writing those diverse suppliers capable of and likely to participate as subcontractors for this project.

4. Describe steps taken by your firm to divide work into areas in which diverse suppliers/contractors would be capable of performing.

5. What efforts were taken to negotiate with prospective diverse suppliers/contractors for specific sub-bids? Include the names, addresses, and telephone numbers of diverse suppliers/contractors contacted, a description of the information given to diverse suppliers/contractors regarding plans and specifications for the assigned work, and a statement as to why additional agreements were not made with diverse suppliers/contractors.

6. List reasons for rejecting a diverse supplier/contractor which has been contacted.

8. Describe the follow-up contacts with diverse suppliers/contractors made by your firm after the initial solicitation.

9. Describe the efforts made by your firm to provide interested diverse suppliers/contractors with sufficiently detailed information about the plans, specifications and requirements of the contract.

10. Describe your firm's efforts to locate diverse suppliers/contractors.

Based on the above stated good faith efforts made to include supplier diversity, the bidder hereby requests that the original supplier diversity percentage goal be waived and that the percentage goal for this project be set at _____ percent.

The undersigned hereby certifies, having read the answers contained in the foregoing Application for Waiver, that they are true and correct to the best of his/her knowledge, information and belief.

Signature _____

Name _____

Title _____

Company _____

Date _____

AFFIDAVIT

"The undersigned swears that the foregoing statements are true and correct and include all material information necessary to identify and explain the operation of _____ (name of firm) as well as the ownership thereof. Further, the undersigned agrees to provide through the prime contractor or directly to the Contracting Officer current, complete and accurate information regarding actual work performed on the project, the payment therefore and any proposed changes, if any, of the project, the foregoing arrangements and to permit the audit and examination of books, records and files of the named firm. Any material misrepresentation will be grounds for terminating any contract which may be awarded and for initiating action under federal or state laws concerning false statements."

Note - If, after filing this information and before the work of this firm is completed on the contract covered by this regulation, there is any significant change in the information submitted, you must inform the Director of Facilities Planning and Development of the change either through the prime contractor or directly.

Signature _____

Name _____

Title _____

Date _____

Corporate Seal (where appropriate)

Date _____

State of _____

County of _____

On this _____ day of _____, 19____,
before me appeared (name) _____ to me personally known, who, being
duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by (name of firm)

_____ to execute the affidavit and did so as his or her own free act and deed.

(Seal)

Notary Public _____

Commission expires _____

AFFIDAVIT FOR AFFIRMATIVE ACTION

State of Missouri)
)
County of) ss.

_____ first being duly sworn on his/her oath states: that he/she is the (sole proprietor, partner, or officer) of _____ a (sole proprietorship, partnership, corporation), and as such (sole proprietor, partner, or officer) is duly authorized to make this affidavit on behalf of said (sole proprietorship, partnership, corporation); that under the contract known as " _____ " Project No. _____ less than 50 persons in the aggregate will be employed and therefore, the applicable Affirmative Action requirements as set forth in the "Nondiscrimination in Employment Equal Opportunity," Supplemental Special Conditions, and Article 13 in the General Conditions do not apply.

Subscribed and sworn before me this _____ day of _____, 19_____.

My commission expires _____, 19_____.

CERTIFYING SUPPLIER DIVERSITY AGENCIES

Diverse firms are defined in General Conditions Articles 1.1.7 and those businesses must be certified as disadvantaged by an approved agency. The Bidder is responsible for obtaining information regarding the certification status of a firm. A list of certified firms may be obtained by contacting the agencies listed below. Any firm listed as disadvantaged by any of the following agencies will be classified as a diverse firm by the Owner.

St. Louis Development Corporation
1520 Market St., Ste. 2000
St. Louis, MO 63103
P: 314.982.1400
W: www.stlouis-mo.gov/slcdc/

Bi-State Development
211 N. Broadway, Ste. 700
St. Louis, MO 63102
P: 314.982.1400
W: www.metrostlouis.dbesystem.com

St. Louis Minority Business Council
211 N. Broadway, Ste. 1300
St. Louis, MO 63102
P: 314.231.5555
W: www.slmbc.org

U.S. Small Business Administration - St. Louis, MO
8(a) Contractors, Minority Small Business
1222 Spruce Street, Suite 10.103
St. Louis, MO 63101
P: 314.539.6600
W: www.sba.gov

Lambert St. Louis International Airport
Business Diversity Development Office
11495 Navaid
Bridgeton, MO 63044
P: 314-426-8111
W: www.flystl.com/business/business-diversity-development-1/directories

City of Kansas City, Missouri
Human Relations Department, MBE/WBE Division
4th Floor, City Hall
414 E. 12th Street
Kansas City, MO 64106
P: 816.513.1836
W: kcmohrd.mwdbe.com/?TN=kcmohrd

Mid-States Minority Supplier Development Council
505 N. 7th Street, Ste. 1820
St. Louis, MO 63101
P: 314.278.5616
W: midstatesdc.org

U.S. Small Business Administration - Kansas City, MO
8(a) Contractors, Minority Small Business
1000 Walnut, Suite 500
Kansas City, MO 64106
P: 816.426.4900
W: kcmohrd.mwdbe.com/?TN=kcmohrd

Missouri Department of Transportation
Division of Construction
1617 Missouri Blvd.
P.O. Box 270
Jefferson City, MO 65102
P: 573.526.2978
W: www.modot.org/mrcc-directory

Illinois Department of Transportation
MBE/WBE Certification Section
2300 Dirksen Parkway
Springfield, IL 62764
217/782-5490; 217/785-1524 (Fax)
W: webapps.dot.illinois.gov/UCP/ExternalSearch

State of Missouri OA
Office of Equal Opportunity
301 W. High St. HSC Rm 870-B
Jefferson City, MO 65101
P: 877.259.2963
W: oa.mo.gov/sites/default/files/sdvelisting.pdf
oeo.mo.gov/

Minority Newspapers

Dos Mundos Bilingual Newspaper
902A Southwest Blvd.
Kansas City, MO 64108
816-221-4747
www.dosmundos.com

Kansas City Hispanic News
2918 Southwest Blvd.
Kansas City, MO 64108
816/472-5246
www.kchispanicnews.com

The Kansas City Globe
615 E. 29th Street
Kansas City, MO 64109
816-531-5253
www.thekcglobe.com/about_us.php

St. Louis American
4144 Lindell
St. Louis, MO 63108
314-533-8000
www.stlamerican.com

St. Louis Chinese American News
1766 Burns Ave, Suite 201
St. Louis, MO 63132
314-432-3858
www.scanews.com

St. Louis Business Journal
815 Olive St., Suite 100
St. Louis, MO 63101
314-421-6200
www.bizjournal.com/stlouis

Kansas City Business Journal
1100 Main Street, Suite 210
Kansas City, MO 64105
816-421-5900
www.bizjournals.com/kansascity

AFFIDAVIT OF SUPPLIER DIVERSITY PARTICIPATION

The apparent low Bidder shall complete and submit this form within 48 hours of bid opening for each Diverse firm that will participate on the contract.

1. Diverse Firm: _____
 Contact Name: _____
 Address: _____
 Phone No.: _____ E-Mail: _____

Status (check one) MBE WBE Veteran Service Disabled Veteran DBE
 If MBE, Certified as (circle one): 1) Black American 2) Hispanic American 3) Native American 4) Asian American

2. Is the proposed diverse firm certified by an approved agency [see IFB article 15]? Yes No

Agency: _____ [attach copy of certification authorization from agency]

Certification Number: _____

3. Diverse firm scope work and bid/contract dollar amount of participation (List Base Bid and Alternate work separately). The final Dollar amount will be determined at substantial completion:

	Scope of Work	Bid/Contract Amount	Final Dollar Amount
Base Bid			
Alternate #1			
Alternate #2			
Alternate #3			
Alternate #4			
Alternate #5			
Alternate #6			

The undersigned certifies that the information contained herein (i.e. Scope of Work and Bid/Contract Amount) is true and correct to the best of their knowledge, information and belief.

General Contractor: _____ Diverse Firm: _____

Signature: _____ Signature: _____

Name: _____ Name: _____

Title: _____ Title: _____

Date: _____ Date: _____

The undersigned certifies that the information contained herein (i.e. Scope of Work and Final Dollar Amount) is true and correct to the best of their knowledge, information and belief. If the Final Dollar Amount is different than the Bid/Contract Amount, then attach justification for the difference.

Contractor: _____ Diverse Firm: _____

Signature: _____ Signature: _____

Name: _____ Name: _____

Title: _____ Title: _____

Date: _____ Date: _____

University of Missouri
INFORMATION FOR BIDDERS

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1. Contract Documents and Definitions

1.1 The “Drawings,” “Specifications,” and “Contract Documents” are defined in the “General Conditions of the Contract for Construction.”

1.2 The Drawings, Specifications, and other Contract Documents may be obtained as indicated in the Advertisement for Bids.

1.3 As used herein, “Bid” refers to an offer or proposal submitted to the Owner to enter into a contract for the work identified in the Drawings, Specifications and other Contract Documents.

1.4 As used herein, “Bidder” means an individual or business entity that submits a Bid to the Owner as a prime bidder or general contractor.

1.5 All other terms used herein shall have the meanings defined herein or in the General Conditions of the Contract for Construction or other Contract Documents.

2. Bidder Obligations

2.1 Before submitting a Bid, each Bidder shall carefully examine the Drawings and Specifications and related Contract Documents, visit the site of the work, and fully inform themselves as to all existing conditions, facilities, restrictions, and other matters that could affect the work or the cost thereof.

2.2 Each Bidder shall include in their Bid the cost of all work and materials required to complete the contract in a first-class manner, as specified in the Drawings, Specifications, and other Contract Documents. All work shall be done as defined in the Specifications and as indicated on the Drawings.

2.3 Failure or omission of any Bidder to receive or to examine any form, instrument, addendum, or other document, or to visit the site of the work and acquaint themselves with existing conditions, shall in no way relieve the Bidder from any obligation with respect to their Bid or any awarded contract. No extra compensation will be allowed concerning any matter about which the Bidder should have fully informed themselves prior to submitting a Bid.

2.4 Submission of a Bid shall be deemed acceptance by the Bidder of the above obligations and every obligation required by the Contract Documents in the event the Bid is accepted by the Owner.

3. Interpretation of Documents

3.1 If any prospective Bidder is in doubt about the meaning of any part of the Drawings, Specifications, or

other Contract Documents, the Bidder shall submit a written request to the Architect for an interpretation.

3.2 Any request for interpretation shall be delivered to the Architect at least one (1) week prior to time for receipt of bids.

3.3 A Bid shall be based only on an interpretation issued in the form of an addendum mailed to each person or business entity that is on the Architect’s record as having received a set of the Contract Documents.

3.4 Bidders shall not be entitled to rely on oral interpretations or written statements not issued in an addendum from either the Architect or a representative, agent, or employee of the Owner.

4. Bids

4.1 Bids shall be submitted on a single “Bid for Lump Sum Contract” form (“Bid Form”) as furnished by the Owner or Architect. Bids shall be received separately or in combination as required by Bid Form

4.2 In addition to the Bid Form, the Bid shall include any documents or information required to be submitted by this Information for Bidders or the Contract Documents.

4.3 Bids shall include amounts for alternate bids, unit prices, and cost accounting data where required by the Bid Form.

4.4 Bidders shall apportion each base Bid between various phases of the work, where stipulated in the Bid Form.

4.5 Bids shall be presented in sealed envelopes, which shall be plainly marked “Bids for (indicate name of project from cover sheet)” and mailed or delivered to the building and room number specified in the Advertisement for Bids.

4.6 Each Bidder shall be responsible for actual delivery of their bid during business hours, and it shall not be sufficient to show that a Bid was mailed in time to be received before scheduled closing time for receipt of bids, nor shall it be sufficient to show that a Bid was somewhere in a university facility.

4.7 The Bidder’s price shall include all federal sales, excise, and similar taxes that may be lawfully assessed in connection with their performance of work and purchase of materials to be incorporated in the work. City and State taxes shall not be included as stated in the General Conditions of the Contract for Construction.

4.8 No Bidder shall stipulate in their Bid any conditions not contained in the Bid Form or Contract Documents. Inclusion of any additional conditions or taking exception to any terms may result in rejection of the Bid.

4.9 The Owner reserves the right to waive informalities in bids and to reject any or all bids.

5. Modification and Withdrawal of Bids

5.1 A Bidder may withdraw their Bid at any time before the scheduled closing time for receipt of bids. No Bidder may withdraw their Bid after the scheduled closing time for receipt of bids.

5.2 Only a written request for modification or correction of a previously submitted Bid, contained in a sealed envelope that is plainly marked "Modification of Bid on (name of project on cover sheet)," which is addressed in the same manner as a Bid and received by Owner before the scheduled closing time for receipt of bids, will be accepted and the Bid modified in accordance with such written request.

6. Signing of Bids

6.1 All bids shall be signed manually, by an individual authorized to sign on behalf of the Bidder. The title or office held by the person signing for the Bidder shall appear below the signature.

6.2 A Bid should contain the full and correct legal name of the Bidder. If the Bidder is an entity registered with the Missouri Secretary of State, the Bidder's name on the Bid form should appear as shown in the Secretary of State's records.

6.3 A Bid from a partnership or joint venture shall be signed in the name of the partnership or joint venture by at least one partner or joint venturer or by an Attorney-in-Fact. If signed by Attorney-in-Fact there should be attached to the Bid, a Power of Attorney evidencing authority to sign the Bid executed by all partners or joint venturers.

6.4 A Bid from a corporation shall be signed by an officer of the corporation.

6.5 A Bid from a limited liability company (LLC) shall be signed by a manager or a managing member of the LLC.

6.6 A Bid from an individual or sole proprietor shall be signed in the name of the individual by the individual or an Attorney-in-Fact. If signed by Attorney-in-Fact there should be attached to the Bid, a Power of Attorney evidencing authority to sign the Bid

executed by the individual.

7. Bid Security

7.1 Each Bid shall be accompanied by a Bid Bond, certified check, or cashier's check, acceptable to and payable without condition to "The Curators of the University of Missouri" in an amount at least equal to five percent (5%) of the Bidder's Bid including additive alternates ("Bid Security").

7.2 Bid security is required as a guarantee that the Bidder will enter into a written contract and furnish a Performance Bond within the time and in form as specified herein or in the Contract Documents; and, if successful Bidder fails to do so, the Bid Security will be realized upon or retained by the Owner. The apparent low Bidder shall notify the Owner in writing within forty-eight (48) hours of the Bid opening of any circumstance that may affect the Bid Security including, but not limited to, an error in the Bid. This notification will not guarantee release of the Bidder's security and/or the Bidder from the Bidder's obligations.

7.3 If a Bid Bond is given as a Bid Security, the amount of the Bid Bond may be stated as an amount equal to at least five percent (5%) of the Bid, including additive alternates, described in the Bid. The Bid Bond shall be executed by the Bidder and a responsible surety licensed in the State of Missouri with a Best's rating of no less than A-/XL.

7.4 It is specifically understood that the Bid Security is a guarantee and shall not be considered as liquidated damages for failure of Bidder to execute and deliver the contract and Performance Bond, nor limit or fix the Bidder's liability to the Owner for any damages sustained because of failure to execute and deliver the required contract and Performance Bond.

7.5 The Bid Security of the two (2) lowest, responsive, responsible bidders will be retained by the Owner until a contract has been executed and an acceptable Performance Bond has been furnished, as required hereby, when such Bid Security will be returned. The Bid Bonds of all other Bidders will be destroyed and all other alternative forms of Bid Security will be returned to them within ten (10) days after the Owner has determined the two (2) lowest, responsive, responsible bids.

8. Bidder's Statement of Qualifications

8.1 Each Bidder shall present evidence of their experience, qualifications, financial responsibility, and ability to carry out the terms of the contract by completing and submitting with their Bid the "Bidder's Statement of Qualifications" form included with the Bid

documents.

8.2 Financial information required to be included with the Statement of Qualifications may be submitted by the Bidder in a separately sealed envelope, which will not be opened by the Owner during the public Bid opening.

8.3 The Bidder's Statement of Qualifications will be treated as confidential information by the Owner to the extent permitted by the Missouri Sunshine Law, Section 610.010, RSMo et seq.

8.4 Bids not accompanied by the Bidder's Statement of Qualifications may be rejected.

9. Award of Contract

9.1 The Owner reserves the right to let other contracts in connection with the work, including, but not limited to, contracts for furnishing and installation of furniture, equipment, machines, appliances, and other apparatus.

9.2 In awarding the contract, the Owner may take into consideration the ability of the Bidder, and their subcontractors, to handle promptly the additional work; the skill, facilities, capacity, experience, ability, responsibility, previous work, and financial standing of Bidder; the Bidder's ability to provide the required bonds and insurance; the quality, efficiency and construction of equipment proposed to be furnished; the period of time within which equipment is proposed to be furnished and delivered; success in achieving the specified Supplier Diversity Goals or demonstrating a good faith effort to do so as described in Article 15 of this document; and the Bidder's status as suspended or debarred. Inability of any Bidder to meet the requirements mentioned above may be cause for rejection of their Bid.

10. Contract Execution

10.1 The awarded Bidder shall submit within fifteen (15) days from receipt of notice of award, the documents required in Article 9 of the General Conditions of the Contract for Construction.

10.2 No bids will be considered binding upon the Owner until all such required documents have been furnished. Failure of Contractor to execute and submit such documents within the time specified will be treated, at the option of the Owner, as a breach of the Bidder's Bid Security and the Owner shall be under no further obligation to the Bidder.

11. Contract Security

11.1 When the Contract Sum exceeds \$50,000, the

Contractor shall procure and furnish a Performance Bond and a Payment Bond in the form prepared by the Owner. Each bond shall be in the amount equal to one hundred percent (100%) of the Contract Sum, as well as adjustments to the Contract Sum. The Performance Bond shall secure and guarantee the Contractor's faithful performance of the Contract, including but not limited to the Contractor's obligation to correct any defects after final payment has been made as required by the Contract Documents. The Payment Bond shall secure and guarantee payment of all persons performing labor on the Project under the Contract and furnishing materials in connection with the Contract in accordance with Section 107.170, RSMo. These bonds shall be in effect through the duration of the Contract plus any Guaranty Period required by the Contract Documents.

11.2 The bonds required hereunder shall be meet all requirements of Article 11 of the General Conditions of the Contract for Construction.

11.3 If the surety of any bond furnished by the Contractor is declared bankrupt or becomes insolvent or its right to conduct business in the State of Missouri is terminated, or it ceases to meet the requirements of this Article 11, the Contractor shall within ten (10) days substitute another bond and surety, both of which must be acceptable to the Owner. If the Contractor fails to make such substitution, the Owner may procure such required bonds on behalf of Contractor at Contractor's expense.

12. Time of Completion

12.1 The awarded Contractor shall agree to commence work within five (5) days of the date "Notice to Proceed" is received from the Owner, and the entire work shall be completed by the completion date specified or within the number of consecutive calendar days stated in the Special Conditions. The duration of the construction period, when specified in consecutive calendar days, shall begin when the contractor receives notice requesting the documents required in Article 9 of the General Conditions of the Contract for Construction.

13. Number of Contract Documents

13.1 The Owner will furnish the Contractor a copy of the executed contract, Performance Bond, and Payment Bond.

13.2 The Owner will furnish the Contractor the number of copies of complete sets of Drawings and Specifications for the work, as well as clarification and change order Drawings pertaining to change orders required during construction as set forth in the Special Conditions.

14. Missouri Products and Missouri Firms

14.1 The Curators of the University of Missouri have adopted a policy which is binding upon all employees and departments of the University of Missouri, and which by contract, shall be binding upon independent contractors and subcontractors with the University of Missouri whereby all other things being equal, and when the same can be secured without additional cost over foreign products, or products of other states, a preference shall be granted in all construction, repair and purchase contracts, to all products, commodities, materials, supplies, and articles mined, grown, produced, and manufactured in marketable quantity and quality in the State of Missouri, and to all firms, corporations or individuals doing business as Missouri firms, corporations, or individuals. Each Bidder submitting a Bid agrees to comply with and be bound by the foregoing policy.

15. Supplier Diversity

15.1 Award of Contract

15.1.1 The Bidder shall have a minimum goal of providing participation of Diverse Firms in the project, through self-performance, if a Diverse Firm, or by subcontracting with Diverse Firms as subcontractors, suppliers, or manufacturers, in the amount of the percent of contract price stated in the Bid Form ("Supplier Diversity Goals"). The Owner will take into consideration the Bidder's success in achieving the Supplier Diversity Goals in awarding the contract. Inability of any Bidder to meet one or more of the Supplier Diversity Goals may be cause for rejection of their Bid, unless the Bidder has demonstrated that they made a good faith effort to comply as set forth below.

15.1.2 In addition to the Supplier Diversity Goals set forth in the Bid Form, a three (3) point bonus preference will be given to a Bidder that is a certified Service-Disabled Veteran Enterprises (SDVE) business doing business as Missouri firm, corporation, or individual, or that maintains a Missouri office or place of business. The bonus preference will **not** be given to a Bidder for the use of SDVE subcontractors, suppliers, or manufacturers. The bonus preference shall be calculated and applied by reducing the Bid amount of the SDVE Bidder by three (3) percent of the apparent low, responsive Bidder's Bid. Based on this calculation, if the SDVE Bidder's resulting total Bid valuation is less than the Bid of the apparent low, responsive Bidder, the SDVE Bid becomes the apparent low, responsive Bid. This reduction is for evaluation purposes only and will have no impact on the actual amount(s) of the SDVE Bidder's Bid or the amount(s) of any contract awarded.

15.2 List of Diverse Firms

15.2.1 The Bidder shall submit, within forty-eight (48) hours of the receipt of bids to the University Contracting Officer, a list of Diverse Firms that will be performing as contractor, subcontractor, supplier, or manufacturer on the project. The list shall separately identify each Diverse Firm by name and address. If acceptance or non-acceptance of alternates will affect the designation of a subcontractor, supplier, or manufacturer, the Bidder shall provide information for each affected category.

15.2.2 Failure to include a complete list of Diverse Firms that will be used to meet the Supplier Diversity Goals may be grounds for rejection of the Bid.

15.2.3 The list of Diverse Firms shall be submitted in addition to any other listing of subcontractors required in the Bid Form or elsewhere in this document.

15.3 Supplier Diversity Goal Computation

15.3.1 The Bidder may count toward the Supplier Diversity Goal only expenditures to Diverse Firms that perform a commercially useful function in the work of a contract. A Diverse Firm is considered to perform a commercially useful function when it is responsible for executing a distinct element of the work or contract and is carrying out its responsibilities by actually performing managing and supervising the work.

15.3.2 The Bidder may count toward its Supplier Diversity Goals work granted to a second or subsequent tier subcontractor that is a Diverse Firm provided the Diverse Firm assumes the actual and contractual responsibility for performing work on the project. The Bidder may count toward its Supplier Diversity Goals expenditures for materials and/or supplies obtained from a Diverse Firm, provided the Diverse Firm assumes the actual and contractual responsibility for the provision of the materials and/or supplies. To perform a commercially useful function, a supplier or manufacturer that is a Diverse Firm must be responsible for negotiating price, determining quality and quantity, ordering the material, installing (where applicable) and paying for the material itself.

15.3.3 A Diverse Firm does not perform a commercially useful function if its role is solely that of an extra participant in a transaction, contract, or project through which funds are passed in order to obtain the appearance of participation. In determining whether a firm is such an extra participant, the Owner will examine similar transactions, particularly those in which Diverse Firms do not participate.

15.3.4 A Bidder that is a certified Diverse Firm may count one hundred percent 100% of the contract amount

towards the applicable Supplier Diversity Goal(s), less any amounts awarded to another Diverse Firm. For projects with separate Supplier Diversity Goals, the Bidder will be required to obtain participation in the other categories for which it is not certified through participation by subcontractors, suppliers, or manufacturers. Therefore, an MBE Bidder is expected to obtain the required SDVE and WBE/DBE/Veteran participation; a WBE/DBE/Veteran Bidder is expected to obtain the required MBE and SDVE participation; and a SDVE Bidder is expected to obtain the required MBE and WBE/DBE/Veteran participation.

15.3.5 If the Bidder is a joint venture and the joint venture itself is certified as a Diverse Firm, the joint venture may count toward the Supplier Diversity Goals that portion of the total dollar value of the work equal to the percentage of the ownership and control of the Diverse Firm participant in the joint venture. When a Diverse Firm performs work as a participant in a joint venture where the joint venture is **not** separately certified as a Diverse Firm, only the portion of the Contract Sum equal to the distinct, clearly defined portion of the work that the Diverse Firm performs with its own forces shall count toward the Supplier Diversity Goals.

15.3.6 If a Diverse Firm is certified in more than one Supplier Diversity category, that Diverse Firm may be used to satisfy more than one Supplier Diversity goal, provided that the Diverse Firm is awarded a sufficient percentage of the contract work to meet or exceed all applicable Supplier Diversity Goals.

15.4 Certification of Diverse Firms

15.4.1 The Bidder shall submit, within forty-eight (48) hours of the time for receipt of bids, to the University Contracting Officer, the information requested in the “Supplier Diversity Compliance Evaluation Form” for every Diverse Firm the Bidder intends to award work to under the contract to meet the Supplier Diversity Goals.

15.4.2 “Diverse Firm” is defined in Article 1 of the General Conditions of the Contract for Construction. The Bidder is responsible for obtaining information regarding the certification status of a Diverse Firm. A list of certified Diverse Firms may be obtained by contacting the agencies listed in the document entitled “Supplier Diversity Certifying Agencies.”

15.4.3 Bidders are urged to encourage their prospective subcontractors, joint venture participants, team partners, suppliers and manufacturers who are Diverse Firms but are not currently certified to obtain certification from one of the approved agencies prior to

bidding.

15.5 Supplier Diversity Participation Waiver

15.5.1 The Bidder is required to make a good faith effort to locate and contract with Diverse Firms. If a Bidder has made a good faith effort to secure the required Supplier Diversity Participation and has failed, the Bidder shall submit within forty-eight (48) hours of the time for receipt of bids to the University Contracting Officer, the information requested in “Application for Supplier Diversity Participation Waiver.” The Contracting Officer will review the Bidder’s actions as set forth in the Bidder’s “Application for Waiver” and any other factors deemed relevant by the Contracting Officer to determine if a good faith effort has been made to meet the Supplier Diversity Goal(s). If the Bidder is judged not to have made a good faith effort, the Bid may be rejected. Bidders who demonstrate that they have made a good faith effort to meet the Supplier Diversity Goal(s) may be awarded the contract regardless of the actual percent of Supplier Diversity Participation, provided that the Bid is otherwise acceptable and is determined to be the lowest, responsive, responsible Bid.

15.5.2 To determine the good faith effort of the Bidder, the Contracting Officer may evaluate factors including, but not limited to, the following:

15.5.2.1 The Bidder’s attendance at pre-proposal meetings scheduled to inform Diverse Firms of contracting and subcontracting opportunities and responsibilities associated with Supplier Diversity Participation.

15.5.2.2 The Bidder’s advertisements in general circulation trade association, and diverse (minority) focused media concerning subcontracting opportunities.

15.5.2.3 The Bidder’s written notice to specific Diverse Firms that their services were being solicited in sufficient time to allow for their effective participation.

15.5.2.4 The Bidder’s follow-up attempts to the initial solicitation(s) to determine with certainty whether Diverse Firms were interested.

15.5.2.5 The Bidder’s efforts to divide the work into packages suitable for subcontracting to Diverse Firms.

15.5.2.6 The Bidder’s efforts to provide interested Diverse Firms with sufficiently detailed information about the Drawings, Specifications and requirements of the contract, and clear scopes of work for the Diverse Firms to bid on.

15.5.2.7 The Bidder's efforts to solicit for specific sub-bids from Diverse Firms in good faith. Documentation should include names, addresses, and telephone numbers of Diverse Firms contacted, a description of all information provided to the Diverse Firms, and an explanation as to why agreements were not reached.

15.5.2.8 The Bidder's efforts to locate Diverse Firms not on the directory list and assist Diverse Firms in becoming certified as such.

15.5.2.9 The Bidder's initiatives to encourage and develop participation by Diverse Firms.

15.5.2.10 The Bidder's efforts to help Diverse Firms overcome legal or other barriers impeding the participation of Diverse Firms in the construction contract.

15.5.2.11 The availability of Diverse Firms and the adequacy of the Bidder's efforts to increase the participation of such business provided by the persons and organizations consulted by the Bidder.

15.6 Submittal of Forms

15.6.1 Within forty-eight (48) hours of the time for receipt of bids, the apparent low Bidder shall submit to the University Contracting Officer all Supplier Diversity Compliance Evaluation Form(s), and/or Application for Waiver with supporting information, and an "Affidavit of Supplier Diversity Participation" for every Diverse Firm the Bidder intends to award work on the contract. The affidavit will be signed by both the Bidder and the Diverse Firm. Failure to submit the documents in the time indicated may result in rejection of the Bid.

15.7 Additional Bid/Proposer Information

15.7.1 The Contracting Officer reserves the right to request from the apparent low Bidder additional information regarding the Bidder's proposed Supplier Diversity Participation and supporting documentation. The Bidder shall respond in writing to the Contracting Officer within twenty-four (24) hours of a request.

15.7.2 The Contracting Officer reserves the right to request additional information after the Bidder has responded to prior requests. This information may include follow up and/or clarification of the information previously submitted.

15.7.3 The Owner reserves the right to consider additional Supplier Diversity Participation submitted by the Bidder after bids are opened. The Owner may

elect to waive the good faith effort requirement if such additional participation achieves the Supplier Diversity Goal.

15.7.4 The Bidder shall provide to the Owner information related to the Supplier Diversity Participation included in the Bidder's proposal, including, but not limited to, the complete Application for Waiver, evidence of certification of participating Diverse firms, dollar amount of participation of Diverse Firms, information supporting a good faith effort as described above, and a list of all Diverse Firms that submitted bids to the Bidder with the Diverse Firm's price, and the name and the price of the firm awarded the scope of work.

16. List of Subcontractors

16.1 If a list of subcontractors is required on the Bid Form, the Bidder shall list the name, city, and state of the firm(s) that will accomplish that portion of the contract requested in the space provided. This list is separate from both the list of Diverse Firms required in Section 15.2 and the complete list of subcontractors required in Section 10.1 of this document. Should the Bidder choose to perform any of the listed portions of the work with its own forces, the Bidder shall enter its own name, city, and state in the space provided. If acceptance or non-acceptance of alternates will affect the designation of a subcontractor, the Bidder shall provide that information on the Bid Form.

16.2 Failure of the Bidder to supply the list of subcontractors required or the listing of more than one subcontractor for any category without designating the portion of the work to be performed by each, shall be grounds for the rejection of the Bid. The Bidder can petition the Owner to change a listed subcontractor within forty-eight (48) hours of the Bid opening. The Owner reserves the right to make the final determination on a petition to change a subcontractor. The Owner will consider factors such as clerical and mathematical errors in the Bid, a listed subcontractor's inability to perform the work, etc. Any request to change a listed subcontractor shall include at a minimum, a Bid sheet showing tabulation of the Bid; all subcontractor bids with documentation of the time they were received by the contractor; and a letter from the listed subcontractor on their letterhead stating why they cannot perform the work if applicable. The Owner reserves the right to ask for additional information.

16.3 Upon award of the contract, the requirements of Article 10 herein and Article 5 of the General Conditions of the Contract for Construction will apply.

University of Missouri

General Conditions

of the

Contract

for

Construction

July 2024 Edition

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**ARTICLE 1
GENERAL PROVISIONS**

1.1 Basic Definitions

As used in the Contract Documents, the following terms shall have the meanings and refer to the parties designated in these definitions.

1.1.1 Owner

The Owner is The Curators of the University of Missouri. The Owner may act through its Board of Curators or any duly authorized committee or representative thereof. The Owner may also be referred to herein as "University".

1.1.2 Contracting Officer

The Contracting Officer is the duly authorized representative of the Owner with the authority to execute contracts. Communications to the Contracting Officer shall be forwarded via the Owner's Representative.

1.1.3 Owner's Representative

The Owner's Representative is authorized by the Owner as the administrator of the Contract and will represent the Owner during the progress of the Work. Communications from the Architect to the Contractor and from the Contractor to the Architect shall be through the Owner's Representative, unless otherwise indicated in the Contract Documents.

1.1.4 Architect

When the term "Architect" is used herein, it shall refer to the Architect or the Engineer specified and defined in the Contract for Construction or its duly authorized representative. Communications to the Architect shall be forwarded to the address shown in the Contract for Construction.

1.1.5 Owner's Authorized Agent

When the term "Owner's Authorized Agent" is used herein, it shall refer to an employee or agency acting on the behalf of the Owner's Representative to perform duties related to code inspections, testing, operational systems check, certification or accreditation inspections, or other specialized work.

1.1.6 Contractor

The Contractor is the person or entity with whom the Owner has entered into the Contract for Construction. The term "Contractor" means the Contractor or the Contractor's authorized representative.

1.1.7 Subcontractor and Lower-tier Subcontractor

A Subcontractor is a person or organization who has a contract with the Contractor to perform any of the Work. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or its authorized representative. The term "Subcontractor" also is applicable to those furnishing materials to be incorporated in the Work whether

performed at the Owner's site or off site, or both. A lower-tier Subcontractor is a person or organization who has a contract with a Subcontractor or another lower-tier Subcontractor to perform any of the Work at the site. Nothing contained in the Contract Documents shall create contractual relationships between the Owner or the Architect and any Subcontractor or lower-tier Subcontractor of any tier.

1.1.8 Diversity Definitions

"Diverse Firm" shall mean an approved, certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more diverse individuals as described below.

.1 Minority Business Enterprises (MBE)

Minority Business Enterprise (MBE) shall mean an approved certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more minorities as defined below or, in the case of any publicly-owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more minorities as defined below, and whose management and daily business operations are controlled by one (1) or more minorities as defined herein.

.1.1 "African Americans", which includes persons having origins in any of the black racial groups of Africa.

.1.2 "Hispanic Americans", which includes persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race.

.1.3 "Native Americans", which includes persons of American Indian, Eskimo, Aleut, or Native Hawaiian origin.

.1.4 "Asian-Pacific Americans", which includes persons whose origins are from Japan, China, Taiwan, Korea, Vietnam, Laos, Cambodia, the Philippines, Samoa, Guam, the U.S. Trust Territories of the Pacific, or the Northern Marianas.

.1.5 "Asian-Indian Americans", which includes persons whose origins are from India, Pakistan, or Bangladesh.

.2 Women Business Enterprise (WBE)

Women Business Enterprise (WBE) shall mean an approved certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more women or, in the case of any publicly owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more women, and whose management and daily business operations are controlled by one (1) or more women.

.3 Veteran Owned Business

Veteran Owned Business shall mean an approved certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more Veterans or, in the case of any publicly owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more Veterans, and whose management and daily business operations are controlled by one (1) or more Veterans. Veterans must be certified by the appropriate federal agency responsible for veterans' affairs.

.4 Service-Disabled Veteran Enterprise (SDVE)

Service-Disabled Veteran Enterprise (SDVE) shall mean a business certified by the State of Missouri Office of Administration as a Service-Disabled Veteran Enterprise, which is at least fifty-one percent (51%) owned and controlled by one (1) or more Serviced-Disabled Veterans or, in the case

of any publicly-owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more Service-Disabled Veterans, and whose management and daily business operations are controlled by one (1) or more Serviced-Disabled Veterans.

.5 Disadvantaged Business Enterprise (DBE)

A Disadvantaged Business Enterprise (DBE) is a for-profit small business concern where a socially and economically disadvantaged individual owns at least 51% interest and also controls management and daily business operations. These firms can also be referred to as Small Disadvantaged Businesses (SDB). Eligibility requirements for certification are stated in 49 CFR (Code of Federal Regulations), part 26, Subpart D.

U.S. citizens that are African Americans, Hispanics, Native Americans, Asian-Pacific and Subcontinent Asian Americans, and women are presumed to be socially and economically disadvantaged. Also recognized as DBEs are Historically Black Colleges and Universities (HBCU) and small businesses located in Federal HUB Zones.

To be regarded as economically disadvantaged, an individual must have a personal net worth that does not exceed \$1.32 million. To be seen as a small business, a firm must meet Small Business Administration (SBA) size criteria (500 employees or less) and have average annual gross receipts not to exceed \$22.41 million. To be considered a DBE/SDB, a small business owned and controlled by socially and/or economically disadvantaged individuals must receive DBE certification from one of the recognized Missouri state agencies to be recognized in this classification.

1.1.9 Work

Work shall mean supervision, labor, equipment, tools, material, supplies, incidentals operations and activities required by the Contract Documents or reasonably inferable by the Contractor therefrom as necessary to produce the results intended by the Contract Documents in a safe, expeditious, orderly, and workmanlike manner, and in the best manner known to each respective trade.

1.1.10 Approved

The terms “approved”, “equal to”, “directed”, “required”, “ordered”, “designated”, “acceptable”, “compliant”, “satisfactory”, and similar words or phrases will be understood to have reference to action on the part of the Architect and/or the Owner’s Representative.

1.1.11 Contract Documents

The Contract Documents consist of (1) the executed Contract for Construction, (2) these General Conditions of the Contract for Construction, (3) any Supplemental Conditions or Special Conditions identified in the Contract for Construction, (4) the Specifications identified in the Contract for Construction, (5) the Drawings identified in the Contract for Construction, (6) Addenda issued prior to the receipt of bids, (7) Contractor’s bid addressed to Owner, including Contractor’s completed Qualification

Statement, (8) Contractor’s Performance Bond and Contractor’s Payment Bond, (9) Notice to Proceed, (10) and any other exhibits and/or post bid adjustments identified in the Contract for Construction, (11) Advertisement for Bid, (12) Information for Bidders, and (13) Change Orders issued after execution of the Contract. All other documents and technical reports and information are not Contract Documents, including without limitation, Shop Drawings, and Submittals.

1.1.12 Contract

The Contract Documents form the Contract and are the exclusive statement of agreement between the parties. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior representations or agreements, either written or oral. The Contract Documents shall not be construed to create a contractual relationship of any kind between the Owner and a Subcontractor or any lower-tier Subcontractor.

1.1.13 Change Order

The Contract may be amended or modified without invalidating the Contract only by a Change Order, subject to the limitations in Article 7 and elsewhere in the Contract Documents. A Change Order is a written instrument signed by the Owner and the Contractor stating their agreement to a change in the Work, the amount of the adjustment to the Contract Sum, if any, and the extent of the adjustment to the Contract Time, if any. Agreement to any Change Order shall constitute a final settlement of all matters relating to the change in the Work which is the subject of the Change Order, including, but not limited to, all direct and indirect costs associated with such change and any and all adjustments of the Contract Sum, time and schedule.

1.1.14 Substantial Completion

The terms “Substantial Completion” or “substantially complete” as used herein shall be construed to mean the completion of the entire Work, including all submittals required under the Contract Documents, except minor items which in the opinion of the Architect, and/or the Owner’s Representative will not interfere with the complete and satisfactory use of the facilities for the purposes intended.

1.1.15 Final Completion

The date when all punch list items are completed, including all closeout submittals and approval by the Architect is given to the Owner in writing.

1.1.16 Supplemental and Special Conditions

The terms “Supplemental Conditions” or “Special Conditions” shall mean the part of the Contract Documents which amend, supplement, delete from, or add to these General Conditions.

1.1.17 Day

The term “day” as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

1.1.18 Knowledge

The terms “knowledge,” “recognize” and “discover” their respective derivatives and similar terms in the Contract Documents, as used in reference to the Contractor, shall be interpreted to mean that which the Contractor knows or should know, recognizes, or should recognize and discovers or should discover in exercising the care, skill, and diligence of a diligent and prudent contractor familiar with the Work. Analogously, the expression “reasonably inferable” and similar terms in the Contract Documents shall be interpreted to mean reasonably inferable by a diligent and prudent contractor familiar with the Work.

1.1.19 Punch List

“Punch List” means the list of items, prepared in connection with the inspection(s) of the Project by the Owner’s Representative or the Architect in connection with Substantial Completion of the Work or a portion of the Work, which the Owner’s Representative or the Architect has designated as remaining to be performed, completed, or corrected before the Work will be accepted by the Owner.

1.1.20 Force Majeure

An event or circumstance that could not have been reasonably anticipated and is out of the control of both the Owner and the Contractor.

1.2 Specifications and Drawings

1.2.1 The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, construction system, standards and workmanship and performance of related services for the Work identified in the Contract for Construction. Specifications are separated into titled divisions for convenience of reference only. Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. Such separation will not operate to make the Owner or the Architect an arbiter of labor disputes or work agreements.

1.2.2 The drawings herein referred to, consist of drawings prepared by the Architect, and are enumerated in the Contract Documents.

1.2.3 Drawings are intended to show general arrangements, design, and dimensions of work and are partly diagrammatic. Dimensions shall not be determined by scale or rule. If figured dimensions are lacking, they shall be supplied by the Architect on the Contractor’s written request to the Owner’s Representative.

1.2.4 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complimentary, and what is required by one shall be as binding as if required by all; performance by the Contractor

shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results.

1.2.5 In the event of inconsistencies within or between parts of the Contract Documents, or between the Contract Documents and applicable standards, codes and ordinances, the Contractor shall (1) provide the better quality or greater quantity of Work or (2) comply with the more stringent requirement; either or both in accordance with the Owner’s Representative’s interpretation. On the Drawings, given dimensions shall take precedence over scaled measurements and large-scale drawings over small scale drawings. Before ordering any materials or doing any Work, the Contractor and each Subcontractor shall verify measurements at the Work site and shall be responsible for the correctness of such measurements. Any difference which may be found shall be submitted to the Owner’s Representative and the Architect for resolution before proceeding with the Work. If a minor change in the Work is found necessary due to actual field conditions, the Contractor shall submit detailed drawings of such departure for the approval by the Owner’s Representative and the Architect before making the change.

1.2.6 Data in the Contract Documents concerning lot size, ground elevations, present obstructions on or near the site, locations and depths of sewers, conduits, pipes, wires, etc., position of sidewalks, curbs, pavements, etc., and nature of ground and subsurface conditions have been obtained from sources the Architect believes reliable, but the Architect and the Owner do not represent or warrant that this information is accurate or complete. The Contractor shall verify such data to the extent possible through normal construction procedures, including but not limited to contacting utility owners and by prospecting.

1.2.7 Only work included in the Contract Documents is authorized, and the Contractor shall do no work other than that described therein.

1.2.8 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents. The Contractor represents that it has performed its own investigation and examination of the Work site and its surroundings and satisfied itself before entering into this Contract as to:

- .1** conditions bearing upon transportation, disposal, handling, and storage of materials;
- .2** the availability of labor, materials, equipment, water, electrical power, utilities and roads;
- .3** uncertainties of weather, river stages, flooding and similar characteristics of the site;
- .4** conditions bearing upon security and protection of material, equipment, and Work in progress;
- .5** the form and nature of the Work site, including the surface and sub-surface conditions;

.6 the extent and nature of Work and materials necessary for the execution of the Work and the remedying of any defects therein; and

.7 the means of access to the site and the accommodations it may require and, in general, shall be deemed to have obtained all information as to risks, contingencies and other circumstances.

.8 the ability to complete work without disruption to normal campus activities, except as specifically allowed in the Contract Documents.

The Owner assumes no responsibility or liability for the physical condition or safety of the Work site, or any improvements located on the Work site. The Contractor shall be solely responsible for providing a safe place for the performance of the Work. The Owner shall not be required to make any adjustment in either the Contract Sum or Contract Time concerning any failure by the Contractor or any Subcontractor to comply with the requirements of this Paragraph.

1.2.9 Drawings, specifications, and copies thereof furnished by the Owner are and shall remain the Owner's property. They are not to be used on another project and, with the exception of one contract set for each party to the Contract, shall be returned to the Owner's Representative on request, at the completion of the Work.

1.3 Required Provisions Deemed Inserted

Each and every provision of law and clause required by law to be inserted in this Contract shall be deemed to be inserted herein, and the Contract shall be read and enforced as though it were included herein; and if through mistake or otherwise any such provision is not inserted, or is not correctly inserted, then upon the written application of either party the Contract shall forthwith be physically amended to make such insertion or correction.

ARTICLE 2 OWNER

2.1 Information and Services Required of Owner

2.1.1 Permits and fees are the responsibility of the Contractor under the Contract Documents, unless specifically stated in the Contract Documents that the Owner will secure and pay for specific necessary approvals, easements, assessments, and charges required for construction, use or occupancy of permanent structures, or for permanent changes in existing facilities.

2.1.2 When requested in writing by the Contractor, information or services under the Owner's control, which are reasonably necessary to perform the Work, will be furnished by the Owner with reasonable promptness to avoid delay in the orderly progress of the Work.

2.2 Owner's Right to Stop the Work

2.2.1 If the Contractor fails to correct Work which is not in strict accordance with the requirements of the Contract Documents or fails to carry out Work in strict accordance with the Contract Documents, the Owner's Representative may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work will not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity. The Owner's lifting of Stop Work Order shall not prejudice the Owner's right to enforce any provision of this Contract.

2.3 Owner's Right to Carry Out the Work

2.3.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a seven (7) day period after receipt of a written notice from the Owner to correct such default or neglect, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. In such case, an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for the Architect's additional services and expenses made necessary by such default or neglect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to Owner. However, such notice shall be waived in the event of an emergency with the potential for property damage or the endangerment of students, faculty, staff, the public or construction personnel, at the sole discretion of the Owner.

2.3.2 In the event the Contractor has not satisfactorily completed all items on the Punch List within thirty (30) days of its receipt, the Owner reserves the right to complete the Punch List without further notice to the Contractor or its surety. In such case, the Owner shall be entitled to deduct from payments then or thereafter due the Contractor the cost of completing the Punch List items, including compensation for the Architect's additional services. If payments then or thereafter due Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

2.4 Extent of Owner Rights

2.4.1 The rights stated in Article 2 and elsewhere in the Contract Documents are cumulative and not in limitation of any rights of the Owner (1) granted in the Contract Documents, (2) at law or (3) in equity.

2.4.2 In no event shall the Owner have control over, charge of, or any responsibility for construction means, methods, techniques, sequences or procedures or for safety precautions and programs in connection with the Work, notwithstanding any of the rights and authority granted the Owner in the Contract Documents.

ARTICLE 3 CONTRACTOR

3.1 Contractor's Warranty

3.1.1 The Contractor warrants all equipment and materials furnished, and work performed, under this Contract, against defective materials and workmanship for a period of twelve months after acceptance as provided in this Contract, unless a longer period is specified, regardless of whether the same were furnished or performed by the Contractor or any Subcontractors of any tier. Upon written notice from the Owner of any breach of warranty during the applicable warranty period due to defective material or workmanship, the affected part or parts thereof shall be repaired or replaced by the Contractor at no cost to the Owner. Should the Contractor fail or refuse to make the necessary repairs, replacements, and tests when requested by the Owner, the Owner may perform, or cause the necessary work and tests to be performed, at the Contractor's expense, or exercise the Owner's rights under Article 14.

3.1.2 Should one or more defects mentioned above appear within the specified period, the Owner shall have the right to continue to use or operate the defective part or apparatus until the Contractor makes repairs or replacements or until such time as it can be taken out of service without loss or inconvenience to the Owner.

3.1.3 The above warranties are not intended as a limitation but are in addition to all other express warranties set forth in this Contract and such other warranties as are implied by law, custom, and usage of trade. The Contractor, and its surety or sureties, if any, shall be liable for the satisfaction and full performance of the warranties set forth herein.

3.1.4 Neither the final payment nor any provision in the Contract Documents nor partial or entire occupancy of the premises by the Owner, nor expiration of warranty stated herein, will constitute an acceptance of Work not done in accordance with the Contract Documents or relieve the Contractor of liability in respect to any responsibility for non-conforming work. The Contractor shall immediately remedy any defects in the Work and pay for any damage to other Work resulting therefrom upon written notice from the Owner. Should the Contractor fail or refuse to remedy the non-conforming work, the Owner may perform, or cause to be performed all actions necessary to bring the Work into conformance with the Contract Documents at the Contractor's expense.

3.1.5 The Contractor agrees to defend, indemnify, and save harmless The Curators of the University of Missouri, their officers, agents, employees, and volunteers, from and against all loss or expense from any injury or damages to property of others suffered or incurred on account of any breach of the aforesaid obligations and covenants. The Contractor agrees to investigate, handle, respond to and provide defense for and defend against any such liability, claims, and demands at the sole expense of the Contractor, or at the option of the University, agrees to pay to or

reimburse the University for the defense costs incurred by the University in connection with any such liability claims, or demands. The parties hereto understand and agree that the University is relying on and does not waive or intend to waive by any provision of this Contract, any monetary limitations or any other rights, immunities, and protections provided by the State of Missouri, as from time to time amended, or otherwise available to the University, or its officers, employees, agents or volunteers.

3.2 Compliance with Laws, Regulations, Permits, Codes, and Inspections

3.2.1 The Contractor shall, without additional expense to the Owner, comply with all applicable laws, ordinances, rules, permit requirements, codes, statutes, and regulations (which may be collectively referred to as "laws").

3.2.2 Since the Owner is an instrumentality of the State of Missouri, municipal, or political subdivision, ordinances, zoning ordinances, and other like ordinances are not applicable to construction on the Owner's property, and the Contractor will not be required to submit plans and specifications to any municipal or political subdivision authority to obtain construction permits or any other licenses or permits from or submit to, inspection by any municipality or political subdivision relating to the construction on the Owner's property, unless required by the Owner in these Contract Documents or otherwise in writing.

3.2.3 All fees, permits, inspections, or licenses required by municipality or political subdivision for operation on property not belonging to the Owner, shall be obtained by and paid for by the Contractor. The Contractor, of its own expense, is responsible to ensure that all inspections required by said permits or licenses on property, easements, or utilities not belonging to the Owner are conducted as required therein. All connection charges, assessments or transportation fees as may be imposed by any utility company or others are included in the Contract Sum and shall be the Contractor's responsibility.

3.2.4 If the Contractor has knowledge that any Contract Documents are at variance with any laws, including Americans with Disabilities Act – Standards for Accessible Design, ordinances, rules, regulations, or codes applying to the Work, Contractor shall promptly notify the Architect and the Owner's Representative, in writing, and any necessary changes will be adjusted as provided in the Contract Documents. However, it is not the Contractor's primary responsibility to ascertain that the Contract Documents are in accordance with applicable laws, unless such laws bear upon performance of the Work.

3.3 Anti-Kickback

3.3.1 No member or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this Contract or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this Contract if made with a corporation for its general benefit.

3.3.2 No official of the Owner who is authorized in such capacity and on behalf of the Owner to negotiate, make, accept or approve, or to take part in negotiating, making, accepting, or approving any architectural, engineering, inspection, construction, or material supply contract or any Subcontract of any tier in connection with the construction of the Work shall have a financial interest in this Contract or in any part thereof, any material supply contract, Subcontract of any tier, insurance contract, or any other contract pertaining to the Work.

3.4 Supervision and Construction Procedures

3.4.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the Work under the Contract. The Contractor shall supply sufficient and competent supervision and personnel, and sufficient material, plant, and equipment to prosecute the Work with diligence to ensure completion thereof within the time specified in the Contract Documents, and shall pay when due any laborer, Subcontractor of any tier, or supplier.

3.4.2 The Contractor, if an individual, shall give the Work an adequate amount of personal supervision, and if a partnership, corporation, or joint venture or other business entity, the Work shall be given an adequate amount of personal supervision by a partner or executive officer, as determined by the Owner's Representative.

3.4.3 The Contractor and each of its Subcontractors of any tier shall submit to the Owner such schedules of quantities and costs, progress schedules in accordance with 3.18 this document, payrolls, reports, estimates, records, and other data as the Owner may request concerning Work performed or to be performed under the Contract.

3.4.4 The Contractor shall be represented at the site by a competent superintendent from the beginning of the Work until its final acceptance, whenever Contract Work is being performed, unless otherwise permitted in writing by the Owner's Representative. The superintendent for the Contractor shall exercise general supervision over the Work and such superintendent shall have decision making authority of the Contractor. Communications given to the superintendent shall be binding as if given to the Contractor. The superintendent shall not be changed by the Contractor without approval from the Owner's Representative.

3.4.5 The Contractor shall establish and maintain a permanent benchmark to which access may be had during progress of the Work, and Contractor shall establish all lines and levels, and shall be responsible for the correctness of such. The Contractor shall be fully responsible for all layout work for the proper location of Work in strict accordance with the Contract Documents.

3.4.6 The Contractor shall establish and be responsible for wall and partition locations. If applicable, separate contractors shall be entitled to rely upon these locations and for setting their sleeves, openings, or chases.

3.4.7 The Contractor's scheduled outage/tie-in plan, time, and date for any utilities is subject to approval by the Owner's Representative. Communication with the appropriate entity and planning for any scheduled outage/tie-in of utilities shall be the responsibility of the Contractor. Failure of the Contractor to comply with the provisions of this Paragraph shall cause the Contractor to forfeit any right to an adjustment of the Contract Sum or Contract Time for any postponement, rescheduling or other delays ordered by the Owner in connection with such Work. The Contractor shall follow the following procedures for all utility outages/tie-ins or disruption of any building system:

- .1** All shutting of valves, switches, etc., shall be by the Owner's personnel.
- .2** The Contractor shall submit its preliminary outage/tie-in schedule with its baseline schedule.
- .3** The Contractor shall request an outage/tie-in meeting at least two weeks before the outage/tie-in is required.
- .4** The Owner's Representative will schedule an outage/tie-in meeting at least one week prior to the outage/tie-in.

3.4.8 The Contractor shall coordinate all Work so there shall be no prolonged interruption of existing utilities, systems, and equipment of the Owner. Any existing plumbing, heating, ventilating, air conditioning, or electrical disconnection necessary, which affect portions of this construction or building or any other building, must be scheduled with the Owner's Representative to avoid any disruption of operation within the building under construction or other buildings or utilities. In no case shall utilities be left disconnected at the end of a workday or over a weekend. Any interruption of utilities, either intentionally or accidentally, shall not relieve the Contractor from repairing and restoring the utility to normal service. Repairs and restoration shall be made before the workers responsible for the repair and restoration leave the job.

3.4.9 The Contractor shall be responsible for repair of damage to property on or off the project occurring during construction of project, and all such repairs shall be made to meet code requirements or to the satisfaction of the Owner's Representative if code is not applicable.

3.4.10 The Contractor shall be responsible for all shoring required to protect the Work or adjacent property and shall pay

for any damage caused by failure to shore or by improper shoring or by failure to give proper notice. Shoring shall be removed only after completion of permanent supports.

3.4.11 The Contractor shall maintain at the Contractor's own cost and expense, adequate, safe and sufficient walkways, platforms, scaffolds, ladders, hoists and all necessary, proper, and adequate equipment, apparatus, and appliances useful in carrying on the Work and which are necessary to make the place of Work safe and free from avoidable danger for students, faculty, staff, the public and construction personnel, and as may be required by safety provisions of applicable laws, ordinances, rules regulations and building and construction codes.

3.4.12 During the performance of the Work, the Contractor shall be responsible for providing and maintaining warning signs, lights, signal devices, barricades, guard rails, fences, and other devices appropriately located on site which shall give proper and understandable warning to all persons of danger of entry onto land, structure, or equipment, within the limits of the Contractor's work area.

3.4.13 The Contractor shall pump, bail, or otherwise keep any general excavations free of water. The Contractor shall keep all areas free of water before, during and after concrete placement. The Contractor shall be responsible for protection, including weather protection, and proper maintenance of all equipment and materials installed, or to be installed by the Contractor.

3.4.14 The Contractor shall be responsible for care of the Work and must protect same from damage of defacement until acceptance by the Owner. All damaged or defaced Work shall be repaired or replaced to the Owner's satisfaction, without cost to the Owner.

3.4.15 When requested by the Owner's Representative, the Contractor, at no extra charge, shall provide scaffolds or ladders in place as may be required by the Architect or the Owner for examination or inspection of Work in progress or completed.

3.4.16 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors of any tier and their agents and employees, and any other entity or persons performing portions of the Work.

3.4.17 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Owner's Representative or the Architect in their administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor.

3.4.18 The Contractor shall be responsible for inspection of portions of the Work already performed under this Contract to determine that such portions are compliant and in proper condition to receive subsequent Work.

3.5 Use of Site

3.5.1 The Contractor shall limit operations and storage of material to the area within the Work limit lines shown on Drawings, except as necessary to connect to existing utilities, shall not encroach on neighboring property, and shall exercise caution to prevent damage to existing structures.

3.5.2 Only materials and equipment, which are to be used directly in the Work, shall be brought to and stored on the Work site by the Contractor. After equipment is no longer required for the Work, it shall be promptly removed from the Work site. Protection of construction materials and equipment stored at the Work site from weather, theft, damage and all other adversity is solely the responsibility of the Contractor.

3.5.3 No project signs shall be erected without the written approval of the Owner's Representative.

3.5.4 The Contractor shall ensure that the Work is at all times performed in a manner that affords reasonable access, both vehicular and pedestrian, to the site of the Work and all adjacent areas. Particular attention shall be paid to access for emergency vehicles, including fire trucks. Wherever there is the possibility of interfering with normal emergency vehicle operations, the Contractor shall obtain permission from both campus and municipal emergency response entities prior to limiting any access. The Work shall be performed, to the fullest extent reasonably possible, in such a manner that public areas adjacent to the site of the Work shall be free from all debris, building materials and equipment likely to cause hazardous conditions. Without limitation of any other provision of the Contract Documents, the Contractor shall not interfere with the occupancy or beneficial use of (1) any areas and buildings adjacent to the site of the Work or (2) the Work in the event of partial occupancy. The Contractor shall assume full responsibility for any damage to the property comprising the Work or to the owner or occupant of any adjacent land or areas resulting from the performance of the Work.

3.5.5 The Contractor shall not permit any workers to use any existing facilities at the Work site, including, without limitation, lavatories, toilets, entrances, and parking areas other than those designated by Owner. The Contractor, Subcontractors of any tier, suppliers and employees shall comply with instructions or regulations of the Owner's Representative governing access to, operation of, and conduct while in or on the premises and shall perform all Work required under the Contract Documents in such a manner as not to unreasonably interrupt or interfere with the conduct of the Owner's operations. Any request for Work, a suspension of Work or any other request or directive received by the Contractor from occupants of existing buildings shall be referred to the Owner's Representative for determination.

3.5.6 The Contractor and the Subcontractor of any tier shall have its' name, acceptable abbreviation or recognizable logo and the name of the city and state of the mailing address of the principal office of the company, on each motor vehicle and motorized self-propelled piece of equipment which is used in connection with the project. The signs are required on such vehicles during the time the Contractor is working on the project.

3.6 Review of Contract Documents and Field Conditions by Contractor

3.6.1 The Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by the Architect and the Owner and shall at once report in writing to the Architect and the Owner's Representative any errors, inconsistencies or omissions discovered. If the Contractor performs any construction activity which it knows or should have known involves a recognized error, inconsistency, or omission in the Contract Documents without such written notice to the Architect and the Owner's Representative, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable costs for correction.

3.6.2 The Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the Contract Documents before commencing activities. Errors, inconsistencies, or omissions discovered shall be reported in writing to the Architect and the Owner's Representative within twenty-four (24) hours. During the progress of the Work, the Contractor shall verify all field measurements prior to fabrication of building components or equipment and proceed with the fabrication to meet field conditions. The Contractor shall consult all Contract Documents to determine the exact location of all work and verify spatial relationships of all work. Any question concerning said location or spatial relationships shall be submitted to the Owner's Representative. Specific locations for equipment, pipelines, ductwork and other such items of work, where not dimensioned on plans, shall be determined in consultation with the Owner's Representative and the Architect. The Contractor shall be responsible for the proper fitting of the Work in place.

3.6.3 The Contractor shall provide, at the proper time, such material as required for support of the Work. If openings or chases are required, whether shown on Drawings or not, the Contractor shall see they are properly constructed. If required openings or chases are omitted, the Contractor shall cut them at the Contractors own expense, but only as directed by the Architect, through the Owner's Representative.

3.6.4 Should the Contract Documents fail to particularly describe materials or goods to be used, it shall be the duty of the Contractor to inquire of the Architect and

the Owner's Representative what is to be used and to supply it at the Contractor's expense, or else thereafter replace it to the Owner's Representative's satisfaction. At a minimum, the Contractor shall provide the quality of materials as generally specified throughout the Contract Documents.

3.7 Cleaning and Removal

3.7.1 The Contractor shall keep the Work site and surrounding areas free from accumulation of waste materials, rubbish, debris, and dirt resulting from the Work and shall clean the Work site and surrounding areas as requested by the Architect and the Owner's Representative, including mowing of grass greater than six (6) inches high. The Contractor shall be responsible for the cost of clean up and removal of debris from premises. The building and premises shall be kept clean, safe, in a workmanlike manner, and in compliance with OSHA standards and code at all times. At completion of the Work, the Contractor shall remove from and about the Work site tools, construction equipment, machinery, fencing, and surplus materials. Further, at the completion of the Work, all dirt, stains, and smudges shall be removed from every part of the building, all glass in doors and windows shall be washed, and entire Work shall be left broom clean in a finished state ready for occupancy. The Contractor shall advise his Subcontractors of any tier of this provision, and the Contractor shall be fully responsible for leaving the premises in a finished state ready for use to the satisfaction of the Owner's Representative. If the Contractor fails to comply with the provisions of this Paragraph, the Owner may do so, and the cost thereof shall be charged to the Contractor.

3.8 Cutting and Patching

3.8.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly.

3.8.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

3.8.3 If the Work involves renovation and/or alteration of existing improvements, the Contractor acknowledges that cutting and patching of the Work is essential for the Work to be successfully completed. The Contractor shall perform any cutting, altering, patching, and/or fitting of the Work necessary for the Work and the existing improvements to be fully integrated and to present the visual appearance of an entire, completed, and unified project. In performing any Work which requires cutting or patching, the Contractor shall use its best efforts to protect and preserve the visual appearance and

aesthetics of the Work to the reasonable satisfaction of both the Owner's Representative and the Architect.

3.9 Indemnification

3.9.1 To the fullest extent permitted by law, the Contractor shall defend, indemnify, and hold harmless the Owner, the Architect, the Architect's consultants, and the agents, employees, representatives, insurers and re-insurers of any of the foregoing (hereafter collectively referred to as the "Indemnitees") from and against claims, damages (including loss of use of the Work itself), punitive damages, penalties and civil fines unless expressly prohibited by law, losses and expenses, including, but not limited to, attorneys' fees, arising out of or resulting from performance of the Work to the extent caused in whole or in part by negligent acts or omissions or other fault of the Contractor, a Subcontractor of any tier, or anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by the negligent acts or omissions or other fault of a party indemnified hereunder. The Contractor's obligations hereunder are in addition to and shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that the Owner may possess. If one or more of the Indemnitees demand performance by the Contractor of obligations under this Paragraph or other provisions of the Contract Documents and if the Contractor refuses to assume or perform, or delays in assuming or performing the Contractor's obligations, Contractor shall pay each Indemnitee who has made such demand its respective attorneys' fees, costs, and other expenses incurred in enforcing this provision. The defense and indemnity required herein shall be a binding obligation upon the Contractor whether or not an Indemnitee has made such demand. Even if a defense is successful to a claim or demand for which the Contractor is obligated to indemnify the Indemnitees from under this Paragraph, the Contractor shall remain liable for all costs of defense.

3.9.2 The indemnity obligations of the Contractor under this Section 3.9 shall survive termination of this Contract or final payment thereunder. In the event of any claim or demand made against any party which is entitled to be indemnified hereunder, the Owner may in its sole discretion reserve, return or apply any monies due or to become due the Contractor under the Contract for the purpose of resolving such claims; provided, however, that the Owner may release such funds if the Contractor provides the Owner with reasonable assurance of protection of the Owner's interests. The Owner shall in its sole discretion determine if such assurances are reasonable. The Owner reserves the right to control the defense and settlement of any claim, action or proceeding which the Contractor has an obligation to indemnify the Indemnitees against.

3.9.3 In claims against any person or entity indemnified under this Section 3.9 by an employee of the Contractor, a

Subcontractor of any tier, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under this Section 3.9 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor of any tier under workers' or workmen's compensation acts, disability benefit acts or other employee benefit acts.

3.9.4 The obligations of the Contractor under Paragraph 3.9.1 shall not extend to the liability of the Architect, the Architect's agents or employees, arising out of the preparation and approval of maps, drawings, opinions, reports, surveys, Change Orders, designs, or Specifications.

3.10 Patents

3.10.1 The Contractor shall hold and save harmless the Owner and its officers, agents, servants, and employees from liability of any nature or kind, including cost and expense, for, or on account of, any patented or otherwise protected invention, process, article, or appliance manufactured or used in the performance of the Contract, including its use by the Owner, unless otherwise specifically stipulated in the Contract Documents.

3.10.2 If the Contractor uses any design, device, or material covered by letters patent or copyright, the Contractor shall provide for such use by suitable agreement with the Owner of such patented or copyrighted design, device, or material. It is mutually agreed and understood, without exception, that the Contract Sum include, and the Contractor shall pay all royalties, license fees or costs arising from the use of such design, device, or material in any way involved in the Work. The Contractor and/or sureties shall indemnify and save harmless the Owner from any and all claims for infringement by reason of the use of such patented or copyrighted design, device, or material or any trademark or copyright in connection with Work agreed to be performed under this Contract and shall indemnify the Owner for any cost, expense, or damage it may be obligated to pay by reason of such infringement at any time during the prosecution of the Work or after completion of the Work.

3.11 Delegated Design

3.11.1 If the Contract Documents specify the Contractor is responsible for the design of any Work as part of the project, then the Contractor shall procure all design services and certifications necessary to complete the Work as specified, from a design professional licensed in the State of Missouri. The signature and seal of that design professional shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals related to the Work. The design professional shall maintain insurance as required per Article 11.

3.12 Materials, Labor, and Workmanship

3.12.1 Materials and equipment incorporated into the Work shall strictly conform to the Contract Documents and representations and approved Samples provided by Contractor

and shall be of the most suitable grade of their respective kinds for their respective uses and shall be fit and sufficient for the purpose intended, merchantable, of good new material and workmanship, and free from defect. Workmanship shall be in accordance with the highest standard in the industry and free from defect in strict accordance with the Contract Documents.

3.12.2 Materials and fixtures shall be new and of latest design unless otherwise specified and shall provide the most efficient operating and maintenance costs to the Owner. All Work shall be performed by competent workers and shall be of best quality.

3.12.3 The Contractor shall carefully examine the Contract Documents and shall be responsible for the proper fitting of his material, equipment, and apparatus into the building.

3.12.4 The Contractor shall base its bid only on the Contract Documents.

3.12.5 Materials and workmanship shall be subject to inspection, examination, and testing by the Architect and the Owner's Representative at any and all times during manufacture, installation, and construction of any of them, at places where such manufacture, installation, or construction is performed.

3.12.6 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

3.12.7 Unless otherwise specifically noted, the Contractor shall provide and pay for supervision, labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work.

3.12.8 Substitutions

3.12.8.1 A substitution is a Contractor proposal of an alternate product or method in lieu of what has been specified or shown in the Contract Documents, which is not an "or equal" as set forth in Section 3.13.

3.12.8.2 The Contractor may make a proposal to the Architect and the Owner's Representative to use substitute products or methods as set forth herein, but the Architect's and the Owner's Representative's decision concerning acceptance of a substitute shall be final. The Contractor must do so in writing and setting forth the following:

.1 Full explanation of the proposed substitution and submittal of all supporting data including technical information, catalog cuts, warranties, test results, installation instructions, operating procedures, and other

like information necessary for a complete evaluation of the substitution.

.2 Reasons the substitution is advantageous and necessary, including the benefits to the Owner and the Work in the event the substitution is acceptable.

.3 The adjustment, if any, in the Contract Sum, in the event the substitution is acceptable.

.4 The adjustment, if any, in the time of completion of the Contract and the construction schedule in the event the substitution is acceptable.

.5 An affidavit stating that (a) the proposed substitution conforms to and meets all of the Contract Document requirements and is code compliant, except as specifically disclosed and set forth in the affidavit and (b) the Contractor accepts the warranty and correction obligations in connection with the proposed substitution as if originally specified by the Architect. Proposals for substitutions shall be submitted to the Architect and the Owner's Representative in sufficient time to allow the Architect and the Owner's Representative no less than ten (10) working days for review. No substitution will be considered or allowed without the Contractor's submittal of complete substantiating data and information as stated herein.

3.12.8.3 Substitutions may be rejected without explanation at the Owner's sole discretion and will be considered only under one or more of the following conditions:

.1 Required for compliance with interpretation of code requirements or insurance regulations then existing;

.2 Unavailability of specified products, through no fault of the Contractor;

.3 Material delivered fails to comply with the Contract Documents;

.4 Subsequent information discloses inability of specified products to perform properly or to fit in designated space;

.5 Manufacturer/fabricator refuses to certify or guarantee performance of specified product as required; or

.6 When in the judgment of the Owner or the Architect, a substitution would be substantially to the Owner's best interests, in terms of cost, time, or other considerations.

3.12.8.4 Whether or not any proposed substitution is accepted by the Owner or the Architect, the Contractor shall reimburse the Owner for any fees charged by the Architect or other consultants for evaluating each proposed substitution.

3.13 Approved Equal

3.13.1 Whenever in the Contract Documents any article, appliance, device, or material is designated by the name of a manufacturer, vendor, or by any proprietary or trade name, the words "or approved equal," shall automatically follow and shall be implied unless specifically indicated otherwise. The standard products of manufacturers other than those specified will be accepted when, prior to the ordering or use thereof, it is proven to the satisfaction of the Owner's Representative and the Architect they are equal in design, appearance, spare parts availability, strength, durability, usefulness, serviceability, operation cost, maintenance cost, and convenience for the purpose intended. Any general listings of approved

manufacturers in any Contract Document shall be for informational purposes only and it shall be the Contractor's sole responsibility to ensure that any proposed "or equal" complies with the requirements of the Contract Documents and is code compliant.

3.13.2 The Contractor shall submit to the Architect and the Owner's Representative a written and full description of the proposed "or equal" including all supporting data, including technical information, catalog cuts, warranties, test results, installation instructions, operating procedures, and similar information demonstrating that the proposed "or equal" strictly complies with the Contract Documents. The Architect or the Owner's Representative shall take appropriate action with respect to the submission of a proposed "or equal" item. If Contractor fails to submit proposed "or equals" as set forth herein, it shall waive any right to supply such items. The Contract Sum and Contract Time shall not be adjusted as a result of any failure by Contractor to submit proposed "or equals" as provided for herein. All documents submitted in connection with preparing an "or equal" shall be clearly and obviously marked as a proposed "or equal" submission.

3.13.3 No approvals or action taken by the Architect or Owner's Representative shall relieve the Contractor from its obligation to ensure that an "or equal" article, appliance, devise, or material strictly complies with the requirements of the Contract Documents. The Contractor shall not propose "or equal" items in connection with Shop Drawings or other Submittals, and the Contractor acknowledges and agrees that no approvals or action taken by the Architect or Owner's Representative with respect to Shop Drawings or other Submittals shall constitute approval of any "or equal" item or relieve the Contractor from its sole and exclusive responsibility. Any changes required in the details and dimensions indicated in the Contract Documents for the incorporation or installation of any "or equal" item supplied by the Contractor shall be properly made and approved by the Architect at the expense of the Contractor. No "or equal" items will be permitted for components of or extensions to existing systems when, in the opinion of the Architect, the named manufacturer must be provided in order to ensure compatibility with the existing systems, including, but not limited to, mechanical systems, electrical systems, fire alarms, smoke detectors, etc. No action will be taken by the Architect with respect to proposed "or equal" items prior to receipt of bids, unless otherwise noted in the Special Conditions.

3.14 Shop Drawings, Product Data, Samples, and Coordination Drawings/BIM Models

3.14.1 Shop Drawings are drawings, diagrams, schedules, and other data specifically prepared for the Work by the Contractor or a Subcontractor, sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

3.14.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

3.14.3 Samples are physical samples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

3.14.4 Coordination Drawings are drawings for the integration of the Work, including work first shown in detail on Shop Drawings or product data. Coordination Drawings show sequencing and relationship of separate units of work which must interface in a restricted manner to fit in the space provided, or function as indicated. Coordination Drawings are the responsibility of the Contractor and are submitted for informational purposes. The Special Conditions will state whether Coordination Drawings are required. BIM models may be used for coordination in lieu of Coordination Drawings at the Contractor's discretion, unless required in the Special Conditions. The final Coordination Drawings/BIM Model will not change the Contract Documents, unless approved by a fully executed Change Order describing the specific modifications that are being made to the Contract Documents.

3.14.5 Shop Drawings, Coordination Drawings/BIM Models, Product Data, Samples, and similar submittals (collectively referred to as "Submittals") are not Contract Documents. The purpose of their submittal is to demonstrate for those portions of the Work for which submittals are required the way the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents.

3.14.6 The Contractor shall schedule submittal of Shop Drawings and Product Data to the Architect so that no delays will result in delivery of materials and equipment, advising the Architect of priority for checking of Shop Drawings and Product Data, but a minimum of two weeks shall be provided for this purpose. Because time is of the essence in this Contract, unless noted otherwise in the Special Conditions or Technical Specifications, all Submittals, Shop Drawings and Samples must be submitted as required to maintain the Contractor's plan for proceeding but must be submitted within ninety (90) days of the Notice to Proceed. If the Contractor believes that this milestone is unreasonable for any submittal, the Contractor shall request an extension of this milestone, within sixty (60) days of Notice to Proceed, for each submittal that cannot meet the milestone. The request shall contain a reasonable explanation as to why the ninety (90)-day milestone is unrealistic and shall specify a date on which the submittal will be provided, for approval by the Owner's Representative. Failure of the Contractor to comply with this Section may result in delays in the submittal approval process and/or charges for expediting approval, both of which will be the responsibility of the Contractor.

3.14.7 The Contractor, at its own expense, shall submit Samples required by the Contract Documents with reasonable promptness as to cause no delay in the Work or the activities of

separate contractors and no later than twenty (20) days before materials are required to be ordered for scheduled delivery to the Work site. Samples shall be labeled to designate material or products represented, grade, place of origin, name of producer, name of the Contractor and the name and number of the Owner's project. Quantities of Samples shall be twice the number required for testing so that the Architect can return one set of the Samples. Materials delivered before receipt of Architect's approval may be rejected by the Architect and in such event, the Contractor shall immediately remove all such materials from the Work site. When requested by the Architect or the Owner's Representative, Samples of finished masonry and field applied paints and finishes shall be located as directed and shall include sample panels built at the site of approximately twenty (20) square feet each.

3.14.8 The Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples, or similar submittals until the respective submittal has been approved by the Architect. Such Work shall be in accordance with approved Submittals.

3.14.9 By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents such Submittals strictly comply with the requirements of the Contract Documents and that the Contractor has determined and verified field measurements and field construction criteria related thereto, that materials are fit for their intended use and that the fabrication, shipping, handling, storage, assembly and installation of all materials, systems and equipment are in accordance with best practices in the industry and are in strict compliance with any applicable requirements of the Contract Documents. The Contractor shall also coordinate each Submittal with other Submittals.

3.14.10 The Contractor shall be responsible for the correctness and accuracy of the dimensions, measurements and other information contained in the Submittals.

3.14.11 Each Submittal will bear a stamp or specific indication that the Submittal complies with the Contract Documents and the Contractor has satisfied its obligations under the Contract Documents with respect to the Contractor's review and approval of that Submittal. Each Submittal shall bear the signature of the representative of the Contractor who approved the Submittal, together with the Contractor's name, Owner's name, number of the Project, and the item name and specification section number.

3.14.12 The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals by the Architect's approval thereof. Specifically, but not by way of limitation, the

Contractor acknowledges that the Architect's approval of Shop Drawings shall not relieve the Contractor for responsibility for errors and omissions in the Shop Drawings since the Contractor is responsible for the correctness of dimensions, details and the design of adequate connections and details contained in the Shop Drawings.

3.14.13 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect on previous Submittals.

3.14.14 The Contractor represents and warrants that all Shop Drawings shall be prepared by persons and entities possessing expertise and experience in the trade for which the Shop Drawing is prepared and, if required by the Architect or applicable laws, by a licensed engineer or other design professional.

3.15 Record Drawings

3.15.1 The Contractor shall maintain a set of Record Drawings on site in good condition and shall use colored pencils to mark up said set with "record information" in a legible manner to show: (1) bidding addendums, (2) executed Change Orders, (3) deviations from the Drawings made during construction; (4) details in the Work not previously shown; (5) changes to existing conditions or existing conditions found to differ from those shown on any existing drawings; (6) the actual installed position of equipment, piping, conduits, light switches, electric fixtures, circuiting, ducts, dampers, access panels, control valves, drains, openings, and stub-outs; and (7) such other information as either the Owner or the Architect may reasonably request. The prints for Record Drawing use will be a set of "blue line" prints provided by the Architect to the Contractor at the start of construction. Upon Substantial Completion of the Work, the Contractor shall deliver all Record Drawings to the Owner and the Architect for approval. If not approved, the Contractor shall make the revisions requested by the Architect or the Owner's Representative. Final payment and any retainage shall not be due and owing to the Contractor until the final Record Drawings marked by the Contractor as required above are delivered to the Owner.

3.16 Operating Instructions and Service Manuals

3.16.1 The Contractor shall submit four (4) volumes of operating instructions and service manuals to the Architect before completing 50% of the adjusted contract amount. Payments beyond 50% of the adjusted contract amount may be withheld until all operating instructions and service manuals are received. The operating instructions and service manuals shall contain:

.1 Start-up and Shutdown Procedures: Provide a step-by-step write up of all major equipment. When manufacturer's printed start-up, trouble shooting and shut-down procedures are available, they may be incorporated into the operating manual for reference.

.2 Operating Instructions: Written operating instructions shall be included for the efficient and safe operation of all equipment.

.3 Equipment List: List of all major equipment as installed shall include model number, capacities, flow rate, and name-plate data.

.4 Service Instructions: The Contractor shall be required to provide the following information for all pieces of equipment.

.4.1 Recommended spare parts including catalog number and name of local suppliers or factory representative.

.4.2 Belt sizes, types, and lengths.

.4.3 Wiring diagrams.

.5 Manufacturer's Certificate of Warranty: Manufacturer's certificates of warranty shall be obtained for all major equipment. Warranty shall be obtained for at least one year from the date of Substantial Completion. Where longer period is required by the Contract Documents, the longer period shall govern.

.6 Parts catalogs: For each piece of equipment furnished, a parts catalog or similar document shall be provided which identifies the components by number for replacement ordering.

3.16.2 Submission

.1 Manuals shall be bound into volumes of standard 8 1/2" x 11" hard binders. Large drawings too bulky to be folded into 8 1/2" x 11" shall be separately bound or folded and in brown envelopes, cross-referenced and indexed with the manuals.

.2 The manuals shall identify the Owner's project name, project number, and include the name and address of the Contractor and major Subcontractors of any tier who were involved with the activity described in that particular manual.

3.17 Taxes

3.17.1 The Contractor shall pay all applicable sales, consumer, use, and similar taxes for the Work which are legally enacted when the bids are received, whether or not yet effective or scheduled to go into effect. However, certain purchases by the Contractor of materials incorporated in or consumed in the Work are exempt from certain sales tax pursuant to Section 144.062, RSMo. The Contractor shall be issued a Project Tax Exemption Certificate for this Work to obtain the benefits of Section 144.062, RSMo.

3.17.2 The Contractor shall furnish this certificate to all Subcontractors, and any person or entity purchasing materials for the Work shall present such certificate to all material suppliers as authorization to purchase, on behalf of the Owner, all tangible personal property and materials to be incorporated into or consumed in the Work and no other on a tax-exempt basis. Such suppliers shall provide to the purchasing party invoices bearing the name of the exempt entity and the project identification number. Nothing in this Section shall be deemed to exempt from any sales or similar tax the purchase of any construction machinery, equipment or tools used in construction, repairing or remodeling facilities for the Owner. All

invoices for all personal property and materials purchased under a Project Tax Exemption Certificate shall be retained by the Contractor for a period of five years and shall be subject to audit by the Director of Revenue.

3.17.3 Any excess resalable tangible personal property or materials which were purchased for the project under this Project Tax Exemption Certificate but which were not incorporated into or consumed in the Work shall either be returned to the supplier for credit or the appropriate sales or use tax on such excess property or materials shall be reported on a return and paid by such purchasing party not later than the due date of the purchasing party's Missouri sales or use tax return following the month in which it was determined that the materials were not used in the Work.

3.17.4 If it is determined that sales tax is owed by the Contractor on property and materials due to the failure of the Owner to revise the certificate expiration date to cover the applicable date of purchase, the Owner shall be liable for the tax owed.

3.17.5 The Owner shall not be responsible for any tax liability due to the Contractor's neglect to make timely orders, payments, etc. or the Contractor's misuse of the Project Tax Exemption Certificate. The Contractor represents that the Project Tax Exemption Certificate shall be used in accordance with Section 144.062, RSMo and the terms of the Project Tax Exemption Certificate. The Contractor shall indemnify the Owner for any loss or expense, including but not limited to, reasonable attorneys' fees, arising out of the Contractor's use of the Project Tax Exemption Certificate.

3.18 Contractor's Construction Schedules

3.18.1 The Contractor, within fifteen (15) days after the issuance of the Notice to Proceed, shall prepare and submit for the Owner's and the Architect's information the Contractor's construction schedule for the Work and shall set forth interim dates for completion of various components of the Work and Work Milestone Dates as defined herein. The schedule shall not exceed time limits current under the Contract Documents, shall be revised on a monthly basis or as requested by the Owner's Representative as required by the conditions of the Work, and shall provide for expeditious and practicable execution of the Work. The Contractor shall conform to the most recent schedule.

3.18.2 The construction schedule shall be in a detailed format satisfactory to the Owner's Representative and the Architect and in accordance with the detailed schedule requirements set forth in this document and the Special Conditions. If the Owner's Representative or the Architect has a reasonable objection to the schedule submitted by Contractor, the construction schedule shall be promptly revised by the Contractor. The Contractor shall monitor the progress of the Work for conformance with the requirements of the construction schedule and shall promptly advise the Owner of any delays or potential delays.

3.18.3 As time is of the essence to this Contract, the University expects that the Contractor will take all necessary steps to ensure that the project construction schedule shall be prepared in accordance with the specific requirements of the Special Conditions to this Contract. At a minimum, the Contractor shall comply with the following:

- .1 The schedule shall be prepared using Primavera P3, Oracle P6, Microsoft Project or other software acceptable to the Owner's Representative.
- .2 The schedule shall be prepared and maintained in CPM format, in accordance with Construction CPM Scheduling, published by the Associated General Contractors of American (AGC).
- .3 Prior to submittal to the Owner's Representative for review, the Contractor shall obtain full buy-in to the schedule from all major Subcontractors, in writing if so, requested by Owner's Representative.
- .4 Schedule shall be updated, in accordance with Construction CPM Scheduling, published by the AGC, on a monthly basis at minimum, prior to, and submitted with, the monthly pay application or as requested by the Owner's Representative.
- .5 Along with the update the Contractor shall submit a narrative report addressing all changes, delays and impacts, including weather to the schedule during the last month, and explain how the end date has been impacted by same.
- .6 The submission of the updated schedule certifies that all delays and impacts that have occurred on or to the project during the previous month have been factored into the update and are fully integrated into the schedule and the projected completion date.

Failure to comply with any of these requirements will be considered a material breach of this Contract. See Special Conditions for detailed scheduling requirements.

3.18.4 In the event the Owner's Representative or the Architect determines that the performance of the Work, as of a Milestone Date, has not progressed or reached the level of completion required by the Contract Documents, the Owner shall have the right to order the Contractor to take corrective measures necessary to expedite the progress of construction, including, without limitation, (1) working additional shifts or overtime, (2) supplying additional manpower, equipment, facilities, (3) expediting delivery of materials, and (4) other similar measures (hereinafter referred to collectively as "Extraordinary Measures"). Such Extraordinary Measures shall continue until the progress of the Work complies with the stage of completion required by the Contract Documents. The Owner's right to require Extraordinary Measures is solely for the purpose of ensuring the Contractor's compliance with the construction schedule. The Contractor shall not be entitled to an adjustment in the Contract Sum concerning Extraordinary Measures required by the Owner under or pursuant to this Paragraph. The Owner may exercise the rights furnished the Owner under or pursuant to this Paragraph as frequently as the Owner deems necessary to ensure that the Contractor's performance of the Work will

comply with any Milestone Date or completion date set forth in the Contract Documents.

ARTICLE 4 ADMINISTRATION OF THE CONTRACT

4.1 Rights of the Owner

4.1.1 The Owner's Representative will administer the Construction Contract. The Architect will assist the Owner's Representative with the administration of the Contract as indicated in these Contract Documents.

4.1.2 If, in the judgment of the Owner's Representative, it becomes necessary to accelerate the Work, the Contractor, when directed by the Owner's Representative in writing, shall cease work at any point and transfer its workers to such point or points and execute such portions of the Work as may be required to enable others to hasten and properly engage and carry out the Work, all as directed by the Owner's Representative. The additional cost of accelerating the Work, if any, will be borne by the Owner, unless the Contractor's work progress is behind schedule as shown on the most recent progress schedule.

4.1.3 If the Contractor refuses, for any reason, to proceed with what the Owner believes to be Contract Work, the Owner may issue a Construction Directive, directing the Contractor to proceed. The Contractor shall be obligated to promptly proceed with such work. If the Contractor feels that it is entitled to additional compensation as a result of a Construction Directive, it may file a claim for additional compensation and/or time, in accordance with 4.4 of this Contract.

4.1.4 The Owner's Representative, may, by written notice, require the Contractor to remove from involvement with the Work, any of the Contractor's personnel or the personnel of its Subcontractors of any tier whom the Owner's Representative may deem abusive, incompetent, careless, or a hindrance to proper and timely execution of the Work. The Contractor shall comply with such notice promptly, but without detriment to the Work or its progress.

4.1.5 The Owner's Representative will schedule Work status meetings that shall be attended by representatives of the Contractor and appropriate Subcontractors of any tier. Material suppliers shall attend status meetings if required by the Owner's Representative. These meetings shall include preconstruction meetings.

4.1.6 The Owner does not allow smoking on University property.

4.2 Rights of the Architect

4.2.1 The Architect will interpret requirements of the Contract Documents with respect to the quality, quantity, and other technical requirements of the Work itself within a reasonable time after written request of the Contractor. The

Contractor shall provide Owner's Representative a copy of such written request.

4.3 Review of the Work

4.3.1 The Architect, the Owner's Representative, and the Owner's Authorized Agent shall, at all times, have access to the Work; and the Contractor shall provide proper and safe facilities for such access.

4.3.2 The Owner's Representative shall have authority to reject Work that does not strictly comply with the requirements of the Contract Documents. Whenever the Owner's Representative considers it necessary or advisable for implementation of the intent of the Contract Documents, Owner's Representative shall have the authority to require additional inspection or testing of the Work, whether or not such Work is fabricated, installed, or completed.

4.3.3 The fact that the Architect or the Owner's Representative observed, or failed to observe, faulty Work, or Work done which is not in accordance with the Contract Documents, regardless of whether or not the Owner has released final payment, shall not relieve the Contractor from responsibility for all damages and additional costs of the Owner as a result of defective or faulty Work.

4.4 Claims

4.4.1 A Claim is a demand or assertion by the Contractor seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extension of time or any other relief with respect to the terms of the Contract. The term "Claim(s)" also includes demands and assertions of the Contractor arising out of or relating to the Contract Documents, including Claims based upon breach of contract, mistake, misrepresentation, or other cause for Contract Modification or rescission. Claims must be made by written notice. The Contractor shall have the responsibility to substantiate Claims.

4.4.2 Claims by the Contractor must be made promptly, and no later than within fourteen (14) days after occurrence of the event giving rise to such Claim. Claims must be made by written notice. Such notice shall include a detailed statement setting forth all reasons for the Claim and the amount of additional money and additional time claimed by the Contractor. The notice of Claims shall also strictly comply with all other provisions of the Contract Documents. The Contractor shall not be entitled to rely upon any grounds or basis for additional money on additional time not specifically set forth in the notice of Claim. All Claims not made in the manner provided herein shall be deemed waived and of no effect. The Contractor shall furnish the Owner and the Architect such timely written notice of any Claim provided for herein, including, without limitation, those in connection with alleged concealed or unknown conditions, and shall cooperate with the Owner and the Architect in any effort to mitigate the alleged or potential damages, delay or

other adverse consequences arising out of the condition which is the cause of such a Claim.

4.4.3 Pending final resolution of a Claim, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments that are not in dispute in accordance with the Contract Documents.

4.5 Claims for Concealed or Unknown Conditions

4.5.1 If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents, or (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then notice by the Contractor shall be given to the Owner's Representative promptly before conditions are disturbed, and in no event later than three (3) days after first observance of the conditions. The Owner's Representative will promptly investigate such conditions. If such conditions differ materially, as provided for above and cause an increase or decrease in the Contractor's cost, or time, required for performance of the Work, an equitable adjustment in the Contract Sum or Contract Time, or both, shall be made, subject to the provisions and restrictions set for herein. If the Owner's Representative determines that the conditions at the site are not materially different from those indicated in the Contract Documents, and that no change in the terms of the Contract is justified, the Owner's Representative will so notify the Contractor in writing. If the Contractor disputes the finding of the Owner's Representative that no change in the terms of the Contract terms is justified, the Contractor shall proceed with the Work, taking whatever steps are necessary to overcome or correct such conditions so that Contractor can proceed in a timely manner. The Contractor may have the right to file a Claim in accordance with the Contract Documents.

4.5.2 It is expressly agreed that no adjustment in the Contract Time or Contract Sum shall be permitted, however, in connection with a concealed or unknown condition which does not differ materially from those conditions disclosed or which reasonably should have been disclosed by the Contractor's (1) prior inspections, tests, reviews and preconstruction investigations for the Project, or (2) inspections, tests, reviews and preconstruction inspections which the Contractor had the opportunity to make or should have performed in connection with the Project.

4.6 Claim for Additional Cost

4.6.1 If the Contractor makes a Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. In addition to all other requirements for notice of a Claim, said notice shall detail and itemize the amount of all Claims and shall contain sufficient data to permit evaluation of same by the Owner.

4.7 Claims for Additional Time

4.7.1 If the Contractor makes a Claim for an increase in the

Contract Time, written notice as provided herein shall be given. In addition to other requirements for notice of a Claim, the Contractor shall include an estimate of the probable effect of delay upon the progress of the Work, utilizing a CPM Time Impact Schedule Analysis, (TIA) as defined in the AGC Scheduling Manual. In the case of a continuing delay, only one Claim is necessary.

.1 Time extensions will be considered for excusable delays only. That is, delays that are beyond the control and/or contractual responsibility of the Contractor.

4.7.2 If weather days are the basis for a Claim for additional time, such Claim shall be documented by the Contractor by data acceptable to the Owner's Representative substantiating that weather conditions for the period of time in question, had an adverse effect on the critical path of the scheduled construction. Weather days shall be defined as days on which critical path work cannot proceed due to weather conditions (including but not limited to rain, snow, etc.), in excess of the number of days shown on the anticipated weather day schedule in the Special Conditions. To be considered a weather day, at least four (4) working hours must be lost due to the weather conditions on a critical path scope item for that day. Weather days and anticipated weather days listed in the Special Conditions shall only apply to Monday through Friday. A weather day claim cannot be made for Saturdays, Sundays, New Year's Day, Martin Luther King Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the day after Thanksgiving Day and Christmas Day, unless that specific day was approved in writing for work by the Owner's Representative.

.1 The Contractor must have fulfilled its contractual obligations with respect to temporary facilities and protection of its work, and worker protection for hot and cold weather per OSHA guidelines.

.2 If the contractual obligations have been satisfied, the Owner will review requests for non-compensable time extensions for critical path activities as follows:

.2.1 If the Contractor cannot work on a critical path activity due to adverse weather, after implementing all reasonable temporary weather protection, the Contractor will so notify the Owner's Representative. Each week, the Contractor will notify the Owner's Representative of the number of adverse weather days that it believes it has experienced in the previous week. As provided in the Contract, until such time as the weather days acknowledged by the Owner's Representative exceed the number of days of adverse weather contemplated in the Special Conditions, no request for extension of the Contract Time will be considered.

.2.2 If the Contractor has accumulated in excess of the number of adverse weather days contemplated in the Special Conditions due to the stoppage of work on critical path activities due to adverse weather, the Owner will consider a time extension request from the Contractor that is submitted in accordance with the Contract requirements. The Owner will provide a Change Order extending the time for contract completion or direct an acceleration of the

Work in accordance with the Contract terms and conditions to recover the time lost due to adverse weather in excess of the number of adverse weather working days contemplated in the Special Conditions.

4.7.3 A Force Majeure event or circumstance shall not be the basis of a claim by the Contractor seeking an adjustment in the Contract amount for costs or expenses of any type. With the exception of weather delays, which are administered under Article 4, and not withstanding other requirements of the Contract, all Force Majeure events resulting in a delay to the critical path of the project shall be administered as provided in Article 8.

4.7.4 The Owner will consider and evaluate requests for time extensions due to changes or other events beyond the control of the Contractor on a monthly basis only, with the submission of the Contractor's updated schedule, in conjunction with the monthly application for payment.

4.8 Resolution of Claims and Disputes

4.8.1 The Owner's Representative will review Claims and take one or more of the following preliminary actions within ten days of receipt of a Claim: (1) request additional supporting data from the Contractor, (2) reject the Claim in whole or in part, (3) approve the Claim, or (4) suggest a compromise.

4.8.2 If a Claim has not been resolved, the Contractor shall, within ten (10) days after the Owner's Representative's preliminary response, take one or more of the following actions: (1) submit additional supporting data requested, (2) modify the initial Claim, or (3) notify the Owner's Representative that the initial Claim stands.

4.8.3 If a Claim has not been resolved after consideration of the foregoing and of further information presented by the Contractor, the Contractor has the right to seek administrative review as set forth in Section 4.9. However, Owner's Representative's decisions on matters relating to aesthetics will be final.

4.9 Administrative Review

4.9.1 Claims not resolved pursuant to the procedures set forth in the Contract Documents except with respect to Owner's Representative's decision on matters relating to aesthetic effect, and except for claims which have been waived by the making or acceptance of final payment, or the Contractor's acceptance of payments in full for changes in work may be submitted to administrative review as provided in this Section. All requests for administrative review shall be made in writing.

4.9.2 Upon written request from the Contractor, the Owner's Review Administrator authorized by the Campus Contracting Officer will convene a review meeting between the Contractor and Owner's Representative within fifteen (15) days of receipt of such written request. The Contractor and Owner's Representative will be allowed to present written

documentation with respect to the Claim(s) before or during the meeting. The Contractor and Owner's Representative will be allowed to present the testimony of any knowledgeable person regarding the Claim at the review meeting. The Owner's Review Administrator will issue a written summary of the review meeting and decision to resolve the Claim within fifteen (15) days. If the Contractor is in agreement with the decision the Contractor shall notify the Owner's Review Administrator in writing within five (5) days, and appropriate documentation will be signed by the parties to resolve the Claim.

4.9.3 If the Contractor is not in agreement with the proposal of the Owner's Review Administrator as to the resolution of the Claim, the Contractor may file a written appeal with the UM System Contracting Officer, [in care of the Executive Director of Facilities Planning and Development, University of Missouri, 130 General Services Building, University of Missouri, Columbia, Missouri 65211] within fifteen (15) days after receipt of the Owner's Review Administrator's proposal. The UM System Contracting Officer will call a meeting of the Contractor, the Owner's Representative, and the Owner's Review Administrator by written notice, within thirty (30) days after receipt of the Contractor's written appeal. The Owner's Review Administrator shall provide the UM System Contracting Officer with a copy of the written decision and summary of the review meeting, the Contractor's corrections, or comments regarding the summary of the review meeting, and any written documentation presented by the Contractor and the Owner's Representative at the initial review meeting. The parties may present further documentation and/or present the testimony of any knowledgeable person regarding the Claim at the meeting called by the UM System Contracting Officer.

4.9.4 The UM System Contracting Officer will issue a written decision to resolve the claim within fifteen (15) days after the meeting. If the Contractor is in agreement with the UM System Contracting Officer's proposal, the Contractor shall notify the UM System Contracting Officer in writing within five (5) days, and the Contractor and the Owner shall sign appropriate documents. The issuance of the UM System Contracting Officer's written proposal shall conclude the administrative review process even if the Contractor is not in agreement. However, proposals and any opinions expressed in such proposals issued under this Section will not be binding on the Contractor nor will the decisions or any opinions expressed be admissible in any legal actions arising from the Claim and will not be deemed to remove any right or remedy of the Contractor as may otherwise exist by virtue of Contract Documents or Law. The Contractor and the Owner agree that the Missouri Circuit Court for the County where the Work is located shall have exclusive jurisdiction to determine all issues between them. The Contractor agrees not to file any

complaint, petition, lawsuit or legal proceeding against the Owner except with such Missouri Circuit Court.

ARTICLE 5 SUBCONTRACTORS

5.1 Award of Subcontracts

5.1.1 Pursuant to Article 9, the Contractor shall furnish the Owner and the Architect, in writing, with the name, and trade for each Subcontractor and the names of all persons or entities proposed as manufacturers of products, materials and equipment identified in the Contract Documents and where applicable, the name of the installing contractor. The Owner's Representative will reply to the Contractor in writing if the Owner has reasonable objection to any such proposed person or entity. The Contractor shall not contract with a proposed person or entity to whom the Owner has made reasonable and timely objection.

5.1.2 The Contractor may request to change a Subcontractor. Any such request shall be made in writing to the Owner's Representative. The Contractor shall not change a Subcontractor, person, or entity previously disclosed if the Owner makes reasonable objection to such change.

5.1.3 The Contractor shall be responsible to the Owner for acts, defaults, and omissions of its Subcontractors of any tier.

5.2 Subcontractual Relations

5.2.1 By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor of any tier, to the extent of the Work to be performed by the Subcontractor of any tier, to be bound to the Contractor by terms of the Contract Documents and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these Documents, assumes toward the Owner and the Architect. Each subcontract agreement of any tier shall preserve and protect the rights of the Owner and the Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor of any tier so that subcontracting thereof will not prejudice such rights and shall allow to the Subcontractor of any tier, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with its sub-subcontractors. The Contractor shall make available to each proposed Subcontractor of any tier, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor of any tier shall be bound. Subcontractors of any tier shall similarly make copies of applicable portions of such documents available to their respective proposed Subcontractors of any tier.

5.2.2 All agreements between the Contractor and a Subcontractor or supplier shall contain provisions whereby Subcontractor or supplier waives all rights against the Owner,

Contractor, Owner's Representative, the Architect and all other Additional Insureds for all losses and damages caused by, arising out of, or resulting from any of the perils covered by property or builders risk insurance coverage required of the Contractor in the Contract Documents. If Contractor fails to include said provisions in all subcontracts, Contractor shall indemnify, defend and hold all the above entities harmless in the event of any legal action by Subcontractor or supplier. If insureds on any such policies require separate waiver forms to be signed by any Subcontractors of any tier or suppliers, Contractor shall obtain the same.

5.3 Contingent Assignment of Subcontract

5.3.1 No assignment by the Contractor of any amount or any part of the Contract or of the funds to be received thereunder will be recognized unless such assignment has had the written approval of the Owner, and the surety has been given due notice of such assignment and has furnished written consent hereto. In addition to the usual recitals in assignment Contracts, the following language must be set forth: "It is agreed that the funds to be paid to the assignee under this assignment are subject to performance by the Contractor of the Contract and to claims and to liens for services rendered or materials supplied for the performance of the Work called for in said Contract in favor of all persons, firms or corporations rendering such services or supplying such materials."

ARTICLE 6

SEPARATE CONTRACTS AND COOPERATION

6.1 The Owner reserves the right to let other contracts in connection with the Work.

6.2 It shall be the duty of each Contractor to whom Work may be awarded, as well as all Subcontractors of any tier employed by them, to communicate immediately with each other in order to schedule Work, locate storage facilities, etc., in a manner that will permit all Contractors to work in harmony in order that Work may be completed in the manner and within the time specified in the Contract Documents.

6.3 No Contractor shall delay another Contractor by neglecting to perform the Contractor's work at the proper time. Each Contractor shall be required to coordinate the Contractor's work with other Contractors to afford others reasonable opportunity for execution of their work. Any costs caused by defective, non-compliant, or ill-timed work, including actual damages and liquidated damages for delay, if applicable, shall be borne by the Contractor responsible therefor.

6.4 Each Contractor shall be responsible for damage to the Owner's or another Contractor's property done by the Contractor or the Contractor's employees, through his or their fault or negligence. If any Contractor shall cause

damage to any other Contractor, the Contractor causing such damage shall upon notice of any claim, settle with such Contractor.

6.5 The Contractor shall not claim from the Owner money damages or extra compensation under this Contract when delayed in initiating or completing his performance hereunder, when the delay is caused by labor disputes, acts of God, or the failure of any other Contractor to complete the Contractor's performance under any Contract with the Owner, where any such cause is beyond the Owner's reasonable control.

6.6 Progress schedule of the Contractor for the Work shall be submitted to other Contractors as necessary to permit coordinating their progress schedules.

6.7 If Contractors or Subcontractors of any tier refuse to cooperate with the instructions and reasonable requests of other contractors performing work for the Owner under separate contract, in the overall coordinating of the Work, the Owner's Representative may take such appropriate action and issue such instructions as in his judgement may be required to avoid unnecessary and unwarranted delay.

ARTICLE 7 CHANGES IN THE WORK

7.1 CHANGE ORDERS

7.1.1 A Change Order is a written instrument prepared by the Owner and signed by the Owner and the Contractor formalizing their agreement on the following:

- .1** a change in the Work
- .2** the amount of an adjustment, if any, in the Contract amount
- .3** an adjustment, if any, in the Contract Time

7.1.2 The Owner may at any time, order additions, deletions, or revisions in the Work by a Change Order or a Construction Change Directive. Such Change Order or Construction Change Directive shall not invalidate the Contract and requires no notice to the surety. Upon receipt of any such document, or written authorization from the Owner's Representative directing the Contractor to proceed pending receipt of the document, the Contractor shall promptly proceed with the Work involved in accordance with the terms set forth therein.

7.1.3 Until such time as the Change Order is formalized and signed by both the Owner and the Contractor it shall be considered a Change Order Request.

7.1.4 The amount of adjustment in the Contract price for authorized Change Orders will be agreed upon before such Change Orders becomes effective and will be determined as follows:

- .1** By a lump sum proposal from the Contractor and the Subcontractors of any tier, including overhead and profit.

.2 By a time and material basis with or without a specified maximum. The Contractor shall submit to the Owner's Representative itemized time and material sheets depicting labor, materials, equipment utilized in completing the Work on a daily basis for the Owner's Representative approval. If this pricing option is utilized, the Contractor may be required to submit weekly reports summarizing costs to date on time and material Change Order Requests not yet finalized.

.3 By unit prices contained in the Contractor's original bid and incorporated in the Construction Contract or subsequently agreed upon. Such unit prices contained in the Contractor's original proposal are understood to include the Contractor's overhead and profit. If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are so changed in a proposed Change Order that application of such unit prices to quantities of the Work proposed will cause substantial inequity to the Owner or to the Contractor, the applicable unit prices shall be equitably adjusted.

7.1.5 The Contractor shall submit all fully documented Change Order Requests with corresponding back-up documentation within the time requested by the Owner but no later than fourteen (14) working days following 1.) the Owner's request for pricing in the case of a lump sum; or 2.) the completion of unit price or time and material work.

7.1.6 The Contractor shall submit Change Order Requests in sufficient detail to allow evaluation by the Owner. Such requests shall be fully itemized by units of labor, material and equipment and overhead and profit. Such breakdowns shall be itemized as follows:

.1 Labor: The Contractor's proposal shall include breakdowns by labor, by trade, indicating number of hours and cost per hour for each Subcontractor as applicable. Such breakdowns shall only include employees in the direct employ of the Contractor or Subcontractors in the performance of the Work. Such employees shall only include laborers at the site, mechanics, craftsmen and foremen. Payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor or Subcontractors. Any item or expense outside of these categories is not allowed. The expense of performing Work after regular working hours, on Saturdays, Sundays or legal holidays shall not be included in the above, unless approved in writing and in advance by Owner.

.2 Material, supplies, consumables and equipment to be incorporated into the Work at actual invoice cost to the Contractor or Subcontractors; breakdowns showing all material, installed equipment and consumables fully itemized with number of units installed and cost per unit extended. Any singular item or items in aggregate greater than one thousand dollars (\$1,000) in cost shall be

supported with supplier invoices at the request of the Owner's Representative. Normal hand tools are not compensable.

.3 Equipment: Breakdown for required equipment shall itemize (at a minimum) delivery / pick-up charge, hourly rate and hours used. Operator hours and rate shall not be included in the equipment breakdown. Contractor must use the most cost-effective equipment available in the area and should not exceed the rates listed in the Rental Rate Blue Book for Construction Equipment (Blue Book). The Contractor shall submit documentation for the Blue Book to support the rate being requested.

7.2 Construction Change Directive

7.2.1 A construction change directive is a written order prepared and signed by the Owner, issued with supporting documents prepared by the Architect (if applicable), directing a change in the Work prior to agreement on adjustment of the Contract amount or Contract Time, or both. A Construction Change Directive shall be used in the absence of complete agreement between the Owner and Contractor on the terms of a Change Order. If the Construction Change Directive allows an adjustment of the Contract amount or time, such adjustment amount shall be based on one of the following methods:

.1 A lump sum agreement, properly itemized and supported by substantiating documents of sufficient detail to allow evaluation.

.2 By unit prices contained in the Contractor's original proposal and incorporated in the Construction Contract or subsequently agreed upon.

.3 A method agreed to by both the Owner and the Contractor with a mutually agreeable fee for overhead and profit.

.4 In the absence of an agreement between the Owner and the Contractor on the method of establishing an adjustment of the Contract amount, the Owner, with the assistance of the Architect, shall determine the adjustment amount on the basis of expenditures by the Contractor for labor, materials, equipment, and other costs consistent with other provisions of the Contract. The Contractor shall keep and submit to the Owner an itemized accounting of all cost components, either expended or saved, while performing the Work covered under the Construction Change Directive.

7.2.2 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Owner of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum, Contract Time, or both.

7.2.3 A Construction Change Directive signed by Contractor indicates the agreement of the Contractor therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

7.3 Overhead and Profit

7.3.1 Overhead and Profit on Change Orders shall be applied as follows:

.1 The overhead and profit charged by the Contractor and Subcontractors shall be considered to include, but not limited to, job site office and clerical expense, normal hand tools, incidental job supervision, field supervision, payroll costs and other compensation for project manager, officers, executives, principals, general managers, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, time-keepers, and other personnel employed whether at the site or in principal or a branch office for general superintendent and administration of the Work.

.2 The percentages for overhead and profit charged on Change Orders shall be negotiated and may vary according to the nature, extent, and complexity of the Work involved but in no case shall exceed the following:

- 15% To the Contractor or the Subcontractor of any tier for Work performed with their respective forces or materials purchased
- 5% To the Contractor on Work performed by other than the Contractor's forces
- 5% To first tier Subcontractor on Work performed by his Subcontractor

.3 The Contractor will be allowed to add 2% for the cost of bonding and insurance to their cost of work. This 2% shall be allowed on the total cost of the added work, including overhead and profit.

.4 Not more than three mark-ups, not to exceed individual maximums shown above, shall be allowed regardless of the number of tier Subcontractors. Overhead and profit shall be shown separately for each Subcontractor of any tier and the Contractor.

.5 On proposals covering both increases and decreases in the amount of the Contract, the application of overhead and profit shall be on the net change in direct cost for the Contractor or Subcontractor of any tier performing the Work.

.6 The percentages for overhead and profit credit to the Owner on Change Orders that are strictly decreases in the quantity of work or materials shall be negotiated and may vary according to the nature, extent, and complexity of the Work involved, but shall not be less than the following:

Overhead and Profit

- 7.5% Credit to the Owner from the Contractor or Subcontractor of any tier for Work performed with their respective forces or materials purchased
- 2.5% Credit to the Owner from the Contractor on Work performed by other than his forces
- 2.5% Credit to the Owner from the first tier Subcontractor on Work performed by his Subcontractor of any tier

7.4 Extended General Conditions

7.4.1 The Contractor acknowledges that the percentage mark-up allowed on Change Orders for overhead and

profit cover the Contractor's cost of administering and executing the Work, inclusive of Change Orders that increase the Contract Time. The Contractor further acknowledges that no compensation beyond the specified mark-up percentages for extended overhead shall be due or payable as a result of an increase in the Contract Time.

7.4.2 The Owner may reimburse the Contractor for extended overhead if an extension of the Contract Time is granted by the Owner, in accordance with 4.7.1 and the Owner determines that the extension of the Contract Time creates an inequitable condition for the Contractor. If these conditions are determined by the Owner to exist, the Contractor may be reimbursed by unit prices contained in the Contractor's original bid and incorporated in the Construction Contract or by unit prices subsequently agreed upon.

7.4.3 If unit prices are subsequently agreed upon, the Contractor's compensation shall be limited as follows:

.1 For the portion of the direct payroll cost of the Contractor's project manager expended in completing the Work and the direct payroll cost of other onsite administrative staff not included in Article 7.3.1. Direct payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor;

.2 Cost of the Contractor's temporary office, including temporary office utilities expense;

.3 Cost of temporary utilities required in the performance of the Work;

.4 Profit not to exceed 5% of the total extended overhead direct costs;

7.4.4 All costs not falling into one of these categories and costs of the Contractor's staff not employed onsite are not allowed.

7.5 Emergency Work

7.5.1 If, during the course of the Work, the Owner has need to engage the Contractor in emergency work, whether related to the Work or not, the Contractor shall immediately proceed with the emergency work as directed by the Owner under the applicable provisions of the Contract. In so doing, the Contractor agrees that all provisions of the Contract remain in full force and effect and the schedule for the Work is not impacted in any way unless explicitly agreed to in writing by the Owner.

ARTICLE 8 TIME

8.1 Progress and Completion

8.1.1 The Contractor acknowledges and agrees that time is of the essence of this Contract.

8.1.2 The Contract Time is the period of time set forth in the Contract for Construction required for Substantial Completion and Final Completion of the entire Work or portions of the Work as defined in the Contract Documents. Time limits stated in the Contract Documents are of the essence of the Contract. The Contract Time may only be changed by a Change Order. By executing the Contract, the Contractor confirms that the Contract Time is a sufficient period for performing the Work in its entirety.

8.1.3 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the effective date of insurance and bonds required by Article 11 to be furnished by the Contractor.

8.1.4 The Contractor shall proceed expeditiously and diligently with adequate forces and shall achieve Substantial Completion and Final Completion within the time specified in the Contract Documents.

8.2 Delay in Completion

8.2.1 The Contractor shall be liable for all of the Owner's damages for delay in achieving Substantial Completion and/or Final Completion of the entire Work or portions of Work as set forth in the Contract Documents within the Contract Time unless liquidated damages are specifically provided for in the Contract Documents. If liquidated damages are specifically provided for in the Contract for Construction, the Contractor shall be liable for such liquidated damages as set forth in Section 8.3

8.2.2 All time limits stated in the Contract are of the essence of the Contract. However, if the Contractor is delayed at any time in the progress of the Work by any act or neglect of the Owner or by the Owner's Representative, by changes ordered in the Work, Force Majeure including but not limited to war, armed conflict, riot, civil commotion or disorder, act of terrorism or sabotage; epidemic, pandemic, outbreaks of infectious disease or any other public health crisis, including quarantine or other employee restrictions, compliance with any law or governmental order, rule, regulation or direction, curfew restriction, act of God or natural disaster such as earthquake, volcanic activity, landslide, tidal wave, tsunami, flood, damage or destruction by lightning, drought; explosion, fire, destruction of machines, equipment, prolonged break-down of transport, telecommunication or electric current; general labor disturbance such as but not limited to boycott, strike and lock-out, occupation of factories and premises, or any other causes beyond the Contractor's reasonable control which the Owner's Representative determines may justify delay then, upon submission of the Time Impact Schedule Analysis (TIA) justifying the delay called out in Section 4.7 of these General Conditions, the Contract Time may be extended for a reasonable time to the extent such delay will prevent the Contractor from achieving Substantial

Completion and/or Final Completion within the Contract Time and if performance of the Work is not, was not or would not have been delayed by any other cause for which the Contractor is not entitled to an extension of the Contract Time under the Contract Documents. It shall be a condition precedent to any adjustment of the Contract Time that the Contractor provides the Owner's Representative with written notice of the cause of delay within seven (7) days from the occurrence of the event or condition which caused the claimed delay. If a Force Majeure is approved by the Owner as the basis for a delay claim, an adjustment in the Contract Time to the extent the Force Majeure impacts the schedule is the only remedy. No increase in the Contract Sum for any reason shall be allowed due to a Force Majeure.

8.2.3 The Contractor further acknowledges and agrees that adjustments in the Contract Time will be permitted for a delay only to the extent such delay (1) is not caused, or could not have been anticipated, by the Contractor, (2) could not be limited or avoided by the Contractor's timely notice to the Owner of the delay, (3) prevents the Contractor from completing its Work by the Contract Time, and (4) is of a duration not less than one (1) day. Delays attributable to and within the control of a Subcontractor or supplier shall not justify an extension of the Contract Time.

8.2.4 Notwithstanding anything to the contrary in the Contract Documents, except as otherwise noted in these General Conditions, an extension in the Contract Time, to the extent permitted under this Article, shall be the sole remedy of the Contractor for any (1) delay in the commencement, prosecution or completion of the Work, (2) hindrance or obstruction in the performance of the Work, (3) loss of productivity, or (4) other claims due to or caused by any events beyond the control of both the Owner and the Contractor defined herein as Force Majeure. In no event shall the Contractor be entitled to any compensation or recovery of any damages or any portion of damages resulting from delays caused by or within the control of the Contractor or by acts or omissions of the Contractor or its Subcontractors of any tier or delays beyond the control of both the Owner and the Contractor. If the Contractor contends that delay, hindrance, obstruction or other adverse condition results from acts or omissions of the Owner, the Owner's Representative or the Architect, the Contractor shall provide written notice to the Owner within seven (7) calendar days of the event giving rise to such claim. The Contractor shall only be entitled to an adjustment in the Contract Sum to the extent that such acts or omissions continue after the Contractor's written notice to the Owner of such acts or omissions, but in no case shall Force Majeure be the basis of an increase in the Contract Sum. The Owner's exercise of any of its rights or remedies under the Contract Documents (including, without limitation, ordering changes in the Work, or directing suspension, rescheduling or correction of the Work) regardless of the extent or frequency of the Owner's exercise of such rights or remedies, shall not be the basis of any Claim for an increase in the Contract Sum or Contract Time. In the event Contractor is entitled to an adjustment in the Contract Sum for any delay, hindrance, obstruction or other adverse condition caused by the acts or

omissions of the Owner, the Owner's Representative or the Architect, the Contractor shall only be entitled to its actual direct costs caused thereby and the Contractor shall not be entitled to and waives any right to special, indirect, or consequential damages including loss of profits, loss of savings or revenues, loss of anticipated profits, labor inefficiencies, idle equipment, home office overhead, and similar type of damages.

8.2.5 If the Contractor submits a progress report or any construction schedule indicating, or otherwise expressing an intention to achieve completion of the Work prior to any completion date required by the Contract Documents or expiration of the Contract Time, no liability of the Owner to the Contractor for any failure of the Contractor to so complete the Work shall be created or implied. Further, the Contractor acknowledges and agrees that even if the Contractor intends or is able to complete the Work prior to the Contract Time, it shall assert no Claim and the Owner shall not be liable to the Contractor for any failure of the Contractor, regardless of the cause of the failure, to complete the Work prior to the Contract Time.

8.3 Liquidated Damages

8.3.1 If Liquidated Damages are prescribed on the Bid Form and Special Conditions in the Contract Documents, the Owner may deduct from the Contract Sum and retain as Liquidated Damages, and not as penalty or forfeiture, the sum stipulated in the Contract Documents for each calendar day after the date specified for completion of the Work that the entire Work is not substantially complete and/or finally complete.

8.3.2 The Owner's Representative shall establish the date of Substantial Completion and the date of Final Completion of the Work which shall be conclusive and binding on the Owner and the Contractor for the purpose of determining whether or not Liquidated Damages shall be assessed under terms hereof and the sum total amount due.

8.3.3 Liquidated Damages or any matter related thereto shall not relieve the Contractor or the Contractor's surety of any responsibility or obligation under this Contract.

ARTICLE 9 PAYMENTS AND COMPLETION

9.1 Commencement, Prosecution, and Completion

9.1.1 The Contractor shall commence Work within five (5) days upon the date of a "Notice to Proceed" from the Owner or the date fixed in the Notice to Proceed. The Contractor shall prosecute the Work with faithfulness and diligence, and the Contractor shall complete the Work within the Contract Time set forth in the Contract Documents.

9.1.2 The Owner will prepare and forward three (3) copies of the Contract and Performance Bond to the bidder to whom the Contract for the Work is awarded and such bidder shall return two (2) properly executed prescribed copies of the Contract and Bond to the Owner.

9.1.3 The construction period, when specified in consecutive calendar days, shall begin when the Contractor receives notice requesting the instruments listed in below. Before the Owner will issue Notice to Proceed to permit the Contractor to begin Work, the Owner shall have received the following instruments, properly executed as described in the Contract Documents. The documents below shall have been received by the Owner within fifteen (15) days after receipt of request for documents:

- .1** Contract
- .2** Bond (See Article 11)
- .3** Insurance (See Article 11)
- .4** List of Subcontractors of any tier
- .5** Affirmative Action Plan (See Article 13)

9.1.4 In the event the Contractor fails to provide the Owner such documents, the Contractor may not enter upon the site of the Work until such documents are provided. The date the Contractor is required to commence and complete the Work shall not be affected by the Owner denying the Contractor access to the site as a result of the Contractor's failure to provide such documents and the Contractor shall not be entitled to an adjustment of the Contract Time or Contract Sum as a result of its failure to provide the Owner the required documents

9.1.5 Contracts executed by partnerships shall be signed by all general partners of the partnership. Contracts signed by corporations shall be signed by the President or Vice President and the Secretary or Assistant Secretary. In case the Assistant Secretary or Vice President signs, it shall be so indicated by writing the word "Asst." or "Vice" in front of the words "Secretary" and "President". The corporate seal of the corporation shall be affixed. For all other types of entities, the Contractor and the person signing the Contract on behalf of the Contractor represent and warrant that the person signing the Contract has the legal authority to bind the Contractor to the Contract.

9.1.6 Any successful bidder which is a corporation organized in a state other than Missouri or any bidder doing business in the State of Missouri under a fictitious name shall furnish, at no cost to the Owner, no later than the time at which the executed Contract for Construction, the Payment Bond, and the Performance Bond are returned, a properly certified copy of its current Certificate of Authority and License to do business in the State of Missouri. No contract will be executed by the Owner until such certificate is furnished by the bidder, unless there already is on file with the Owner a current certificate, in which event, no additional certificate will be required during the period of time for which such current certificate remains in effect.

9.1.7 Within fifteen (15) calendar days of the issuance of a Notice to Proceed, the Contractor shall submit one (1) signed copy of the following instruments. No payment will be processed until all of these instruments are received and approved by the Owner's Representative.

- .1 Reproducible progress and payment schedule
- .2 Contractor's Schedule of Values
- .3 List of material suppliers
- .4 Itemized breakdown of all labor rates for each classification. Overhead and profit shall not be included. Payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor or Subcontractors. Any item or expense outside of these categories is not allowed. The expense of performing Work after regular working hours, on Saturdays, Sundays or legal holidays shall not be included in the above, unless approved in writing and in advance by the Owner.
- .5 Itemized breakdown of anticipated equipment rates (breakout operator rate). Overhead and profit shall not be included. Breakdown for required equipment shall itemize (at a minimum) delivery/ pick-up charge, hourly rate and hours used. Operator hours and rate shall not be included in the equipment breakdown. The Contractor must use the most cost-effective equipment available in the area and should not exceed the rates listed in the Rental Rate Blue Book for Construction Equipment (Blue Book). The Contractor shall submit documentation for the Blue Book to support the rate being requested.

9.1.8 The Contractor shall be paid electronically using the Owner's web-based payment program with a direct electronic transfer from the Owner's account into the Contractor's account. The Contractor must submit the following information to the Owner's Representative:

- .1 Bank Transit Number for the Contractor's bank into which the electronic deposit will be made.
- .2 Bank Account Number for the Contractor's account into which the electronic deposit will be made.
- .3 Contractor's E-Mail address so that formal notification of the deposit by the Owner can be provided.

9.2 Contract Sum

9.2.1 The Owner shall compensate the Contractor for all Work described herein, and in the Contract Documents the Contract Sum set forth in the Contract for Construction, subject to additions and deletions as provided hereunder.

9.3 Schedule of Values

9.3.1 Within fifteen (15) days after receipt of the Notice to Proceed, the Contractor shall submit to the Owner's Representative a schedule of values allocated to various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Owner's Representative may require. This schedule, unless objected

to by the Owner's Representative, shall be used as a basis for reviewing the Contractor's Applications for Payment. The values set forth in such schedule may, at the Owner's option be used in any manner as fixing a basis for additions to or deletions from the Contract Sum.

9.3.2 The progress and payment schedule of values shall show the following:

- .1 Enough detail as necessary to adequately evaluate the actual percent complete of any line item on a monthly basis, as determined by the Owner's Representative.
- .2 Line items, when being performed by a Subcontractor or material supplier, shall correlate directly back to the subcontract or purchase order amount if requested by the Owner's Representative.

9.4 Applications for Payment

9.4.1 The Contractor shall submit monthly to the Owner's Representative and the Architect an itemized Application for Payment for operations completed in accordance with the Schedule of Values. Such application shall be supported by such data substantiating the Contractor's right to payment as the Owner's Representative or the Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and reflecting retainage as provided for herein.

9.4.2 Such applications shall not include requests for payment of amounts the Contractor does not intend to pay to a Subcontractor or material supplier

9.4.3 Progress payments shall be made on account of materials and equipment delivered to the site and incorporated in the Work. No payments will be made for materials and equipment stored at the Project site but not yet incorporated into the Work except as provided in Paragraph 9.4.4.

9.4.4 If approved in writing and in advance by the Owner, progress payments may be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. The Owner may in its sole discretion refuse to grant approval for payments for materials and equipment stored at the Project site but not yet incorporated in the Work. Any approval by the Owner for payment for materials and equipment delivered and suitably stored at the site, or stored offsite as noted below, for subsequent incorporation in the Work shall be conditioned upon Contractor's demonstrating that such materials and equipment are adequately protected from weather, damage, vandalism and theft and that such materials and equipment have been inventoried and stored in accordance with procedures established by or approved by the Owner. Nothing in this clause shall imply or create any liability on the part of the Owner for the Contractor's inventory and storage procedures or for any loss or damage to material, equipment or supplies stored on the site, whether incorporated into the Work or not. In the event any such loss or damage occurs, the Contractor remains solely responsible for all costs associated with replacement of the affected materials, supplies and equipment including labor and

incidental costs, and shall have no claim against the Owner for such loss.

No allowance shall be made in the project pay requests for materials not delivered to the site of the Work and incorporated into the Work, except as noted below. For the purposes of this Contract, offsite is defined as any location not owned or leased by the Owner. The Contractor shall submit a list of materials that they are requesting payment for offsite storage within sixty (60) days of Notice to Proceed.

.1 Items considered to be major items of considerable magnitude, if suitably stored, may be allowed in project pay requests on the basis of ninety percent (90%) of invoices

.2 Determination of acceptable "major items of considerable magnitude" and "suitably stored" shall be made by the Owner's Representative.

.3 Aggregate quantities of materials not considered unique to this project will not be considered for offsite storage payment.

.4 The Contractor shall submit to the Owner's Representative a list of the material for which application for payment for offsite storage is anticipated no less than forty-five days (45) prior to the submission of the applicable pay request. The list shall include a material description, applicable division, quantity, and discounts offered to the Owner for early payment. The Contractor shall also submit the location the material will be stored and the method of protection

.5 The storage facility shall be subject to approval by the Owner's representative, shall be located within an acceptable distance of the project sites as established by the Owner's Representative and all materials for the Owner's project must be stored separately from all other items within the storage facility and shall be labeled and stored in the name of "The Curators of the University of Missouri."

.6 The Owner's Representative shall be provided a minimum of two weeks' notice to visit the storage facility and inspect the stored material prior to submission of the pay request.

.7 Upon favorable inspection by the Owner's Representative, the Contractor shall, at the Owner's option, submit a Bill of Sale on forms provided by the Owner's Representative, transferring title of the material or equipment to "The Curators of the University of Missouri."

.8 An invoice provided by the supplier shall be included with the applicable pay request.

.9 The Contractor shall remain fully responsible for all items, until acceptance of the project by the Owner.

.10 The Contractor shall reimburse all costs incurred by the Owner in inspecting and verifying all material stored offsite, including mileage, airfare, meals, lodging and time, charged at a reasonable hourly rate.

.11 The Contractor shall furnish and maintain insurance covering the replacement cost of the material stored offsite against all losses and shall furnish proof of coverage with the application for payment for material stored offsite.

.12 The Contractor is responsible for all costs related to storage and handling of material stored offsite unless otherwise directed by the Owner's Representative.

9.4.5 The Application for Payment shall constitute a representation by the Contractor to the Owner that the Work has progressed to the point indicated; the quality of the Work covered by the Application for Payment is in accordance with the Contract Documents; and the Contractor is entitled to payment in the amount requested.

9.4.6 The Contractor will be reimbursed for ninety-five percent (95%) of the value of all labor furnished and material installed and computed in the same manner, less all previous payments made. On projects where a bond is not required, the Contractor will be reimbursed for ninety percent (90%) of the value of all labor furnished and material installed and computed in the same manner, less all previous payments made.

9.5 Approval for Payment

9.5.1 The Owner's Representative will, within fifteen (15) days after receipt of the Contractor's Application for Payment, either approve Contractor's Application for Payment for such amount as the Owner's Representative determines is properly due or notify the Contractor of the Owner's Representative's reasons for withholding certification in whole or in part as provided in Section 9.6.

9.6 Decisions to Withhold Approval

9.6.1 The Owner's Representative may decide not to certify payment and may withhold approval in whole or in part, to the extent reasonably necessary to protect the Owner. If the Owner's Representative is unable to approve payment in the amount of the Application, the Owner's Representative will notify the Contractor as provided in Paragraph 9.5.1. If the Contractor and Owner's Representative cannot agree on a revised amount, the Owner's Representative will promptly issue approval for payment for the amount for which the Owner's Representative is able to determine is due to the Contractor. The Owner's Representative may also decide not to approve payment or, because of subsequently discovered evidence or subsequent observations, may nullify the whole or a part of approval for payment previously issued, to such extent as may be necessary in the Owner's Representative opinion to protect the Owner from loss because of:

.1 defective or non-compliant Work not remedied, or damage to completed Work;

.2 failure to supply sufficient skilled workers or suitable materials;

.3 third party claims filed or reasonable evidence indicating probable filing of such claims;

.4 failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment, the Owner may, at its sole option issue joint checks to Subcontractors who have presented evidence that it has not been paid in accordance with the Contract;

.5 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;

- .6 damage to the Owner or another contractor;
- .7 reasonable evidence that the Work will not be completed within the Contract Time or an unsatisfactory rate of progress made by the Contractor;
- .8 The Contractor's failure to comply with applicable laws;
- .9 The Contractor's or Subcontractor's failure to comply with applicable wage requirements; or
- .10 The Contractor's failure to carry out the Work in strict accordance with the Contract Documents.

9.6.2 When the above reasons for withholding approval are removed, approval will be made for amounts previously withheld.

9.7 Progress Payments

9.7.1 Based upon Applications for Payment submitted to the Owner by the Contractor and approvals issued by the Owner's Representative, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

9.7.2 The period covered by each Application for Payment shall be one (1) calendar month.

9.7.3 The Owner shall make payment to the Contractor for amounts due and approved by the Owner's Representative not later than thirty (30) days after the Owner approves a properly detailed Application for Payment which is in compliance with the Contract Documents. The Owner shall not have the obligation to process or pay such Application for Payment until it receives an Application for Payment satisfying such requirements.

9.7.4 Based on the Schedule of Values submitted by the Contractor, Applications for Payment submitted by the Contractor shall indicate the actual percentage of completion of each portion of the Contractor's Work as of the end of the period covered by the Application for Payment.

9.7.5 The Contractor shall promptly pay each Subcontractor and supplier, upon receipt of payment from the Owner, out of the amount paid to the Contractor on account of such Subcontractor's or supplier's portion of the Work, the amount to which said Subcontractor or supplier is entitled, reflecting percentages actually retained from payments to the Contractor on account of each Subcontractor's or supplier's portion of the Work, in full compliance with state statute. The Contractor shall, by appropriate agreement with each Subcontractor or supplier, require each Subcontractor or supplier to make payments to Sub-subcontractors in similar manner.

9.7.6 Neither the Owner nor the Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor of any tier nor a laborer or employee of the Contractor except to the extent required by law. Retainage provided for by the Contract Documents are to be retained

and held for the sole protection of the Owner, and no other person, firm or corporation shall have any claim or right whatsoever thereto.

9.7.7 An approval for payment by the Owner's Representative, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

9.8 Failure of Payment

9.8.1 If the Owner is entitled to reimbursement or payment from the Contractor under or pursuant to the Contract Documents, such payment by the Contractor shall be made promptly upon demand by the Owner. Notwithstanding anything contained in the Contract Documents to the contrary, if the Contractor fails to promptly make any payment due the Owner, or the Owner incurs any costs and expenses to cure any default of the Contractor or to correct defective Work, the Owner shall have an absolute right to offset such amount against the Contract Sum and may, in the Owner's sole discretion, elect either to: (1) deduct an amount equal to that to which the Owner is entitled from any payment then or thereafter due the Contractor from the Owner, or (2) issue a written notice to the Contractor reducing the Contract Sum by an amount equal to that to which the Owner is entitled.

9.9 Substantial Completion

9.9.1 Substantial Completion is the stage in the progress of the Work as defined in Paragraph 1.1.14 as certified by the Owner.

9.9.2 When the Contractor considers the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall notify the Owner and the Architect. The Owner's Representative will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Owner's Representative's inspection discloses any item which is not in accordance with the requirements of the Contract Documents, the Contractor shall complete or correct such item upon notification by the Owner's Representative. The Contractor shall then submit a request for another inspection by the Owner's Representative to determine Substantial Completion. When the Work or designated portion thereof is substantially complete, the Owner will issue a Certificate of Substantial Completion. Substantial Completion shall transfer from the Contractor to the Owner responsibilities for security, maintenance, heat, utilities, damage to the Work and insurance. In no event shall the Contractor have more than thirty (30) days to complete all items on the Punch List and achieve Final Completion. Warranties required by the Contract Documents shall commence on the date of Substantial Completion or as agreed otherwise.

9.9.3 At the date of Substantial Completion, the Contractor may apply for, and if approved by Owner's Representative, the Owner, subject to the provisions herein, shall increase total payments to one hundred percent (100%) of the Contract Sum

less one hundred fifty percent (150%) of the value of any incomplete Work and unsettled claims, as determined by the Owner's Representative.

9.10 Partial Occupancy or Use

9.10.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and the Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, security, maintenance, heat, utilities, damage to the Work and insurance. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by the Owner's Representative.

9.10.2 Immediately before such partial occupancy or use, the Owner, and the Contractor shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work. Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

9.11 Final Completion and Final Payment

9.11.1 Upon receipt of written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Owner's Representative and the Architect will promptly make such inspection and, when the Owner's Representative and the Architect find the Work acceptable under the Contract Documents and the Contract fully performed, the Owner's Representative will promptly issue a final approval for payment; otherwise, the Owner's Representative will return the Contractor's Final Application for Payment to the Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application. Submission of a Final Application for Payment shall constitute a further representation that conditions listed in Paragraph 9.11.2 as precedent to the Contractor being entitled to final payment have been fulfilled. All warranties and guarantees required under or pursuant to the Contract Documents shall be assembled and delivered by the Contractor to the Owner's Representative as part of the final Application for Payment. The final approval for payment will not be issued by the Owner's Representative until all warranties and guarantees have been received and accepted by the Owner.

9.11.2 The Owner will request the Contractor to submit the application for final payment along with a manually signed notarized letter on the Contractor's letterhead certifying that:

.1 Labor costs, prevailing wage rates, fringe benefits and material costs have been paid.

.2 Subcontractors of any tier and manufacturers furnishing materials and labor for the project have fully completed their Work and have been paid in full.

.3 The project has been fully completed in accordance with the Contract Documents as modified by Change Orders.

.4 The acceptance by the Contractor of its final payment, by check or electronic transfer, shall be and operate as a release of all claims of the Contractor against the Owner for all things done or furnished or relating to the Work and for every act or alleged neglect of the Owner arising out of the Work.

9.11.3 Final payment constituting the entire unpaid balance due shall be paid by the Owner to the Contractor within thirty (30) days after the Owner's receipt of Contractor's Final Application for Payment which satisfies all the requirements of the Contract Documents and the Owner's receipt of all information and documents set forth in Section 9.11.

9.11.4 No payment under this Contract, including but not limited to final payment, shall constitute acceptance by the Owner of any Work or act not in accordance with the requirements of the Contract Documents.

9.11.5 No recourse shall be had against any member of the Board of Curators, or officer thereof, for any payment under the Contract or any claim based thereon.

ARTICLE 10

PROTECTION OF PERSONS AND PROPERTY

10.1 Safety Precautions and Programs

10.1.1 The Contractor shall at all times conduct operations under this Contract in a manner to avoid the risk of bodily harm to persons or risk of damage to any property. The Contractor shall promptly take precautions which are necessary and adequate against conditions created during the progress of the Contractor's activities hereunder which involve a risk of bodily harm to persons or a risk of damage to property. The Contractor shall continuously inspect Work, materials, and equipment to discover and determine any such conditions and shall be solely responsible for discovery, determination, and correction of any such conditions. The Contractor shall comply with applicable safety laws, standards, codes, and regulations in the jurisdiction where the Work is being performed, specifically, but without limiting the generality of the foregoing, with rules, regulations, and standards adopted pursuant to the Williams-Steiger Occupational Safety and Health Act of 1970 and applicable amendments.

10.1.2 The Contractor and all Subcontractors to the Contract must require all on-site employees to complete the ten-hour construction safety training program required under Section 292.675, RSMo, unless they have previously completed the program and have documentation of having done so. The Contractor will forfeit a penalty to the Owner of \$2,500 plus an additional \$100 for each employee employed by the Contractor or Subcontractor, for each calendar day, or

portion thereof, such employee is employed without the required training.” (Section 292.675, RSMo).

10.1.3 In the event the Contractor encounters on the site, material reasonably believed to be asbestos, polychlorinated biphenyl (PCB), lead, mercury, or other material known to be hazardous, which has not been rendered harmless, the Contractor shall immediately stop Work in the area affected and report the condition to the Owner’s Representative and the Architect in writing. The Work in the affected area shall not thereafter be resumed except by written agreement of the Owner’s Representative and the Contractor if in fact the material is asbestos or polychlorinated biphenyl (PCB) and has not been rendered harmless. The Work in the affected area shall be resumed in the absence of asbestos or polychlorinated biphenyl (PCB), or when it has been rendered harmless by written agreement of the Owner’s Representative and the Contractor. “Rendered Harmless” shall mean that levels of such materials are less than any applicable exposure standards, including but limited to OSHA regulations.

10.2 Safety Of Persons and Property

10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide protection to prevent damage, injury, or loss to:

- .1** students, faculty, staff, the public, construction personnel, and other persons who may be affected thereby;
- .2** the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor or the Contractor’s Subcontractors of any tier; and
- .3** other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

10.2.2 The Contractor shall give notices and comply with applicable laws, standards, codes, ordinances, rules, regulations, and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury, or loss.

10.2.3 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, safeguards for safety and protection, including, but not limited to, posting danger signs and other warnings against hazards, promulgating safety regulations, and notifying owners and users of adjacent sites and utilities.

10.2.4 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise the highest degree of care and carry on such activities under supervision of properly qualified personnel.

10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property

insurance required by the Contract Documents) to property caused in whole or in part by the Contractor, a Subcontractor of any tier, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable, and for which the Contractor is responsible under Article 10, except damage or loss attributable solely to acts or omissions of the Owner or the Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor’s other obligations stated elsewhere in the Contract.

10.2.6 The Contractor shall designate a responsible member of the Contractor’s organization at the site whose duty shall be the prevention of accidents, and the maintaining, enforcing and supervising of safety precautions and programs. This person shall be the Contractor’s superintendent unless otherwise designated by the Contractor in writing to the Owner’s Representative and the Architect. The Contractor shall hold regularly scheduled safety meetings to instruct the Contractor’s personnel on safety practices, accident avoidance and prevention, and the Project Safety Program. The Contractor shall furnish safety equipment and enforce the use of such equipment by its employees and its Subcontractors of any tier.

10.2.7 The Contractor shall not load or permit any part of the construction or site to be loaded so as to endanger its safety.

10.2.8 The Contractor shall promptly report in writing to the Owner all accidents arising out of or in connection with the Work which cause death, lost time injury, personal injury, or property damage, giving full details and statements of any witnesses. In addition, if death, serious personal injuries, or serious property damages are caused, the accident shall be reported immediately.

10.2.9 The Contractor shall promptly notify in writing to the Owner of any claims for injury or damage to personal property related to the Work, either by or against the Contractor.

ARTICLE 11 INSURANCE AND BONDS

11.1 Insurance

11.1.1 The Contractor shall secure from the date of the Contract for Construction and maintain for such periods of time as set forth below, insurance of such types and in such amounts specified below, to protect the Contractor, the Owner and others against all hazards or risks of loss described below. The form of such insurance together with carriers thereof, in each case, shall be approved by the Owner, but, regardless of such approval, it shall be the responsibility of the Contractor to maintain the insurance coverages set forth herein.

11.1.2 The Contractor shall not be allowed on the Owner's property without proof of the insurance coverages set forth herein

11.2 Commercial General Liability

11.2.1 The Contractor shall secure and maintain from the date of the Contract, and for a period of at least ten (10) years from the date of Final Completion of the entire Work, Commercial General Liability insurance ("CGL") with a combined single limit of not less than \$2,000,000 per occurrence, \$5,000,000 general aggregate, \$5,000,000 products and completed operations aggregate, and \$1,000,000 personal injury and advertising injury. General Aggregate must apply per project. An umbrella policy may be used to satisfy these limits.

11.2.2 CGL insurance shall be written on a Commercial form CG 00 01 or an equivalent form providing the same coverages and shall cover claims and liability in connection with or resulting from the Contractor's operations and activities under the Contract, for personal injuries, occupational sickness, disease, death or damage to property of others, including loss of use resulting therefrom, arising out of any operations or activities of the Contractor, its agents, or any Subcontractors of any tier or by anyone directly or indirectly employed by either of them.

11.2.3 CGL insurance shall include premises, operations, independent contractors, products-completed operations, personal injury and advertising injury and liability assumed under an insured contract (including the tort liability of another assumed in a business contract) coverages. In particular, and not by way of any limitation, the CGL insurance shall cover the Contractor's indemnity obligations contained in the Contract Documents.

11.2.4 There shall be no endorsement or modification of the CGL policy limiting the scope of coverage for liability arising from blasting, explosion, collapse, or underground property damage.

11.2.6 The Contractor waives all rights against the Owner and its agents, officers, representatives, and employees for recovery of damages to the extent those damages are covered by the CGL policy required hereunder.

11.3 Licensed for Use Vehicle Liability

11.3.1 The Contractor shall secure and maintain from the date of the Contract for Construction until the date of Final Completion of the entire Work, insurance, to be on comprehensive form, which shall protect the Contractor against any and all claims for all injuries and all damage to property arising from the use of automobiles, trucks and motorized vehicles, in connection with the performance of Work under this Contract, and shall cover the operation on or off the site of the Work of all motor vehicles licensed for

highway use whether they are owned, non-owned or hired. Such insurance shall include contractual liability coverage and shall provide coverage on the basis of the date of any accident. The liability limits under such policy shall not be less than \$2,000,000 combined single limit for bodily injury and property damage per accident.

11.3.2 The Contractor waives all rights against the Owner and its agents, officers, directors, and employees for recovery of damages to the extent such damages are covered by the automobile liability insurance required hereunder.

11.4 Workers' Compensation Insurance

11.4.1 The Contractor shall purchase and maintain workers' compensation insurance and employers' liability insurance which shall protect the Contractor from claims for injury, sickness, disease or death of the Contractor's employees or statutory employees. The insurance policies required hereunder shall include an "all states" or "other states" endorsement. In case any Work is subcontracted, the Contractor shall require any Subcontractor of any tier to provide the insurance coverages required under this Paragraph.

11.4.2 The Contractor's workers' compensation insurance coverage shall be in compliance with all applicable laws, including the statutes of the State of Missouri. The Contractor's employers' liability coverage limits shall not be less than \$1,000,000 each accident for bodily injury by accident or \$1,000,000 each employee for bodily injury by disease.

11.5 General Insurance Requirements and Professional Liability

11.5.1 Any Consultant/Contractor providing professional design services as part of the Contract shall be required to provide and maintain, from the date of this Contract and for a period of ten (10) years after the date of Final Completion, Professional Liability insurance, in a claims made form, to cover any claims, including but not limited to errors, omissions, and negligence, which may arise from the design and related services performed by the Consultant. The minimum limits for such policy shall be \$1,000,000.00 per claim/\$1,000,000.00 aggregate.

11.5.2 "The officers, employees, and agents of The Curators of the University of Missouri" shall be added as Additional Insured with respect to the CGL, umbrella/excess and Automobile Liability policies required herein. A certificate of insurance evidencing all coverage required is to be provided at least ten (10) days prior to the inception date of the Contract between the Contractor and the University. The Contractor is required to maintain coverages as stated and required to notify the University of a carrier change or cancellation within two (2) business days. The University reserves the right to request a copy of the policy. The University reserves the right to require higher limits on any contract provided notice of such requirement is stated in the request for proposals for such contract. The Contractor shall request that its insurer(s)

include the following disclaimer in any insurance policy, rider or endorsement issued pursuant to this Additional Insured requirement: "Neither the requirement for Additional Insured status nor any of the Contractor's action in compliance with such requirement, either direct or indirect, is intended to be and neither shall be construed as a waiver of any sovereign immunity, governmental immunity or any other type of immunity enjoyed by The Curators of the University of Missouri, the Board of Curators of the University of Missouri, or any of its officers, employees or agents."

The Additional Insured status must be conveyed by using the ISO CG 20 10 (2004) edition or equivalent and the ISO CG 20 37 (2004) edition. The policy shall be endorsed to be primary coverage and any other insurance carried by the Owner shall be excess only and will not contribute with Contractors' insurance. To confirm, the Endorsement should accompany the insurance certificate.

11.5.3 All insurance coverages procured by the Contractor shall be provided by agencies and insurance companies acceptable to and approved by Owner. All insurance coverage shall be provided by insurance companies that are duly licensed to conduct business in the State of Missouri as an admitted carrier, except that the Professional Liability insurance required herein may be provided by any insurance company legally authorized to do business in the State of Missouri. The form and content of all insurance coverage provided by the Contractor are subject to the approval of the Owner. All required insurance coverages shall be obtained and paid for by the Contractor. Any approval of the form, content or insurance company by the Owner shall not relieve the Contractor from the obligation to provide the coverages required herein. All insurance coverage procured by the Contractor shall be provided by insurance companies having policyholder ratings no lower than "A-" and financial ratings not lower than "XI" in the Best's Insurance Guide, latest edition in effect as of the date of the Contract, and subsequently in effect at the time of renewal of any policies required by the Contract Documents. Insurance coverages required hereunder shall not be subject to a deductible amount on a per-claim basis of more than \$10,000.00 and shall not be subject to a per-occurrence deductible of more than \$25,000.00. Insurance procured by the Contractor covering the Additional Insureds shall be primary insurance and any insurance maintained by Owner shall be excess insurance.

11.5.4 All insurance required hereunder shall provide that the insurer's cost of providing the insureds a defense and appeal, including attorneys' fees, shall be supplementary and shall not be included as part of the policy limits but shall remain the insurer's separate responsibility. The Contractor shall cause its insurance carriers for all required coverages, except for workers' compensation, to waive all rights of subrogation against the Owner and its officers, employees and agents.

11.5.5 The Contractor shall furnish the Owner with certificates, Additional Insured endorsements, policies, or binders which indicate the Contractor and/or the Owner and other Contractors (where required) are covered by the required insurance showing type, amount, class of operations covered, effective dates and dates of expiration of policies prior to commencement of the Work. The Contractor is required to maintain coverages as stated and required to notify the University of a carrier change or cancellation within two (2) business days. The University reserves the right to request a copy of the policy. The Contractor fails to provide, procure, and deliver acceptable policies of insurance or satisfactory certificates or other evidence thereof, the Owner may obtain such insurance at the cost and expense of the Contractor without notice to the Contractor.

11.5.6 With respect to all insurance coverages required to remain in force and affect after final payment, The Contractor shall provide the Owner additional certificates, policies and binders evidencing continuation of such insurance coverages along with the Contractor's application for final payment and shall provide certificates, policies and binders thereafter as requested by the Owner.

11.5.7 The maintenance in full current force and effect of such forms and amounts of insurance and bonds required by the Contract Documents shall be a condition precedent to the Contractor's exercise or enforcement of any rights under the Contract Documents.

11.5.8 Failure of the Owner to demand certificates, policies and binders evidencing insurance coverages required by the Contract Documents, approval by the Owner of such certificates, policies and binders or failure of the Owner to identify a deficiency from evidence that is provided by the Contractor shall not be construed as a waiver of the Contractor's obligations to maintain the insurance required by the Contract Documents.

11.5.9 The Owner shall have the right to terminate the Contract if the Contractor fails to maintain the insurance required by the Contract Documents.

11.5.10 If the Contractor fails to maintain the insurance required by the Contract Document, the Owner shall have the right, but not the obligation, to purchase said insurance at Contractor's expense. If the Owner is damaged by the Contractor's failure to maintain the insurance required by the Contract Documents, the Contractor shall bear all reasonable costs properly attributable to such failure.

11.5.11 By requiring the insurance set forth herein and in the Contract Documents, the Owner does not represent or warrant that coverage and limits will necessarily be adequate to protect the Contractor, and such coverages and limits shall not be deemed as a limitation on the Contractor's liability under the indemnities granted to the Owner in the Contract Documents. For those policies requiring the Owner to be added as an

Additional Insured, as set forth herein, the Owner and all other indemnified parties shall be an Additional Insured for the full limits carried by the Contractor, not just the limits required herein.

11.5.12 If Contractor's liability policies do not contain a standard separation of insureds provision, such policies shall be endorsed to provide cross-liability coverage.

11.5.13 If a part of the Work hereunder is to be subcontracted, the Contractor shall: (1) cover any and all Subcontractors in its insurance policies; (2) require each Subcontractor to secure insurance which will protect said Subcontractor and supplier against all applicable hazards or risks of loss designated in accordance with Article 11; and (3) require each Subcontractor or supplier to assist in every manner possible in the reporting and investigation of any accident, and upon request, to cooperate with any insurance carrier in the handling of any claim by securing and giving evidence and obtaining the attendance of witnesses as required by any claim or suit.

11.5.14 It is understood and agreed that the insurance coverages required by the provisions of this Contract are required in the public interest and that the Owner does not assume any liability for acts of the Contractor or Subcontractors of any tier or their employees in the performance of the Contract or Work.

11.6 Builder's Risk Insurance

11.6.1 The Contractor shall purchase and maintain, in a company or companies lawfully authorized to do business in the State of Missouri, as an admitted carrier, builder's risk insurance on the entire Work. Such insurance shall be written on a completed value form for the entire Work. The insurance shall apply on a replacement cost basis.

11.6.2 The insurance as required herein shall name as insureds the Owner, the Contractor, and all Subcontractors of any tier. The insurance policy shall contain a provision that the insurance will not be canceled, allowed to expire or materially changed until at least thirty (30) days prior written notice has been given to the Owner.

11.6.3 The insurance as required herein shall cover the entire Work, including reasonable compensation for Architect's services and expenses made necessary by an insured loss. Insured property shall include portions of the Work located away from the site (including all offsite stored materials) but intended for use at the site and shall also cover portions of the Work in transit. The policy shall include as insured property scaffolding, falsework, and temporary buildings located at the site. The policy shall cover the cost of removing debris, including demolition as may be made legally necessary by the operation of any law, ordinance, or regulation.

11.6.4 The insurance required herein shall be on an all risk form and shall be written to cover all risks of physical

loss or damage to the insured party and shall insure at least against the perils of fire and extended coverage, theft, vandalism, malicious mischief, collapse, lightning, earthquake, flood, frost, water damage, windstorm and freezing.

11.6.5 If there are any deductibles applicable to the insurance required herein, the Contractor shall pay any part of any loss not covered because of the operation of such deductibles.

11.6.6 The insurance as required herein shall be maintained in effect until the earliest of the following dates:

- .1** the date which all persons and organization who are insureds under the policy agree in writing that it shall be terminated;
- .2** the date on which final payment of this Contract has been made by the Owner to the Contractor; or
- .3** the date on which the insurable interests in the property of all insureds other than the Owner have ceased.

11.6.7 The Owner and the Contractor waive all rights against (1) each other and any of their Subcontractors of any tier, suppliers, agents and employees, each of the other, (2) the Architect and Architect's consultants, and (3) separate contractors described in Article 6, if any, and any of their subcontractors of any tier, suppliers, agents and employees, for damages caused by fire or other perils to the extent covered by property insurance or other insurance applicable to the Work, except such rights as they have to proceeds of such insurance. The Owner or the Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 6, if any, and the Subcontractors of any tier, suppliers, agents, and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, was at fault or was negligent in causing the loss and whether or not the person or entity had an interest in the property damaged.

11.6.8 A loss insured under the Contractor's property insurance shall be adjusted by the Owner in good faith and made payable to the Owner for the insureds, subject to requirements of the Contract Documents. The Contractor shall pay Subcontractors of any tier their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors of any tier to make payments to their Subcontractors in similar manner. The Contractor shall waive its rights to subrogation for any loss or damage to the Contractor's property or equipment coverage in favor of the Owner and other indemnified parties.

11.7 Bonds

11.7.1 When the Contract Sum exceeds Fifty Thousand Dollars (\$50,000), the Contractor shall procure and furnish a Performance Bond and a Payment Bond in the form prepared by the Owner, each in an amount equal to one hundred percent (100%) of the Contract Sum, as well as adjustments to the Contract Sum. The Performance Bond shall secure and guarantee the Contractor's faithful performance of this Contract, including but not limited to the Contractor's obligation to correct defects after final payment has been made as required by the Contract Documents. The Payment Bond shall secure and guarantee payment of all persons performing labor on the Project under this Contract and furnishing materials in connection with this Contract. These Bonds shall be in effect through the duration of the Contract plus the Guaranty Period as required by the Contract Documents.

11.7.2 The bonds required hereunder shall be executed by a responsible surety licensed in the State of Missouri, with a Best's rating of no less than A-/XI. The Contractor shall require the attorney in fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of this power of attorney indicating the monetary limit of such power.

11.7.3 If the surety of any bond furnished by the Contractor is declared bankrupt or becomes insolvent or its right to conduct business in the State of Missouri is terminated, or it ceases to meet the requirements of this Section, the Contractor shall within ten (10) days substitute another bond and surety, both of which must be acceptable to the Owner. If Contractor fails to make such substitution, the Owner may procure such required bonds on behalf of the Contractor at the Contractor's expense.

11.7.4 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds to such person or entity.

11.7.5 The Contractor shall keep the surety informed of the progress of the Work, and, where necessary, obtain the surety's consent to or waiver of: (1) notice of changes in the Work; (2) request for reduction or release of retention; (3) request for final payment; and (4) any other material required by the surety. The Owner shall be notified by the Contractor, in writing, of all communications with the surety, as it relates to items one through four. The Owner may, in the Owner's sole discretion, inform surety of the progress of the Work, any defects in the Work, or any defaults of the Contractor under the Contract Documents and obtain consents as necessary to protect the Owner's rights, interest, privileges and benefits under and pursuant to any bond issued in connection with the Work.

11.7.6 The Contractor shall indemnify and hold harmless the Owner and any agents, employees, representative or member of the Board of Curators from and against any

claims, expenses, losses, costs, including reasonable attorneys' fees, as a result of any failure of the Contractor to procure the bonds required herein.

ARTICLE 12 UNCOVERING AND CORRECTION OF THE WORK

12.1 Uncovering of the Work

12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it shall, if required in writing by the Architect or the Owner's Representative, be uncovered for the Architect's observation and be replaced at the Contractor's expense without change in the Contract Time.

12.1.2 If a portion of the Work has been covered which the Architect or the Owner's Representative has not specifically requested to observe, prior to its being covered, the Architect or the Owner's Representative may request to see such Work, and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be charged to the Owner. If such Work is not in accordance with the Contract Documents, the Contractor shall pay such costs unless the condition was caused by the Owner or a separate contractor in which event the Owner will be responsible for payment of such costs.

12.2 Correction of the Work

12.2.1 The Architect or the Owner's Representative shall have the right to reject Work not in strict compliance with the requirements of the Contract Documents. The Contractor shall promptly correct Work rejected by the Architect or the Owner's Representative for failing to conform to the requirements of the Contract Documents, whether observed before or after final completion and whether or not fabricated, installed, or completed. If Work has been rejected by the Architect or the Owner's Representative, the Architect or the Owner's Representative shall have the right to require the Contractor to remove it from the Project site and replace it with Work that strictly conforms to the requirements of the Contract Documents regardless, if such removal and replacement results in "economic waste." The Contractor shall pay all claims, costs, losses and damages caused by or resulting from the correction, removal or replacement of defective, or non-compliant Work, including but not limited to, all costs of repair or replacement of Work of others. The Contractor shall bear costs of correcting, removing and replacing such rejected Work, including additional testing and inspections and compensation for the Architect's services and expenses made necessary thereby. If prior to the date of final payment, the Contractor, a Subcontractor, or anyone for whom either is responsible uses or damages any portion of the Work, including, without limitation, mechanical, electrical, plumbing, and other building systems, machinery, equipment or other mechanical device, the Contractor shall cause such item to be restored to "like new" condition at no expense to the Owner.

12.2.2 If, within twelve (12) months after the date of Final Completion of the Work or designated portion thereof, or after the date for commencement of warranties, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found not to be in strict accordance with the requirements of the Contract Documents, the Contractor shall correct or remove and replace such defective Work, at the Owner's discretion. Such twelve (12) month period is referred to as the "Guarantee Period." The obligations under this Paragraph shall cover any repairs, removal, and replacement to any part of the Work or other property caused by the defective Work.

12.2.3 The Contractor shall remove from the site portions of the Work which are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

12.2.4 If the Contractor fails to correct nonconforming Work within a reasonable time, the Owner may correct or remove it and replace such nonconforming Work. If the Contractor does not proceed with correction of such nonconforming Work within a reasonable time fixed by written notice from the Owner, the Owner may take action to correct or remove the nonconforming work at the Contractor's expense.

12.2.5 The Contractor shall bear the cost of correcting destroyed or damaged Work or property, whether completed or partially completed, of the Owner or of others caused by the Contractor's correction or removal of Work which is not in accordance with the requirements of the Contract Documents.

12.2.6 Nothing contained in Article 12 shall be construed to establish a period of limitation with respect to other obligations that the Contractor might have under the Contract Documents. Establishment of the twelve (12) month Guarantee Period as described in Article 12 relates only to the specific obligation of the Contractor to correct, remove or replace the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations under the Contract Documents. The requirements of Article 12 are in addition to and not in limitation of any of the other requirements of the Contract for warranties or conformance of the Work to the requirements of the Contract Documents.

12.3 Acceptance of Nonconforming Work

12.3.1 The Owner may accept Work which is not in accordance with the Contract Documents, instead of requiring its removal and correction, in its sole discretion. In such case, the Contract Sum will be adjusted as appropriate and equitable. Such adjustment shall be made

whether or not final payment has been made. Nothing contained herein shall impose any obligation upon the Owner to accept nonconforming or defective Work.

ARTICLE 13 MISCELLANEOUS PROVISIONS

13.1 Written Notice

13.1.1 All notices required to be given by the Contractor under the terms of this Contract shall be made in writing. Written notice when served by the Owner will be deemed to have been duly served if delivered in person to the individual or a member of the firm or entity or to an office of the corporation for which it was intended, or if delivered at or sent to the last business address known to the party giving notice.

13.2 Rights and Remedies

13.2.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

13.2.2 No action or failure to act by the Owner, the Architect, or the Owner's Representative will constitute a waiver of a right or duty afforded to the Owner under the Contract Documents, nor will such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed in writing.

13.2.3 The terms of this Contract and all representations, indemnifications, warranties and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion and acceptance of the Work and termination or completion of the Work and shall remain in effect so long as the Owner is entitled to protection of its rights under applicable law.

13.2.4 The Contractor shall carry out the Work and adhere to the current construction schedule during all disputes or disagreements with the Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements except as the Owner and the Contractor may otherwise agree to in writing.

13.3 Tests and Inspections

13.3.1 Tests, inspections, and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, codes, or regulations shall be made at an appropriate time. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory, the Owner's Authorized Agent, or entity acceptable to the Owner, and the Contractor shall bear related costs of tests, inspections, and approvals as required in the Contract Documents. The Contractor shall give the Architect, the Owner's Representative, and the Owner's Authorized Agent timely notice of when and where tests and inspections are to be made

so the Architect, the Owner's Representative and/or the Owner's Authorized Agent may observe procedures or perform the necessary tests or inspections.

13.3.2 If the Architect, the Owner's Representative, or the Owner's Authorized Agent determine that portions of the Work require additional testing, inspection or approval not included in the Contract Documents, or required by law, the Architect, or the Owner's Representative will instruct the Contractor to make arrangements for such additional testing, inspection, or approval by an entity acceptable to the Owner's Representative and the Contractor shall give timely notice to the Architect, the Owner's Representative or the Owner's Authorized Agent, of when and where tests and inspections are to be made so the Architect, the Owner's Representative and/or the Owner's Authorized Agent, may choose that the tests or inspections can be performed or observed. The Owner will bear such costs except as provided elsewhere in Article 13.

13.3.3 If such procedures for testing, inspection, or approval under Article 13 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, the Contractor shall bear all costs made necessary by such failure including those of repeated procedures and compensation for the Architect's and Owner's Authorized Agent's services and expenses.

13.3.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor, and promptly delivered to the Owner's Representative and the Architect.

13.3.5 The Contractor shall take all necessary actions to ensure that all tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

13.3.6 The Contractor shall arrange for and pay for all costs of all testing required by the Contract Documents or any applicable laws for materials to be tested or certified at or on the place or premises of the source of the material to be supplied. The Owner shall have the right to require testing of all materials at the place of the source of the material to be supplied if not required by the Contract Documents or any applicable laws. The Owner shall bear the costs of such tests and inspections not required by the Contract Documents or by applicable laws, unless prior defective Work provides the Architect or the Owner with a reasonable belief that additional defective Work may be found, in which case the Contractor shall be responsible for all costs of tests and inspections ordered by the Owner or the Architect, whether or not such tests or inspection reveals that Work is in compliance with the Contract Documents.

13.4 Nondiscrimination in Employment Equal Opportunity

13.4.1 The University serves from time to time as a contractor for and/or receives funds from the United States

government. Accordingly, the Contractor shall comply with applicable federal laws, rules, and regulations, including those relating to nondiscrimination, equal employment opportunity, and affirmative action in the employment of certain entities or individuals, including, but not limited to, minorities (Executive Order 11246), women (Executive Order 11375), persons with disabilities (29 USC 706 and Executive Order 11758), and certain veterans (38 USC 4212 formerly [2012]), and those related to contracting with small or disadvantaged business concerns (Publication L. 95-507). Contract clauses required by the Federal Government in such circumstances are incorporated herein by reference.

13.4.2 If applicable, the Contractor shall comply with the equal opportunity requirements of 41 CFR Part 60, which are incorporated into this Contract by reference.

13.5 Supplier Diversity Participation Goals

13.5.1 The Contractor shall provide participation of Diverse Firms in the Project, through self-performance, if a Diverse Firm, or by subcontracting with Diverse Firms as Subcontractors, suppliers or manufacturers, in an amount that is no less than the percent of Contract Sum that was promised in the Contractor's bid and/or the amount accepted by the Owner.

13.5.2 If the Contractor must remove any Diverse Firm as a Subcontractor, supplier or manufacturer under the Contract, the Contractor shall replace the Diverse Firm with one or more Diverse Firms in an amount equal to the dollar value of the work awarded to the Diverse Firm that was removed. The Contractor shall immediately notify the Owner's Representative in writing of the Contractor's intent to remove any Diverse Firm as a Subcontractor, supplier or manufacturer, and the Contractor's plan to provide the promised amount of Supplier Diversity Participation. All changes of a Diverse Firm as a Subcontractor of any tier, supplier or manufacturer under the Contract shall be approved by the Executive Director of Facilities Planning and Development.

13.5.3 If the Contractor fails to meet or to maintain the promised amount of Supplier Diversity Participation, the Contractor shall immediately notify in writing the Owner's Representative and the Executive Director of Facilities Planning and Development. Such notice shall include a description of the Contractor's good faith effort to provide the promised Supplier Diversity Participation.

13.5.4 If the Executive Director of Facilities Planning and Development finds that the Contractor has failed to comply in good faith with the promised Supplier Diversity Participation the Executive Director may take appropriate action, including but not limited to, declaring the Contractor ineligible to participate in any contracts with the Owner for a period not to exceed six (6) months, and/or directing that the Contractor's actions be declared a material breach of the Contract and that the Contract be terminated.

13.5.5 The Contractor and his Subcontractors shall develop, implement, maintain, and submit in writing to the Executive Director of Facilities Planning and Development, an affirmative action program if at least fifty (50) persons in the aggregate are employed under this Contract. If less than fifty (50) persons in the aggregate are to be employed under this Contract, the Contractor shall submit, in lieu of the written affirmative action program, a properly executed "Affidavit for Affirmative Action" in the form as included in the Contract Documents. For the purpose of this Section, an "Affirmative Action Program" means positive actions to influence all employment practices (including, but not limited to, recruiting, hiring, promoting, and training) in providing equal employment opportunity regardless of race, color, sex, national origin, religion, age (where the person affected is between 40 and 70), disabled and Vietnam-era veteran status, and handicapped otherwise qualified status. Such affirmative action program shall include:

.1 A written policy statement committing the total organization to affirmative action and assigning management responsibilities and procedures for evaluation and dissemination.

.2 The identification of a person designated to handle action.

.3 The establishment of non-discriminatory selection standards, objective measures to analyze recruitment, an upward mobility system, a wage and salary structure, and standards applicable to lay-off, recall, discharge, demotion, and discipline.

.4 The exclusion of discrimination from collective bargaining agreements.

.5 Performance of an internal audit of the reporting system to monitor execution and to provide for future planning.

13.5.6 In the enforcement of the non-discrimination requirements in Section 13.4 and 13.5, the Owner may use any reasonable procedures available, including but not limited to: requests, reports, site visits, and inspection of relevant documents of Contractors and Subcontractors of any tier. The Contractor shall submit a final Affidavit of Diversity Participation for each Diverse Firm at the end of the project stating the actual amount paid to the Diverse Firm.

13.6 Wage Rates (If the Contract amount is less than \$75,000, the requirements of this Section will not apply. Any adjustments that increase the Contract cost above \$75,000 will be subject to this Section, per Section 290.230, RSMo.)

13.6.1 The Contractor and its Subcontractors shall pay all workers performing work under the Contract not less than the prevailing hourly rate of wages or the public works contracting minimum wage, whichever is applicable, as set out in the Annual Wage Order that is attached to and made part of the specifications for work under the Contract, in accordance with Sections 290.210 to 290.340, RSMo

(Missouri Prevailing Wage Law) and related regulations. The Annual Wage Order(s) published by the Missouri Department of Labor and Industrial Relations (MDLIR) for the location where the Work is performed is incorporated into the Contract by this reference. The Contractor shall use applicable MDLIR regulations, including, but not limited to, 8 CSR 30-3.010-3.060, in determining the appropriate occupational titles and rates for workers used in the execution of this Contract. All determinations and/or interpretations regarding wage rates and classification of workers will be made by the office of the University of Missouri Executive Director of Facilities Planning and Development.

13.6.2 If this Project is financed in whole or in part from Federal funds (as indicated in the bid or Contract Documents), then this Contract shall be subject to all applicable federal labor statutes, rules, and regulations, including provisions of the Davis-Bacon Act, 40 U.S.C. § 3141 et seq., and the "Federal Labor Standards Provisions." Where the Missouri Prevailing Wage Law and the Davis-Bacon Act require payment of different wages for work performed under this Contract, the Contractor and all Subcontractors shall pay the greater of the wages required under either law, on a classification-by-classification basis.

13.6.3 The Contractor will forfeit a penalty to the Owner of \$100 per day (or portion of a day) for each worker that is paid less than the specified rate for any work done under the Contract by the Contractor or by any Subcontractor. The Owner shall deduct from any unpaid amounts then or thereafter due the Contractor under the Contract all sums and amounts due and owing as a result of any violation of Sections 290.210 to 290.340, RSMo. (Section 290.250, RSMo) The Contractor agrees to abide by any decision made by the Owner regarding underpayment of wages to workers and amounts owed them as well as penalties for underpayment of wages.

13.6.4 The prevailing wage rate(s) and public works contracting minimum wage(s) included in the Annual Wage Order(s) include fringe benefits as set forth in Sections 290.219 and 290.257, RSMo. Fringe benefit payments may be made to the worker in cash, or irrevocably made by a Contractor or Subcontractor to a trustee or to a third person pursuant to a fund, plan or program, or pursuant to an enforceable commitment, or any combination thereof, to carry out a financially responsible plan or program which was communicated in writing to the workmen affected, for medical or hospital care, pensions on retirement or death, compensation for injuries or illness resulting from occupational activity, or insurance to provide any of the foregoing, for unemployment benefits, life insurance, disability and sickness insurance, accident insurance, for vacation and holiday pay, for defraying costs of apprenticeship or other similar programs, or for other bona fide fringe benefits, but only where the Contractor or Subcontractor is not required by other federal or state law to provide any of the benefits as referenced in Section 290.210(5), RSMo.

13.6.5 The Contractor shall make full payment of the applicable required wages to workers in legal tender. Pay for travel, mileage, meals, bonuses, or other expenses are not fringe benefits and cannot be considered part of the workers wage rate. The Contractor shall not make any deductions for food, sleeping accommodations, transportation, use of small tools, uniforms, or anything of any kind or description, unless the Contractor and employee enter into an agreement in writing at the beginning of the worker's term of employment, and such agreement is approved by the Owner as fair and reasonable in accordance with Section 290.315, RSMo.

13.6.6 The Contractor shall submit to the Owner with the Contractor's periodic pay request, certified payroll records for labor performed by the Contractor and Subcontractors of any tier. The Contractor shall submit all required certified payroll information records electronically in pdf format using the Owner's web-based payment program. The certified payroll forms shall contain the name, address, personal identification number, and occupational title of the workers as well as the hours they work each day. The Owner's acceptance of certified payroll records does not in any way relieve the Contractor of any responsibility for the payment of prevailing wages to workers on the project. The Contractor shall also maintain copies of the certified payroll records. The Owner may, at any time, request copies of, and/or inspect all of the Contractor's payroll records for the Work to verify compliance. The Contractor shall furnish the Owner copies of payroll records within ten (10) days of the Owner's written request. The Contractor shall provide copies of workers I-9 forms within twenty-four (24) hours of written notice. Such payroll records shall be maintained in accordance with Article 13.7.1 and shall be available for inspection for two (2) years after final completion of the Work. Falsification of the certified payroll records may result in the debarment of the Contractor or Subcontractor from future work with the University.

13.6.7 If applicable, the Contractor shall comply with the Copeland "Anti-Kick Act, 18 U.S.C. § 874, 40 U.S.C. § 3145, and the requirements of 29 C.F.R. pt. 3 as may be applicable, which are incorporated by reference into this contract.

13.6.8 The Contractor shall specifically incorporate the obligations of Section 13.6 into the subcontracts, supply agreements and purchase orders for the Work and require the same of any Subcontractors of any tier.

13.6.9 If Contractor fails to comply with the provisions of Section 13.6 of this Contract or with Sections 290.210 to 290.340, RSMo and related regulations, the Owner may, in its sole discretion, immediately terminate the Contract upon written notice. The rights and remedies of the Owner provided herein shall not be exclusive and are in addition to other rights and remedies provided by law or under this Contract.

13.6.10 The Contractor may pay entry-level workers or federally-registered apprentices fifty percent (50%) of the pay of a journeyman in their same occupational title, in accordance with Section 290.235, RSMo and 8 CSR 30-3.030. Per 8 CSR 30-3.030, an entry-level worker is "[a]ny worker who is not a journeyman and who is not otherwise enrolled in a federally-registered apprenticeship program but is participating in an on-the-job training program provided by the contractor for whom they perform work on a public construction project." The University of Missouri may require documentation showing, to the University's sole satisfaction, that an entry-level worker is participating in an on-the-job training program with the Contractor. The combined total of such entry-level workers and federally registered apprentices shall not exceed a one-to-one ratio with the number of journeyman workers in any occupational title on the project.

13.6.11 The Contractor shall post the wage rates for the Contract in a dry, accessible place at the field office on the project or, where there is no field office, at the Contractor's local office or batch plant so long as a copy is provided to workers upon request, as required by 8 CSR 30-3.050. The wage rates shall be kept in a clearly legible condition for the duration of the project.

13.6.12 Neither the Contractor, nor any Subcontractor of any tier, nor any person hired by them or acting on their behalf, shall request, demand or receive, either before or after such worker is engaged, that such worker pay back, return, donate, contribute, or give any part or all of said worker's wages, salary, or thing of value, to any person, upon the statement, representation, or understanding that failure to comply with such request or demand will prevent such worker from procuring or retaining employment, and no person shall, directly or indirectly, pay, request or authorize any other person to violate this Section as set forth in Section 290.305, RSMo, the exception being to an agent or representative of a duly constituted labor organization acting in the collection of dues or assessments of such organization. No Contractor or Subcontractor may directly or indirectly receive a wage subsidy, bid supplement, or rebate for employment on this project if such wage subsidy, bid supplement, or rebate has the effect of reducing the wage rate paid by the employer on a given occupational title below the applicable wage rate as provided in the Contract. In the event a wage subsidy, bid supplement, or rebate is provided or received, the entity receiving such subsidy, supplement, or rebate shall report the date and amount of such subsidy, supplement, or rebate to the University within thirty days of receipt of payment. This disclosure report shall be a matter of public record.

13.6.13 The Contractor will pay workers overtime for all hours worked over ten (10) hours per day and forty (40) hours per week in accordance with Section 290.230, RSMo. For all overtime work performed, not less than one and one-half the prevailing hourly rate of wages for work of a similar character in the locality in which the Work is performed or the public works contracting minimum wage, whichever is applicable,

shall be paid. For all work performed on a Sunday or holiday, not less than twice the prevailing hourly rate of pay or public works contracting minimum wage will apply in accordance with Section 290.230, RSMo. For purposes of this Section, holidays are as follows: January first, the last Monday in May, July fourth, the first Monday in September, November 11, the fourth Thursday in November, December twenty-fifth. If any holiday falls on a Sunday, the following Monday shall be considered a holiday.

13.7Records

13.7.1 The Owner, or any parties it deems necessary, shall have access to and the right to examine any accounting or other records of the Contractor involving transactions and Work related to this Contract for five (5) years after final payment or five (5) years after the final resolution of any on going disputes at the time of final payment. All records shall be maintained in accordance with generally accepted accounting procedures, consistently applied. Subcontractors of any tier shall be required by Contractor to maintain records and to permit audits as required of Contractor herein.

13.8Codes and Standards

13.8.1 The Work shall be performed to comply with the International Code Council (ICC) Codes, and the codes and standards noted below. The latest editions and supplements of these codes and standards in effect on the date of the execution of the Contract for Construction shall be applicable unless otherwise designated in the Contract Documents. Codes and standards required by accreditation agencies will also be used unless the ICC requirements are more stringent. In the event that special design features and/or construction systems are not covered in the ICC codes, the applicable edition of the National Fire Protection Association (NFPA) family of standards and/or the NFPA 101 Life Safety Code shall be used.

- .1 ICC International Building Code and reference standards
- .2 ICC International Plumbing Code
- .3 ICC International Mechanical Code
- .4 ICC International Fire Code
- .5 ICC International Fuel Gas Code
- .6 NFPA 70 National Electric Code (NEC)
- .7 Americans with Disabilities Act – Standards for Accessible Design.
- .8 American National Standard Safety Code for Elevators, Dumbwaiters, Escalators, and Moving Walks as published by the American Society of Mechanical Engineers (ASME), American National Standards Institute (ANSI) A17.1
- .9 NFPA 101 Life Safety Code (as noted above)
- .10 American Concrete Institute (ACI)
- .11 American National Standards Institute (ANSI)
- .12 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .13 American Refrigeration Institute (ARI)

- .14 American Society for Testing and Materials (ASTM)
- .15 Missouri Standard Specification for Highway Construction, Missouri State Highway Commission
- .16 National Electrical Manufacturers Association (NEMA)
- .17 Underwriter's Laboratories, Inc. (UL), Federal Specifications
- .18 Williams Steiger Occupational Safety and Health Act of 1970 (OSHA)

13.9 General Provisions

13.9.1 Any specific requirement in this Contract that the responsibilities or obligations of the Contractor also apply to a Subcontractor is added for emphasis and are also hereby deemed to include a Subcontractor of any tier. The omission of a reference to a Subcontractor in connection with any of the Contractor's responsibilities or obligations shall not be construed to diminish, abrogate or limit any responsibilities or obligations of a Subcontractor of any tier under the Contract Documents or the applicable subcontract.

13.9.2 This Contract shall be interpreted, construed, enforced, and regulated under and by the laws of the State of Missouri. Whenever possible, each provision of this Contract shall be interpreted in a manner as to be effective and valid under applicable law. If, however, any provision of this Contract, or a portion thereof, is prohibited by law or found invalid under any law, only such provision or portion thereof shall be ineffective, without invalidating or affecting the remaining provisions of this Contract or valid portions of such provision, which are hereby deemed severable. The Contractor and the Owner further agree that in the event any provision of this Contract, or a portion thereof, is prohibited by law or found invalid under any law, this Contract shall be reformed to replace such prohibited or invalid provision or portion thereof with a valid and enforceable provision which comes as close as possible to expressing the intention of the prohibited or invalid provision.

13.9.3 The Contractor and the Owner each agree that the State of Missouri Circuit Court for the County where the Project is located shall have exclusive jurisdiction to resolve all Claims and any issue and disputes between the Contractor and the Owner. The Contractor agrees that it shall not file any petition, complaint, lawsuit or legal proceeding against the Owner in any other court other than the State of Missouri Circuit Court for the County where the Project is located.

13.9.4 The Owner's total liability to the Contractor and anyone claiming by, through, or under the Contractor for any Claim, cost, loss, expense, or damage caused in part by the fault of the Owner and in part by the fault of The Contractor or any other entity or individual shall not exceed the percentage share that the Owner's fault bears to the total fault of the Owner, the Contractor and all other entities and individuals as determined on the basis of comparative fault principles.

13.9.5 The Contractor agrees that the Owner shall not be liable to the Contractor for any special, indirect, incidental, or consequential damage whatsoever, whether caused by the

Owner's negligence, fault, errors or omissions, strict liability, breach of contract, breach of warranty or other cause or causes whatsoever. Such special, indirect, incidental or consequential damages include, but are not limited to loss of profits, loss of savings or revenue, loss of anticipated profits, labor inefficiencies, idle equipment, home office overhead, and similar types of damages.

13.9.6 Nothing contained in this Contract or the Contract Documents shall create any contractual relationship with or cause of action in favor of a third party against the Owner.

13.9.7 No member or officer of the Board of Curators of the University incurs or assumes any individual or personal liability under the Contract or by reason of the default of the Owner in the performance of any terms thereof. The Contractor releases and discharges all members or officers of the Board of Curators of the University from any liability as a condition of and as consideration for the award of the Contract to the Contractor.

13.9.8 The Contractor hereby binds itself, its partners, successors, assigns and legal representatives to the Owner in respect to covenants, agreements and obligations contained in the Contract Documents. The Contractor shall not assign the Contract or proceeds hereof without written consent of the Owner. If the Contractor attempts to make such an assignment without such consent, it shall be void and confer no rights on third parties, and the Contractor shall nevertheless remain legally responsible for all obligations under the Contract. The Owner's consent to any assignment is conditioned upon the Contractor entering into a written assignment which contains the following language: "It is agreed that the funds to be paid to the assignee under this assignment are subject to performance by the Contractor and to claims and to liens for services rendered or materials supplied for the performance of the Work required in said Contract in favor of all persons, firms, corporations rendering such services or supplying such materials."

13.10 Certifications

13.10.1 Suspension and Debarment

The Contractor certifies to the best of its knowledge and belief that it and its principals are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any department or agency in accordance with Federal Executive Orders 12549 (2/18/86) and 12689 (8/15/89).

13.10.2 Anti-Discrimination Against Israel Act

If this Contract is for \$100,000 or more, and if the Contractor is a company with ten (10) or more employees, then Contractor certifies that it, and any company affiliated with it, does not boycott Israel, and will not boycott Israel during the term of this Contract. In this Paragraph, the terms "company" and "boycott Israel" shall have the meanings described in Section 34.600 of the Missouri Revised Statutes.

13.10.3 Byrd Anti-Lobbying Amendment

.1 If this Contract exceeds \$100,000 and is funded by Federal funding, Contractor agrees to file the required certification, in compliance with 31 U.S.C. § 1352 (as amended).

.2 Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, officer or employee of Congress, or an employee of a Member of Congress in connection with obtaining any Federal contract, grant, or any other award covered by 31 U.S.C. § 1352.

.3 Each tier shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the recipient who in turn will forward the certification(s) to the awarding agency.

13.10.4 Work Authorization

The Contractor and all subcontractors performing work under this Contract shall enroll and participate in a federal work authorization program operated by the United States Department of Homeland Security, E-Verify or an equivalent federal work authorization program, to verify information of newly hired employees, under the Immigration Reform and Control Act of 1986 (IRCA), P.L.99-603. By executing a contract with The Curators of the University of Missouri, the Contractor shall affirm its enrollment and participation in a federal work authorization program with respect to the employees working in connection with the contracted service and affirm that it does not knowingly employ any person who is an unauthorized alien in connection with the contracted services. The Contractor shall maintain documentation of its participation in a federal work authorization program and make such documentation available to the University upon request.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 Termination by Owner for Cause

14.1.1 In addition to other rights and remedies granted to the Owner under the Contract Documents and by law, the Owner may terminate the Contract if the Contractor:

.1 refuses or fails to supply enough properly skilled workers, superintendents, foremen, or managers;

.2 refuses or fails to supply sufficient or proper materials;

.3 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;

.4 disregards laws, ordinances, rules, codes, regulations or orders of an authority having jurisdiction;

.5 disregards the authority of the Owner's Representative, the Architect, or the Owner's Authorized Agent;

.6 breaches any warranty or representations made by the Contractor under or pursuant to the Contract Documents;

.7 fails to furnish the Owner with assurances satisfactory to the Owner evidencing the Contractor's ability to complete the Work in compliance with all the requirements of the Contract Documents;

.8 fails after commencement of the Work to proceed continuously with the construction and completion of the Work for more than ten (10) days, except as permitted under the Contract Documents;

.9 fails to maintain a satisfactory rate of progress with the Work or fails to comply with approved progress schedules; or

.10 violates in any substantial way any provisions of the Contract Documents.

14.1.2 When any of the above reasons exist, the Owner may, without prejudice to any other rights or remedies of the Owner, terminate this Contract by delivering a written notice of termination to the Contractor and the Contractor's surety, and may:

.1 take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

.2 accept assignment of subcontracts pursuant to Section 5.3; and

.3 finish the Work by whatever reasonable method the Owner may deem expedient, including turning the Work over to the surety.

14.1.3 The Contractor, in the event of a termination under Section 14.1, shall not be entitled to receive any further payments under the Contract until the Work is completed in its entirety. Then, if the unpaid balance under the Contract shall exceed all expenses of the Owner in finishing the Work, including additional compensation for the Architect's services and expenses made necessary thereby, such excess will be paid to the Contractor; but, if such expenses of the Owner to finish the Work shall exceed the unpaid balance, the Contractor and its surety shall be liable for, and shall pay the difference and any damages to the Owner. The obligation of the Contractor and its surety for payment of said amounts shall survive termination of the Contract.

14.1.4 In exercising the Owner's right to secure completion of the Work under any of the provisions hereof, the Owner shall have the right to exercise the Owner's sole discretion as to the manner, methods, and reasonableness of costs of completing the Work.

14.1.5 The rights of the Owner to terminate pursuant to Article 14.1 will be cumulative and not exclusive and shall be in addition to any other remedy provided by law or the Contract Documents.

14.1.6 Should the Contractor fail to achieve Final Completion of the Work within thirty (30) calendar days following the date of Substantial Completion, the Owner may exercise its rights under Section 14.1.

14.2 Suspension by the Owner for Convenience

14.2.1 The Owner may, without cause, order the Contractor in writing to suspend, delay, or interrupt the Work in whole or in part for such period of time as the Owner may determine.

14.2.2 An adjustment will be made to the Contract Sum for increases in the cost of performance of the Contract caused by suspension, delay or interruption. However, in the event of a suspension under Section 14.2, Contractor hereby waives and forfeits any claims for payment of any special, indirect, incidental or consequential damages such as lost profits, loss of savings or revenue, loss of anticipated profits, idle labor or equipment, home office overhead, and similar type damages. No adjustment will be made to the extent:

.1 that performance is, was, or would have been so suspended, delayed or interrupted by another cause for which the Contractor in whole or in part is responsible, or

.2 that an equitable adjustment is made or denied under another provision of this Contract.

14.3 Owner's Termination for Convenience

14.3.1 The Owner may, at any time, terminate the Contract in whole or in part for the Owner's convenience and without cause. Termination by the Owner under this Paragraph shall be by a notice of termination delivered to the Contractor specifying the extent of termination and the effective date.

14.3.2 Upon receipt of a notice of termination for convenience, the Contractor shall immediately, in accordance with instructions from the Owner, proceed with performance of the following duties regardless of delay in determining or adjusting amounts due under this Paragraph:

.1 cease operation as specified in the notice;

.2 place no further orders and enter into no further subcontracts for materials, labor, services or facilities except as necessary to complete Work not terminated;

.3 terminate all subcontracts and orders to the extent they relate to the Work terminated;

.4 proceed to complete the performance of Work not terminated; and

.5 take actions that may be necessary, or that the Owner may direct, for the protection and preservation of the terminated Work.

14.3.3 Upon such termination, the Contractor shall recover as its sole remedy payment for Work properly performed in connection with the terminated portion of the Work prior to the effective date of termination and for items properly and timely fabricated off the Project site, delivered and stored in accordance with the Owner's instructions and for all Owner approved claims, costs, losses and damages incurred in settlement of terminated contracts with Subcontractors and suppliers. The Contractor hereby waives and forfeits all other claims for payment and damages, including, without limitation, anticipated profits, consequential damages and other economic losses.

14.3.4 The Owner shall be credited for (1) payments previously made to the Contractor for the terminated portion of

the Work, (2) claims which the Owner has against the Contractor under the Contract and (3) the value of the materials, supplies, equipment, or other items that are to be disposed of by the Contractor that are part of the Contract Sum.

14.3.5 Upon determination by a court that termination of Contractor or its successor in interest pursuant to Section 14.1 was wrongful, such termination will be deemed converted to a termination for convenience pursuant to Section 14.3, and Contractor's sole and exclusive remedy for wrongful termination is limited to recovery of the payments permitted for termination for convenience as set forth in 14.3.

SECTION 1.E
SPECIAL CONDITIONS

1. DEFINITIONS

a. "Drawings"

Drawings referred to in and accompanying Project Manual consist of Drawings prepared by and bearing name of below defined Architect, bearing date of **July 12, 2024** and entitled “**Veterinary Science Building Demolition**”; project number **CP233041**.

b. Architect

PWArchitects, Inc.
2021 Forum Blvd., Ste. 101
Columbia, Missouri 65203
Phone: 573.449.2683

c. Mechanical & Electrical Engineer

Introba
6 South Old Orchard
St. Louis, Missouri 63119
Phone: 1.800.404.7677

d. Civil Engineer

Engineering Surveys & Services
1113 Fay Street
Columbia, Missouri 65201
Phone: 573.449.2646

e. Other Definitions: See Article 1., General Conditions.

2. SPECIAL SCHEDULING REQUIREMENTS

a. Special scheduling requirements supplemental to the bid form

- (1) Coordinate permits for street closures and traffic control measures with City. Allow a minimum of 30 days review time for closures or lane changes lasting more than 30 days. Contractor shall be responsible for obtaining all City required permits and coordinating City permit timelines with Construction scheduling. Contractor shall be responsible for permit cost.
- (2) Contractor may not mobilize on-site until after September 16, 2024.

3. SCOPE OF WORK

- a. The Contractor shall furnish all labor, materials, tools, equipment necessary for, and incidental to, construction of this project as indicated on Drawings and specified herein.
- b. Work shall include everything requisite and necessary to finish work properly, notwithstanding that every item of labor or materials or accessories required to make project complete may not be specifically mentioned.
- c. General Description of Work
 - (1) Project consists of the demolition of the Veterinary Science Building. Associated work includes:
 - a. Removal of indicated site amenities, including sidewalks, stairs, landscape walls, and parking stops.
 - b. Disconnection of water, sewer, gas, steam, telecom, and electrical services to the building.
 - c. Refeeding electrical to new and existing site lighting as indicated.
 - d. Rough grading of site.
 - e. Construction of new parking areas; resurfacing of existing parking areas.

4. LOCATION

Work shall be performed under this Contract on campus of the University of Missouri – Columbia, at Veterinary Science Building, 1590 Rollins Street.

5. NUMBER OF CONSTRUCTION DOCUMENTS

- a. The Owner will provide electronic data files to the Contractor for their convenience and use in progressing the Work and the preparation of shop drawings or other submittal requirements required for construction of the referenced project. The electronic data files shall reflect Construction Documents and Bid Addenda only. These files will be transmitted subject to the following terms and conditions:
 - (1) The Owner makes no representation as to the compatibility of these files with the Contractor's hardware or software.
 - (2) Data contained on these electronic files shall not be used by the Contractor or anyone else for any purpose other than as a convenience in progressing the Work or in the preparation of shop drawings or other required submittals for the referenced project. Any other use or reuse by the Contractor or by others will be at their own sole risk and without liability or legal exposure to Owner. The Contractor agrees to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of

action of any nature against the Owner and its consultants, contractors, agents, employees, and representatives that may arise out of or in connection with the use of the electronic files transmitted.

- (3) Furthermore, the Contractor shall, to the fullest extent permitted by law, indemnify and hold harmless the Owner and its consultants, contractors, agents, employees, and representatives, against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.
- (4) These electronic files are not contract documents. Differences may exist between these electronic files and corresponding hard-copy construction documents. The Owner makes no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed or sealed hard-copy construction documents prepared by the Consultant and the electronic files, the signed and sealed hard-copy construction documents shall govern. The Contractor is responsible for determining if any conflict exists. By use of these electronic files, the Contractor is not relieved of their duty to fully comply with the contract documents.
- (5) Because information presented on the electronic files can be modified, unintentionally or otherwise, the Owner reserves the right to remove all indications of ownership and/or involvement from each electronic display.
- (6) Under no circumstances shall delivery of the electronic files be deemed a sale by the Owner and no warranties are made, either expressed or implied, of merchantability and fitness for any particular purpose. In no event shall the Owner be liable for any loss of profit, or any consequential damages as a result of use or reuse of these electronic files.

6. SUBMITTALS

- a. The Contractor shall submit for approval to the Architect, equipment lists and Shop Drawings, as expediently as possible. Failure of the Contractor to submit Shop Drawings in a timely manner will result in the Owner holding back Contractor payments. (See General Conditions)
- b. The material and equipment lists shall be submitted and approved before any material or equipment is purchased and shall be corrected to as-built conditions before the completion of the project.
- c. The Contractor shall submit electronic versions of all required Shop Drawings, material and equipment lists. The Contractor shall upload all Shop Drawings to a secure information sharing website determined by the Owner notifying the Owner and Consultant that these shop drawings are available for review. Each submittal shall have the General Contractors digital stamp affixed to the first page signifying their review and acceptance. Review comments, approvals, and rejections will be posted on this same site with notification to the contractor. Submittals requiring a professional seal shall be submitted hard copy with a manual seal affixed.

- (1) The Contractor shall identify each submittal item with the following:
 - (a) Project Title and Location
 - (b) Project Number
 - (c) Supplier's Name
 - (d) Manufacturer's Name
 - (e) Contract Specification Section and Article Number
 - (f) Contract Drawing Number
 - (g) Acrobat file name: Spec Section_Times Submitted-Spec Title: 033000_01-Cast-In-Place-Concrete.pdf
 - (2) Reference the accompanying Shop Drawing and Submittal Log at the end of this section (1.E.3) for required submittal information.
- d. The Contractor shall submit to the Architect electronic copies of all required Operating Instructions and Service Manuals for the Architect's and the Owner's sole use prior to completing 50% of the adjusted contract. Payments beyond 50% of the contract amount may be withheld until all Operating Instructions and Service Manuals are received as referenced in the accompanying Operating Instructions and Service Manual Log at the end of this section (1.E.4).
- e. The Contractor shall submit to the Owner's Representative all items referenced in the accompanying Closeout Log (1.E.5) within 30 days following substantial completion of the work. The Owner's Representative will maintain the closeout log and include as an agenda item at all coordination meetings.

7. NOTIFICATION

Before beginning Demolition Work or service outages, the Contractor shall provide, at minimum, seventy-two (72) hours advance notice to Owner's Representative for purpose of verifying utility locations including, but not limited to, gas, telecommunications, electric, water, steam, sewer, and nitrogen. Contractor shall minimize the number of outages, minimize the length of outages and related work shall be continuous until the utility is restored.

8. USE OF PREMISES

- a. Access: Access to construction site shall be as indicated on Drawings and as directed by the Owner's Representative.
- b. Parking:
 - (1) The Owner will issue Contractor two (2) service vehicle parking permits to park in location directed by the Owner's Representative. The permits will be issued at no cost to the contractor up to the contract completion

date. After the contract completion date, the permits will be re-issued on an as available basis at the contractor's expense. These permits are to be used for general contractor or subcontractor owned and labeled vehicles only. Personal vehicles are prohibited from use of these permits. Violation of this requirement may result in ticketing and/or towing at the vehicle owner's expense and suspension of progress payments.

- (2) Parking of personal vehicles within project access/lay down/staging areas is prohibited. Violation of this requirement may result in ticketing and/or towing at the vehicle owner's expense and suspension of progress payments.
- (3) Parking or driving on sidewalks, landscaped areas, within fire and service lanes or generally in areas not designated for vehicular traffic is prohibited except as allowed in the contract documents. Violation of this requirement may result in ticketing and/or towing at the vehicle owner's expense and suspension of progress payments.
- (4) Sidewalk(s) and Hardscape – Parking/driving on hardscapes is strictly prohibited unless specifically directed by the Owner's Representative through the MU sidewalk permitting process. Restricted use permits will be limited to activities that are constrained by an absolute need to access from a sidewalk. Such activities shall be considered the exception and not the norm. Adequate signage, fencing and alternate routes must be provided in the immediate and adjacent areas.
- (5) Free parking for contractor employees is available in the Ashland Road Contractor lot on an as available basis. This space is for use by contractor employees for parking their personal vehicles only and is not to be used for staging or storage.
- (6) Vendor Permits may be purchased by contractor management personnel on an as available basis by contacting the Parking and Transportation office in the General Services Building. These permits will allow contractor management personnel to park in various University lots while conducting business on University construction projects.
- (7) Temporary University parking permits may be purchased by contractor employees for use with their personal vehicles on an as available basis by contacting the Parking and Transportation office in the General Services Building.
- (8) Conley Avenue between Missouri Avenue and University Avenue and Hitt Street between University Avenue and the Memorial Union are designated for pedestrian use only during the work week between the hours of 8:15 AM and 3:45 PM. Unless otherwise indicated in the

contract documents, this area is strictly off limits to vehicular traffic without authorization from the Owner's Representative.

- c. Storage of materials: The Contractor shall store all materials within project limits. The Contractor shall confine apparatus, materials, and operation of workers to location established by the Owner's Representative. The Contractor shall not unreasonably encumber premises with materials. In addition, storage trailer locations may be available within 1-1/2 miles of project site as directed by the Owner's Representative. Storage trailer locations shall be subject to approval by the Owner's Representative and are available to the Contractor without cost.
- d. Utilities: Water, sewer, and electricity can be obtained from existing site utilities at locations designated by the Owner's Representative at the following rates:

ELECTRIC*

Demand Rate (Greater than 50 kW Demand):

Demand Rate Per Max Summer kW (June- September)\$15.45
Energy Rate Per kWh\$0.065

Non-Demand Rate (Less than 50 kW Demand):

Energy Rate Per kWh\$0.102

** Electric rates are adjusted monthly (up or down) to reflect fuel and purchased utilities market fluctuations.*

WATER

For each (1,000 Gallons)\$4.25

SANITARY SEWER

For each kGal\$6.70

STORM SEWER

For each 100 square feet of impervious surface area.....\$0.276

Provisions for obtaining power, including temporary extensions, shall be furnished and maintained by the Contractor. Upon completion of the work, such extensions shall be removed and any damage caused by use of such extensions shall be repaired to the satisfaction of the Owner's Representative, at no cost to the Owner.

- e. Restroom: The Contractor shall provide and maintain, in a sanitary condition, chemical type portable toilet facilities at work site for use by his personnel. Toilets and toilet location shall be subject to approval by the Owner's Representative.
- f. Smoking is prohibited at the University of Missouri and all properties owned,

operated, leased or controlled by the University of Missouri. Violation of the policy is defined as smoking any tobacco products, including e-cigarettes.

- g. Landfill: The Contractor shall not use the Owner's landfill. Dumping or disposal of excavated or demolition materials on Owner's property shall not be permitted. The Contractor shall remove and legally dispose of excavated or demolished materials off the Owner's property.
- h. Care of Project Work Site: The contractor shall be responsible for maintaining the construction site in a reasonably neat and orderly condition by regular cleaning and mowing of the premises as determined by the Owner's Representative.
- i. Discharge to Sewer Request: The University of Missouri's MS4 permit and NPDES Storm Water Discharge Permits along with the City of Columbia's POTW Operating Permit as well as local ordinances, and state and federal environmental regulations prohibit hazardous materials from being disposed into either the storm water or sanitary sewer systems. Unless specifically approved, all chemical products such as paints, dyes, lawn care products, maintenance products, and oil is prohibited from drain disposal. Any product, including contaminated water, being discarded into the storm water or sanitary sewer systems requires written approval from the Owner through a formal "Discharge to Sewer Request" form obtained at [Discharge to Sewer Request Form](#). The contractor should submit the form to the Owner's Representative, not to the Department of Environmental Health and Safety as the form indicates.
- j. All concrete waste material including washout water shall be totally contained and removed from the Owner's property.
- k. Artifacts Found During Construction: Contractor shall immediately notify the Owner's Representative when artifacts are uncovered or found during the demolition or construction process. Artifacts include, but are not limited to, tools, drawings (construction or other), photographs, books and other objects/devices which may hold historical importance/significance. Do not remove or disturb the object(s) in question. Artifacts are not considered part of demolished materials and shall remain the property of the University of Missouri.
- l. **"Permit Required Confined Space" Entry Communication and Coordination**
(See OSHA 1926 subpart aa – Construction Confined Space for the definition of "permit required confined spaces" - Note: OSHA does not apply to the University. However, the University will provide a list of all known "permit required confined spaces")

There are no known "permit required confined spaces" within the project limits. Each contractor shall conduct a survey to confirm whether or not any confined spaces exist within the project limits. It is incumbent upon each contractor to list all "permit required spaces".

The Contractor shall notify the Owner's Representative if 1) conditions change resulting in a non-permit required confined space being reclassified to a "permit required confined space" after evaluation of the space by a competent person; 2) a space previously thought to be non-permit required space is classified as a "permit required confined space" after evaluation by a competent person; or 3) during the course of construction a "permit required confined space" is created after evaluation by a competent person.

The Contractor shall submit to the Owner's Representative a copy of the cancelled confined space entry permit and a written report summarizing the permit space program followed and all hazards confronted or created during entry operations. This information shall be submitted within one week of cancelling the permit.

9. PROTECTION OF OWNER'S PROPERTY

- a. The Contractor shall be responsible for repair of damage to building exterior and interior, drives, curbs, streets, walks, grass, shrubbery and trees, which was caused by workmen or equipment employed during progress of work. All such repairs shall be made to satisfaction of the Owner's Representative, at no cost to the Owner, or reimburse the Owner if the Owner elects to make repairs. For landscape damage, the Owner shall make such repairs. Compensation for these repairs shall be determined by the Owner's Representative using the "Valuation of Landscape Trees, Shrubs, and other Plants" as published by the International Society of Arboriculture, as last revised.
- b. Construction Project Fencing:
 - (1) Fencing requirements, as indicated on Drawings, shall be constructed of 9 or 11-gauge chain link not less than six (6) feet in height and not more than 2-inch mesh with posts spaced not more than ten (10) feet apart and all corner and gate posts embedded in concrete. All other posts shall be sufficiently secured in ground to maintain proper and adequate support of fence. Fenced in area shall have at least two (2) access gates and all gates shall be lockable.
 - (2) Fence screening fabric shall be used on all perimeter fencing. Fabric shall be green in color, full height of the project fence, securely attached and properly maintained throughout the duration of the project.
 - (3) Using existing landmarks, lamp posts, trees or other Owner property for support of fencing is strictly prohibited unless a written waiver is obtained from Owner's Representative.
 - (4) Use of ribbon, snow fence, chicken wire, rope, and wooden barricades as

fencing is prohibited.

- (5) Fencing shall be maintained in an "as-installed" condition throughout the life of the project.
- (6) The Contractor may use used fencing provided it is in good condition and is satisfactory to the Owner's Representative.

c. Preserving and Protecting Existing Vegetation:

- (1) Protection and compensation for damages:
 - (a) Trees and shrubs within work area designated to remain shall be protected from damage during construction by fixed chain link fencing or armoring as indicated on Drawings or specified herein. Plant protection devices shall be installed before work has begun and shall be maintained for duration of work unless otherwise directed by Owner's Representative.
- (2) Plants within work area designated for removal shall be removed by Contractor.
- (3) To prevent compaction of soil over tree roots, vehicles or equipment shall not at any time park or travel over, nor shall any materials be stored within drip line of trees designated to remain.
- (4) Owner's Representative will stop work immediately when proper measures are not being employed to protect trees and shrubs. Contractor will be notified to resume work after required protection measures are implemented.
- (5) Pruning of limbs necessary to repair damage or provide clearance for work shall be done by the MU Landscape Services Department. Limbs shall be cut off cleanly and cut surfaces treated according to established horticultural standards.

10. SUBSTITUTIONS and EQUALS

- a. Substitutions are defined in General Conditions article 3.11.8 for and Equals are defined General Conditions Article 3.12 .
- b. Use of materials, products or equipment other than those named and described in the Contract Documents are substitutions and/or equal. Substitutions and/or equals submitted during the bidding period shall be received by both the Architect and the Owner at least ten calendar days prior to the date for receipt of bids. To be considered, bidder's proposal shall include a complete description of the proposed substitution and/or equal and a comparison of significant qualities of the

proposed substitution and/or equal with those specified including drawings, performance and test data, and other information necessary for an evaluation. The Architect's decision on the approval or disapproval of a proposed substitution and/or equal shall be final.

- c. If the Architect and Owner approve a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approval made in any other manner.

11. CODES AND STANDARDS

The Contractor shall comply with applicable codes and standards as listed in General Conditions. The following codes and standards shall also apply:

- a. City of Columbia - Sewer Line Installation Standards - Department of Public Works

“All sanitary sewer construction shall be in accordance with the City of Columbia Specifications and Standards and in conformance with the rules and regulations of the Missouri Clean Water Commission.”

12. PERMITS

- a. Permits and inspection for work on UM property are required.
- b. The Owner's Representative shall secure University Authority Having Jurisdiction building permits required for the project and shall provide a list of required inspections to the Contractor.
 - (1) The Contractor shall coordinate and provide reasonable scheduling and access to the Work for the Owner's Inspection.
 - (2) Re-inspection of work as a result of either failed inspection or work not ready as scheduled may be at the Contractor's expense.
- c. The Contractor shall comply with applicable codes and standards as listed in the Contract Documents and General Conditions.
- d. All permits, including but not limited to Hot Work, Fire Alarm, Energized Work and HVAC interruption shall be coordinated and scheduled with the Owner's Representative or designee prior to commencement of the work.

13. SPECIALTIES

- a. Owner furnished topsoil: The Owner will place the topsoil and provide final grade. The contractor shall rough grade to the following specification:

- (1) The sub-grade is to be left at minus six inches (6”) in all areas unless indicated otherwise. All planting bed sub-grades are to be left at minus eighteen inches (18”). The contractor is to remove all deleterious material from the sub-grade prior to placing topsoil. All subgrade areas shall contain at least 6” of subsoil, (ie. cover clean rock backfilled areas). All subgrade areas shall be “ripped” a minimum of 6” deep and a maximum of 12” apart in opposite directions with minimal tire traffic to follow. All exposed deleterious material and unacceptable rock shall be removed.
- (2) The contractor shall adjust all yard boxes valve boxes, pull boxes, cleanouts, and manhole lid rings etc. (includes irrigation, sewers, water and electric), to the indicated finish grade.
- (3) Final plantings will be by the Owner. The Owner will water and maintain all seed, sod and landscaping.

14. PRE-BID INSPECTION

All pre-bid inspections of work areas shall be scheduled with pre-bid inspection guide, telephone: (573) 882-2228.

15. MODIFICATIONS TO INFORMATION TO BIDDERS

a. Information to Bidders:

- (1) Referenced Information to Bidders, Page IFB/5.
Add new Article 15.8.5 as follows:

15.8.5 Within 48 hours of the receipt of bids, the apparent low bidder shall submit to the Director of Facilities Planning and Development an “Affidavit of Supplier Diversity Participation” for every diverse subcontractor or supplier the bidder intends to award work to on the contract. The affidavit will be signed by both the bidder and the diverse firm.

16. MODIFICATIONS TO GENERAL CONDITIONS

a. General Conditions:

- (1) Add to the Insurance Requirements in General Conditions Article 11, Asbestos Liability Coverage, for specified asbestos abatement in the contract documents, in a limit no less than \$1,000,000 combined single limit, per occurrence and aggregate, for both bodily injury and property damage combined. The Owner will accept coverage from the Asbestos Removal Subcontractor in lieu of the General Contractor subject to all requirements set forth in article 11.
- (2) Add to the Insurance Requirements in General Conditions Article 11,

Pollution Liability Coverage, for specified hazardous waste disposal in the contract documents, in a limit no less than \$1,000,000 combined single limit, per occurrence and aggregate, for both bodily injury and property damage combined. The Owner will accept coverage from the Hazardous Waste Disposal Subcontractor and/or Hauler in lieu of the General Contractor subject to all requirements set forth in article 11.

17. PROJECT SCHEDULING

The project scheduling specification for the project are included immediately after the Special Conditions. For this project the Contractor shall meet the following scheduling requirements.

Contractor Schedule – Contractor is responsible for the schedule and he may provide with in-house personnel or hire a third party scheduling consultant. See Contractor Schedule Specification included in these documents.

18. PROJECT MANAGEMENT/COMMUNICATION REQUIREMENTS

- a. The Contractor shall be represented at the site by both a competent full-time Project Manager and a full-time, competent superintendent with no other assigned duties or responsibilities from the beginning of the work until its final acceptance, unless otherwise permitted by the Owner's Representative. The superintendent for the Contractor for the general building work shall exercise general supervision over all subcontractors of any tier engaged on the work with decision-making authority of the Contractor.
- b. The Contractor shall use a current industry standard (Primavera, Microsoft Project, etc.) project scheduling software which provides as a minimum: Critical paths, milestones, estimated and actual start and completion dates, scheduled vs. actual progress, and detailed task and subtask breakdown. The following schedules shall be provided as a minimum and kept current: Overall project schedule, four- (4-) week look-ahead, and two- (2-) week look-ahead.
- c. The Contractor shall furnish on-site Internet access for use by his Project Manager and superintendent. The contractor shall utilize the Owner's secure information sharing system for submittals, construction payment process, change orders, RFI's/ASI's, O&M manuals and all other project manual requirements as directed by the Owner's Representative. Field staff are also required to utilize this software as directed by the Owner's Representative.
- d. The Contractor shall provide at least two (2) job site FM handheld communication radios (walkie-talkies) for use by the on-site superintendent and the Owner's Representative, or the Contractor shall provide his on-site superintendent with a handheld cellular telephone.

19. SAFETY PRECAUTIONS AND PROGRAMS

- a. The Bidder's Statement of Qualifications includes a requirement that the Bidder provide its Worker's Compensation Experience Modification Rates (EMR) and Incidence Rates for the three recent years. The Bidder shall also include the EMR and Incidence Rates of listed major subcontractors on the Bid for Lump Sum Contract. If the EMR exceeds 1 or the Incidence Rate exceeds 13, the Contractor or major subcontractor shall take additional safety measures including, but not limited to, developing a site specific safety plan and assigning a Safety Manager to the Project to perform inspections on a schedule as determined acceptable by the Owner with written reports to be submitted to the Owner. The Owner reserves the right to reject a Bidder or major subcontractor whose rates exceed these stated rates.
- b. The contractor shall provide Emergency Contact Information for the Contractor's on-site staff and home office management as well as contact information for all major subcontractor personnel. This information shall contain business and personal phone numbers for each individual for contact during or after hours in case of an emergency. This information shall be submitted within 15 days of the Notice to Proceed.

20. HOT WORK PERMITTING AND GENERAL REQUIREMENTS

Hot work Requirements: The contractor shall comply with the following hot work requirements and the requirements of the International Fire Code and 2014 NFPA 51B.

- a. Hot work shall be defined as any work involving burning, welding, grinding, cutting, or similar operations that are capable of initiating fires or explosions.
- a. The Contractor shall utilize the hot work permit decision tree and permit provided in the 2014 NFPA 51B for all Hot Work operations.
- b. A hot work permit shall be used on all hot work performed outside a designated hot work area. The hot work permit shall be posted and clearly visible within proximity of the hot work area. The hot work permit authorizing individual (PAI) shall be as designated by the Contractor.
- c. Notify the Owner's Representative 24 hours prior to starting hot work in buildings with operational fire alarm or fire suppression systems. The Owner's Representative will coordinate the appropriate system outage with Campus Maintenance personnel.
- d. Unless otherwise instructed by the Owner's Representative, the Contractor shall post a copy of each completed hot work permit to the Owner's project management file system the following business day.

- e. Special hot work requirements: Use thermal imaging cameras after hot work operations- describe criteria in detail (for historically significant buildings of wood construction); designate additional fire watch monitoring beyond the NFPA 30 minute post hot work requirement (project has a greater potential for reflash or smoldering fire due to concealed combustible building elements, etc.).

21. GENERAL REQUIREMENTS FOR CRANE AND HOISTING OPERATIONS

All crane and hoisting operations shall be performed in compliance with OSHA 29 CFR 1926. All Operators, riggers, and signal persons must have the proper qualifications and training necessary to perform the intended hoisting activities for this project.

- a. Only fully certified and evaluated Operators shall perform equipment operations. Operators in an “Operator in Training” status shall not be used.
- b. Submittal requirements:
 - 1. Submit copies of Operator certifications, licenses, and evaluations to the Owners Representative.
 - 2. Submit Rigger and Signal Person qualifications to the Owners Representative.
 - 3. Unless otherwise directed by the Owners Representative, submit a lift plan and conduct a lift coordination meeting for hoisting or crane operations for any lift greater than 2,000 pounds, or for any multi pick lift. Include protective measures for existing underground utilities, occupied buildings, pedestrian and vehicle pathways, adjacent buildings and overhead power lines. If the lift is to occur over an occupied building, provide a registered structural engineer’s review and verification that the building can resist the impact of a dropped load for the intended lift. If evacuation of an occupied building is necessary to conduct the lift, the decision for building evacuation or scheduling the lift for off-hours will be determined by the Owner.

22. WARRANTY WALKTHROUGH

Contractor shall attend a walk-thru with the Owner at 11 months after acceptance to review and document any warranty items to be addressed as part of the 12-month warranty stated in article 3.1 of the General Conditions.

END OF SECTION

Contractor Schedule

1. GENERAL

- a) Time is of the essence for this contract.
The time frames spelled out in this contract are essential to the success of this project. The University understands that effective schedule management, in accordance with the General Conditions and these Special Conditions is necessary to insure to that the critical milestone and end dates spelled out in the contract are achieved.
- b) Related Documents
Drawings and general provisions of the Contract, including General Conditions' Article 3.17 shall apply to this Section.
- c) Stakeholders
A Stakeholder is anyone with a stake in the outcome of the Project, including the University, the University Department utilizing the facility, the Design Professionals, the Contractor and subcontractors.
- d) Weather
 - (1) Contractor acknowledges that there will be days in which work cannot be completed due to the weather, and that a certain number of these lost days are to be expected under normal weather conditions in Missouri.
 - (2) Rather than speculate as to what comprises "normal" weather at the location of the project, Contractor agrees that it will assume a total of 44 lost days due to weather over the course of a calendar year, and include same in its as planned schedule. For projects of less than a calendar year, lost weather days should be prorated for the months of construction in accordance with the following schedule.
 - (3) Anticipated weather days for allocation/proration only. For projects lasting 12 months or longer, the 44 days per year plus whatever additional months are included will constitute normal weather.

Jan – 5 days	Feb – 5 days	Mar – 4 days	Apr – 4 days
May – 3 days	Jun – 3 days	Jul – 2 days	Aug – 2 days
Sep – 3 days	Oct – 4 days	Nov – 4 days	Dec – 5 days

2. SCHEDULING PROCESS

- a) The intent of this section is to ensure that a well-conceived plan, that addresses the milestone and completion dates spelled out in these documents, is developed with input from all stakeholders in the project. Input is limited to all reasonable requests that are consistent with the requirements of the contract documents, and do not prejudice the Contractor's ability to perform its work consistent with the contract documents.
Further, the plan must be documented in an understandable format that allows for each stakeholder in the project to understand the plan for the construction and/or renovation contained in the Project.
- b) Contractor Requirements
 - (1) Schedule Development
Contractor shall prepare the Project Schedule using Primavera SureTrack or P3, Microsoft Project, Oracle P6, or other standard industry scheduling software, approved by the Owner's Representative.

(2) Schedule Development

Within 2 weeks of the NTP, contractor shall prepare a schedule, in CPM format, but in detailed bar chart format at a minimum, that reflects the contractor's and each subcontractors plan for performing the contract work.

Contractor shall review each major subcontractor's schedule with the sub and obtain the subcontractor's concurrence with the schedule, prior to submitting to the University.

(3) Schedule Updates.

(a) Schedule Updates will be conducted once a month, at a minimum.

Actual Start and Finish dates should be recorded regularly during the month. Percent Complete, or Remaining Duration shall be updated as of the data date, just prior to Contractor's submittal of the update data.

(b) Contractor will copy the previous months schedule and will input update information into the new monthly update version.

(c) Contractor will meet with the Owner's Representative to review the draft of the updated schedule. At this meeting, Owner's Representative and Contractor will:

(i) Review out of sequence progress, making adjustments as necessary,

(ii) Add any fragments necessary to describe changes or other impacts to the project schedule and

(iii) Review the resultant critical and near critical paths to determine any impact of the occurrences encountered over the last month.

(4) Schedule Narrative

After finalization of the update, the Contractor will prepare a Narrative that describes progress for the month, impacts to the schedule and an assessment as to the Contractor's entitlement to a time extension for occurrences beyond its control during the month and submit in accordance with this Section.

(5) Progress Meetings

(a) Review the updated schedule at each monthly progress meeting. Payments to the Contractor may be suspended if the progress schedule is not adequately updated to reflect actual conditions.

(b) Submit progress schedules to subcontractors to permit coordinating their progress schedules to the general construction work. Include 4 week look ahead schedules to allow subs to focus on critical upcoming work.

3. CRITICAL PATH METHOD (CPM)

a) This Section includes administrative and procedural requirements for the critical path method (CPM) of scheduling and reporting progress of the Work.

b) Refer to the General and Special Conditions and the Agreement for definitions and specific dates of Contract Time.

c) Critical Path Method (CPM): A method of planning and scheduling a construction project where activities are arranged based on activity relationships and network calculations determine when activities can be performed and the critical path of the Project.

d) Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall project duration.

e) Network Diagram: A graphic diagram of a network schedule, showing the activities and activity relationships.

- f) Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling, the construction project. Activities included in a construction schedule consume time and resources.
- g) Critical activities are activities on the critical path.
- h) Predecessor activity is an activity that must be completed before a given activity can be started.
- i) Milestone: A key or critical point in time for reference or measurement.
- j) Float or Slack Time: The measure of leeway in activity performance. Accumulative float time is not for the exclusive use or benefit of the Owner or Contractor, but is a project resource available to both parties as needed to meet contract milestones and the completion date.
- k) Total float is herein defined as the measure of leeway in starting or completing an activity without adversely affecting the planned project completion date.
- l) Weather: Adverse weather that is normal for the area must be taken into account in the Contractor's Project Schedule. See 1.d.3, above.
- m) Force Majeure Event: Any event that delays the project but is beyond the control and/or contractual responsibility of either party.
- n) Schedule shall including the following, in addition to Contractor's work.
 - (1) Phasing: Provide notations on the schedule to show how the sequence of the Work is affected by the following:
 - (a) Requirements for phased completion and milestone dates.
 - (b) Work by separate contractors.
 - (c) Work by the Owner.
 - (d) Coordination with existing construction.
 - (e) Limitations of continued occupancies.
 - (f) Uninterruptible services.
 - (g) Partial occupancy prior to Substantial Completion.
 - o) Area Separations: Use Activity Codes to identify each major area of construction for each major portion of the Work. For the purposes of this Article, a "major area" is a story of construction, a separate building, or a similar significant construction element.

4. TIME EXTENSION REQUESTS

- a) Refer to General Conditions of the Contract for Construction, Article 4.7 Claims for Additional Time.
- b) Changes or Other Impacts to the Contractor's Work Plan

The Owner will consider and evaluate requests for time extensions due to changes or other events beyond the control of the Contractor on a monthly basis only, with the submission of the Contractor's updated schedule, in conjunction with the monthly application for payment. The Update must include:

 - (1) An activity depicting the event(s) impacting the Contractors work plan shall be added to the CPM schedule, using the actual start date of the impact, along with actually required predecessors and successors.
 - (2) After the addition of the impact activity(ies), the Contractor will identify subsequent activities on the critical path, with finish to start relationships that can be realistically adjusted to overlap using good, standard construction practice.
 - (a) If the adjustments above result in the completion date being brought back within the contract time period, no adjustment will be made in the contract time.
 - (b) If the adjustments above still result in a completion date beyond the contract completion date, the delay shall be deemed excusable and the contract completion date shall be extended by the number of days indicated by the analysis.

- (c) Contractor agrees to continue to utilize its best efforts to make up the time caused by the delays. However the Contractor is not expected to expend costs not contemplated in its contract, in making those efforts.

- c) Questions of compensability of any delays shall be held until the actual completion of the project. If the actual substantial completion date of the project based on excusable delays, excluding weather delays, exceeds the original contract completion date, AND there are no delays that are the responsibility of the contractor to consider, the delays days shall be considered compensable. The actual costs, if any, of the Contractor's time sensitive jobsite supervision and general conditions costs, shall be quantified and a change order issued for these costs.

SHOP DRAWING AND SUBMITTAL LOG

Project: Veterinary Science Building Demolition

Project Number: MU No. CP 233041/ PWA 202403

Contractor:

Section	Submittal No.	Contractor	Action						Remarks	Date Returned	Copies		
			Date Received	#	Date Sent to Consultant	#	Date Returned	Cont'r			Owner	File	
01 7419	CONSTRUCTION WASTE MANAGEMENT												
	CWMP - Construction Waste Management Plan												
02 4100	DEMOLITION												
	Demolition Plan												
	Schedule of Building Demolition Activities												
	Pre-Demolition Photographs or Video												
02 8233	ASBESTOS AND HAZARDOUS MATERIALS REMOVAL SPECIFICATION												
	Product Data + SDS information												
	Notifications to Regulatory Agencies												
	Worker Qualifications												
	Disposal Plan/Information												
09 9000	PAINTING AND COATING												
	Product Data												
	Samples												
	Certifications - Manufacturer												
	Manufacturer Instructions												
	Maintenance Data												
23 0500	BASIC MECHANICAL MATERIALS AND METHODS												
	Product Data												
	Shop Drawings												
26 0543	UNDERGROUND DUCTS, RACEWAYS, AND UTILITY STRUCTURES												
	Product Data (Duct Bank Materials)												
	Product Data (Conduit and Accessories)												
	Product Data (Warning Tape)												
26 0923	LIGHTING CONTROL DEVICES												
	Product Data												
26 2416	PANELBOARDS												
	Product Data												
	Shop Drawings												

SHOP DRAWING AND SUBMITTAL LOG

Section	Submittal No.	Contractor	Action						Remarks	Date Returned	Copies		
			Date Received	#	Date Sent to Consultant	#	Date Returned	Cont'r			Owner	File	
31 1000	SITE CLEARING												
	Pre-Demolition Photographs or Video - coordinate with submittal requirements of Section 02 4100 Demolition												
31 2000	EARTH MOVING												
	Product Data - Warning Tapes												
	Samples - Warning Tapes												
	Material Test Reports												
	Pre-Excavation Photographs or Video												
32 1216	ASPHALT PAVING												
	Product Data (Mix Design)												
	Qualification Data												
	Material Certificates												
	Material Test Reports												
32 1313	CONCRETE PAVING												
	Product Data (Mix Design)												
	Qualification Data												
	Material Certificates												
	Material Test Reports												
32 1373	CONCRETE PAVING JOINT SEALANTS												
	Product Data (Joint Sealants)												
	Product Data (Joint Backing Materials)												
	Samples												
	Paving Joint Sealant Schedule												
33 1415	SITE WATER DISTRIBUTION PIPING												
	Product Data												
33 4200	STORM WATER CONVEYANCE												
	Shop Drawings												
33 6313	STEAM ENERGY DISTRIBUTION AND PIPING SPECIALTIES												
	Test Reports												
33 6321	MECHANICAL INSULATION (CONCRETE CHASES AND MANHOLES)												
	Product Data												

CLOSEOUT LOG

Project: Veterinary Science Building Demolition

Project Number: MU No. CP 233041/ PWA 202403

Contractor:

Section	Description	Contractor / Subcontractor	Date Rec/d	# of Copies	CPM Initials	Remarks
GC /3.14; 02 4100	As-built drawings (Field Redlines)					
01 7419	Waste Management Final Report					
02 8233	Shipping Records, Receipts, Waste Tickets, Incineration Information, Certificate of Completion					
26 0543	As-built drawings - Show dimensioned locations of underground ducts and handholds					
26 2416	Keys: Two spares for each type of panelboard cabinet lock					
31 1000	As-built drawings - Show dimensioned locations of capped utilities and other sub-surface conditions					

SECTION 1.F

INDEX OF DRAWINGS

Drawings referred to in and accompanying Project Manual consist of following sheets dated **July 12, 2024.**

CP233041 Veterinary Science Building Demolition

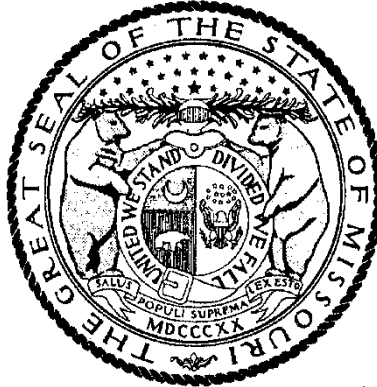
Sheet	1	of	18	G001	COVER SHEET
Sheet	2	of	18	G002	LOCATION MAP, LIST OF DRAWINGS, CODES
Sheet	3	of		V1.01	BOUNDARY & TOPOGRAPHIC SURVEY
			18		(FOR REFERENCE ONLY)
Sheet	4	of		V1.02	BOUNDARY & TOPOGRAPHIC SURVEY
			18		(FOR REFERENCE ONLY)
Sheet	5	of	18	D101	BUILDING DEMOLITION, STAGING, & SALVAGE PLAN
Sheet	6	of	18	C0.01	GENERAL NOTES
Sheet	7	of	18	C1.01	TEMPORARY TRAFFIC CONTROL PLAN
Sheet	8	of	18	C2.01	EROSION CONTROL PLAN
Sheet	9	of	18	C3.01	SITE DEMOLITION PLAN
Sheet	10	of	18	C3.02	UTILITY DEMOLITION PLAN
Sheet	11	of	18	C4.01	SITE PLAN
Sheet	12	of	18	C5.01	GRADING & DRAINAGE PLAN
Sheet	13	of	18	C6.01	UTILITY PLAN
Sheet	14	of	18	C7.01	SITE, EROSION CONTROL, & STORM SEWER DETAILS
Sheet	15	of		ME0.01	MECHANICAL/ELECTRICAL SYMBOLS, ABBREVIATIONS, AND
			18		SCHEDULE
Sheet	16	of	18	ME3.01	MECHANICAL/ELECTRICAL DEMOLITION PLAN
Sheet	17	of	18	E4.01	SITE LIGHTING PLAN
Sheet	18	of	18	ME7.01	MECHANICAL/ELECTRICAL DETAILS

END OF SECTION

Missouri

Division of Labor Standards

WAGE AND HOUR SECTION



MICHAEL L. PARSON, Governor

Annual Wage Order No. 31

Section 010
BOONE COUNTY

In accordance with Section 290.262 RSMo 2000, within thirty (30) days after a certified copy of this Annual Wage Order has been filed with the Secretary of State as indicated below, any person who may be affected by this Annual Wage Order may object by filing an objection in triplicate with the Labor and Industrial Relations Commission, P.O. Box 599, Jefferson City, MO 65102-0599. Such objections must set forth in writing the specific grounds of objection. Each objection shall certify that a copy has been furnished to the Division of Labor Standards, P.O. Box 449, Jefferson City, MO 65102-0449 pursuant to 8 CSR 20-5.010(1). A certified copy of the Annual Wage Order has been filed with the Secretary of State of Missouri.

Original Signed by _____

Todd Smith, Director
Division of Labor Standards

Filed With Secretary of State: _____ **March 8, 2024**

Last Date Objections May Be Filed: **April 8, 2024**

Prepared by Missouri Department of Labor and Industrial Relations

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Asbestos Worker	\$61.30
Boilermaker	\$32.35*
Bricklayer-Stone Mason	\$55.22
Carpenter	\$51.42
Lather	
Linoleum Layer	
Millwright	
Pile Driver	
Cement Mason	\$45.65
Plasterer	
Communication Technician	\$57.87
Electrician (Inside Wireman)	\$58.36
Electrician Outside Lineman	\$32.35*
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Elevator Constructor	\$32.35*
Glazier	\$65.64
Ironworker	\$69.98
Laborer	\$43.79
General Laborer	
First Semi-Skilled	
Second Semi-Skilled	
Mason	\$59.96
Marble Mason	
Marble Finisher	
Terrazzo Worker	
Terrazzo Finisher	
Tile Setter	
Tile Finisher	
Operating Engineer	\$65.05
Group I	
Group II	
Group III	
Group III-A	
Group IV	
Group V	
Painter	\$41.79
Plumber	\$72.46
Pipe Fitter	
Roofer	\$55.00
Sheet Metal Worker	\$58.29
Sprinkler Fitter	\$65.10
Truck Driver	\$32.35*
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

*The Division of Labor Standards received fewer than 1,000 reportable hours for this occupational title. The public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.

**The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title as defined in RSMo Section 290.210.

Heavy Construction Rates for
BOONE County

Section 010

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Carpenter	\$63.45
Millwright	
Pile Driver	
Electrician (Outside Lineman)	\$80.19
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Laborer	\$50.35
General Laborer	
Skilled Laborer	
Operating Engineer	\$66.32
Group I	
Group II	
Group III	
Group IV	
Truck Driver	\$32.35*
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

Use Heavy Construction Rates on Highway and Heavy construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(3).

Use Building Construction Rates on Building construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(2).

If a worker is performing work on a heavy construction project within an occupational title that is not listed on the Heavy Construction Rate Sheet, use the rate for that occupational title as shown on the Building Construction Rate Sheet.

*The Division of Labor Standards received fewer than 1,000 reportable hours for this occupational title. Public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.

**The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title.

OVERTIME and HOLIDAYS

OVERTIME

For all work performed on a Sunday or a holiday, not less than twice (2x) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work.

For all overtime work performed, not less than one and one-half (1½) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work or contractual obligation. For purposes of this subdivision, "**overtime work**" shall include work that exceeds ten hours in one day and work in excess of forty hours in one calendar week; and

A thirty-minute lunch period on each calendar day shall be allowed for each worker on a public works project, provided that such time shall not be considered as time worked.

HOLIDAYS

January first;
The last Monday in May;
July fourth;
The first Monday in September;
November eleventh;
The fourth Thursday in November; and
December twenty-fifth;

If any holiday falls on a Sunday, the following Monday shall be considered a holiday.

SECTION 1.H
ALTERNATES

Base Bid may be increased in accordance with following Additive Alternate proposal(s) as Owner may elect:

1. Additive Alternate No. 1: Resurface and re-stripe existing parking lot as described on sheet C3.01.

END OF SECTION

SECTION 01 7419
CONSTRUCTION WASTE MANAGEMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. All of the Contract Documents, including General and Special Conditions and Division 01 General Requirements, apply to the work of this Section.

1.02 SUMMARY

- A. This Section specifies requirements for the Contractor's implementation of waste management controls and systems for the duration of the Work.

The intent of this Section is to develop and implement a Construction Waste Management Plan (CWMP) in order to quantify material diverted from Solid Waste Disposal Facility or incineration. Target goal is at least fifty (50) percent of non-hazardous Demolition and Construction Debris generated by the construction project is diverted through recycling or salvage. Quantities must be reported by weight and consistent in units reported and calculation method throughout.

Diversion Methods and Materials Eligible for Reporting:

1. Appropriate materials suitably placed in a Clean Fill Site may be reported.
2. Appropriate materials diverted for use as Wood Derived Fuel (WDF) may be reported.

Diversion Methods and Materials Ineligible for Reporting:

3. Material disposal by incineration.
4. Excavated soil and land-clearing debris.
5. Material for use as Alternative Daily Cover (ADC).
6. Hazardous waste; should be disposed of according to relevant regulations.

- B. Contractor may subcontract work of this Section to a sub-contractor specializing in recycling and salvaging of construction waste.

1.03 DEFINITIONS

- A. ALTERNATIVE DAILY COVER (ADC): Material (other than earthen material) that is placed on the surface of the active face of a municipal solid waste landfill at the end of each operating day.
- B. AVERAGE RECYCLING RATE: The weighted average for the diversion of materials by the commingled (mixed-stream) recycling facility over time.
- C. CLEAN FILL SITE: Re-grading fill site for land reclamation or other beneficial use. Typically requiring permits, regular site maintenance and hours of operation. With material consisting of demolition debris and construction waste from buildings, roads and highway pavement, and other structures. Commonly comprised of brick, ceramics, concrete, and asphalt paving fragments that are virtually inert and pose neither a pollution threat to ground or surface waters nor a fire hazard. May contain minimal amounts of wood, metal, and inert solids.
- D. COMMINGLED WASTE: Waste streams that are combined on the project site and hauled away for sorting into recyclable streams. Also known as mixed or single-stream recycling.

- E. DEMOLITION AND CONSTRUCTION DEBRIS: Debris, waste and surplus materials, including recyclables, generated as a result of the Contractor's onsite activities while executing the requirements of the contract. Also, commonly includes materials from renovation, demolition, or deconstruction activities.
- F. RECYCLE: Recovery of materials, otherwise diverted from the solid waste stream for remanufacturing.
- G. SALVAGE: Recovery of useful items repurposing without the need for remanufacturing or reducing to raw materials due to their intrinsic value.
- H. SOLID WASTE DISPOSAL FACILITY: A managed landfill, regulated at the Federal, State, and/or Local level.

1.04 INTENT

- 01. The Project shall generate the least amount of Demolition and Construction debris as practical. The Contractor shall develop and employ processes that ensure that the amount of demolition and construction debris actually generated during the execution of this project due to error, poor planning, breakage, mishandling, contamination, or other factors is minimized.
- 02. Of the construction and demolition debris generated, as much as is economically feasible shall be reused, salvaged, or recycled. Disposal of construction and demolition debris in solid waste disposal facilities shall be minimized to the greatest extent practical but at a minimum shall be consistent with the percentage goal stated herein.
- 03. The Contractor shall develop, for the Owner's review, a Construction Waste Management Plan (CWMP) for this Project.
- 04. Contractor shall be responsible for ensuring that construction and demolition debris, not otherwise salvaged or recycled will be disposed of at appropriately licensed solid waste disposal facilities.

1.05 SUBMITTALS

- A. Construction Waste Management Plan (CWMP): Within 45 calendar days after receipt of Notice to Proceed, the Contractor shall provide a plan for review by the owner. The Construction Waste Management Plan shall be uploaded in the format provided on the University of Missouri FP&D website link:

https://collaborate.umsystem.edu/sites/fpd/_layouts/15/WopiFrame.aspx?sourcedoc={2B743FEC-E36D-467A-A159-3D8B82D6E47F}&file=Const%20Waste%20Management%20Worksheet.xls&action=default

and shall at a minimum contain the following:

- 1. Analysis of the proposed jobsite waste to be generated, including types and estimated quantities.
- 2. Solid Waste Disposal Facility Options: The name of the facilities landfills where construction and demolition debris not otherwise salvaged or recycled will be disposed of, the applicable landfill tipping disposal fees, and the projected cost of such disposal.
- 3. Solid Waste Disposal Facility Certification: Contractor's statement of verification that facilities proposed for use are licensed for types of waste to be deposited and have sufficient capacity to receive waste from this project.

4. Recycling Facility Options: Facilities providing commingled or mixed-stream recycling must provide diversion rates either specific to the project, or an average diversion rate that is regulated by the local or state authority. The average recycling rate for the facility must exclude ADC. Measurements must be based on weight (not volume), using scales. Reporting increments shall be no more than annually and must use consistent time increments throughout calculations.
 5. Alternatives: A list of each material proposed to be salvaged or recycled during the course of the Project and the planned reuse strategy or diversion destination of each. Include the following and any additional items proposed:
 - a. Cardboard
 - b. Clean wood
 - c. Beverage containers
 - d. Concrete
 - e. Slurry wall materials
 - f. Bricks and masonry
 - g. Asphalt
 - h. Metals from framing, banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze
 - i. Mechanical and electrical equipment
 - j. Building components which can be removed relatively intact from existing construction
 - k. Packaging materials
 - l. Glass
 - m. Scraps from new gypsum wall board
 - n. Carpet and pad
 - o. Acoustical ceiling panels
 - p. Plastics
 6. Meetings: A description of the regular meetings to be held to ensure proper execution of the construction waste management plan.
 7. Debris Handling Procedures: A description of the means by which any construction waste materials identified above will be protected from contamination, and a description of the means to be employed in recycling the above materials consistent with requirements for acceptance by designated facilities.
 8. Transportation: A description of the means of transportation of the debris (whether debris will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site).
- B. Waste Management Progress Report: Concurrent with each Application for Payment, submit a written Waste Management Progress Report in the same format as required for Final Report. Submission of this report shall be a prerequisite to the Owner's approval of the Contractor's application for Payment. Provide a statement indicating original estimated total diversion rate, diversion to date, and expected final diversion rate. Include narrative regarding discrepancies or activity since the previous report.

- C. Waste Management Final Report: Within five (5) Calendar Days of Substantial Completion, submit a written Construction Waste Management Final Report summarizing the types and quantities of materials recycled, salvaged, and disposed of under the Construction Waste Management Plan. This report shall be in the same format as the monthly reports. Include the name and location of disposal facilities. Quantities must be reported by weight and consistent in units reported and calculation method throughout. The Construction Waste Management Final Report shall be submitted using the Owner's information sharing website Projex, unless directed otherwise - Waste Management Log and include the following:
1. Material category
 2. Generation point
 3. Total quantity of waste by category
 4. Total quantity of waste reused
 5. Total quantity of waste salvaged, both estimated and actual
 6. Total quantity of waste recycled, both estimated and actual
 7. Total quantity of waste diverted (salvaged and recycled)
 8. Total quantity of waste diverted (salvaged and recycled) as a percentage of total waste
- D. Other Submittals:
1. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations.
 2. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations.
 3. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
 4. Landfill Disposal Records: Indicate receipt and acceptance of waste by landfills facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
 5. Wood Derived Fuel Processing Facility Records: Indicate receipt and acceptance of materials by (WDF) processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
 6. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 ON-SITE OPERATIONS

- A. Manager: The Contractor shall designate an on-site person responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for the Project.
- B. Distribution: The Contractor shall distribute copies of the Waste Management Plan to the Job Site Foreman, each Subcontractor, and the Owner's Representative.
- C. Instruction: The Contractor shall provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the Project.

- D. Separation Facilities: The Contractor shall lay out and label a specific area to facilitate separation of materials for recycling, salvage, and return. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials. Location shall be acceptable to the Owner's Representative.
1. Commingling Waste: Commingling waste at the job site may be allowed, provided that the following conditions are met:
- a. Comminglers shall be included in the Construction Waste Management Plan (CWMP)
 - b. Additional comminglers must be pre-approved by the Architect via CWMP addenda, prior to tipping on the job site.
- E. Hazardous Wastes: Any unforeseen hazardous wastes shall be separated, stored, and disposed of according to local regulations and as directed by the Owner.

END OF SECTION

Construction Waste Management PLAN

Recycled, Diverted, and Reused Materials - ESTIMATED

Matl. Stream	Date	Diversion Method / Location	Receipt #	Notes (Material)	Source	Units	Cubic Feet	Square Feet	Lineal Feet	Per Unit (lbs)	Weight (lbs)	Total Stream Weight (lbs)
Concrete Rubble												0.00
	mm/dd/yyyy	eg: Clean Fill		eg: Somename Rd.	eg: Demolition						0.00	0.00
Dimensional Lumber and Wood Cut Pieces												0.00
	mm/dd/yyyy	eg: ACME Inc. Compost		eg: misc wood	eg: Demolition						0.00	0.00
Clean Gypsum Wallboard												0.00
	mm/dd/yyyy	eg: ACME Inc. Compost		eg: gyp board	eg: Demolition						0.00	0.00
Doors & Frames												0.00
	mm/dd/yyyy	eg: SomeGroup Donation		eg: wood trim	eg: Demolition						0.00	0.00
Steel												0.00
	mm/dd/yyyy	eg: ACME Inc. Recycling		eg: steel	eg: Demolition						0.00	0.00
Cardboard & Paper												0.00
	mm/dd/yyyy	eg: ACME Inc. Recycling		eg: pkg boxes	eg: Packaging						0.00	0.00
Scrap Metal												0.00
	mm/dd/yyyy	eg: ACME Inc. Recycling		eg: zinc/steel	eg: Demolition						0.00	0.00
Carpet & Padding												0.00
	mm/dd/yyyy	eg: ACME Carpeting & Flooring		eg: carpet	eg: Demolition						0.00	0.00
Casework												0.00
	mm/dd/yyyy	eg: University Salvage		eg: casework	eg: Demolition						0.00	0.00
Miscellaneous Equipment												0.00
	mm/dd/yyyy	eg: ACME International Inc.		eg: misc	eg: Demolition						0.00	0.00
ESTIMATED Total Waste Diverted											0.00	(lbs)

Landfill Materials Description - ESTIMATED

Matl. Stream	Date	Diversion Method / Location	Receipt #	Notes (Material)	Source	Units	Cubic Feet	Square Feet	Lineal Feet	Per Unit (lbs)	Weight (lbs)	Total Stream Weight (lbs)
General Mixed Waste												0.00
	mm/dd/yyyy	eg: ACME International Inc.		eg: misc	eg: Demolition						0.00	0.00
Alternative Daily Cover												0.00
	mm/dd/yyyy	eg: ACME International Inc.		eg: misc	eg: Demolition						0.00	0.00
ESTIMATED Total Waste to Landfill											0.00	(lbs)

Total Construction Waste - ESTIMATED

0.00

Percentage of Waste Diverted From Landfill - ESTIMATED

0.00%

Construction Waste Management REPORT

Recycled, Diverted, and Reused Materials - ACTUAL

Matl. Stream	Date	Diversion Method / Location	Receipt #	Notes (Material)	Source	Units	Cubic Feet	Square Feet	Lineal Feet	Per Unit (lbs)	Weight (lbs)	Total Stream Weight (lbs)
Concrete Rubble												0.00
	mm/dd/yyyy	eg: Clean Fill		eg: Somename Rd.	eg: Demolition						0.00	
											0.00	
Dimensional Lumber and Wood Cut Pieces												0.00
	mm/dd/yyyy	eg: ACME Inc. Compost		eg: misc wood	eg: Demolition						0.00	
											0.00	
Clean Gypsum Wallboard												0.00
	mm/dd/yyyy	eg: ACME Inc. Compost		eg: gyp board	eg: Demolition						0.00	
											0.00	
Doors & Frames												0.00
	mm/dd/yyyy	eg: SomeGroup Donation		eg: wood trim	eg: Demolition						0.00	
											0.00	
Steel												0.00
	mm/dd/yyyy	eg: ACME Inc. Recycling		eg: steel	eg: Demolition						0.00	
											0.00	
Cardboard & Paper												0.00
	mm/dd/yyyy	eg: ACME Inc. Recycling		eg: pkg boxes							0.00	
											0.00	
Scrap Metal												0.00
	mm/dd/yyyy	eg: ACME Inc. Recycling		eg: zinc/steel	eg: Demolition						0.00	
											0.00	
Carpet & Padding												0.00
	mm/dd/yyyy	eg: ACME Carpeting & Flooring		eg: carpet	eg: Demolition						0.00	
											0.00	
Casework												0.00
	mm/dd/yyyy	eg: University Salvage		eg: casework	eg: Demolition						0.00	
											0.00	
Miscellaneous Equipment												0.00
	mm/dd/yyyy	eg: ACME International Inc.		eg: misc	eg: Demolition						0.00	
											0.00	
ACTUAL Total Waste Diverted											0.00 (lbs)	

Landfill Materials Description - ACTUAL

Matl. Stream	Date	Diversion Method / Location	Receipt #	Notes (Material)	Source	Units	Cubic Feet	Square Feet	Lineal Feet	Per Unit (lbs)	Weight (lbs)	Total Stream Weight (lbs)
General Mixed Waste												0.00
	mm/dd/yyyy	eg: ACME International Inc.		eg: misc	eg: Demolition						0.00	
											0.00	
Alternative Daily Cover												0.00
	mm/dd/yyyy	eg: ACME International Inc.		eg: misc	eg: Demolition						0.00	
											0.00	
ACTUAL Total Waste to Landfill											0.00 (lbs)	

Total Construction Waste - ACTUAL

0.00

Percentage of Waste Diverted From Landfill - ACTUAL

0.00%

Solid Waste Conversion Factors

Material	Approximate Density (lbs/cy)	Remarks
Cardboard	100	
Gypsum Wallboard	500	
Mixed Waste	350	
Rubble	1400	
Steel	1000	
Wood	300	

Burn Dump Debris/Ash	800-1000	Dry Loose
	1500-1800	Wet for Dust Suppression
	2300	Wet mixed with soil
Construction Debris, Asphalt or Concrete: Loose	2400	
Construction Debris, Wood ; Uncompacted	400	Increase up to 100% if compacted using heavy equipment
Earth	2100	Loose/Dry. Plus 30% when compacted.
	3000	Excavated/Wet
Gravel or Crushed Stone Loose/Dry	2600	Increase 20% if wet
Household Trash	800	
Liquid Waste	1600	202 gal./cubic yard ~ 7 Lbs./Gal. E.g. Antifreeze, Waste Oil, Solvent
Metals, Un-compacted	600	e.g. Appliances, Metal Siding
Sand, Loose/Dry	2400	Increase 20% if damp and 30% if wet/compacted
Stone, Graded 8" max. Loose	2700	e.g. Gabion Construction. Increase 10% consolidated in place
Tire Burn Ash	500-800	
Tires, Auto and Pickup	220	Average 10 tires per cubic yard
Tires, OTR	See Remarks	Average 500 pounds per tire
Tires, Truck	480	Average 4 tires per cubic yard
Vehicles, Auto and Pickup	See Remarks	Use 3000 Pounds/Vehicle
Wood Chips, Shredded/Dry Wood Chips/Bark w/30% Soil	300	
	800	
Yard Waste (Vegetation) Loose	600	

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<http://www.calrecycle.ca.gov/SWFacilities/CDI/Tools/Calculations.htm>

SECTION 02 4100 DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Building demolition .
- B. Abandonment and removal of existing utilities and utility structures.

1.02 RELATED REQUIREMENTS

- A. Section 00 1.E – Special Conditions: Site fences, security, protective barriers, and waste removal.
- B. Section 01 7419 – Construction Waste Management.
- C. Section 02 8233 – Technical Specifications: Asbestos and Hazardous Materials Removal Specification.

1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction Current Edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2019.

1.04 SUBMITTALS

- A. See Division One for submittal procedures.
- B. Demolition Plan: Submit demolition plan as follows:
 - 1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
 - 2. Identify demolition firm.
 - 3. Include a summary of safety and protection procedures.
 - 4. Indicate of drawings the protection measures proposed for protecting individuals and property, environmental protection, dust control, and noise control.
- C. Schedule of Building Demolition Activities:
 - 1. Detailed sequence of demolition work with starting and ending dates for each activity.
 - 2. Note any anticipated dates of interruption of utilities.
 - 3. Shutoff and capping or re-routing of utilities.
- D. Pre-Demolition Photographs or Video: Show existing conditions of adjoining construction and site improvements. Include finish surfaces and other items that might be misconstrued as damage caused by demolition operations.
- E. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Demolition Meeting: Convene a pre-demolition meeting one week before starting work of this section; require attendance by all relevant personnel. Maintain and submit minutes of meeting.
 - 1. Inspect and discuss condition of construction to be demolished.
 - 2. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities required to make progress and avoid delays.
 - 3. Review and finalize protection requirements.
 - 4. Review procedures for noise and dust control.
 - 5. Review items to be salvaged and returned to Owner.

1.06 PROJECT CONDITIONS

- A. Building will be vacated, and its use discontinued before the start of work.

- B. Regulated Construction and Demolition Waste: Regulated construction and demolition wastes are present in the portions of the building to be selectively demolished. Reports on the presence of regulated construction and demolition wastes are included in Division One. Examine reports to become aware of locations where regulated construction and demolition wastes are present.
- C. On-site storage or sale of removed items or materials is not permitted.

1.07 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 SCOPE

- A. Remove the entire building and associated infrastructure as indicated on the Project Documents.
- B. Remove foundation walls and footings in their entirety.
- C. Remove other items indicated, for salvage and/or recycling.
- D. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as specified in other Sections.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with all requirements specified in Division One.
- B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 1. Obtain required permits.
 2. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
 3. Maintain fire watch during and for at least 24 hours after flame-cutting operations.
 4. Maintain adequate ventilation when using cutting torches.
 5. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 6. University has a Title V Permit that states that no fugitive particulate matter emissions shall go beyond the premise of origin in the quantities that the particulate matter may be found on surfaces beyond the property line of origin. Conduct demolition operations to comply with University's Title V Permit regulations.
 7. Comply with applicable requirements of NFPA 241.
 - 8. Use of explosives is not permitted.**
 9. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 10. Provide, erect, and maintain temporary barriers and security devices.
 11. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 12. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 13. Do not close or obstruct roadways or sidewalks without permit.
 14. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 15. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

- C. Do not begin removal until receipt of notification to proceed from Owner.
- D. Do not begin removal until built elements to be salvaged or relocated have been removed.
- E. Protect existing structures and other elements that are not to be removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.
- F. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- G. Hazardous Materials: Comply with 29 CFR 1926 and state and local regulations.
- H. If undocumented hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos-containing materials, lead, PCB's, and mercury.
- I. Perform demolition in a manner that maximizes salvage and recycling of materials.
 - 1. Dismantle existing construction and separate materials.
 - 2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.
- J. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.03 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare demolition area by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.04 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Remove from site all materials not to be reused on site; comply with requirements of Section 01 7419 – Construction Waste Management.
- C. Leave site in clean condition, ready for subsequent work.
- D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

Asbestos & Hazardous Materials Removal Specification

MU – Veterinary Science Building

1509 Rollins Street

Columbia, Missouri 65201

July 8, 2024 | Terracon Project Number: 15247179



Prepared for:

University of Missouri

Campus Facilities – Planning, Design & Construction

E111 General Services Building

Columbia, Missouri 65211



Nationwide

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- Facilities
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Waste Removal Overview**

Section 2 Asbestos Survey Information

Section 3 Technical Specification

Section 1

Asbestos and Hazardous Waste Removal Overview

Asbestos Abatement

Coordinate asbestos containing material removal operations with University of Missouri Planning, Design and Construction.

Remove identified asbestos containing materials (ACM) using regulatory approved work practices.

See Section 2, for drawings showing the general locations and estimated quantities of ACM to be removed.

- Contractor can use building owner's electricity.
- Contractor can use owner's water.
- The owner will remove all non-affixed objects from the work area.

Contain work areas with negative pressure enclosures prior to the removal of asbestos containing materials.

Items that are considered fixed or stationary, located in the abatement area, should be pre-cleaned using HEPA vacuuming and/or wet cleaning methods. Once cleaned, the items must be covered and sealed with at least two layers of six mil poly sheeting to protect and keep surfaces free from dust or water damage during the removal of ACM.

All operations and work performed on the project will be conducted using state-of-the-art industry standards. The abatement contractor shall furnish all tools, equipment, labor and materials for the proper removal and disposal of asbestos containing materials in accordance with all applicable asbestos regulations including but not limited to the National Emission Standards for Hazardous Air Pollutants (NESHAP) 40 CFR Part 61, Subpart M, and shall fully comply with all Federal, State, and Local laws and regulations.

All required engineering controls, negative pressure containments, critical barriers, critical and curtained openings, negative air machines, splash guards, decontamination units, signs, postings, etc. shall be in place and operational prior to potential or actual disturbance of ACM and remain intact and operational until final air clearance is achieved.

The abatement contractor shall provide documentation that proves they are a State of Missouri Licensed Asbestos Abatement Contractor. The abatement contractor shall ensure that all personnel who perform work on this project will have appropriate State of Missouri asbestos certifications.

Work areas will be visually inspected to assess completion of asbestos removal prior to encapsulation. Following completion of removal and encapsulation the work areas must pass Phase Contrast Microscopy (PCM) air clearance. Abatement activities shall be deemed complete when final visual and/or final air clearance has been achieved for each work area.

The Contractor shall ensure that all building systems disturbed, if any, during the abatement are fully operational after final clearance has been achieved and all clean up and equipment is removed from the work area before leaving the work site. In other words, the abatement contractor shall repair at their costs any disruption in operational building systems such as telecommunication lines, electrical lines, etc. that are damaged due to the ACM removal.

Lead-Based Paint

A common route of entry for lead into the body is through dust associated with the process of demolition. Demolition workers are at risk of inhaling lead dust and they can also carry the lead dust to their homes.

Lead-based paint abatement is not required prior to demolition. The Lead Renovation, Repair, and Painting Rule applies to contractors who renovate or partially demolish pre-1978 residential buildings. However, it is recommended that contractors use lead-safe practices during total demolition activities.

Lead-safe work practices minimize lead-based paint dust and debris generated during demolition activities.

These practices include:

- Containing dust inside the work area
- Using dust-minimizing work methods, such as wetting surfaces
- Maintaining clean work areas
- Conducting a careful cleanup following the demolition.

Hazardous Materials

The abatement project will also include the removal and proper disposal of the following hazardous materials/universal waste located within the renovation area.

Items containing PCBs, Mercury, batteries (excluding household varieties), CFCs and radioactive sources include:

- Estimated quantity of potential PCB containing components – 304 fluorescent light ballasts;
- Estimated quantity of potential mercury containing components – 787 fluorescent light bulbs;
- Estimated quantity of potential battery containing components – 5 exit signs;
- Estimated quantity of components potentially containing radioactive material – 1 drum labeled with radioactive warnings;
- Estimated quantity of potential CFC containing items – 31 refrigerators and freezers, and air conditioning system equipment; and
- Three tanks of Carbon Dioxide (CO²).

Appliances and heating/cooling equipment, including ovens, hot water heaters, and refrigerators were observed in the onsite buildings. These items should be properly recycled or disposed of in accordance with local regulations prior to demolition activities. Items such as refrigerators and air conditioning equipment may contain chlorofluorocarbons (CFCs). CFCs are organic compounds that consists of carbon, hydrogen, chlorine, and fluorine. Many CFCs have been widely used as refrigerants, propellants, and solvents.



Section 2

Asbestos Survey Information

Veterinary Science Building 1509 Rollins Street Columbia, MO 65201

Asbestos containing materials identified below shall be removed prior to demolition of the building.

Asbestos-containing materials to be removed.

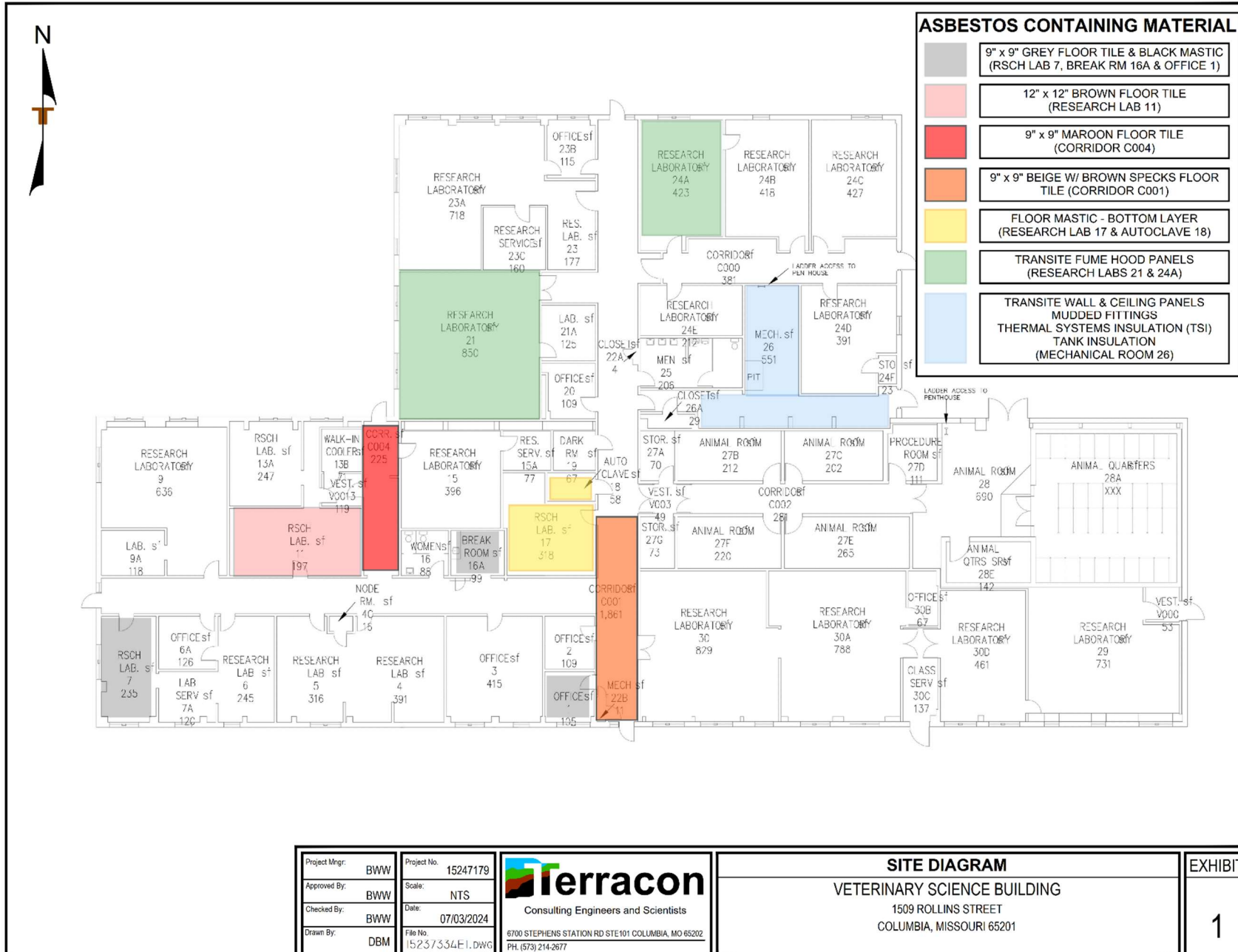
HA No.	Material Description	Material Location	% and Type Asbestos*	NESHAP Classification	Condition	Estimated Quantity**
4	9" x 9" Grey Floor Tile and Black Mastic	FS1 (Research Lab 7), FS9 (Break room 16A), FS12 (Office 1)	Floor Tile (3% Chrysotile) Mastic (8% Chrysotile)	Category I Non-friable	Poor	500 Square Feet (SF)
12	12" x 12" Brown Floor Tile (mastic negative)	FS4 (Research Lab 11)	Floor Tile (3% Chrysotile)	Category I Non-friable	Poor	240 SF
16	9" x 9" Maroon Floor Tile (mastic negative)	FS6 (Corridor C004)	Floor Tile (6% Chrysotile)	Category I Non-friable	Poor	230 SF
21	9" x 9" Beige with Brown Specks Floor Tile (mastic negative)	FS11 (Corridor C001)	Floor Tile (4% Chrysotile)	Category I Non-friable	Poor	2,000 SF
22	Floor Mastic - Bottom Layer (White 12"x12" floor tile negative)	FS14 (Research Lab 17), FS15 (Autoclave 18)	Adhesive (8% Chrysotile)	Category I Non-friable	Poor	400 SF



HA No.	Material Description	Material Location	% and Type Asbestos*	NESHAP Classification	Condition	Estimated Quantity**
26	Transite Wall Panels	FS27 (Mechanical Room 26)	17% Chrysotile	Category II Non-friable	Poor	1,100 SF
27	Transite Fume Hood	FS18 (Research Lab 21), FS20 (Research Lab 24A)	18% Chrysotile	Category II Non-friable	Poor	85 SF
33	Mudded Fittings – Thermal System Insulation	FS27 (Mechanical Room 26)	Insulation (88% Chrysotile)	RACM	Poor	30 Linear Feet (LF)
34	TSI	FS27 (Mechanical Room 26)	29% Amosite	RACM	Poor	110 LF
35	Tank Insulation	FS27 (Mechanical Room 26)	Insulation (86% Chrysotile)	RACM	Poor	3-foot diameter, 500-gallon tank, approximately 1" thick insulation layer

***Estimated quantities** – quantities based on a cursory field evaluation, and actual quantities may vary significantly, especially if asbestos-containing materials are present in hidden and/or inaccessible areas not evaluated as part of this survey. This is not a bidding document; contractors are responsible for determining their own opinion of quantities.

****% & Type Asbestos** – this column contains both the analytical result of the sample with the highest concentration of asbestos detected in the samples that make up the HA and the types of asbestos identified.



ASBESTOS CONTAINING MATERIAL	
	9" x 9" GREY FLOOR TILE & BLACK MASTIC (RSCH LAB 7, BREAK RM 16A & OFFICE 1)
	12" x 12" BROWN FLOOR TILE (RESEARCH LAB 11)
	9" x 9" MAROON FLOOR TILE (CORRIDOR C004)
	9" x 9" BEIGE W/ BROWN SPECKS FLOOR TILE (CORRIDOR C001)
	FLOOR MASTIC - BOTTOM LAYER (RESEARCH LAB 17 & AUTOCLAVE 18)
	TRANSITE FUME HOOD PANELS (RESEARCH LABS 21 & 24A)
	TRANSITE WALL & CEILING PANELS MUDDIED FITTINGS THERMAL SYSTEMS INSULATION (TSI) TANK INSULATION (MECHANICAL ROOM 26)

Project Mgr:	BWW
Approved By:	BWW
Checked By:	BWW
Drawn By:	DBM

Project No.	15247179
Scale:	NTS
Date:	07/03/2024
File No.	15237334E1.DWG

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SITE DIAGRAM
VETERINARY SCIENCE BUILDING 1509 ROLLINS STREET COLUMBIA, MISSOURI 65201

EXHIBIT
1

Section 3
Technical Specification



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Asbestos Removal Technical Specifications

Chapter 1 General

1.1 Summary of Work:

- 1.1.1 **This technical specification, all project-related drawings, the bid document, and all other contract documentation, apply to the Work. The contract documents between owner and contractor show the work of the contract, related requirements, and conditions impacting the project. Related requirements and conditions include all applicable federal, state, and local codes and regulations, required notices and permits, restrictions on use of the site, requirements for partial owner occupancy during work, coordination of work with other contractors, and phasing of the work. Whenever there is a conflict or overlap of the above documentation with federal, state, and local regulations, the most stringent provisions apply.**
- 1.1.2 The scope of work is presented in Section 2 of this bid document.
- 1.1.3 Work summarized briefly as follows:
 - 1.1.3.1 Pre-abatement activities includes but many not be limited to pre-abatement meetings, inspections, notifications, permits, submittal approvals, preparations, emergency arrangements and standard operating procedures.
 - 1.1.3.2 Abatement activities include but may not be limited to removal and disposal of ACM and/or PACM, asbestos contaminated waste, record keeping, security, and inspection and monitoring.
 - 1.1.3.3 Cleaning and decontaminating activities includes but may not be limited to final inspection and air testing, and certification of work completion and decontamination.

1.2 Owner's Responsibility:

- 1.2.1 The owner will be responsible for providing the following notifications to other building occupants concerning the work to be completed under these specifications:
 - 1.2.1.1 Any prospective employer applying for or bidding for work whose employees reasonably can be expected to work in or adjacent to asbestos removal work areas.
 - 1.2.1.2 Employees of the owner who will work in or adjacent to the asbestos removal work areas.
 - 1.2.1.3 On multi-employer work sites, all employers who will be performing work within or adjacent to the asbestos removal work areas.
 - 1.2.1.4 Tenants who are occupying the space adjacent to the asbestos removal work areas.
- 1.2.2 Any other specific owner's responsibilities will be included in owner's agreement with contractor and/or the scope of work for the project covered by these specifications.

1.3 Contractor's Responsibility:

- 1.3.1 The contractor will be responsible for the following:
 - 1.3.1.1 To comply with all federal, state and local regulations including but not limited to OSHA 1910.1001 and OSHA 1926.1101.
 - 1.3.1.2 Remove and dispose of all asbestos-containing materials, asbestos-containing waste and proper generation and distribution of waste shipment records and waste disposal manifest(s).
 - 1.3.1.3 Ensure that all persons engaged in the asbestos removal project hold valid asbestos worker certificates.
 - 1.3.1.4 Comply with all local, state and federal notifications.

- 1.3.1.5 Maintain all project records for as many years as required by local, state and/or federal regulatory requirements.
- 1.3.1.6 Provide any build-back re-insulation if required.
- 1.3.1.7 Perform personnel monitoring as required by OSHA.

1.4 Definitions:

ACE: Asbestos Contaminated Element

ACM: Asbestos Containing Material

ACS: Asbestos Contaminated Soil

ACWM: Asbestos Contaminated Waste Material

AWDF: Asbestos Waste Decontamination Facility

Aerosol: A system consisting of particles, solid or liquid, suspended in air.

Aggressive Sampling: EPA defined clearance sampling method using air moving equipment such as fans and leaf blowers to stir the air.

Aggressive Method: Means removal or disturbance of a building material by sanding, abrading, grinding, or other method that breaks, crumbles, or disintegrates intact ACM and/or PACM.

Air Cell: Pre-formed, factory-made insulation normally used on pipes and duct-work. This corrugated cardboard almost always contains asbestos fibers combined with cellulose or refractory binder.

Air Sample Collection Filter: A membrane filter used to collect fibers/particulates which when processed is analyzed to determine fiber counts. The membrane is usually made of mixed cellulose material for Phase Contrast Microscopy (PCM), and polycarbonate or mixed cellulose for Transmission Electron Microscopy (TEM.)

Air Monitoring: The process of measuring the fiber content of a specific volume of air.

Amended Water: Water to which a surfactant has been added.

Asbestos: Asbestos is any one of a group of six similar minerals including chrysotile, crocidolite, amosite, actinolite, anthophyllite and tremolite.

Asbestos Contaminated Element (ACE): Building elements such as ceilings, walls, lights and duct-work that are contaminated with asbestos.

Asbestos Containing Material (ACM): Any material containing one percent (1%) or more by volume of asbestos of any type or mixture of types. This is a Federal standard. Stricter State standards may apply.

Asbestos Containing Waste Material (ACWM): Any material which is known to be, suspected of, or contaminated with asbestos which is to be removed from a work area for disposal.

Asbestos Waste Decontamination Facility (AWDF): Airlock system consisting of drum/bag washing facility and temporary storage area for cleaned containers. Used as exit for waste and equipment leaving the abatement area. May be used in an emergency to evacuate personnel.

Authorized Person: Means any person authorized by the employer and required by work duties to be present in a regulated area.

Authorized Visitor: The owner or a representative of any federal, state and local regulatory or other agency having authority over the project.

Barrier: Any material that seals off the work area to inhibit the movement of fibers.

Breathing Zone: A hemisphere forward of the shoulders with a radius of approximately 6 to 9 inches.

Bridging Encapsulant: An encapsulant that forms a discrete layer on the surface of an in-place asbestos matrix.

Bulk Test: The collection and analysis of samples of suspected asbestos materials. A small amount, or bulk, of the material is physically removed from the structure and placed in a rigid airtight container for transportation to an accredited laboratory for analysis.

Category I Non-friable: (NESHAP definition) Category I non-friable ACM includes asbestos-containing gaskets, packings, resilient floor coverings, resilient floor covering mastic, and asphalt roofing products. Asbestos roofing products include built-up roofing, asphalt-containing single ply membrane systems, asphalt shingles, asphalt-containing underlayment felts, asphalt-containing roof coatings and mastics, and asphalt-containing base flashing. ACM roofing products that use other bituminous or resinous binders (such as tars or pitches) are also considered to be Category I ACM.

Category II Non-friable: (NESHAP definition) Category II are all other non-friable ACM, excluding Category I non-friable ACM.

Ceiling Concentration: The concentration of an airborne substance that shall not be exceeded.

Certified Industrial Hygienist (CIH): An industrial hygienist certified in comprehensive practice by the American Board of Industrial Hygiene.

Changing Area: Normally the first chamber of the Personnel Decontamination Facility, i.e., "clean room."

Class I Asbestos Work (OSHA): This means activities involving the removal of TSI and surfacing ACM and PACM.

Class II Asbestos Work (OSHA): This means activities involving the removal of ACM and/or PACM which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile, floor tile mastic, and asbestos cement product.

Class III Asbestos Work (OSHA): This means repair and maintenance operations, where ACM and/or PACM, including thermal system insulation and surfacing material, are likely to be disturbed.

Class IV Asbestos Work (OSHA): This means maintenance and custodial activities during which employees contact ACM and/or PACM and activities to clean up waste and debris containing ACM and/or PACM.

Clean Room: This means an uncontaminated room having facilities for the storage of employees' street clothing and uncontaminated materials and equipment.

Closely Resemble: This means that workplace conditions which have contributed to the levels of historic asbestos exposure and are no more protective than conditions of the current workplace.

Competent Person: This means a person properly trained and who is capable of identifying existing asbestos hazards in the workplace and selecting an appropriate control strategy for asbestos exposure and has the authority to take corrective measures to eliminate them, under requirements of 29 CFR 1926.1101

Count: Refers to "fiber count," or the average number of fibers greater than five micrometers in length per cubic centimeter of air.

Critical Barrier: This means one or more layers of plastic sealed over all openings into a work area or any other similarly placed physical barrier sufficient to prevent airborne asbestos in a work area from migrating to an adjacent area.

C.P.I.H.: Asbestos abatement contractor's professional industrial hygienist. Also known as "Competent Person."

Decontamination Area: This means an enclosed area adjacent and connected to the regulated area consisting of an equipment room, shower area, and clean room, which is used for the decontamination of workers, waste materials, and equipment that are contaminated with asbestos.

Demolition: The wrecking or taking out of any load-supporting building structural component and any related razing, removing, or stripping of asbestos products.

Disposal Bag: Six (6) millimeter thick leak-tight plastic bag used for transporting asbestos-containing waste material from work and to disposal site. Each is labeled as follows:

Disturbance: This means any contact which releases fibers from ACM and/or PACM, or debris containing ACM and/or PACM.

Drum: A rigid, impermeable container made of cardboard, metal or plastic which can be sealed in an air and liquid tight manner.

EDF: Equipment Decontamination Facilities

Employee Exposure: This means that exposure to airborne asbestos that would occur if the employee were not using respiratory protection.

Encapsulant: A material that surrounds or embeds asbestos fibers in an adhesive matrix, to prevent release of fibers.

Encapsulation: Treatment of asbestos-containing materials with encapsulant.

Enclosure: The construction of an air-tight, impermeable, permanent barrier around asbestos-containing materials to control the release of asbestos fibers into the air.

Entrance Port: A name sometimes used for the main entrance airlock in an OSHA defined negative air containment area.

Equipment Room: This means a contaminated room located within the decontamination area that is supplied with impermeable bags or containers for the disposal of contaminated protective clothing and equipment.

f/cc: Abbreviation for fibers per cubic centimeter of air, a standard measurement unit used to measure the level of fiber concentration in the air.

Filter: A media component used in respirators to remove solid or liquid particles from the air breathed.

Friable Asbestos Containing Material: Material that contains more than one percent (1%) asbestos by weight that can be crumbled, pulverized, or reduced to powder by hand pressure.

Glovebag: This means an impervious plastic bag-like enclosure with glove-like appendages through which material and tools may be handled.

HEPA Filter: A high efficiency particulate air (HEPA) filter capable of trapping and retaining 99.97% of asbestos fibers greater than 0.3 microns in length.

HEPA Filter Vacuum Collection Equipment: HEPA filtered vacuum collection equipment with a filter system capable of collecting and retaining 99.97% of asbestos fibers greater than 0.3 microns in length.

High-Efficiency Filter: A filter which removes from air 99.97% or more of monodisperse dioctyl phthalate (DOP) particles having a mean particle diameter of 0.3 micrometers.

Industrial Hygienist (I.H.): A person who is professionally qualified by education, training, and experience to anticipate, recognize, evaluate and develop controls for occupational health hazards.

I.H. Technician: A person working under the supervisions of the I.H. with special training, experience, certifications and licenses required for the industrial hygiene work assigned to be performed.

Intact: This means that ACM and/or PACM has not crumbled, been pulverized, or otherwise deteriorated so that it is likely to remain bound with its matrix.

Lock-Back: Encapsulation of all surfaces in the regulated work area at the conclusion of ACM and/or PACM removal and before removal of primary barriers.

MCEF: Membrane Cellulose Ester Filter

Negative Exposure Assessment: This means a demonstration by the employer that employee exposure to airborne asbestos during an operation is expected to be consistently below the PELs.

Negative Pressure: Air pressure lower than surrounding areas, created by exhausting air from a sealed space such as a contained work area.

Negative Pressure Respirator: A respirator in which the air pressure inside the respiratory inlet covering is positive during exhalation in relation to the pressure of the outside atmosphere and negative during inhalation in relation to the air pressure of the outside atmosphere.

Negative Pressure Ventilation System: A local exhaust system, utilizing HEPA filtration capable of maintaining a negative pressure inside the work area and a constant air flow from adjacent areas into the work area and that exhausts that air through HEPA filters to air outside the work area.

NESHAP: National Emission Standards for Hazardous Air Pollutants

Non-friable Asbestos-Containing Material (NF-ACM): Material that contains more than one percent (1%) asbestos by weight but cannot be crumbled, pulverized, or reduced to powder by hand pressure when dry.

OSHA: Occupation Safety and Health Administration

Owner: The governmental or public body or authority, corporation, association, firm, or person with whom the contractor has entered into the agreement and for whom the work is to be provided and who is the authorized representative of the owner of the facility where the work is to be performed.

OV: Organic Vapor

PACM: OSHA acronym for "Presumed Asbestos Containing Material"

PAPR: Powered Air-Purifying Respirator

PCM: Abbreviation for Phase Contrast Microscopy. Phase contrast microscopy uses a light microscope for the purpose of counting fibers.

PDF: Personnel Decontamination Facilities

Penetrating Encapsulant: An encapsulant that is absorbed by the asbestos matrix without leaving a discrete surface layer.

Personal Air Sampling: Air sample collected with a special battery-powered, portable, low-volume pump unit which is fitted on the body of the monitored person. The collection device (filter cassette) is located within the individual's breathing zone.

Personal Monitoring: Sampling of the fiber concentrations within the breathing zone of an employee.

P.I.H.: Professional (qualified) I.H. who meets all the definition requirements of AIHA and OSHA of a "Competent Person" under 29 CFR 1926.1101, has completed at least three specialized courses on asbestos abatement, supervision, and management in EPA endorsed training programs, formal training in respiratory protection and waste disposal, and has a minimum experience of five (5) projects of similar complexity with this project of which at least three (3) projects, served as the supervisor, licensed when required by state or local regulations.

Plastic Sheeting: Barrier material not as strong as polyethylene.

PLM: Abbreviation for Polarized Light Microscopy with dispersion staining using light microscopy and refractive indices to identify type of asbestos present.

Polyethylene Sheeting: Strong, usually transparent plastic barrier material.

Positive/Negative Pressure Fit Check: A negative-pressure respirator fit check, performed by placing the palm of one hand over the exhalation valve and exhaling (positive pressure) and feeling for facepiece-to-face fit leakage and covering the filters cartridges with the palms of the hand and inhaling (negative pressure) while feeling for facepiece-to-face fit leakage.

Pressure Differential System: A system which restricts airflow from adjacent areas into work area and continuously re-filters air from the HEPA filtration machine. Minimal exhaust ventilation is utilized by maintaining a pressure differential of two hundredths of an inch (0.02") of water (H₂O.) using a manometer.

Project Designer: This means a person who has successfully completed training requirements for an asbestos abatement project designer established by 40 CFR 763.

Protection Factor: The ratio of the ambient concentration of an airborne substance to the concentration of the substance inside the respirator at the breathing zone of the wearer. The protection factor is a measure of the degree of protection provided by a respirator to the wearer.

QNFT: Quantitative Fit Test

RACM: EPA-NESHAP acronym for "Regulated Asbestos Containing Material"

Regulated Area: An area established by the employer to demarcate areas where Class I, II, and III asbestos work is conducted, and any other adjoining area where debris and waste from such asbestos work accumulate; and a work area within which airborne concentrations of asbestos exceed, or there is a reasonable possibility they may exceed, the permissible exposure limits (PEL.)

Removal: Means all operations (including demolition) where ACM and/or PACM is taken out or stripped from structures or substrates.

Removal Encapsulant: A penetrating encapsulant specifically designed for removal of ACM rather than encapsulation.

Renovation: The modifying of any existing structure, or portion thereof.

Repair: Overhauling, rebuilding, reconstructing, or reconditioning of, mechanical equipment, structures, or substrates, including encapsulation or other repair of ACM and/or PACM attached to mechanical equipment, structures, or substrates.

Respirator: A device designed to protect the wearer from the inhalation of harmful atmospheres.

RPP: Respiratory Protection Program

RPPC: Respiratory Protection Program Coordinator

SAR: Supplied Air Respirator

SCBA: Self Contained Breathing Apparatus

Sealant: Another name for encapsulating material. This term also refers to the paint which is used to cover brown-coat ceilings after asbestos surfaces have been removed.

Sealed Work Area: Refers to the work area after containment barriers and decontamination facilities have been erected and a negative pressure air system installed.

Showers: Shower stalls installed in the PDF and used as part of the decontamination process, required for every person leaving the sealed work area. Also used in the EDF to wash disposal bags.

S.O.P.: Standard Operating Procedures

Station Sample or Area Sample: Refers to air samples collected at a specific spot, or station, with high-volume air pumps.

Surfactant: A chemical wetting agent added to water to improve penetration, thus increasing the effective wetting properties of water when applied to asbestos containing materials.

Surfacing Material: This means material that is sprayed, troweled-on or otherwise applied to surfaces (such as acoustic plaster on ceilings, fireproofing materials on structural members, or other materials on surfaces for acoustic, fireproofing, decorative texturing, and other purposes).

Surfacing ACM: This means surfacing material which contains more than 1% asbestos.

TEM: Abbreviation for Transmission Electron Microscopy. TEM is used for the purpose of fiber counting and has the analytical capacity of specifically identifying asbestos fibers.

Thermal System Insulation (TSI): This means ACM and/or PACM containing greater than 1% asbestos that is applied to pipes, fittings, boilers, breech, tanks, ducts or other mechanical/structural components to prevent heat loss or gain.

Testing: One of two types of testing done in relation to asbestos bulk and air testing.

Time Weighted Average (TWA): The average concentration of a contaminant in air during a specific time period.

VAT: Vinyl Asbestos Tile

Visible Emissions: Any emission containing particulate that is visually detectable without the aid of instruments. This does not include condensed uncombined water vapor.

Wetting Agent: See Surfactant

Wet Cleaning: The process of eliminating asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning utensils which have been dampened with amended water or diluted removal encapsulant.

Work Area: The area where asbestos-related work or removal operations are performed which is isolated to prevent the spread of asbestos dust, fibers, debris and entry by unauthorized personnel. Work area is a regulated area as defined by 29 CFR 1926.

1.5 Contractor Use of Premises:

- 1.5.1 The contractor shall cooperate fully with the owner to minimize conflicts and to facilitate the owner's safe and smooth continued operational use of the building.
- 1.5.2 The contractor shall use existing facilities strictly within the limits shown in the contract documents and the approved pre-abatement plan of action
- 1.5.3 The Contractor must maintain emergency exits from the work areas and building in case of fire or medical emergencies. It is the contractor's responsibility to maintain these exits and to make sure all exits are easily accessible and easily opened from the inside.

1.6 Differing Site Conditions:

- 1.6.1 The quantities (if indicated) and location of ACM, PACM, and ACE indicated on the drawings and the extent of work included in Section 2 of the bid document is only best estimates. It is the contractor's responsibility to notify the federal, state, and/or local regulators of the quantities to be removed. It is also the contractor's responsibility to notify the owner of any newly discovered ACM and/or PACM within 24 hours of such discovery.

1.7 Authority to Stop Asbestos Removal:

- 1.7.1 If the owner presents a verbal and/or written "Stop Asbestos Removal" order, the contractor will immediately stop all asbestos removal and initiate fiber reduction activities. The contractor will not resume asbestos removal until authorized verbally and/or in writing by the owner. A "Stop Asbestos Removal" order will be issued at any time the owner determines abatement conditions are not within specification requirements. Stoppage will continue until conditions have been corrected. Standby time and cost required for corrective action is at the contractor's expense. The occurrence of the following events shall be reported in writing to the owner and shall require the contractor to automatically stop asbestos removal and initiate fiber reduction activities:
 - Excessive airborne fibers outside the containment area (0.1 f/cc or greater).
 - Any breach in containment barriers.
 - Loss of negative air pressure.

- Serious injury on the job site.
- Fire and/or safety emergency.
- Respiratory system failure.
- Power failure.
- Excessive airborne fibers inside the containment (0.5 f/cc or greater when wet methods are employed).

1.8 Contractor Requirements:

- 1.8.1 This section covers furnishing of all labor, materials, services, equipment, supervision and permits necessary to perform the removal of ACM located at the site described herein.
- 1.8.1.1 This work shall be performed in accordance with this specification, contract documents, and any other applicable federal, state, and local government regulations concerning asbestos or related construction activities.
- 1.8.1.2 In the event of conflicting requirements, the most stringent provisions shall be applicable.
- 1.8.1.4 Work under this contract shall be performed in strict accordance with current OSHA, AHERA (when applicable), and NESHAP regulations.

1.9 Pre-Construction Conference:

- 1.9.1 The contractor may be required to attend a mandatory pre-construction conference meeting scheduled by the owner. At this meeting, the contractor shall present, in writing, to the owner three (3) copies of the following:
- Written negative exposure assessment when used.
 - Project schedule breakdown in accordance with the time restraints.
 - A plan for preparation of the work site, decontamination chamber, and shower/waste water disposal.
 - Description of protective clothing and approved respirators to be used.
 - Delineation of responsibility of work site supervision including a listing of emergency telephone numbers.
 - Explanation of regulated area containment and isolation techniques.
 - Brief description of removal methods to be used and equipment to be utilized.
 - Description of the final clean-up procedures to be used.
 - Brief explanation of the handling of ACM and/or PACM and ACWM and the disposal site to be utilized.
- 1.9.2 Additional job progress meetings may be scheduled by the owner during the course of the construction.

1.10 Contractor Logbook:

- 1.10.1 The contractor shall maintain a logbook at the job site, which shall be available at all times to the owner. Complete copies shall be submitted to the owner within fifteen (15) days of project completion. The logbook serves as a ready reference for this project and may be used in legal proceedings, thus, care must be taken to assure its completeness and its documentation accuracy. The logbook shall contain the following information at a minimum and shall be maintained in a three (3) ring binder. Any deviation shall be confirmed in writing by the owner.
- Date stamped copies of all federal, state and local project notifications and filings including waivers and copies of applicable regulations.
 - Copies of certification by a physician of each employee's capability to wear a respirator per the OSHA Respirator Standards (29 CFR 1910.134).

- Copies of asbestos project notifications to the local fire, police and rescue services including telephone numbers.
- Name and home telephone numbers of key personnel including the on the job supervisor's immediate supervisor, the buildings owner's representative, security personnel, and appropriate federal, state and local regulatory personnel.
- Contractor's standard operating procedures and any deviations therefrom.
- Project technical specification including plans and drawings and any deviations therefrom.
- Sign-in and sign-out forms noting who entered the work area, their affiliation with the project, time and purpose of entry and departure time.
- Records of pertinent daily events, checks of containment and equipment and all accidents and injuries occurring on the job.
- Personal air sampling forms with results for final report inclusion.
- EPA generator identification number, copy of waste disposal manifest, and name of disposal site used. If a subcontractor is used, all information required above must still be provided. All the above documentation including trip tickets and land fill invoices shall be provided to owner after project completion.
- Reports of inspection by federal, state, and local authorities.
- Detailed reports of any problems and incidents that arose, the date and time, and how they were handled. These reports must be signed by supervisory personnel.
- Emergency procedures.
- Copy of the project schedule and any deviations therefrom.
- Organization of personnel at the job site including delineation of supervisory responsibility.
- The contractor shall submit a copy of the valid state business entity license for an asbestos abatement contractor. All certificates for proposed workers, foremen, and supervisors must be presented. Any changes or substitutions must be approved by the owner.
- In the event that glove bag removal techniques are used, the contractor shall submit a copy of the glove bag instructions.

1.11 Availability of Trained Personnel:

- 1.11.1 There shall be a sufficient number of trained workers and supervisors to accomplish the work within the required schedule. No individual person who has not been fully trained and qualified, as below, shall be employed to speed up completion of the work.
- 1.11.1.1 All personnel of the contractor involved with the asbestos abatement work must be trained, tested, and certified prior to any work and shall be familiar with the standard operating procedures of the contractor.
- 1.11.1.2 All workers and supervisors shall be thoroughly familiar with all applicable regulations and practices for asbestos abatement work and must possess valid state asbestos licenses.
- 1.11.1.3 All workers shall be trained in the use and care of respirators.
- 1.11.1.4 All workers shall have successfully completed training courses required for asbestos removal workers as required, recognized, sponsored, and supported by the United States Department of Labor, Occupational Safety and Health Administration, the United States Environmental Protection Agency, and all state and local regulatory agencies. Documentation of the successful completion of applicable courses is required with submittals and close-out report.
- 1.11.1.5 All workers shall have state and local certifications whenever state and local regulations require the workers to be certified and shall be available for owner inspection prior to work starting.
- 1.11.1.6 Any worker without the above qualifications shall not be allowed in the work area at any time.

1.12 Building Security:

- 1.12.1 The security of the premises and grounds are the responsibility of the owner unless otherwise specified in the bid document.
- 1.12.2 The security of the work area against inadvertent and/or willful entry of unauthorized personnel is the responsibility of the contractor. The contractor is responsible for all tools, equipment, materials, etc. whether they are in the work area or not.

1.13 Standard Operating Procedures (SOP):

- 1.13.1 The asbestos contractor shall have established standard operating procedures (SOP) in printed form, on site, consisting of simplified diagrams, sketches and pictures that establish and explain clearly the ways and procedures to be followed during all phases of work. The SOP must be modified as necessary to address any specific requirements of the project and shall be submitted for review and approval prior to the start of any abatement work. The minimum topics and areas to be covered by the SOP are:

- Minimum Personnel Qualifications
- Contingency Plans
- Security and Safety in the Workplace (including a worksite safety plan - see 1.15)
- Respiratory Protection Systems and Training
- Worker Protection, Medical Examinations, Record Keeping, Protective Clothing, Entering and Exiting Procedures
- Work Area Limitations
- Decontamination Facilities, PDF and EDF
- Negative Pressure Systems
- Containment Barriers and Coverings of Work Area
- Monitoring, Inspection, and Testing
- Removal of ACM and/or PACM and/or ACE
- Removal of ACS
- Glove bag applications and their instructions
- Enclosure of ACM and/or PACM
- Encapsulation of ACM and/or PACM
- Project close-out documents production and distribution
- Project Decontamination
- Work Area Clearance
- Disposal of ACM and/or PACM and/or ACE Waste
- Fire Protection, Emergency Evacuation, and Exit Plan
- A Plan for Blood Borne Pathogens

1.14 Contractor Pre-Work Submittal:

- 1.14.1 Submit before start of work the following:
 - 1.14.1.1 Copies of current abatement contractor required licenses and insurance.
 - 1.14.1.2 Product data for surfactants and/or removal encapsulants, lock back encapsulants or other hazardous materials, instruction for use and recommendations of manufacturer, and data substantiating compliance with requirements including MSDS's.
 - 1.14.1.3 Certification from manufacturer that the wetting product will wet ACM as required by NESHAP 40 CFR 61, Subpart M.
 - 1.14.1.4 The contractor shall prove they have an established asbestos abatement business for three (3) years. Have conducted within the last three (3) years, three (3) asbestos abatement projects three (3) of which are comparable in complexity and dollar value with this project. Have not been cited or has not been a defending party of any legal action for violation of asbestos regulations during the last three (3) years. Carries liability insurance for asbestos

abatement work. Is licensed in whatever state it is doing business and has on file such records. Has an adequate number of qualified personnel available for this project. Has an established written SOP for training, medical surveillance, entry and exit procedures, respiratory protection, safety, emergency and monitoring. Has available equipment, materials and supplies in adequate quantity, capacity and number to perform the work of this project.

1.15 Work Site Safety Plan:

1.15.1 Taking all emergency precautions and following all emergency procedures is the responsibility of the contractor and shall at minimum have a work site safety plan which includes the following:

1.15.1.1 The contractor shall establish emergency and fire exits from the work area. All emergency exits shall be equipped with at least two (2) sets of protective clothing and respirators (for emergency entrance) at all times.

1.15.1.2 The contractor shall notify the local police and fire departments of the asbestos abatement project. The contractor must coordinate with the police all security aspects of the project. All emergency evaluation and safety aspects must be coordinated with the local fire department and/or emergency response teams. **A notice of verification that all of the above parties have been notified must be presented to the owner.**

1.15.1.3 The contractor shall be prepared to administer immediate first aid to injured personnel before and after decontamination. Seriously injured personnel shall be treated immediately or evacuated without delay for decontamination. When an injury occurs, the contractor shall stop and implement fiber reduction techniques such as, water misting the work area air until the injured person has been removed from the work area.

1.16 Codes and Regulations:

1.16.1 **Except to the extent that more explicit or more stringent requirements are written directly into the contract documents, all current applicable codes, regulations, and standards have the same force and effect (and are made a part of the contract documents by reference) as if copied directly into the contract documents, or as if published copies are bound herewith.**

1.16.2 The contractor shall assume full responsibility and liability for compliance with all applicable federal, state, and local regulations pertaining to notifications, work practices, hauling and disposal of ACM and/or PACM, and/or ACE, and/or ACS and protection of workers, visitors to the site and persons occupying areas adjacent to the site. The contractor is responsible for providing medical examinations and maintaining medical records for workers as required by the applicable federal, state, and local regulations. The contractor shall hold the owner harmless for failure to comply with any applicable work, hauling, disposal, safety, health and/or other actions on the part of himself, his employees, or his subcontractors. The contractor incurs all costs including all sampling/analytical costs for sampling to comply with OSHA regulations. In addition, the abatement contractor shall determine the applicability of any process patent that may be used and be responsible for paying any fees, royalties, or licenses that may be required for the use of patented processes.

1.16.3 Federal requirements which govern asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following:

1.16.3.1 U.S. Department of Labor, Occupational Safety and Health Administration, (OSHA):

- Code of Federal Regulations Title 29 Part 1910 Section 1001
- Code of Federal Regulations Title 29 Part 1926 Section 1101
- Code of Federal Regulations Title 29 Part 1910 Section 134

1.16.3.2 U.S. Environmental Protection Agency (EPA):

- Code of Federal Regulations Title 40 Part 763 Subpart E
- Code of Federal Regulations Title 40 Part 61 Subpart A

- Code of Federal Regulations Title 40 Part 61 Subpart M
- 1.16.3.3 U.S. Department of Transportation
- Code of Federal Regulations (applicable parts of) 49 CFR Parts 171-180
- 1.16.4 All state requirements which govern asbestos abatement work or hauling and disposal of asbestos waste materials shall apply.
- 1.16.5 All local requirements shall apply.
- 1.16.6 EPA guidance documents that discuss asbestos abatement work or hauling and disposal of asbestos waste materials are available on EPA's Web site www.epa.gov and are incorporated herein by reference.
- Guidance for Controlling Asbestos-Containing materials in Buildings (Purple Book) - EPA 560/5-85-024
 - Asbestos Waste Management Guidance - EPA 530-SW-85-007
 - A Guide to Respiratory Protection for the Asbestos Abatement Industry - EPA-560-OPTS-86-001
- 1.16.7 The contractor shall send written notification prior to beginning work on abatement of asbestos containing materials as required by NESHAP, 40 CFR 61, Subpart M to the regional asbestos NESHAP contact or their designee.
- 1.16.7.1. Include, at a minimum, the following information in the notification sent to the NESHAP contact:
- Name and address of owner's facility.
 - Description of the facility being demolished or renovated, including size, age, and prior use of facility.
 - Estimate of the approximate amount of friable asbestos material present in the facility in terms of linear feet of pipe, and surface area on other facility components.
 - Location of the facility being demolished or renovated.
 - Scheduled starting and completion dates of demolition or renovation.
 - Nature of planned demolition or renovation and method(s) to be used.
 - Procedures to be used to comply with the requirements of NESHAP 40 CFR 61 Subpart M.
 - Name and location of the waste disposal site where the friable asbestos waste material will be deposited.
- 1.16.7.2. If applicable, send written notification within required time-frames as required by state and local regulations prior to beginning removal of asbestos-containing materials.
- 1.16.7.3. Copies of NESHAP and other notifications shall be submitted to the owner for the facility's record in the same time-frame notification is given to the EPA, state, and local authorities.
- 1.16.8 A asbestos waste shipment document is required for transporting asbestos waste to a disposal site.
- 1.16.9 Maintain current licenses as required by applicable federal, state, and local jurisdictions for the removal, transporting, disposal or other regulated activities related to the work of this contract.
- 1.16.10 Maintain two (2) copies of applicable federal, state, and local regulations. Make available one (1) copy of each at the job site where workers will have easy access to the regulations. Keep on file in the contractor's office one (1) copy of each regulation.
- 1.17 Project Personnel:**
- 1.17.1 The contractor and assigned personnel for this project shall meet the following minimum requirements:

- 1.17.1.1 The C.P.I.H. shall have at least three (3) years of experience monitoring and supervising abatement construction. Have participated as C.P.I.H. in five (5) abatement projects, three (3) of which are of comparable complexity and dollar value with this project. Have developed at least one (1) complete written standard operating procedure for abatement and has trained abatement workers for three (3) years. Have specialized training in asbestos abatement management, respiratory protection and training, asbestos waste disposal, abatement, personnel monitoring, inspection and testing. Have medical records. Have certifications and licenses where required by state and/or local government.
- 1.17.1.2 Abatement workers shall have specialized training in abatement construction, OSHA and EPA regulations, the standard operating procedure of the company, asbestos hazards and respiratory protection. Have one (1) year of abatement construction experience. Have medical records and any other OSHA requirements. Have licenses where required by state and/or local government.

1.18 Contingency Plans and Arrangements:

- 1.18.1 Prepare a contingency plan for emergencies including fire, accident, failure of power, failure of negative air system, failure of supplied air system or any other event that may require modification of standard operating procedures during abatement, including specific procedures to ensure safe exiting and to provide medical attention in the event of an emergency. Post the telephone numbers and locations of emergency services including fire, ambulance, doctor, hospital, police, power company and telephone company in the clean room of PDF. Notify all these emergency services as to the danger of entering the containment area. The Contractor must ensure that all of its employees know of all fire and emergency plans, telephone numbers and exit procedures.

1.19 Project Security:

- 1.19.1 The contractor is responsible for providing 24 hour security for all regulated areas throughout the duration of the their work.

Chapter 2 Respiratory Protection

2.1 General:

- 2.1.1 The contractor shall provide respiratory protection in accordance with this specification, the OSHA regulation 29 CFR 1910.1001, 29 CFR 1910.134 and 29 CFR 1926.1101, EPA regulations 40 CFR 763.120 and 121, ANSI standards Z88.2, CGA Pamphlet G-7 and specification G-7.1, the NIOSH standards, and comply with all current state and local requirements. In case of conflict, the most stringent requirements are applicable for this project.

2.2 Respiratory Protection Program (RPP):

- 2.2.1 It is the responsibility of the contractor to develop, implement and maintain a respiratory protection program.

2.3 Written Statement of Company Policy:

- 2.3.1 The contractor shall provide a written statement of intent to provide a safe and healthful work place for workers. This written statement shall include assignment of individual responsibility, accountability, enforcement procedures and authority for required activities.

2.4 Respirators for Abatement Operations:

- 2.4.1 Where a person is or could reasonably be expected to be exposed during abatement operations to airborne asbestos, one of the following minimum levels of respiratory protection is required:



NIOSH Approved Respiratory Protection	Maximum Use Concentration
Half-Mask Air Purifying with HEPA Filters	1 f/cc
Full-Facepiece Air Purifying with HEPA Filters	5 f/cc
Powered Air Purifying (PAPR) Full Facepiece with HEPA Filters	100 f/cc
Full Facepiece - Supplied Air Continuous Flow with HEPA Filters	100 f/cc
Full Facepiece - Supplied Air operated in Pressure Demand mode	100 f/cc

- 2.4.1.1 Type "C" Compressed Air (OSHA 1910.134(d)(1) and CAS Z275.3.09) shall comply with the following requirements:
 - The compressor shall be sized according to the respirator manufacturer’s recommendation for supply capacity.
 - The receiver shall be of the capacity and a size for emergency escape using decontamination procedures for all workers.
 - The compressor shall be equipped with a visual and audible compressor failure alarm so that all workers may be alerted of compressor failure.
 - The compressor shall be equipped with a high temperature alarm with shut off capability.
 - The compressor shall be equipped with a carbon monoxide monitor. This monitor should be equipped with an alarm that can be heard or seen by all workers using the system.
 - The system shall include an in-line air purifying absorbent bed and filters.
 - The compressor shall provide Grade D or better quality breathing air.
- 2.4.1.2 The contractor shall demonstrate, prior to its use, the air system including receiver capacity, etc., to the owner for approval.
- 2.4.1.3 A belt must be provided for the air hose. The hose length shall not exceed 300 feet.
- 2.4.1.4 The contractor shall have available for authorized visitors, two (2) extra or spare air hoses and connectors to allow entry into the work area at any time without removing a worker from the work area.
- 2.4.2 Combination pressure-demand SAR/SCBA or pressure-demand SCBA shall be equipped with full facepieces. Full facepieces shall be worn with either a bonnet-type disposable head cover/hood or with a full head cover/hood which is part of a fully enclosed protective garment. When bonnet type head cover/hoods are used with full facepieces, the respirators shall always be donned with the head straps located under the hood. This allows removal of the head covering prior to showering without disturbing the respirator (which is worn into the shower).
- 2.4.3 Reserve air shall be provided per OSHA regulations 29 CFR 1910.134 as part of any supplied air system used with the above respirators.

2.5 Use of Respirators:

- 2.5.1 The Contractor shall provide respirators to their employees as follows:
 - 2.5.1.1 During all Class I and II asbestos jobs.
 - 2.5.1.2 During all Class II and III work this is not performed using wet methods.
 - 2.5.1.3 During all Class II and III asbestos jobs where the employer does not produce a “negative exposure assessment”.
 - 2.5.1.4 During all Class III jobs where TSI or surfacing ACM and/or PACM is being disturbed.

2.5.1.5 During all Class IV work performed within regulated areas where employees performing other work are required to wear respirators.

2.5.1.6 During all work while employees are exposed above the TWA or excursion limit.

2.6 Worker and Supervisor Respirator Training:

2.6.1 Contractor shall provide formal instructions in the proper use of respirators to workers and supervisors. Supervisors shall have a more comprehensive training in addition to the basic worker training.

2.7 Respirator Fit Test:

2.7.1 Perform the appropriate fit test, either a quantitative fit test (QNFT) or qualitative fit test (QLFT) in accordance with OSHA regulations 29 CFR 1910.134 to determine satisfactory fit with any respirator which creates a negative pressure in the facepiece, such as negative-pressure air-purifying respirators or a SAR fitted with an emergency HEPA filter back-up.

2.7.2 Routine donning of respirators with tight fitting facepiece requires negative and positive pressure test to ensure adequate sealing. This shall be performed by the wearer prior to each entry into the work area.

2.7.3 For SCBA, SAR/SCBA, and SAR perform a negative pressure test, block the end of the breathing tube with the palm of the hand(s) and for negative pressure air-purifying respirators close off the cartridge(s) or filter(s) by covering with the palms of the hands. The wearer shall inhale gently and hold breath for at least ten (10) seconds. The facepiece shall collapse slightly without inward leakage of air into the facepiece.

2.7.4 For SCBA, SAR/SCBA, SAR perform a positive pressure test for negative pressure air-purifying respirators, the exhalation valve is closed off and wearer exhales gently for at least ten (10) seconds. A slightly positive pressure shall be built up inside the facepiece without any outward leakage of air from the facepiece.

2.8 Cleaning, Disinfecting, Inspection, Repair and Storage:

2.8.1 Respirators shall be cleaned after each use by the wearer at the end of each work shift. Every worker's respirator shall bear identification and shall always be assigned to the same worker. Perform continuous inspection of respirators to identify malfunctions. Inspections shall be performed in accordance with manufacturer's instructions. Replacement parts for respirators shall be from the manufacturer of the respirator only. Substitution of parts from a different brand or type of respirator, or unauthorized modification will void the approval of the respirator. Store the respirator in a convenient, clean, and sanitary location to ensure proper function when used. Protect against dust, chemicals, sunlight, excessive heat and cold, and mechanical damage. Store thoroughly dried respirator in sealed plastic bag or in a container with a tight-fitting lid.

2.9 Regular Program Evaluation and Special Problems of Use:

2.9.1 The contractor shall periodically assess the effectiveness of the respiratory protection program during all phases of asbestos abatement operations. Contractor shall monitor supervisor and worker compliance with requirements of their program. In addition to general assessment of the overall respiratory protection program, specific evaluations of the respirator cleaning, inspection, maintenance, repair, storage, and use procedures shall be frequently conducted to ensure that the desired results of these operations are consistently achieved.

2.10 Proper Respirator Use Procedures:

2.10.1 The Contractor shall establish a well-defined procedure for donning and doffing of respirators when entering and exiting the work area through the PDF. Donning and doffing of respirators and work clothes shall be accomplished using the "buddy" system, involving two employees assisting each other to ensure full and satisfactory compliance with the establish procedures. The procedures

described in this document for clean room (entry), shower room (entry), equipment room (entry), work area and equipment room (exit), shower room (exit) and clean room (exit) for pressure-demand SAR and pressure-demand SAR/SCBA are made, by reference, part of these specifications.

Chapter 3 Worker Protection

3.1 Training Prior to Engaging in Abatement Work:

- 3.1.1 The contractor shall ensure that workers are trained in accordance with OSHA 29 CFR 1926.1101 and this section. Workers shall be trained and be knowledgeable on the following topics:
- Methods of recognizing ACM and/or PACM.
 - Health effects of asbestos exposure.
 - Effects of smoking and asbestos exposure.
 - Activities that could result in hazardous exposures.
 - Protective controls, practices and procedures to minimize exposure including engineering controls, work practices, respirators, housekeeping procedures, hygiene facilities, protective clothing, decontamination procedures, emergency procedures, and waste transportation and disposal.
 - Review OSHA 29 CFR 1910.134 for respirators.
 - Medical surveillance program.
 - Review OSHA 29 CFR 1926.1101.
 - Review this section of the project specifications.

3.2 Medical Examination:

- 3.2.1 The contractor shall provide medical examination for all workers and any other employees entering the work area per OSHA 29 CFR 1926.1101 regardless of exposure level. In addition, the contractor's physician shall perform an evaluation of each individual's ability to work in heat stress environments.

3.3 Protective Clothing:

- 3.3.1 The contractor shall provide all safety clothing and equipment required by OSHA for personal protection for all workers. These items might include, but are not limited to, steel-toed boots, hard hats, eye protection, hearing protection, gloves, etc. for all workers. The contractor is required to ensure all equipment is well-maintained and meets OSHA requirements for personal protection. Provide all persons entering the work area with disposable full body coveralls, disposable head covers and eighteen inch (18") boot type covers. Ensure that disposable clothing integrity will not be compromised by employees. Provide disposable plastic or rubber gloves to protect hands. Cloth gloves may be worn inside the disposable gloves but shall not be used alone. Use tape to secure sleeves at the wrists and to secure foot coverings at the ankle.

3.4 Decontamination Procedures:

- 3.4.1 The contractor shall ensure that all workers adhere to the following personal decontamination procedures whenever they leave the work area:
- 3.4.1.1 Before exiting the work area, remove gross contamination from clothing using a HEPA vacuum.
- 3.4.1.2 When exiting the work area, remove disposable coveralls, and all other disposable clothes, head covers, and disposable footwear covers or boots in the equipment room.
- 3.4.1.3 Still wearing the respirator, and completely naked, proceed to showers. Showering is mandatory. Care must be taken to follow reasonable procedures in removing the respirator to

avoid asbestos fiber inhalation while showering. The following procedure is required as a minimum:

- Thoroughly wet body including hair and face. If using a PAPR, hold blower unit above head to keep canister dry.
 - With respirator still in place thoroughly wash body, hair, respirator facepiece, and all parts of the respirator except the blower unit and battery pack on a PAPR. Pay particular attention to clean seal between face and respirator and under straps.
 - Take a deep breath, hold it and/or exhale slowly and completely wash face and respirator. While still holding breath, remove respirator and hold it away from face before starting to breathe.
- 3.4.1.4 Carefully wash facepiece of respirator inside and out. If using PAPR, shut down in the following sequence, first cap inlets to filter cartridges, then turn off blower unit (this sequence will help keep debris which has collected on the inlet side of the filter from dislodging and contaminating the outside of the unit). Thoroughly wash blower unit and hoses. Carefully wash battery pack with wet rag. Be extremely cautious of getting water in battery pack as this will short out and destroy the battery.
- 3.4.1.5 Shower completely with soap and water. Rinse thoroughly.
- 3.4.1.6 Rinse shower room walls and floor prior to exit.
- 3.4.1.7 Proceed from shower to changing room and change into street clothes or into new disposable work items.
- 3.4.1.8 Dispose of wet filters from air purifying respirator.
- 3.4.1.9 Carefully wash facepiece of respirator inside and out.
- 3.4.1.10 Shower completely with soap and water. Rinse thoroughly.
- 3.4.1.11 Rinse shower room walls and floor prior to exit.
- 3.4.1.12 Proceed from shower to changing room and change into street clothes or into new disposable work items.

3.5 Limitations within Work Area:

- 3.5.1 The contractor shall ensure that workers do not eat, drink, smoke, chew gum or tobacco, or in any way break the protection of the respiratory protection system in the work area.

3.6 Emergency Fire Exit:

- 3.6.1 As per this specification and the abatement design drawings when provided, the contractor must maintain easy access to all emergency exits. If an emergency exit must be covered with 6 mil poly as a critical barrier for asbestos containment, do the following:
- 3.6.1.1 Post Exit signs.
 - 3.6.1.2 Tape a utility knife to the wall next to the exit for cutting the poly.
 - 3.6.1.3 Red paint or red duct tape should "frame" the exit and the knife, making it both visible and easy to find.

3.7 Emergency Fire Plan:

- 3.7.1 Go through the fire exit procedures with all persons working in the building.
- 3.7.2 In case of fire, use the stairs, not the elevator.
- 3.7.3 Post emergency telephone numbers.
- 3.7.4 Place easily accessible fire extinguishers in each work area.

Chapter 4 Decontamination Facilities:

4.1 Description:

- 4.1.1 Provide each work area with separate PDF and EDF when feasible. Ensure that the PDF is the only means of ingress and egress from the work area and that all equipment, bagged waste material and other material exit the work area only through the EDF.

4.2 General Requirements:

- 4.2.1 All persons entering and exiting the work area shall follow the entry and exit procedures required by the applicable regulations and this specification. Process all equipment and materials exiting the work area through the EDF and decontaminate as required by this specification. Construct walls and ceilings of PDF and EDF, airtight with at least six (6) millimeter opaque polyethylene sheeting and attach to existing building components or to a temporary frame-work. Use a minimum of two (2) layers of reinforced six (6) millimeter polyethylene to cover floor under PDF. Construct doors from overlapping polyethylene sheets so that they overlap adjacent surfaces. Weigh sheets at bottom so that they quickly close after release. Put arrows on sheets showing direction of overlap and travel. If the building is partially occupied, construct solid barriers on the public side to protect sheeting. Construct rigid enclosures as indicated on drawings or when necessary.
- 4.2.2 Adequate toilet facilities shall exist either in the clean room adjacent to the PDF or shall be readily nearby.

4.3 Temporary Utilities to PDF and EDF:

- 4.3.1 The contractor shall provide temporary water service connection to the PDF and EDF. Provide back-flow protection at the point of connection to the owner's system. Provide UL rated electric hot water heater to supply hot water at a minimum of 100°F to the showers of the PDF.
- 4.3.2 Water supply must be properly pressurized and temperature balanced at shower discharge and be secured at the shower and at the source at the end of each work shift to prevent flooding or water damage to other building components from ruptured hoses.

4.4 Personnel Decontamination Facilities (PDF):

- 4.4.1 The contractor shall provide a PDF consisting of serial arrangement of clean room, shower room and equipment room. Provide adequately sized PDF to accommodate the number of employees scheduled for the project. The center chamber of the three chamber PDF shall be fitted with as many portable walk-through shower stalls as necessary so that all employees will be able to go through the entire decontamination procedure within 15 minutes. There shall be a minimum of one (1) shower per six full work shift persons calculated by the largest work shift. Construct PDF of opaque or colored polyethylene for privacy. Construct PDF so that it will not allow for parallel routes of exit without showering.
- 4.4.2 The clean room of the PDF must be physically and visually separated from the rest of the building for the purpose of workers changing into protective clothing or dressing into street clothing. Construct using six (6) millimeter minimum thickness polyethylene sheeting to provide an airtight room. Provide a minimum of two (2), three (3) feet wide flapped airlocks constructed from sheets of polyethylene. One (1) airlock shall be from the outside and one (1) of two (2) from the shower. Keep the floor of this room dry and clean at all times. Do not allow over-flow from shower into this room. Damp wipe all surfaces twice after each shift change with a disinfectant solution. Provide in this room an adequate supply of disposable bath towels and disposable protective clothing. Provide at a minimum, hooks for employees clothes and chair to sit on. Provide a portable Type "ABC" fire extinguisher in this room as per NFPA Standard 10. Require all persons to remove all street clothes in this room and dress in disposable protective clothing and respiratory protection equipment. Ensure that any person entering this room will do so either from the outside with street clothes or from the showers completely naked and thoroughly washed. If a female is required to enter or exit

the work area make all necessary provisions to ensure her privacy throughout the decontamination process.

4.4.3 The shower room of the PDF provides a completely water tight operational compartment to be used for transit of all personnel entering the work area from the changing room, or for showering by all persons headed out of the work area after undressing in the equipment room. Construct each stall and shower walls so that water running down the walls will drip into the shower pan. Install a freely draining smooth wooden floor on top of the shower pan. Separate this room from the rest of the building and the equipment room and clean room with airtight walls fabricated of a minimum six (6) millimeter polyethylene. Provide splash-proof entrances to clean and equipment rooms with two (2), three (3) feet wide flapped airlocks constructed of polyethylene.

4.4.3.1 Provide shower heads and controls, temporary cold and hot water, drainage, soap dish, and a continuous supply of soap. Maintain sanitary conditions at all times. Arrange controls so that a single individual can shower without assistance. Pump waste water to drain or storage drum for disposal. If pumped to drain, provide twenty (20) micron and five (5) micron waste water filters. Change filters daily. Locate filters inside shower so that water lost during filter changes drains into shower pan. Hose down all surfaces of the shower room after each shift and clean debris from the shower pan. Dispose of residue as asbestos contaminated waste.

4.4.4 The equipment room of the PDF provides a completely airtight compartment to be used to store work equipment, reusable footwear and warm clothing and as a transit and change station. Separate this room from the work area and showers with airlocks three (3) feet wide, constructed of three (3) six (6) millimeter polyethylene sheets on the work area side and two (2) on the shower side. Separate this room from the work area and other rooms with airtight walls and ceiling constructed of maximum six (6) millimeter polyethylene sheeting. If the airborne asbestos levels in the work area are expected to be higher than .5 f/cc, add an intermediate cleaning space between the equipment room and the work area. Clean all surfaces (by damp wiping) of the equipment room after each shift change. Provide an additional floor layer of six (6) millimeter clear polyethylene sheeting per work shift change and remove contaminated layer after each work shift. Provide temporary electrical sub-panel in this room to accommodate any power tools and equipment in work area. Provide benches for workers to sit. Provide a walk-off pan in the work area outside of the equipment room for persons to clean foot-wear when exiting the work area.

4.4.5 Small Asbestos Projects (mini-containment): Enclosure requirements. A personal decontamination enclosure system shall consist of, at least, a shower room and a clean room separated from each other by an airlock and from the work area and other areas by curtained doors. All other provisions for large asbestos projects shall apply. Equipment storage, personal gross decontamination, and removal of clothing shall occur in the work area just prior to entering the shower. **NOTE:** The full personal decontamination enclosure specified for large asbestos projects is recommended for mini-containments.

4.5 Equipment and Waste Decontamination Facilities (EDF):

4.5.1 The contractor shall provide an EDF consisting of a serial arrangement of wash room and holding room for removal of equipment and ACM and/or PACM waste from work area. Do not allow entry or exit of people through EDF other than in emergencies. Clean debris and residue from inside EDF on a daily basis. Wipe down or hose down all surfaces after each shift and clean wash pan of debris. See Chapter 15 for waste/equipment removal through EDF.

4.5.2 Pre-clean waste bags and equipment before moving into the wash room.

4.5.3 Provide wash room for cleaning of equipment and bagged or containerized ACWM passed from the work area. Construct wash room of framing and polyethylene sheeting, at least six (6) millimeter in thickness. Locate room so that ACWM, after being wiped clean, can be passed to a holding room. Separate this room from the work area by a triple flap airlock of six (6) millimeter polyethylene sheeting.

- 4.5.4 Provide a holding room as a drop location for equipment and bagged ACWM passed from the wash room. Construct holding room of framing and polyethylene sheeting, at least six (6) millimeter thickness. Separate the holding room from the wash room with a triple flap airlock and another solid, lockable door to the outside.
- 4.5.5 Where there is only one egress from the work area, the holding area of the waste decontamination enclosure system may branch off from the equipment decontamination room, which doubles as a waste wash room, of the personal decontamination enclosure or pass completely through the PDF.
- 4.5.6 In small asbestos projects where only one egress from the work area exists, the shower room may be used as a waste wash room. In this instance, the clean room shall not be used for waste storage, but shall be used for waste transfers to carts, which shall be immediately removed from the clean room.

Chapter 5 Negative Pressure Filtration Systems:

5.1 General Negative Pressure Requirements:

- 5.1.1 The contractor shall provide enough HEPA filtered negative air machines (HEPA Units) to completely exchange the work area air four (4) times per hour. The contractor shall demonstrate the number of HEPA Units needed per work area for four (4) room air changes by calculating the volume flow rate (cfm) delivered by each HEPA Unit under a two inch (2") pressure drop across filters. Provide at least one standby HEPA Unit in the event of a HEPA Unit failure or emergency such as contamination in surrounding non-work area. All large and small asbestos projects shall employ HEPA Unit equipment ventilation.

5.2 HEPA Units:

- 5.2.1 The cabinet shall be constructed of steel or other durable materials able to withstand damage from rough handling and transportation. The width of the cabinet should be less than thirty (30) inches to fit through standard-size doors. The cabinet shall be factory-sealed to prevent asbestos-containing dust from being released during use, transport, or maintenance. Access to and replacement of all filters shall be from intake end. The unit shall be mounted on casters or wheels.
- 5.2.2 The rate capacity of the fan is the usable air-moving capacity under actual operating conditions. Use centrifugal-type fan.
- 5.2.3 The final filter shall be a HEPA type. The filter media (fold into closely pleated panels) must be completely sealed on all edges with a structurally rigid frame.
 - 5.2.3.1 Locate a continuous rubber gasket between the filter and the filter housing to form a tight seal.
 - 5.2.3.2 Each filter shall be individually tested and certified by the manufacturer to have an efficiency of not less than ninety-nine point ninety-seven (99.97) percent when challenged with three (3.0) μm dioctylphthalate (DOP) particles. Each filter shall bear an appropriate label to indicate ability to perform under specified conditions.
 - 5.2.3.3 Each filter shall be marked with the name of the manufacturer, serial number, air flow rating, efficiency and resistance, and the direction of air flow.
- 5.2.4 Pre-filters, which protect the final filter by removing the larger particles, are required to prolong the operating life of the HEPA filter. Two stages of pre-filtration are required. The first-stage pre-filter shall be a low-efficiency type for particles ten (10) μm and larger. The second-stage pre-filter shall have a medium efficiency effective for particles down to five (5) μm . Pre-filters shall be installed either on or in the intake grid of the unit and held in place with special housings or clamps.
- 5.2.5 Electrical components shall be approved by the National Electrical Manufacturers Association (NEMA) and Underwriter's Laboratories (UL). Each HEPA Unit shall be equipped with overload protection sized for the equipment. The motor, fan, fan housing, and cabinet shall be grounded.

5.2 Pressure Differential:

- 5.2.1 The contractor shall provide a fully operational negative air system within the work area continuously maintaining a pressure differential across work area enclosures of 0.02 inches of water. Demonstrate to the owner the pressure differential by use of a pressure differential meter or a manometer before disturbance of any ACM.

5.3 Auxiliary Generator:

- 5.3.1 When required, the contractor shall provide an auxiliary gasoline or diesel powered generator located outside of the building in a location protected from the weather. Arrange so that if a power failure occurs the generator automatically starts and supplies power to a minimum of fifty percent (50%) of the HEPA Units in operation.

5.4 Supplemental Make-up Air Inlets:

- 5.4.1 The contractor shall create, where required for proper air flow through the work area, make-up air inlets to allow air from outside the building into the work area. Locate auxiliary makeup air inlets as far as possible from the HEPA Unit (e.g., on an opposite wall), off the floor (preferably near the ceiling), and away from barriers that separate the work area from occupied clean areas. Cover with flaps to reseal automatically if the negative pressure system should shut down for any reason. Use spray adhesive on the flap and around the opening so that flap seals if it closes.

5.5 Testing the System:

- 5.5.1 The contractor shall test the negative pressure system before any ACM and/or PACM is wetted or removed. After the work area has been prepared, the decontamination facility set up, and the exhaust machines(s) installed, start the HEPA Unit one at a time. Demonstrate operation and testing of negative pressure system. HEPA Units connected in series shall be considered a single HEPA Unit for the test. A minimum of one HEPA Unit, having a capacity at least equal to the primary unit, shall be used as back-up and for primary unit filter changes.

5.6 Demonstration of Negative Air System Operation:

- 5.6.1 The contractor shall demonstrate the operation of the negative pressure system to include, but not limited to, the following:
 - 5.6.1.1 Plastic barriers and sheeting should move lightly in toward work area.
 - 5.6.1.2 Curtain of decontamination units move lightly in toward work area.
 - 5.6.1.3 Noticeable movement of air through the decontamination unit. Use smoke tube to demonstrate air movement from clean room to shower room, from shower room to equipment room, and from equipment room to work area.
 - 5.6.1.4 Use a differential pressure meter or manometer to demonstrate a pressure difference of at least 0.02 inches of water across every barrier and to the outside. Modify the negative pressure system as necessary to successfully demonstrate the above.

5.7 Use of System During Abatement Operations:

- 5.7.1 Start HEPA Units before beginning work and before any ACM and/or PACM is disturbed. After abatement work has begun, run HEPA Units continuously to maintain a constant negative pressure until decontamination of the work area is complete. Do not turn off HEPA Units at the end of the work shift or when abatement operations temporarily stop.
- 5.7.2 Do not shut down negative air system during abatement operations procedures, unless authorized by the owner in writing.

- 5.7.3 Start abatement work at a location farthest from the HEPA Units and proceed toward them. If an electric power failure occurs, immediately stop all removal work and do not resume until power is restored and all HEPA Units are operating again.
- 5.7.4 At completion of abatement work, allow exhaust machines to run as specified under this specification or as required by regulation to remove airborne fibers that may have been generated during abatement work and cleanup and to purge the work area with clean air. HEPA Units may be required to run after decontamination if dry or only partially wetted asbestos material was encountered during any abatement work.

5.8 Openings in Enclosure:

- 5.8.1 Openings made in the enclosure system to accommodate these HEPA Units shall be made air-tight with tape and/or caulking. Where possible, only the intake and the filter access panel shall remain within the work area to permit filter changing, while minimizing HEPA Unit contamination and the likelihood of contamination of non-working areas.

5.9 Installation and Care:

- 5.9.1 HEPA Units shall be exhausted to the outside of the building or structure and away from occupied areas. Proper installation, air monitoring and daily inspections shall be conducted to insure that the ducts do not release asbestos into uncontaminated areas. Fans, ducts and joints shall comply with the following:
 - 5.9.1.1 Ducts of at least equivalent shape and dimensions as that of the HEPA Unit exhaust shall be used to exhaust to the outside of the building or structure.
 - 5.9.1.2 All fans, ducts and joints shall be sealed, braced and supported to maintain an air-tight system.

5.10 Exhaust Location:

- 5.10.1 At no time shall the HEPA Unit exhaust within 50 feet of air intake or adversely affect the air intake of the building or structure or other buildings or structures.

5.11 Dismantling the System:

- 5.11.1 When a final inspection and the results of the final air tests indicate that the area has been decontaminated, HEPA Units may be removed from the work area. Before removal from the work area, remove and properly dispose of pre-filters, and seal intake to the HEPA Unit with six (6) millimeter polyethylene to prevent environmental contamination from the pre-filter.

Chapter 6 Materials and Equipment

6.1 Materials:

- 6.1.1 It is the contractor's responsibility to furnish all materials and equipment to complete the asbestos removal project and all materials used for this project are subject to the following general requirements.
 - 6.1.1.1 All materials delivered to the job site must be in the original packages, containers or bundles bearing the name of the manufacturer and the brand name. Replacement insulation/materials must be equivalent to those removed and in conformance with all acceptable codes, including installation.
 - 6.1.1.2 The contractor shall store all materials that are subject to damage off the ground away from wet or damp surfaces and under sufficient cover to prevent damage or contamination.

- 6.1.1.2.1 Damaged or deteriorating materials shall not be used and shall be removed from the premises. Materials that become contaminated with asbestos shall be disposed of in accordance with all applicable regulations and procedures herein.
- 6.1.1.3 The contractor shall provide plastic sheeting of 6 and 12 millimeter thickness in widths large enough to minimize the frequency of joints.
- 6.1.1.4 The tape used for sealing of adjacent sheets of plastic sheeting and for attachment of plastic sheets to finished and unfinished surfaces of dissimilar material must be capable of adhering under dry and wet conditions including use of amended water.
- 6.1.1.5 The surfactant (wetting agent) to be used consists of 50% polyoxyethylene ether and 50% polyoxyethylene/polyglycol ester or the equivalent. This shall be mixed with water to provide a concentration of one (1) ounce surfactant to five (5) gallons of water or to the manufacturer's recommendation. The Contractor shall have available a sufficient quantity of equipment to mix and spray the wetting agent.
- 6.1.1.6 The contractor shall supply a sufficient number of appropriately labeled six (6) millimeter clear plastic bags or other approved containers suitable to receive and retain any asbestos containing or asbestos contaminated materials until disposal at an approved site. These bags and/or containers must be both air and water tight.
 - 6.1.1.6.1 These containers shall be labeled at a minimum in accordance with OSHA Regulation 1910.1001 and 1926.1101, and DOT Regulation 49 CFR Parts 171 & 172, Hazardous Substance: Final Rule.
 - 6.1.1.6.2 Labeled asbestos bags shall not be turned inside-out for the disposal of non-asbestos containing materials. Any material placed in a labeled asbestos bag whether inside-out or not shall be treated as ACWM.
- 6.1.1.7 The contractor shall supply all warning signs and labels as required by OSHA regulation 29 CFR 1910.1001 and 1926.1101.
- 6.1.1.8 The contractor shall provide (if required) an encapsulant of the bridging and/or penetrating type.
 - 6.1.1.8.1 The encapsulant selected should be able to withstand most impact or abrasion and protect the encapsulated surface.
 - 6.1.1.8.2 The encapsulant selected for use by the contractor shall be one of the types demonstrating probable effective performance in tests conducted by an independent testing laboratory.
 - 6.1.1.8.3 The encapsulant shall have high flame retarding characteristics and a low toxic fume and smoke emission rating. Ratings shall be as follows:
 - ASTM 84 Flame Spread Class A
 - 6.1.1.8.4 The encapsulant selected should not be noxious or toxic to application workers or to subsequent users of the building.
 - 6.1.1.8.5 The encapsulant selected should have acceptable weathering and aging characteristics.
 - 6.1.1.8.6 The encapsulant selected should be capable of adhering to the surfaces exposed during this removal project.
- 6.1.1.9 The contractor shall provide all other materials such as lumber, nails, hardware, etc., which may be required to construct and dismantle the decontamination area and the barriers that isolate the work area.

6.2 Tools and Equipment:

- 6.2.1 The contractor shall provide suitable tools for the stripping, removal, encapsulation and/or disposal activities including but not limited to: hand-held scrapers, nylon brushes, sponges, rounded edge shovels, brooms, carts, etc.
- 6.2.2 The contractor shall provide scaffolding as required to accomplish the specified work and shall meet all applicable safety regulations concerning the use of scaffolding and any open structural members on scaffolding shall be sealed to prevent incursion of asbestos.
- 6.2.3 The contractor shall also have on-site industrial dry/wet vacuums equipped with High Efficiency Particulate Air filtration approved for asbestos removal. Power tools used to drill, cut into, or otherwise disturb asbestos material shall be equipped with HEPA filtered local exhaust ventilation.
 - 6.2.3.1 These HEPA filters must be capable of 99.97% efficiency at 0.3 microns or larger.
- 6.2.4 The contractor shall have available HEPA Units capable of filtering asbestos fibers of 0.3 microns or larger at 99.97% efficiency.
 - 6.2.4.1 The contractor shall take whatever action necessary, including the installation of additional circuit breaker panel boards, if required, to ensure adequate circuits of sufficient amperage capable of powering HEPA Units uninterrupted for the duration of the project.
- 6.2.5 HEPA Units shall be maintained as per manufacturer's requirements. The contractor shall produce evidence of proper maintenance and periodic testing if requested by owner.
- 6.2.6 The contractor shall have equipment of sufficient size and capacity to remove contaminated gravel/soil when required.

Chapter 7 Containment Barriers and Coverings of Work Area

7.1 Regulated Areas:

- 7.1.1 The contractor shall seal off the perimeter of the work area to completely isolate abatement areas and to contain all airborne asbestos contamination created by abatement work. Cover all surfaces of the work area to protect them from cross contamination, to facilitate more efficient clean-up, and to protect the finishes from the asbestos abatement work. Should the area beyond the seal off limits become contaminated as a consequence of the work, the contractor shall clean those areas in accordance with procedures described in this section at no additional cost to the owner.

7.2 Preparation Prior to Sealing-off:

- 7.2.1 Place all tools, scaffolding, staging, etc. necessary for the work in the area to be isolated prior to erection of temporary plastic sheeting enclosure. Remove all uncontaminated removable furniture, equipment, and/or supplies from the work area before commencing work, or completely cover with two layers of polyethylene sheeting at least six (6) millimeter thickness, secured in-place with duct tape. Such furniture and equipment shall be considered outside the work area unless covering plastic or seal is breached. Disable ventilating system or any other system bringing air into or out of the work area. Disable system utilizing positive means that will prevent accidental premature restarting of equipment, i.e., disconnecting wires, removing circuit breakers, lockable switch, etc. The environment of the work area shall be completely isolated from all other air flows in the building.

7.3 Control Access to Work Area:

- 7.3.1 The contractor shall ensure access to the work area is only through the PDF. All other means of access shall be closed off and sealed and warning signs displayed on the clean side of the sealed access. Where the work area is immediately adjacent to or within view of occupied areas, provide a visual barrier of opaque or black polyethylene sheeting at least six (6) millimeter in thickness so that the work procedures are not visible to building occupants. Where the area adjacent to the work

area is accessible to the public, construct a solid barrier on the public side with nominal two inch (2") x four inch (4") wood or metal studs on sixteen inch (16") centers, securely anchored to prevent movement, covered with minimum one half inch (1/2") plywood.

- 7.3.2 Provide warning signs at each visual and physical barrier per OSHA requirements.

7.4 Critical Barriers:

- 7.4.1 The contractor shall completely separate the work area from other portions of the building and the outside with sheet plastic critical barriers of at least one (1) layer of six (6) millimeter in thickness and sealed with duct tape. Individually, seal all ventilation openings (supply and exhaust), lighting fixtures, clocks, doorways, windows, convectors and speakers, and other openings into the work area with duct tape alone or with polyethylene sheeting of at least one (1) layer of six (6) millimeter in thickness, secured in-place with duct tape. Maintain seal until all work including project decontamination is completed. Take care in sealing off lighting fixtures to avoid melting or burning of plastic sheeting. Provide sheet plastic barriers at least six (6) millimeter in thickness as required to completely seal openings from the work area into adjacent areas. Seal the perimeter of all sheet plastic barriers with duct tape or spray adhesive or additional means as necessary and with owner approval.

7.5 Primary Barriers:

- 7.5.1 The contractor shall clean all contaminated furniture, equipment and supplies when present with a HEPA vacuum cleaner or wet cleaning, as specified in this section, prior to being moved or covered. Clean all surfaces in work area with HEPA vacuum or by wet wiping prior to the installation of any sheet plastic.

7.5.1.1 The entire work area is enclosed with 2 of six (6) millimeter polyethylene sheeting. Cover floor of the work area with two (2) individual layers of clear polyethylene sheeting, each at least six (6) millimeters in thickness, turned up walls at least 12 inches (12"). Form a sharp right angle, bend at junction of floor and wall so that there is no radius which could be stepped-on causing the wall attachment to be pulled loosened or breached. Use both spray adhesive and duct tape on all seams in floor covering. Locate seams top layer at right angles to seams in bottom layer. Install sheeting so that top layer can be removed independently of bottom layer. Cover carpets and wood floors with additional polyethylene as necessary. Remove all electrical and mechanical items, such as lighting fixtures, clocks, diffusers, registers, escutcheon plates, etc., which cover any part of the surface to be worked on. Cover all walls in work area including critical barrier sheet plastic barriers with 2 layers of polyethylene sheeting, at least six (6) millimeters in thickness, mechanically supported and sealed with duct tape or spray adhesive in the same manner as "critical barrier" sheet plastic barriers. Tape all joints including those joining with the floor covering. It is the contractors responsibility to protect all surfaces, such as wood floors and carpets, from damage.

7.5.1.2 Elevator: Cover walls, floor and ceiling of elevator with two (2) layers of six (6) millimeter polyethylene. Arrange entry to work area so that the elevator door is in a positively pressurized space outside the clean room of the decontamination unit. At completion of work the elevator shall be cleaned as per this specification.

7.5.1.3 Stairs and Ramps: Where stairs or ramps are covered with plastic, provide three quarter inch (3/4") exterior grade plywood treads securely held in place over plastic. Do not cover stairs or ramps with unsecured sheet plastic. Do not cover rungs or rails with any type of protective materials.

7.6 Extension of Work Area:

- 7.6.1 If the enclosure barrier is breached in any manner that could allow the passage of asbestos debris or airborne fibers, then, where possible, add the affected area to the work area. Enclose it as required by this section and decontaminate it as described elsewhere in this specification. If

contaminated area cannot be added to the work area, decontamination measures shall start immediately after contamination is discovered and all abatement work will stop in the work area. Decontamination procedures will continue until exposure returns to background levels.

7.7 Secondary Barriers:

- 7.7.1 If required, provide an additional layer of plastic as a drop cloth to protect the primary layer from debris generated by the asbestos abatement work. Replace as necessary, but once a shift at a minimum.

Chapter 8 Work Area Preparation

8.1 Preliminary Procedures:

- 8.1.1 The contractor shall be responsible for preparing the entire work area for asbestos removal. This includes preliminary work area preparation, work area isolation and worker decontamination systems. Workers shall be fully protected with respirators and protective clothing during the preparation phase of the work area and immediately prior to the first disturbance of asbestos containing or asbestos contaminated materials and until clean-up is completed. Preliminary work area preparations are subject to the following procedures.
 - 8.1.1.1 The contractor shall provide temporary power and lighting, and ensure safe installation of temporary power sources and equipment as per OSHA regulations for temporary electrical systems.
 - 8.1.1.2 The contractor shall ensure that all furniture, machinery, equipment, draperies, blinds, etc., which the owner is required to remove have been removed prior to pre-clean. When movable objects are within the work area pre-clean using HEPA filtered vacuum equipment and/or wet wiping methods as appropriate. Remove such items from the work area and store in a location to be determined by the owner.
 - 8.1.1.3 Shutdown and lock-out all electrical circuits. The contractor shall provide temporary power and lighting to all work areas. Exact electrical arrangements will be tailored to the particular space and systems involved. All electrical circuits will be turned off at the electrical panel box outside the removal area. Potential for electrical shock is a major threat to life in a work area where water will be sprayed on ceilings, conduits, lighting fixtures and other electrical items. Electrical lines which are used to power work lights and equipment will conform to all electrical safety standards and will be protected by a ground fault interrupter. The owner may monitor shutdown.
 - 8.1.1.4 Positive pressurization shall be restricted to circumstances where HVAC must service the remainder of the building or structure and the HVAC equipment is in the work area or the ducts run through the work area. The appropriate HVAC duct and plenum outlets, inlets and exhaust dampers shall be sealed with sheathing and caulking, covered with a double layer of at least six (6) mil plastic sheeting and taped air-tight. The HVAC duct and plenum joints shall be taped air-tight. The mixing and balancing damper positions shall be altered and the return fan(s) shall be shut down to produce the required positive pressures. The supply fan(s) shall be placed in a manual "on" position to prevent shut down by fail safe mechanisms. Precautions shall be taken during abatement activities to insure that the ducts, seals and static pressure lines are not damaged.
 - 8.1.1.5 Contaminated HVAC filters shall be handled and disposed of as ACWM. The ducts and filter assembly shall be wet cleaned and/or HEPA vacuumed where system air samples and/or dust samples indicate asbestos contamination.

8.2 Other Work Areas:

8.2.1 When abatement is to be performed within a boiler room, boilers shall be shut down and the burner and boiler accesses and breech shall be sealed until abatement is completed and satisfactory air monitoring results have been achieved.

8.2.2 Elevators running through the work area shall be shut-down except as noted herein:

8.2.2.1 In projects where the elevator cannot be shut-down, the hoist-way door frames shall be enclosed with nominal 2" x 4" framing, sixteen (16) inches center-to-center, covered with five-eighths ($\frac{5}{8}$) inch sheathing, preferably plywood or similar building material and caulked at all seams. The enclosures shall be covered with two (2) seamless layers of at least six (6) mil plastic sheeting taped air-tight. A final larger layer of at least six (6) mil plastic sheeting shall be taped air-tight, but with slack, forming a larger perimeter diaphragm to sense air movement caused by elevator operation.

8.2.2.2 Elevator shaft ports for pressure equalization when within the work area, shall be vented to the outside or non-working area using oversized solid-walled ducts or chambers constructed of a minimum of three-eighths ($\frac{3}{8}$) inch sheathing over nominal two inch (2") x four inch (4") framing, sixteen inches (16") center-to-center. The joints shall be caulked and the ducts or chambers shall be sealed with two (2) layers of at least six (6) mil plastic sheeting and duct tape. This system shall be subjected to and pass a negative pressure test daily.

8.3 Glove Bag or Mini-Containment Projects:

8.3.1 All project areas shall be vacated by the occupants prior to work area preparation and until full abatement has been achieved.

8.3.2 The project area shall be isolated by cordoning it off with barrier tape and shall be accessible through only one entrance/exit.

8.3.3 Caution signs shall be posted at any location and approaches to a location wherever airborne concentrations of asbestos may exceed ambient background levels. Signs shall be posted that permit a person to read the sign and take the necessary protective measures to avoid exposure.

8.4 Pre-abatement Settling Period:

8.4.1 Upon completion of the construction of all plastic barriers and decontamination systems, but prior to actual abatement activities, adequate time shall be allowed to ensure that barriers settle in-place and remain intact.

8.5 Inspection of Barriers:

8.5.1 All plastic barriers including decontamination facilities shall be inspected at least twice a day by the abatement supervisor with observations entered in the daily log. Repair any damage immediately.

8.6 Testing of Barriers:

8.6.1 With the HEPA Units in operation, the abatement supervisor shall use smoke tubes to test work area barriers and enclosures. This shall be done prior to beginning abatement and once a day thereafter until clearance has been obtained. Record findings in the daily log.

Chapter 9 Worker Decontamination

9.1 Contractor's Written Decontamination and Work Procedures:

9.1.1 The PDF shall be provided outside the work area and attached where persons will enter or exit the work area. The contractor shall supply written decontamination and work procedures, to be posted in the clean room of the PDF.

9.2 Entering Work Area:

9.2.1 All personnel entering the work area shall adhere to the following procedures:

- Personnel shall remove all clothes and put on protective disposable coveralls.
- Personnel shall put on clean respirators.
- Personnel then may enter the work area.
- No clothing other than disposable coveralls shall be worn into the work area and subsequently be removed from the work area (i.e., all clothing worn into the work area shall be treated as asbestos waste.)

9.3 Decontamination Procedures:

9.3.1 Personal decontamination procedures shall be followed by all personnel (workers and visitors) each time they leave the work area per Chapter 3 - Worker Protection, Section 3.4 Decontamination Procedures.

9.4 Activities Not Permitted:

9.4.1 Workers and visitors shall not eat, drink, smoke or chew gum or tobacco in the clean room. The clean room shall not be used for equipment or tool storage or as an office.

9.5 First Disturbances:

9.5.1 Workers shall be fully protected with respirators and protective clothing during the preparation phase of the work area and immediately prior to the first disturbance of asbestos-containing or asbestos contaminated materials and until clean-up is completed.

9.6 Posting of Signs:

9.6.1 The entrance of the clean room should have a lockable door that has a sign in English, Spanish, and any/all other appropriate languages that may be required that reads:

**DANGER
ASBESTOS
MAY CAUSE CANCER
CAUSES DAMAGE TO LUNGS
AUTHORIZED PERSONNEL ONLY
WEAR RESPIRATORY PROTECTION AND PROTECTIVE CLOTHING IN THIS AREA**

9.6.2 Signs shall be posted at all entrances to the work area including all sealed entrances.

9.7 Inspection of Work Area and Decontamination Enclosures:

9.7.1 It is the contractor's responsibility to contact the owner upon completion of the enclosure system. The following applies: Prior to any asbestos containing material being removed, the contractor shall notify the owner that the enclosure system is completed so that it may be inspected.

9.7.2 All plasticizing and sealing of work area, building of worker and equipment decontamination enclosure systems, preparation of the negative air system, and all equipment required for the project shall be completed, tested and properly stored or placed prior to notification of the owner.

9.8 Maintenance of the Work Area and the Decontamination Enclosure

9.8.1 It is the contractor's responsibility to maintain the work area and decontamination systems.

Chapter 10 Removal of ACM and/or PACM

10.1 Competent Person Supervision:

10.1.1 All Class I and II Work (as defined by OSHA), including installation and operation shall be supervised by a competent person as defined in 29 CFR 1926.1101. ACM and/or PACM removal work areas are specified in Section 2 of the bid document.

10.2 Wetting Materials:

- 10.2.1 Provide water to which a surfactant has been added. Use a mixture of surfactant and water which results in wetting of the ACM and/or PACM and retardation of fiber release during disturbance of the material.
- 10.2.2 Provide a penetrating type encapsulant designed specifically for removal of ACM and/or PACM. Use a product which results in encapsulating of the ACM and/or PACM and retardation of fiber release during disturbance of the material.
- 10.2.3 During removal procedures involving amosite/crocidolite, special care must be taken to ensure proper wetting.

10.3 Wet Removal of ACM and/or PACM:

- 10.3.1 Thoroughly wet ACM and/or PACM to be removed prior to stripping and/or tooling to reduce fiber dispersal into the air. Use a fine spray (mist) of amended water or penetrating encapsulant. Saturate material sufficiently to wet to the substrate without causing excess dripping. Allow time for water or penetrating encapsulant to penetrate material thoroughly. If amended water is used, spray material repeatedly during the work process to maintain a continuously wet condition. If a penetrating encapsulant is used, apply in strict accordance with manufacturer's written instructions. Perforate outer covering of any insulation which has been painted and/or jacketed in order to allow penetration of amended water or penetrating encapsulant, or where necessary, carefully strip away while simultaneously spraying amended water or penetrating encapsulant on the installation to minimize dispersal of asbestos fibers into the air.
- 10.3.2 If ACM and/or PACM does not wet well with amended water because it is coated or thick, remove as follows:
 - 10.3.2.1 Mist work area continuously with amended water whenever necessary to reduce airborne fiber levels.
 - 10.3.2.2 Remove saturated ACM and/or PACM in small sections from all areas. Do not allow material to dry out. As it is removed, simultaneously pack material while still wet into disposal bags. Twist neck of bags, bend over and seal with minimum three wraps of duct tape. Clean outside and move to wash down station adjacent to material decontamination facility.
 - 10.3.2.3 Spray fireproofing or architectural finish on scratch coat with a fine mist of amended water or penetrating encapsulant. Allow time for materials to saturate to substrate. Do not over saturate causing excess dripping. Scrape materials from substrate. Remove materials in manageable quantities and control the descent to staging or floor below. If over ten feet (10'), use drop chute to contain material through descent. Remove residue remaining on scratch coat after scraping using stiff nylon bristled hand brush. If a penetrating encapsulant is used remove residue completely before encapsulant dries. Keep residue wet until completely removed.
 - 10.3.2.4 Spray fireproofing or architectural finish on wire lath with a fine mist of amended water or penetrating encapsulant. Allow time to completely saturate material. Do not over saturate to cause excess dripping. If surface of material has been painted or otherwise coated, cut small holes as required and apply amended water or penetrating encapsulant from above. If entire ceiling system is to be removed, cut wire lath into two feet by six feet (2' x 6') sections and cut hanger wires. Roll up complete with ACM and/or PACM and hand place in disposal bag. Do not drop on floor. After removal of lath and ACM and/or PACM, remove any over spray on decking and structure above using stiff nylon bristled brush. Depending on hardness of over-spray, scrapers may be necessary to remove over-spray.
 - 10.3.2.5 Remove outer layer of pipe wrap while spraying amended water in order to saturate ACM and/or PACM. Spray with a fine mist of amended water or penetrating encapsulant. Allow time to saturate material to substrate. Cut bands holding performed pipe insulation, silt jackets at seams, remove and hand place in a disposal bag. Remove job molded fitting insulation in

chunks and hand place in a disposal bag. Do not drop to floor. Remove any residue on pipe or fitting with stiff bristle nylon hand brush or scraper/wire brush. In locations where pipe fitting insulation is removed from pipe insulated with non-asbestos containing material, remove approximately 6 inches (6") of the non-asbestos containing material adjacent to ACM removed.

10.4 Limited Removal of ACM and/or PACM with Glove Bag:

10.4.1 If any conflict between the below supplied information and OSHA 1926.1101 arises, OSHA 1926.1101 shall apply. In using the glove bag method for removing pipe insulation, decontamination procedures may not be required. However, disposable clothing, respirators, critical barriers and negative air may be required. Discard the clothing in accordance with applicable regulations. Glove bags will be utilized in work areas specified in Section 2 of the bid document.

10.4.1.1 The negative air requirement may be satisfied in either of two ways:

10.1.1.1.1 Create negative air in the glove bag, relative to the room; or

10.4.1.1.2 Create negative air in a "mini containment" relative to outside the "mini containment."

10.4.1.2 The former can be accomplished using a powered HEPA vacuum source. **Caution:** If too much vacuum is achieved, the glove bag may collapse.

10.4.2 Procedures are as follows.

10.4.2.1 Prior to any glove bag ACM and/or PACM removal:

10.4.2.1.1 Turn off heating, ventilation and air conditioning systems in work area. Provide temporary heating and cooling as required. Critical barrier all openings and cover entrance with a polyethylene flap.

10.4.2.1.2 Polyethylene sheets (10' x 10' - 6 millimeter minimum) shall be used as drop cloths on the floor or platform under glove bag removal.

10.4.2.1.3 Purchase or fabricate bags of 6 millimeter (minimum) thick clear plastic material. Have present in the work area all materials and equipment for installation of glove bags and the removal and disposal of asbestos.

10.4.2.1.4 Have for each individual project both an emergency bag repair and an emergency "spill" plan for the entire work area.

10.4.2.2 Install the glove bag according to the manufacturer's recommendations. At completion of the installation, conduct a smoke test to confirm that there are no leaks at any of the seals.

10.4.2.3 Cut the material covering along the top seam and begin wetting the material. Cut covering all around the section to be removed. Remove ACM and/or PACM in small sections. Lower the material gradually into the glove bag. Do not permit material to drop. Dropping material is more likely to cause loss of glove bag seal.

10.4.2.4 Remove approximately 6 inches (6") of the non-asbestos containing material adjacent to ACM removed. Wash pipe clean.

10.4.2.5 Provide HEPA filter vacuum. Run vacuum during cutting, removal and to clean area after removal.

10.4.2.6 When ACM covered piping and fittings are to demolished and removed from the work area, wet the section of piping and pipe fitting(s) to be removed, wrap with 6 millimeter polyethylene sheets, cut out the entire pipe section including pipe fitting(s) in such a way to minimize damage, seal the cut ends and place in labeled container for transporting to approved disposal site.

10.4.2.7 Where piping and/or fitting(s) are to remain, remove the asbestos from the pipe fitting and pipe section with a 6 millimeter plastic glove bag as follows:

- Spray asbestos with amended water to enhance penetration.
- Remove saturated asbestos material in small sections with tools in bag by teams, on staging platforms, if needed.
- Spray exposed pipe with amended water and clean with a nylon brush to ensure that no insulation materials remain on the pipe or joint.
- Spray the inside of the glove bag with water to ensure that there are no airborne asbestos fibers.
- Following removal of the ACM and/or PACM insulation, ensure that all visible material is inside the glove bag.
- Spray all tools in the glove bag with amended water while it is still attached.
- Pull one of the gloves inside out to the outside of the glove bag and place cleaned tools in the glove.
- Twist and tie off the glove in two places to facilitate keeping both the tools and the glove bag sealed as the glove is cut between the ties to remove the glove.
- Immerse the glove holding the tools in water. Remove the tools from the immersed glove and re-clean the tools.
- Evacuate the glove bag with a portable HEPA vacuum and while the bag is collapsed, squeeze bag below tool pouch, and twist bag. Seal bag with tape or locking ties, separating the waste from the removal area.
- Vacuum the inside of the top of the glove bag and unsealed portion of the glove bag below. Keep HEPA vacuum connected until the glove bag is removed.
- Cut the glove bag along the top and sides, then remove from the pipe.
- Wet pipe and wash the removal area thoroughly. Dispose of glove bag, material and disposable equipment at an approved disposal site.

10.4.2.8 Packed and sealed containers with the required labeling shall be delivered, by the contractor, to an approved disposal site. Labels and all necessary signs shall be in accordance with EPA and OSHA regulations.

10.4.3 Final Clearance and Removal:

10.4.3.1 Encapsulate surfaces formerly covered with ACM and/or PACM using a colored encapsulant that will be readily visible when dry.

10.4.3.2 Following this encapsulation, the immediate area around the removal location, including all poly sheets, shall be wet wiped with amended water and HEPA vacuumed.

10.4.3.3 Critical barriers at a given work area may only be removed after air-clearance is achieved in the work area as determined by either PCM or TEM air clearance methods. Section 2 of the bid document will provide details of clearance methods for each work area.

10.4.3.4 In the event that air clearance fails, re-cleaning is required using HEPA vacuuming and wet wipe cleaning the work area and re-taking air clearance sampling. These steps must be repeated alternately until the air clearance is achieved. Only then can critical barriers be removed.

10.4.4 Worker Protection:

10.4.4.1 An exposure assessment must be performed if workers are exposed to airborne asbestos fibers. Workers shall shower immediately after removal and proper disposal of work cloths. Glove bag workers shall wear full respiratory protection and protective clothing.

10.4.5 Personnel Decontamination Unit:

- 10.4.5.1 If wet decontamination is to be used, see section 3.4 “Decontamination Procedures.” The following describes use of dry decontamination procedures typically used in glove bag operations.
 - 10.4.5.1.1 Require all persons, without exception, to pass through this decontamination sequence for exiting from the work area for any purpose.
 - 10.4.5.1.2 Workers enter the work area wearing disposable coveralls and respirator.
 - 10.4.5.1.3 One worker or supervisor shall use the brush attachment on the HEPA vacuum to vacuum another worker or supervisor who will then reciprocate in kind.
 - 10.4.5.1.4 While still wearing respiratory protection, each worker or supervisor shall remove their coverall suit, turning it inside out while removing it. Roll up the suit, pack it in the hood and place the suit in a disposal bag. Then HEPA vacuum one another a second time.
 - 10.4.5.1.5 After each worker or supervisor has disposed of their coverall suit, HEPA evacuate the air from the disposal bag and twist the bag shut forming a neck. Triple wrap the bag with duct tape. Bend the neck back into itself (goose neck it) and seal the bag with a triple wrap of duct tape.
 - 10.4.5.1.6 If using PAPR, shut down by first capping inlets to filter cartridges. Then turn off the blower unit. Thoroughly wash the blower unit and hoses. Carefully wash the battery pack with a wet rag. Be extremely cautious to avoid getting water in the battery pack, as that would cause the pack to short out and would destroy the battery. Wash the respirator facepiece inside and out. At the completion of these steps, thoroughly wash face and hands with soap and water.

10.5 Removal of Vinyl Asbestos Floor Tile (VAT):

- 10.5.1 Remove vinyl asbestos floor tile (VAT) and associated asbestos containing mastic in accordance with these specifications and OSHA 1926.1101. VAT and associated asbestos containing mastic removal work areas are specified in Section 2 of the bid document.
- 10.5.2 When VAT and associated asbestos containing mastic is to be removed and such VAT and associated asbestos containing mastic is in a work area, remove the primary barriers from the floor only but not the walls, and remove VAT and associated asbestos containing mastic so that it does not become friable during removal. After removal of VAT and associated asbestos containing mastic, proceed with decontamination and final inspection and if required by contract documents air testing of the work area. Clearance requirements are stated in Section 2 of the bid document.
- 10.5.3 Where VAT and associated asbestos containing mastic is the only ACM and/or PACM to be removed in a room, the room shall be secured against entry by any unauthorized or untrained personnel. Post warning signs and erect temporary barricades. The removal shall be executed under the guidance and monitoring of the C.P.I.H. so that the non-friable VAT and associated asbestos containing mastic does not become friable during removal. After removal of VAT and associated asbestos containing mastic, the C.P.I.H. shall perform a final inspection of the room. Clearance requirements are stated in Section 2 of the bid document.
- 10.5.4 Removal of VAT and associated asbestos containing mastic shall be performed with wet methods and hand scrapers. Heating and/or the application of dry ice may be used also. Power tools, grinders or other machines which may produce any dust during removal of VAT and associated asbestos containing mastic are not allowed.

10.6 "Lock-back" Encapsulant:

- 10.6.1 Lock-back encapsulant is an integral part of ACM and/or PACM removal. At the conclusion of ACM and/or PACM removal and before removal of the primary barriers all surfaces shall be encapsulated with a bridging type encapsulant. When dry, lock-back encapsulant shall be of such color that it can be easily seen.

- 10.6.2 Deliver encapsulant to the job site in original, new and unopened packages and containers bearing the manufacturer's name and label, thinning instructions and application instructions. A copy of the OSHA material safety data sheet (MSDS) for the encapsulant is required to accompany the encapsulant.
- 10.6.3 Before beginning work read the encapsulant MSDS and provide workers with the required protective equipment. Require that appropriate protective equipment be used at all times. In addition to protective breathing equipment required by OSHA requirements or by this specification, use painting pre-filters on respirators to protect the dust filters when organic solvent based encapsulants are in use.
- 10.6.4 Apply two (2) coats of encapsulant to the exposed surfaces after all ACM and/or PACM has been removed. Apply in strict accordance with the manufacturer's printed instructions for use of the encapsulant.
- 10.6.5 Apply encapsulant with an airless spray gun and nozzle orifice as recommended by the encapsulant manufacturer or by hand wiping methods. Apply the first coat encapsulant while the scratch coat or piping is still damp from the asbestos removal procedures. If the surface has been permitted to dry, wet wipe or vacuum surface with a HEPA filtered vacuum prior to spraying with the encapsulant. Apply second coat over the first coat in strict conformance with the manufacturer's instructions.
- 10.6.6 Seal edges of ACM and/or PACM exposed by removal at inaccessible ports such as a sleeve, wall penetration, etc. with two (2) coats of encapsulant. Prior to sealing, permit the exposed edges to dry completely to permit penetration of the encapsulant.

Chapter 11 Monitoring, Inspection and Testing

11.1 General:

- 11.1.1 The contractor shall perform throughout abatement work monitoring, inspection and testing inside the work area in accordance with OSHA requirements and this specification. The C.P.I.H. shall periodically inspect and oversee the performance of the contractor's workers. The C.P.I.H. shall continuously inspect and monitor conditions inside the work area to ensure compliance with this specification. In addition, the C.P.I.H. shall personally manage air sample collection, analysis and evaluation for personnel samples to satisfy OSHA requirements.
- 11.1.2 The owner may employ an independent industrial hygienist to perform various consulting services on behalf of the owner. The independent industrial hygienist will perform monitoring, inspection, testing, and other support services to ensure that the abatement work proceeds in accordance with this specification and that the abated areas have been successfully decontaminated. The work of the independent industrial hygienist will in no way relieve the abatement contractor from their responsibility to perform their work in accordance with contract documents, to perform continuous inspection, monitoring and testing for the safety of their employees, and to perform other such services as specified in this specification. The cost of the independent industrial hygienist and his services will normally be borne by the owner. Exceptions include repeat final inspections and final testing that may be required due to unsatisfactory results. Costs associate with repeated final inspections and testing, if required, will be paid for by the contractor.
- 11.1.3 If fibers counted by the independent industrial hygienist during abatement work outside the work area utilizing NIOSH 7400 air monitoring methods exceed the specified respective limits (i.e. permissible exposure limit), then the contractor shall stop work. The asbestos contractor may request confirmation of above results by analysis of samples with TEM. Request must be in writing and submitted to the owner. Cost for the TEM confirmation of results will be borne by the contractor for both the collection and analysis of samples, and for the time delay that may result, for this confirmation.

11.2 Monitoring, Inspection and Testing by Abatement Contractor:

- 11.2.1 The C.P.I.H. is responsible for managing all personnel monitoring, inspecting and testing required by this specification, the OSHA regulation 29 CFR 1926.1101, and for continuous monitoring of all sub-systems and procedures affecting the safety of the contractor's employees. Safety of the contractor's employees and providing safe conditions inside and outside the work area shall be the primary concern of the C.P.I.H. The analytical laboratory that will be used by the contractor to analyze the personal air samples shall participate in the PAT rounds, at a minimum. Keep a daily log of personal samples taken and analyzed and make such log available to the owner. The daily log for personnel shall contain information on the person sampled, the date of sample collection the time of sample start and finish, flow rate, sample volume and fiber/cc. Collect and analyze personal samples for at least twenty percent (20%) of the workers on each shift.

Chapter 12 Project Decontamination

12.1 General:

- 12.1.1 The entire work of project decontamination shall be monitored by the owner.

12.2 Work Area Clearance:

- 12.2.1 Air testing and other requirements which must be met before release of the contractor and re-occupancy of the work area are specified elsewhere in this specification.

12.3 Work Description:

- 12.3.1 The work of decontamination includes the decontamination of the air within the work area and the decontamination and removal of project equipment and temporary facilities installed prior to abatement work including primary and critical barriers, Decontamination facilities (PDF and EDF) and negative pressure systems.
- 12.3.2 The work of decontamination includes the cleaning, and decontamination of all surfaces ceilings, walls, floor, etc. of the work area, and all equipment in the work area.

12.4 Pre-Decontamination Conditions:

- 12.4.1 Before decontamination work starts, all ACM and/or PACM, ACE, secondary barriers (drop cloths) of polyethylene sheeting, and ACWM shall be removed and disposed along with any gross debris generated by the work.
- 12.4.2 At the start of work for decontamination, the following will be in place:
- 12.4.2.1 Primary barrier consisting of two (2) layers of polyethylene sheeting on floor and 2 layers on walls.
 - 12.4.2.2 Critical barriers which forms the sole barrier between the work area and other portions of the building or the outside.
 - 12.4.2.3 Critical barrier sheeting over lighting fixtures and clocks, ventilation openings, doorways, convectors, speakers and other openings.
 - 12.4.2.4 Decontamination facilities for personnel and equipment and negative air pressure system are operating.

12.5 First Cleaning:

- 12.5.1 Carry out a first cleaning of all surfaces of the work area including items of remaining sheeting, tools, scaffolding and/or staging by use of damp-cleaning and mopping, and a HEPA filtered vacuum. Do not perform dry dusting or dry sweeping. Use each surface of a cleaning cloth one time only and then dispose of as ACWM. Continue this cleaning until there is no visible debris from removed materials or residue on plastic sheeting or other surfaces. Replace pre-filters in HEPA unit(s) and dispose of as ACWM. If two (2) wall layers of poly are used, the cleaned, exposed layer of poly shall

be removed from walls and floors and disposed of ACWM. If only one layer of wall poly is used, it shall remain in place until after the second cleaning. Use oscillating fans as necessary to assure circulation of air in all parts of the work area during this period.

12.6 Pre-clearance Inspection and Testing:

- 12.6.1 The owner will perform a thorough and detailed visual inspection at the end of the first cleaning to determine whether there are any signs of visible ACM and/or PACM or dust in the work area. If the visual inspection is satisfactory, the owner will notify the contractor that the work area is ready for lock-back encapsulation. The owner reserves the right to utilize their own independent industrial hygienist to perform a pre-clearance inspection and air sampling for verification.

12.7 Lock-back Encapsulation:

- 12.7.1 With the express permissions of the owner, perform a lock-back encapsulation of all surfaces from which ACM and/or PACM was removed. Execute in accordance with provisions specified elsewhere in this specification. Maintain negative pressure in work area during encapsulation work. Wait 24 hours to allow HEPA Units to clean air of airborne fibers after lock-back encapsulation has been applied.

12.8 Second Cleaning:

- 12.8.1 Following the lock-back encapsulation and after the required waiting period, perform a thorough cleaning of all surfaces of the work area in the same manner as the first cleaning. Immediately following the second cleaning, remove all primary barrier sheeting and EDF, leaving only:
- 12.8.1.1 Critical barrier which forms the sole barrier between the work area and other portions of the building or the outside.
 - 12.8.1.2 Critical barrier sheeting over lighting fixtures and clocks, ventilation openings, doorways, convectors, speakers and other openings.
 - 12.8.1.3 Decontamination facilities for personnel in operating condition.
 - 12.8.1.4 Negative pressure system in continuous operation.
 - 12.8.1.5 Allow 24 hours to elapse after the second cleaning to allow HEPA Units to clean the air of fibers.

12.9 Aggressive Air Cleaning:

- 12.9.1 After the required waiting period which follows the second cleaning, an air stream from a high speed leaf blower or equivalent device shall be swept across all surfaces within the work area for a period of not less than five (5) minutes for each 1,000 square feet of surface area. Allow 24 hours to elapse after the aggressive air cleaning to allow HEPA Units to clean the air of fibers. Final clearance sampling may be conducted as per Chapter 14.

12.10 Additional Cleaning and Waiting Periods:

- 12.10.1 If final air clearance fails, carry out a third cleaning of all surfaces in the work area in the same manner as the first cleaning. The cleaning is now being applied to existing room surfaces. Take care to avoid water marks or other damage to surfaces. The HEPA Units shall be in continuous operation and critical barriers and the decontamination units remain in place and operational.
- 12.10.2 Federal, state, and local regulations may require waiting periods after a failed clearance and before re-sampling of air. The most stringent regulations apply. Use oscillating fans as necessary to assure circulation of air in all parts of work area during the waiting period. Maintain negative pressure system in operation. Where waiting periods are not required by federal, state, or local regulations or by contract, the owner and contractor may agree to shorten waiting periods. However, the contractor is responsible for the results of final air clearance regardless of the amount of waiting period selected.

12.11 Final Clean-up:

- 12.11.1 All accumulations of ACWM shall be containerized and removed from the work area.
- 12.11.2 All decontaminated tools and equipment shall be removed from the work area.
- 12.11.3 All containerized waste shall be removed from the work area and the holding area.
- 12.11.4 All surfaces in the work area shall be wet cleaned using rags, mops and sponges. HEPA vacuums shall be used to clean all surfaces after gross clean-up. The work area should be ready for re-occupancy.
- 12.11.5 Clearance air monitoring shall be satisfactory as specified or as required by regulation.
- 12.11.6 The critical barriers shall be removed only after satisfactory clearance air monitoring results have been achieved.

12.12 Glove Bag or Containment Failure:

- 12.12.1 If a glove bag or containment is used and fails or loses its integrity, the following shall be required:
 - 12.12.1.1 As necessary, isolation barriers shall be constructed.
 - 12.12.1.2 Area HVAC systems shall be shut down immediately and all openings shall be sealed with a least six (6) millimeter plastic sheeting.
 - 12.12.1.3 Passageways to uncontaminated areas of the building or structure shall be sealed with a least six (6) millimeter plastic sheeting.
 - 12.12.1.4 Negative air pressure equipment ventilation shall be installed and utilized.
 - 12.12.1.5 Clean-up shall be accomplished as follows:
 - 12.12.1.6 All accumulations of asbestos waste material shall be containerized. Metal shovels or HEPA vacuums may be used to pick up or move waste except in the vicinity of any isolation barriers which could be breached. The areas around the isolation barriers shall be cleaned utilizing rubber or plastic dust pans, squeegees or shovels. HEPA vacuums shall be used to clean all surfaces after gross clean up.
 - 12.12.1.7 All surfaces in the work area shall be first wet cleaned using rags, mops and sponges.
 - 12.12.1.8 After the first cleaning, at least twelve (12) hours shall be allowed for asbestos to settle. Thereafter all objects and surfaces in the work area shall be HEPA vacuumed and/or wet cleaned. The isolation barrier shall be breached for entry and exit with minimal frequency and shall be resealed immediately. All windows, doors, HVAC system vents and all other openings shall remain sealed.
 - 12.12.1.9 Removal of contaminated equipment and ACWM and all containerized waste shall be removed from the work area.
 - 12.12.1.10 Clearance air monitoring shall be conducted.
 - 12.12.1.11 The isolation barrier shall be removed only after satisfactory clearance air monitoring results have been achieved.
 - 12.12.1.12 Federal, state, and local requirements, regarding waiting periods are to be observed by the contractor, unless contractor gets a written "waiver" from the governing regulatory agency.

Chapter 13 Final Inspection and Testing

13.1 General:

- 13.1.1 The contractor shall notify the owner twenty four (24) hours in advance for the performance of the final visual inspection and testing. The final visual inspection will be performed by the owner or owner's representative at the conclusion of the first cleaning and after the on-site contractor supervisor completes and signs the "Certification of Visual Inspection by Contractor."

13.2 Final Inspection:

- 13.2.1 Final inspection will include the entire work area, the PDF, EDF, all plastic sheeting, seals over ventilation openings, doorways, windows and other openings. If any debris, residue on surfaces, dust or other matter is detected cleaning shall be repeated. Bulk or dust samples may be collected and analyzed to confirm visual findings. When the area is visually clean, the lock-back encapsulation and second cleaning will commence after the required waiting periods.

13.3 Final Testing:

- 13.3.1 After a satisfactory final visual inspection by the owner, the owner will undertake the final testing. Air samples may be taken and analyzed in accordance with the procedures for PCM or TEM, whichever is required by federal, state or local regulations or by contract. If release criteria are not met, the contractor shall repeat final cleaning and continue decontamination procedures from that point. Additional inspection and testing will be at the expense of the contractor. If contractor prefers TEM analysis when only PCM is required, the cost of TEM will be borne by contractor.
- 13.3.2 If release criteria are satisfactory, remove the critical barriers and shut-down and remove the HEPA units as specified. Any small quantities of residue material found upon removal of the plastic sheeting shall be removed with a HEPA vacuum cleaner with localized isolation. If significant quantities, as determined by the owner, are found then the entire area affected shall be decontaminated as specified in 12.12.

13.4 Final Testing Procedures:

- 13.4.1 Work in an area is complete when the work area is visually clean and airborne fiber levels have been reduced to or below 0.01 f/cc as measured with PCM or 70 structures per square millimeter based on an arithmetic mean concentration of five (5) samples or the fiber concentration within the work area is not statistically larger than the average background count as measured by TEM.
- 13.4.2 To determine if the elevated airborne fiber counts encountered during abatement operations have been reduced to the specified level, the owner may secure samples and analyze them according to the following procedures:
 - 13.4.2.1 "Fibers" referred to in this section shall be either all fibers regardless of composition as counted in the NIOSH 7400 methods, or asbestos fibers of any size as counted using TEM.
 - 13.4.2.2. Final air testing samples will be taken using aggressive sampling techniques when appropriate. Before sampling pumps are started, the exhaust from forced air equipment (leaf blower with at least one (1) horsepower electric motor) will be swept against all walls, ceilings, floors, ledges and other surfaces in the room. This procedures will be continued for 5 minutes per 1,000 square feet of surface area. High velocity fans will be used to continually circulate air during sample collection. Air samples will be collected in areas subject to normal air circulation away from room corners, obstructed locations, and sites near windows, doors and vents. Fans will be shut down only after air sample collection is complete. The negative air system will continue to operate.

Chapter 14 Air Sampling Procedures for Asbestos Projects

14.1 General:

- 14.1.1 The following general air sampling procedures shall be followed. A supporting document provides details the type of air sampling that will be performed for this project.

14.2 Pre-abatement Air Sampling:

- 14.2.1 Five (5) area air samples will be collected from random locations throughout contiguous air areas prior to beginning any abatement activities.
- 14.2.2 The sampling volume for TEM analysis shall be greater than 1,200 liters with a flow rate not to exceed 10 liters per minute
- 14.2.3 The sampling volume for PCM analysis shall be greater than 3,850 liters with a flow rate not to exceed 16 liters per minute.

14.3 Daily Area PCM Air Sampling During Removal:

- 14.3.1 A daily area air sampling scheme shall be developed and should meet the following requirements.
 - 14.3.1.1 Two (2) area samples from outside and adjacent to the work area.
 - 14.3.1.2 One (1) area sample from the clean room of the decontamination unit.
 - 14.3.1.3 One (1) area sample from a maximum distance of five (5) feet from the exhaust of the negative air machine.
 - 14.3.1.4 One (1) area sample adjacent to the exhaust duct of the negative air machine.

14.4 Final TEM Air Clearance Sampling:

- 14.4.1 Collect ten (10) TEM air samples - five (5) area samples from inside the work area and five (5) area samples outside the work area.
- 14.4.2 The sampling volume shall be greater than 1,200 liters with a flow rate not to exceed 10 liters per minute.
- 14.4.3 The final clearance release criteria for TEM analysis shall be less than 70 structures per square millimeter as determined by the arithmetic mean of five (5) inside samples or less than the outside ambient air as determined by the Z test, whichever is greater.
- 14.4.4 All final TEM air samples shall be collected using aggressive collection techniques.
- 14.4.5 All TEM samples will be analyzed using the AHERA method.

14.5 Final PCM Air Clearance Sampling:

- 14.5.1 Collect a five (5) air samples from inside the work area.
- 14.5.2 The sampling volume shall be greater than 3,850 liters with a flow rate not to exceed 16 liters per minute.
- 14.5.3 The final clearance release criteria will be less than .01 fibers per cc. for five (5) samples in accordance with the NIOSH 7400 Method.

14.6 PCM Analytical Method:

- 14.6.1 PCM air sample shall be analyzed using Phase Contrast Microscopy (PCM) in accordance with the NIOSH 7400 Analytical Method.
- 14.6.2 All sample pumps shall be fitted with 25 millimeter ester cellulose filter cassettes.

14.7 OSHA Personal Air Sampling:

- 14.7.1 The Contractor is responsible for OSHA personal air monitoring. Personal air samples shall be collected daily for the purpose of determining an eight hour time weighted average (TWA) and an excursion limit by the Contractor during the asbestos removal process.
- 14.7.2 Personal air samples shall be collected from the breathing zone of a minimum of twenty percent (20%) of the workers performing asbestos removal.

14.7.3 The sampling flow rates shall be between .5 to 2.5 liters per minute.

14.7.4 Results of the OSHA personal air samples must be provided within twenty four (24) hours.

Chapter 15 Waste Removal Through the Equipment Decontamination Facilities (EDF)

15.1 General:

15.1.1 The contractor is responsible for all waste removal and decontamination systems. In addition, the contractor is responsible for keeping the material adequately wet during the entire operation from initial bagging through waste disposal. The asbestos waste containers shall be sealed by the contractor in the work area. The following general procedures apply:

15.1.1.1 The contractor shall place caution labels on the containers in accordance with OSHA Regulation 29 CFR 1910.1101. These caution labels shall be clearly visible and shall contain the following Statements:

**DANGER
CONTAINS ASBESTOS FIBERS
MAY CAUSE CANCER
CAUSES DAMAGE TO LUNGS
DO NOT BREATH DUST
AVOID CREATING DUST**

15.1.1.2 As required by EPA 40 CFR Part 61 NESHAP Revision; Final Rule, each individual waste container shall be tagged with the name or EPA Identification number of the waste generator and the location at which the waste was generated.

15.2 Project Procedures:

15.2.1 The external surfaces of the containers and equipment shall be thoroughly cleaned of gross contamination in the work area before they are placed into the EDF airlock. Workers who perform the cleaning in the work area shall not enter the EDF airlock.

15.2.2 The containers shall then be moved in the EDF by workers stationed inside the EDF. The workers shall again wet clean each container thoroughly.

15.2.3 Upon completion of the second wet cleaning process, each container shall be placed into uncontaminated six (6) mil poly plastic sheeting or bags and sealed tight.

15.2.4 The contractor shall then move the containers into the airlock entering the holding area. Ensure that the workers in the holding area have entered from the uncontaminated side of the EDF. The washroom workers shall not enter the holding area or the work area until waste removal is finished for that period.

15.2.5 Containers and equipment shall be removed from the airlock to the holding area by workers dressed in clean personal protective equipment who have entered from the uncontaminated area.

15.2.6 Workers who only move the waste containers from the holding area to uncontaminated areas (trailer, trucks, etc.) may utilize half-face, dual cartridge type respirators and must be outfitted with proper protective clothing.

15.2.7 The cleaned containers of asbestos material and equipment may be placed in water-tight carts with doors or tops that shall be closed and secured. The carts shall be wet cleaned and/or HEPA vacuumed at least once each day.

15.2.8 The exit from the decontamination enclosure system shall be secured with a lockable door to prevent unauthorized entry.

- 15.2.9 Where the waste removal enclosure is part of the PDF, waste removal shall not occur during shift changes or when otherwise occupied. Precautions shall be taken to prevent cycling of air outward through the shower and clean room.

Chapter 16 Asbestos Waste Disposal

16.1 Applicable Regulations:

- 16.1.1 All asbestos waste shall be stored, transported and disposed of as per, but not limited to, the following regulations:
 - 16.1.1.1 All applicable federal, state, and local regulations.
 - 16.1.1.2 USEPA Asbestos NESHAP 40 CFR 61
 - 16.1.1.3 US Department of Transportation 49 CFR 171-180

16.2 Transporters or Haulers:

- 16.2.1 Transporters and haulers of asbestos waste are subject to the following:
 - 16.2.1.1 The contractor's transporter and disposal site shall be approved by the owner.
 - 16.2.1.2 The contractor shall give twenty four (24) hour notification to the owner prior to removing any asbestos waste from the site. All asbestos waste shall be removed from the site only during normal working hours. No asbestos waste may be taken from the site without authorization from the owner.
 - 16.2.1.3 The contractor shall have the transporter give the dates and times of arrival at the disposal site.
 - 16.2.1.4 The transporter with the contractor shall inspect all the transport containers prior to taking possession and signing the asbestos waste manifest. **The transporter shall not have any off-site transfers or combine this asbestos waste with any other sites asbestos materials.**
 - 16.2.1.5 During loading or unloading, mark vehicles used to transport asbestos-containing waste with the following sign, which must be visible:

**DANGER ASBESTOS HAZARD
CANCER AND LUNG DISEASE HAZARD**

16.3 Waste Storage Container:

- 16.3.1 All asbestos waste hauling storage containers are subject to the following procedures:
 - 16.3.1.1 All asbestos waste hauling containers shall be fully enclosed and lockable (i.e., enclosed dumpster, 40' trailer, etc.) **No open containers will be allowed** (i.e., open dumpsters with canvas covers, etc.) unless a waiver is granted.
 - 16.3.1.2 The asbestos waste hauling containers shall be plasticized and sealed with a minimum of one (1) layer of six (6) millimeter polyethylene on the sides and two (2) layers of six (6) millimeter polyethylene on the floor.
 - 16.3.1.3 The asbestos waste hauling containers shall be labeled with an OSHA Label with the following Statements:

**DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD**

- 16.3.1.4 The waste transport container (truck, dumpster) must be appropriately labeled as required by the U.S. Department of Transportation.
- 16.3.1.5 The asbestos waste containers will not be permitted to leave the work site without the proper signatures.
- 16.3.1.6 The owner may initiate random checks at the disposal site to ensure that the procedures outlined herein are complied with.

16.4 Waste Disposal Manifest:

- 16.4.1 The asbestos waste disposal manifest is subject to the following procedures:
 - 16.4.1.1 An asbestos waste disposal manifest as provided for under NESHAP and/or individual state or local jurisdictions shall be provided by the contractor and is the only manifest to be utilized.
 - 16.4.1.2 The contractor shall complete the asbestos waste disposal manifest and verify that all information and amounts are accurate and that the proper signatures are in place.
 - 16.4.1.3 The asbestos waste disposal manifest shall have the signatures of the contractor and the transporter prior to any waste being removed from the work site.
 - 16.4.1.4 The asbestos waste disposal manifest shall be signed by the disposal facility owner or operator to certify receipt of the asbestos-containing materials covered by the asbestos waste disposal manifest.
 - 16.4.1.5 An original copy of the completed asbestos waste disposal manifest shall be returned to the owner by the contractor within 35 days of removal from the site.

16.5 Compliance:

- 16.5.1 Compliance with the procedures described herein is mandatory and subject to the following:
 - 16.5.1.1 Failure to adhere to these procedures shall constitute a material breach of the contract and the owner shall have the right to and may terminate the contract. Termination shall not relieve the contractor from future compliance.
 - 16.5.1.2 All asbestos containing waste and/or asbestos contaminated materials must be disposed of as asbestos waste. This includes, but is not limited to, asbestos containing waste, all plastic sheeting, contaminated coveralls or "tyvek" suits, filters, foot covering, tape, etc.
 - 16.5.1.3 As work progresses, the contractor shall remove sealed and labeled containers so that available storage space is not exceeded.
 - 16.5.1.4 Disposal of such containers shall be at an authorized disposal site in accordance with the requirements of the appropriate disposal authorities.
 - 16.5.1.5 The contractor shall submit to the owner the completed asbestos waste disposal manifest form and attached receipts.
 - 16.5.1.6 Waste materials must be transported in enclosed trucks to prevent loose containers from falling off the vehicle.
 - 16.5.1.7 At the disposal site, the bags or barrels must be carefully lowered into approved landfills by the workers.
 - 16.5.1.7.1 Damaged bags shall remain in the drum (if used) and the entire contaminated and sealed drum shall be buried.
 - 16.5.1.7.2 Uncontaminated drums may be recycled, if applicable.
 - 16.5.1.8 The contractor shall notify the owner of proposed dates and times of transportation of waste to the landfill.

- 16.5.1.9 The workers shall perform this activity in approved disposable suits and appropriate respirators.
- 16.5.1.10 If temporary storage at the job site is to occur, the area must be secured from entrance by unauthorized persons. Temporary storage off the job site is not permissible.

Chapter 17 Abatement Close-out and Certificate of Compliance

17.1 Completion of Abatement Work:

- 17.1.1 Seal negative air machines with six (6) millimeter polyethylene sheet and duct tape to form a tight seal at intake end before being moved from work area. Complete the work upon meeting the work area clearance criteria and fulfilling the following:
 - 17.1.1.1 Remove all equipment, materials, debris from the work site.
 - 17.1.1.2 Dispose of all asbestos containing waste material as specified elsewhere in this specification.
 - 17.1.1.3 Fulfill other project close-out requirements as specified elsewhere in this section.

17.2 Certificate of Completion by Contractor:

- 17.2.1 The C.P.I.H. shall complete and sign a "Certificate of Completion" at the completion of the abatement and decontamination of a work area.

End Technical Specification

ASBESTOS, HAZARDOUS MATERIALS INVENTORY AND WASTE CHARACTERIZATION SAMPLING

MU – Veterinary Science Building

1509 Rollins Street
Columbia, Missouri 65201

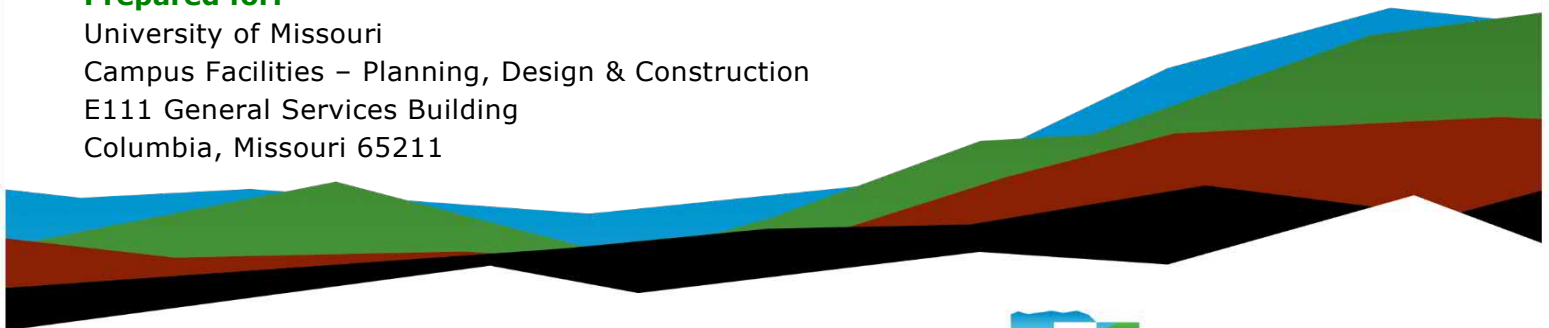
February 16, 2024 | Terracon Project Number: 15237334

MU Project #CP246081 Blanket Agreement / Project #CP233041, WA #1



Prepared for:

University of Missouri
Campus Facilities – Planning, Design & Construction
E111 General Services Building
Columbia, Missouri 65211



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- Materials



February 16, 2024

University of Missouri
 Campus Facilities – Planning, Design & Construction
 E111 General Services Building
 Columbia, Missouri 65211

Attn: Ms. Jody Miller
 Facilities Project Manager
 M: (573) 884-8912
 E: jrmiller@missouri.com

Re: Pre-Demolition Asbestos, Lead-Containing Coatings & Hazardous Materials Inventory
 UM – Veterinary Science Building
 1509 Rollins Street
 Columbia, Missouri 65201
 Terracon Project No. 15237334
 MU Project #CP246081 Blanket Agreement / Project #CP233041, WA #1

Dear Ms. Miller:

Terracon Consultants, Inc. (Terracon) is pleased to submit the attached report for the above referenced site to UM (Client). The purpose of this report is to present the results of an asbestos survey, hazardous materials inventory, and waste characterization sample collection at the above-referenced location, performed on January 5, 2024. This survey was conducted in general accordance with our proposal dated September 28, 2023. We understand that this survey was requested due to proposed demolition of the building.

ASBESTOS

Asbestos was identified at a concentration greater than 1% in samples collected from the following materials:

Material Description	Material Location	NESHAP Category	Estimated Quantity
9" x 9" Grey Floor Tile and Black Mastic	HA#4	Category I Nonfriable	500 Square Feet (SF)
12" x 12" Brown Floor Tile (mastic negative)	HA#12	Category I Nonfriable	240 SF
9" x 9" Maroon Floor Tile (mastic negative)	HA#16	Category I Nonfriable	230 SF
9" x 9" Beige with Brown Specks Floor Tile (mastic negative)	HA#21	Category I Nonfriable	2,000 SF



Material Description	Material Location	NESHAP Category	Estimated Quantity
Black Floor Mastic - Bottom Layer (White 12"x12" floor tile negative)	HA#22	Category I Nonfriable	400 SF
Transite Wall Panels	HA#26	Category II Nonfriable	1,100 SF
Transite Fume Hood	HA#27	Category II Nonfriable	85 SF
Mudded Fittings – Thermal System Insulation	HA#33	RACM	30 Linear Feet (LF)
TSI	HA#34	RACM	110 LF
Tank Insulation	HA#35	RACM	3-foot diameter, 500-gallon tank, approximately 1" thick insulation layer

Notes: NESHAP – National Emission Standards for Hazardous Air Pollutants
 RACM – Regulated Asbestos -Containing Material
 SF – Square Feet
 LF – Linear Feet

Please refer to Section 3.0 of the attached report for a detailed description of the asbestos survey, sampling activities, and findings.

HAZARDOUS MATERIALS INVENTORY

- Estimated quantity of potential PCB containing components – 304 fluorescent light ballasts
- Estimated quantity of potential mercury containing components –787 fluorescent light bulbs.
- Estimated quantity of potential battery containing components – 5 exit signs.
- Estimated quantity of components potentially containing small amounts of radioactive material – 1 drum labeled with radioactive warnings.
- Estimated quantity of potential CFC containing items – 31 refrigerators and freezers
- Three tanks of Carbon Dioxide (CO²)

See Section 5.0 Universal Wastes and Other Regulated Items in this report for additional information.

WASTE CHARACTERIZATION SAMPLE COLLECTION

Terracon collected one (1) representative sample of building materials to be impacted by the demolition activities for laboratory analysis via the Toxicity Characteristic Leaching Procedure (TCLP) for lead. Lead was not identified above the reporting limit through laboratory analysis of the representative sample of building materials to be impacted by demolition activities.

INSPECTION LIMITATIONS

- Mirrors in the building were not destructively sampled. Any potential mastics behind the mirrors must be assumed to be an ACM until destructive sampling and laboratory analysis can be conducted.
- The potential exists that TSI may be hidden inside wall cavities and/or other voids that were inaccessible during our inspection. If encountered during demolition activities, any suspect materials, including but not limited to TSI, must be assumed to be ACMs until destructive sampling and laboratory analysis can be conducted.
- Pipe junctions in the building were not destructively sampled. Any potential pipe gasket insulative rings at the pipe junctions must be assumed to be an ACM until destructive sampling and laboratory analysis can be conducted.

Terracon appreciates the opportunity to provide this service to Jacobs. If you have any questions regarding this report, please contact the undersigned at (314) 692-8811.

Sincerely,

Terracon

Prepared by:



Nick Eilerman
Sr. Staff Industrial Hygienist

Reviewed by:



Mitch Reiber, PG, CIH
Principal

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APPENDIX D	TOXICITY CHARACTERISTIC LEACHING PROCEDURE ANALYTICAL DATA AND CHAIN-OF-CUSTODY FORMS
APPENDIX F	INSPECTOR CERTIFICATIONS

1.0 INTRODUCTION

Terracon Consultants Inc. (Terracon) conducted an asbestos, lead paint, and universal wastes and other regulated items inspection at the University of Missouri (UM) – Veterinary Science Building, located at 1509 Rollins Street in Columbia, Missouri. The inspection was performed in preparation for demolition of the structure. The inspection was conducted by State of Missouri-accredited asbestos inspectors and State of Missouri-licensed lead inspectors in general accordance with our proposal dated September 28, 2023. Representative building areas were visually assessed for asbestos-containing materials (ACM), lead-containing paint (LCP), and universal wastes and other regulated items. Reasonable effort was made to survey accessible areas. Additional suspect materials could be present walls, in voids, or in other concealed/inaccessible areas.

1.1 Reliance

This report is for the exclusive use of UM for the project being discussed. Reliance by any other party on this report is prohibited without written authorization of Terracon and UM. Reliance on this report by UM and all authorized parties will be subject to the terms, conditions, and limitations stated in the proposal, this report, and Terracon’s blanket contract and work authorization for this project.

2.0 BUILDING DESCRIPTION

UM – Veterinary Science Building is a 1-story structure with laboratory and office space (no basement) that is approximately 22,000 square foot in size, reportedly constructed in the 1950s. Interior floors are concrete covered with vinyl floor tile, carpeting or bare concrete in most areas. Walls are gypsum wallboard, cement board panels (transite) or concrete block in most areas. Interior ceilings are gypsum board, drop ceiling tiles or open air in most areas. Walls are brick, stucco, or concrete block in most exterior areas.

3.0 ASBESTOS-CONTAINING MATERIAL SURVEY

The survey was conducted January 5, 2024, by Dan McFarlane and Jacob Louis, State of Missouri-accredited asbestos inspectors. Copies of the asbestos inspector’s accreditations are attached as Appendix F. The survey was conducted in general accordance with the sample collection protocols established in USEPA 40 CFR Part 763 Subpart E 763.86, AHERA. A summary of survey activities is provided below.

3.1 Visual Assessment

Survey activities were initiated with visual observation of the interior/exterior of the building to identify homogeneous areas of suspect ACM. A homogeneous area (HA) consists of building materials that appear similar throughout in terms of color and texture with consideration given to the date of application. The assessment was conducted in visually accessible areas of the building proposed for renovation.

3.2 Physical Assessment

A physical assessment of each HA of suspect ACM was conducted to assess the friability and condition of the materials. A friable material is defined by the USEPA as a material which can be crumbled, pulverized, or reduced to powder by hand pressure when dry. Friability was assessed by physically touching suspect materials.

3.3 Sample Collection

The survey was performed, and suspect ACM samples were collected, in general accordance with the protocols outlined in United States Environmental Protection Agency (USEPA) 40 Code of Federal Regulations (CFR) Part 763 Subpart E 763, known as the Asbestos Hazard Emergency Response Act (AHERA). Samples of suspect materials were collected from randomly selected locations in each homogeneous area. Bulk samples were collected using wet methods as applicable to reduce the potential for fiber release. Samples were placed in sealable containers and labeled with unique sample numbers using an indelible marker. Samples were delivered to an accredited laboratory for analysis by Polarized Light Microscopy (PLM).

Fiberglass, foam glass, rubber, wood products, plastic products, glass and steel are not considered suspect ACM and were, therefore, not sampled.

The selection of sample locations and frequency of sampling were based on Terracon's observations and the assumption that like materials in the same area are homogeneous in content.

Terracon collected 134 bulk samples from 43 homogeneous areas of suspect ACM.

3.4 Sample Analysis

Bulk samples were submitted under chain of custody to EMSL Analytical, Inc. (EMSL) of Saint Louis, Missouri for analysis by Polarized Light Microscopy (PLM) with dispersion staining techniques per USEPA Method 600/R-93/116. The percentage of asbestos, where applicable, was determined by microscopic visual estimation. EMSL is accredited under the National Voluntary Laboratory Accreditation Program (NVLAP) Accreditation No. 200742-0.

3.5 Regulatory Overview

The asbestos National Emission Standards for Hazardous Air Pollutants (NESHAP) regulation (40 CFR Part 61, Subpart M) regulates asbestos fiber emissions and asbestos waste disposal practices. The asbestos NESHAP regulation also requires the identification and classification of existing ACM according to friability prior to demolition or renovation activity. Friable ACM is a material containing more than 1% asbestos that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure. All friable ACM is considered regulated asbestos containing material (RACM).

The asbestos NESHAP regulation classifies ACM as either RACM, Category I non-friable ACM or Category II non-friable ACM. RACM includes all friable ACM, along with Category I and Category II non-friable ACM that has become friable, will be or has been subjected to sanding, grinding, cutting, or abrading, or ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder during

renovation or demolition activity. Category I non-friable ACM are exclusively asbestos-containing packings, gaskets, resilient floor coverings, resilient floor covering mastics and asphalt roofing products that contain more than 1% asbestos. Category II non-friable ACM are all other non-friable materials other than Category I non-friable ACM that contain more than 1% asbestos. Category II non-friable ACM generally includes but is not limited to cementitious material such as: cement pipes, cement siding, cement panels, glazing, mortar, and grouts.

The United States Occupational Safety and Health Administration (USOSHA) asbestos standard for construction (29 CFR 1926.1101) regulates workplace exposure to asbestos. The USOSHA standard requires that employee exposure to airborne asbestos must not exceed 0.1 fibers per cubic centimeter of air (0.1 f/cc) as an eight-hour time weighted average (TWA) and not exceed 1.0 fibers per cubic centimeter of air (1.0 f/cc) over a 30-minute period known as an excursion limit (EL). The TWA and EL are known as USOSHA’s asbestos permissible exposure limits (PELs). The USOSHA standard classifies construction and maintenance activities which could disturb ACM and specifies work practices and precautions which employers must follow when engaging in each class of regulated work.

The Missouri Department of Natural Resources, (MDNR) Air Pollution Control Program, enforces the Asbestos NESAHF as adopted by reference at 10 CSR 10-6.080. The owner or operator must provide MDNR with written notification at least 10 working days prior to the commencement of asbestos abatement activities that will disturb RACM in amounts greater than or equal to 160 square feet, 260 linear feet or 35 cubic feet.

3.6 Findings

Asbestos was identified at a concentration greater than 1% in samples collected from the following materials:

Material Description	Material Location	NESHAP Category	Estimated Quantity
9" x 9" Grey Floor Tile and Black Mastic	HA#4	Category I Nonfriable	500 Square Feet (SF)
12" x 12" Brown Floor Tile (mastic negative)	HA#12	Category I Nonfriable	240 SF
9" x 9" Maroon Floor Tile (mastic negative)	HA#16	Category I Nonfriable	230 SF
9" x 9" Beige with Brown Specks Floor Tile (mastic negative)	HA#21	Category I Nonfriable	2,000 SF
Black Floor Mastic - Bottom Layer (White 12"x12" floor tile negative)	HA#22	Category I Nonfriable	400 SF
Transite Wall Panels	HA#26	Category II Nonfriable	1,100 SF
Transite Fume Hood	HA#27	Category II Nonfriable	85 SF
Mudded Fittings – Thermal System Insulation	HA#33	RACM	30 Linear Feet (LF)
TSI	HA#34	RACM	110 LF
Tank Insulation	HA#35	RACM	3-foot diameter, 500-



Material Description	Material Location	NESHAP Category	Estimated Quantity
			gallon tank, approximately 1" thick insulation layer

The above listed RACM must be removed by a State of Missouri-licensed abatement contractor prior to any activities (renovation and/or demolition) that may disturb this material in accordance with applicable federal, state, and local regulations.

The above listed Category I non-friable ACM that is damaged or could be damaged to the extent that it could be crumbled, pulverized, or reduced to powder when dry, making it friable, must be removed prior to any activities (renovation and/or demolition) that may disturb this material in accordance with applicable federal, state, and local regulations.

The above listed Category II non-friable ACM that has a high probability of becoming crumbled, pulverized, or reduced to powder when dry, making it friable, must be properly removed prior to any activities (renovation and/or demolition) that may disturb this material in accordance with applicable federal, state, and local regulations. USEPA believes that most demolition activities will subject Category II non-friable ACM to the asbestos NESHAP regulation.

Identified asbestos containing materials by homogenous area is included in Appendix A. The summary of sample locations is included in Appendix B. Laboratory analytical reports are included as Appendix C.

4.0 HAZARDOUS BUILDING MATERIALS

Materials such as PCBs, mercury, CFCs, batteries, and radioactive sources can be found in building components. These materials are considered environmental hazards and require special precautions prior to building renovation or demolition to prevent their entry into the environment. On occasion, manufacturers will label the equipment regarding the presence or absence of a hazardous material.

4.1 PCBs

PCBs range from clear, oily liquids to white or yellowish waxy solids, depending on the degree of chlorination. They are stable, thermoplastic and non-flammable materials that found chief use in insulation for electric cables and wires in the production of electric condensers and additives for extreme pressure lubricants. Light ballasts can contain about one ounce of the toxic substance. The transportation, disposal and spill clean-up of PCB-containing ballasts is regulated by the Toxic Substances Control Act (TSCA), which is found in 40 CFR Part 261.

Terracon conducted a representative visual assessment of light fixtures and electrical transformers to characterize PCB content. Typically, ballasts manufactured prior to 1979 are presumed to contain PCBs unless clearly marked as containing "No PCBs". Ballasts that do not contain a "No PCBs" label are presumed to be PCB-containing.

Transformers sometimes contain mineral oil, which may contain minor amounts of PCB and could be considered "PCB contaminated" (PCB content of 50-500 ppm).

4.2 Mercury

Metallic mercury is a silver-white liquid at room temperature. Elemental and inorganic mercury compounds are used in manufacturing scientific instruments, electric equipment, mercury vapor lamps, and high intensity discharge (HID) lights. Mercury is considered a hazardous material due to its ability to bioaccumulate within the environment. Recycling mercury-containing components reduces the load of mercury entering the environment.

4.3 CFCs

A chlorofluorocarbon (CFC) is an organic compound that consists of carbon, hydrogen, chlorine, and fluorine. Many CFCs have been widely used as refrigerants, propellants, and solvents. Chlorofluorocarbons are believed to cause depletion of the atmospheric ozone layer.

4.4 Batteries

Batteries containing nickel-cadmium and lead-acid can be found in emergency lighting, exit signs, and alarm systems. The nickel-cadmium and lead-acid in these batteries are considered toxic.

4.5 Radioactive Sources

There are several types of smoke detectors and fire alarms. Ionization chamber and photoelectric smoke detectors are the two most common types available commercially. Ionization chamber smoke detectors contain a small amount of radioactive material encapsulated in a metal chamber. Typically, the radioactive material is a composite of americium-241.

4.6 Findings

Based on observations made during the site visit, the following universal wastes and other regulated items were noted:

PCBs

- Building areas were observed to have approximately 304 potential PCB-containing fluorescent light ballasts.

Mercury

- Building areas were observed to have approximately 787 potential mercury-containing fluorescent light bulbs and 14 thermometers.

CFCs and Refrigerants

- Approximately 31 total refrigerator and freezer units that could potentially contain CFC's or other hazardous refrigerants were observed during the assessment.

Batteries

- Approximately 5 exits signs that could potentially contain nickel-cadmium or lead-acid batteries were observed in building areas.

Radioactive Sources

- Two fire alarms and a drum that could potentially contain small amounts of radioactive material were observed in building areas.

Other

- Three tanks of Carbon Dioxide (CO²).

Identified items should be removed intact, segregated, packaged, and recycled in accordance with applicable state and federal regulations prior to renovation of the building.

5.0 WASTE CHARACTERIZATION SAMPLE COLLECTION

5.1 Lead TCLP

The Resource Conservation and Recovery Act (RCRA) gave the USEPA authority to regulate the waste status of demolition and renovation debris, including lead-containing materials. Specific notification and testing requirements must be addressed prior to transporting, treating, storing, or disposing of hazardous wastes. Lead containing wastes are considered hazardous waste under RCRA if TCLP results exceed 5 milligrams per liter (mg/L). EPA exempts from most RCRA requirements those generators whose combined hazardous waste generation is less than 100 kilograms (kg) per month.

Lead was not identified above the reporting limit through laboratory analysis of the representative sample of building materials to be impacted by demolition activities. Laboratory results and chain-of-custody can be found in Appendix D.

6.0 GENERAL COMMENTS

Terracon did not perform sampling which required demolition or destructive activities such as dismantling of equipment or removal of protective coverings. Reasonable efforts to access suspect materials within known areas of restricted access (e.g., crawl spaces) were made; however, confined spaces or areas which may pose a health or safety risk to Terracon personnel were not sampled. Sampling did not include suspect materials which could not be safely reached with available ladders/man-lifts. Terracon did not sample suspect materials that may be present in movable equipment such as freezers, kitchen equipment and hoods. Terracon typically investigated for flooring beneath carpeting by lifting small corner sections of carpet. If tiles were seen, they have been identified in the report. If tiles were not seen at corners under the carpet, it does not imply that there are no tiles beneath the carpeted floor.

This survey was conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions in the same locale. The results, findings, conclusions, and recommendations expressed in this report are based on conditions observed during Terracon's survey of the building. The information contained in this report is relevant to the date on which this survey was performed and should not be relied upon to represent conditions at a later date. This report has been prepared on behalf of and exclusively for use by the Client and is not a bidding document. Contractors or consultants reviewing this report must draw their own conclusions regarding further investigation or remediation deemed necessary. Terracon does not warrant the work of regulatory agencies, laboratories or other third parties supplying information that may have been used in the preparation of this report. No warranty, express or implied is made.

INSPECTION LIMITATIONS

- Mirrors in the building were not destructively sampled. Any potential mastics behind the mirrors must be assumed to be an ACM until destructive sampling and laboratory analysis can be conducted.
- The potential exists that TSI may be hidden inside wall cavities and/or other voids that were inaccessible during our inspection. If encountered during demolition activities, any suspect materials, including but not limited to TSI, must be assumed to be ACMs until destructive sampling and laboratory analysis can be conducted.
- Pipe junctions in the building were not destructively sampled. Any potential pipe gasket insulative rings at the pipe junctions must be assumed to be an ACM until destructive sampling and laboratory analysis can be conducted.



APPENDIX A

MU – Veterinary Science Building

1509 Rollins Street

Columbia, Missouri 65201

Terracon Project No. 15237334

IDENTIFIED ASBESTOS CONTAINING MATERIALS BY HOMOGENEOUS AREA (HA)

HA No.	Material Description	Material Location	% and Type Asbestos*	NESHAP Classification	Condition	Estimated Quantity**
4	9" x 9" Grey Floor Tile and Black Mastic	FS1, FS9, FS12	Floor Tile (3% Chrysotile) Mastic (8% Chrysotile)	Category I Non-friable	Poor	500 Square Feet (SF)
12	12" x 12" Brown Floor Tile (mastic negative)	FS4	Floor Tile (3% Chrysotile)	Category I Non-friable	Poor	240 SF
16	9" x 9" Maroon Floor Tile (mastic negative)	FS6	Floor Tile (6% Chrysotile)	Category I Non-friable	Poor	230 SF
21	9" x 9" Beige with Brown Specks Floor Tile (mastic negative)	FS11	Floor Tile (4% Chrysotile)	Category I Non-friable	Poor	2,000 SF
22	Floor Mastic - Bottom Layer (White 12"x12" floor tile negative)	FS14, FS15	Adhesive (8% Chrysotile)	Category I Non-friable	Poor	400 SF
26	Transite Wall Panels	FS27	17% Chrysotile	Category II Non-friable	Poor	1,100 SF

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

MU - Veterinary Science Building | Columbia, Missouri
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HA No.	Material Description	Material Location	% and Type Asbestos*	NESHAP Classification	Condition	Estimated Quantity**
27	Transite Fume Hood	FS18, FS20	18% Chrysotile	Category II Non-friable	Poor	85 SF
33	Mudded Fittings – Thermal System Insulation	FS27	Insulation (88% Chrysotile)	RACM	Poor	30 Linear Feet (LF)
34	TSI	FS27	29% Amosite	RACM	Poor	110 LF
35	Tank Insulation	FS27	Insulation (86% Chrysotile)	RACM	Poor	3-foot diameter, 500-gallon tank, approximately 1" thick insulation layer

***% & Type Asbestos** – this column contains both the analytical result of the sample with the highest concentration of asbestos detected in the samples that make up the HA and the types of asbestos identified.

****Estimated quantities** – quantities based on a cursory field evaluation, and actual quantities may vary significantly, especially if asbestos-containing materials are present in hidden and/or inaccessible areas not evaluated as part of this survey. This is not a bidding document; contractors are responsible for determining their own opinion of quantities.

PC – indicates that the additional stratified point count method (400 points) of analysis was performed after the initial PLM analysis.



APPENDIX B

ASBESTOS SURVEY SAMPLE LOCATION SUMMARY

HA No.	Material Description	Sample Number	Sample Location	Sample Layer Description	Lab Results
1	Roofing Materials (Core Sample)	1A	Roof	Shingle	None Detected
				Brown Shingle	None Detected
				Black Tar Paper	None Detected
				Black Tar	None Detected
				Insulation	None Detected
				Insulation	None Detected
		1B	Roof	Shingle	None Detected
				Brown Shingle	None Detected
				Black Tar Paper	None Detected
				Black Tar	None Detected
				Insulation	None Detected
				Insulation	None Detected
		1C	Roof	Shingle	None Detected
Brown Shingle	None Detected				
Black Tar Paper	None Detected				
Black Tar	None Detected				

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

MU - Veterinary Science Building | Columbia, Missouri
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HA No.	Material Description	Sample Number	Sample Location	Sample Layer Description	Lab Results
				Insulation	None Detected
				Insulation	None Detected
2	Drain Tar	2A	Roof	Silver Coating	None Detected
				Flashing	None Detected
				Black Tar	None Detected
		2B	Roof	Silver Coating	None Detected
				Flashing	None Detected
				Black Tar	None Detected
		2C	Roof	Silver Coating	None Detected
				Flashing	None Detected
				Black Tar	None Detected
3	Flashing - HVAC units	3A	Roof	Flashing	None Detected
		3B	Roof	Flashing	None Detected
		3C	Roof	Flashing	None Detected
4	9" x 9" Grey Floor Tile w/ Black Mastic	4A	FS1	Floor Tile	3% chrysotile
				Black Mastic	8% chrysotile
		4B	FS9	Floor Tile	Positive Stop (Not Analyzed)
				Black Mastic	Positive Stop (Not Analyzed)

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

MU - Veterinary Science Building | Columbia, Missouri

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HA No.	Material Description	Sample Number	Sample Location	Sample Layer Description	Lab Results
		4C	FS12	Floor Tile	Positive Stop (Not Analyzed)
				Black Mastic	Positive Stop (Not Analyzed)
5	4" Black Cove Base w/ Tan Adhesive	5A	FS1	Black Cove Base	None Detected
				Tan Adhesive	None Detected
		5B	FS7	Black Cove Base	None Detected
				Tan Adhesive	None Detected
		5C	FS26	Black Cove Base	None Detected
				Tan Adhesive	None Detected
6	2' x 2' Ceiling Tile (P/HF)	6A	FS1	Ceiling Tile	None Detected
		6B	FS7	Ceiling Tile	None Detected
		6C	FS3	Ceiling Tile	None Detected
7	2' x 4' Ceiling Tile (P/HF)	7A	FS4	Ceiling Tile	None Detected
		7B	FS13	Ceiling Tile	None Detected
		7C	FS18	Ceiling Tile	None Detected
8	Poured Floor - Grey	8A	FS3	Poured Floor	None Detected
		8B	FS3	Poured Floor	None Detected
		8C	FS3	Poured Floor	None Detected
9	Poured Floor - Yellow	9A	FS4	Poured Floor	None Detected
		9B	FS4	Poured Floor	None Detected

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

MU - Veterinary Science Building | Columbia, Missouri
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HA No.	Material Description	Sample Number	Sample Location	Sample Layer Description	Lab Results
		9C	FS4	Poured Floor	None Detected
10	Poured Floor – Beige	10A	FS7	Poured Floor	None Detected
		10B	FS7	Poured Floor	None Detected
		10C	FS7	Poured Floor	None Detected
11	12" x 12" White & Blue Specks Floor Tile	11A	FS4	Floor Tile	None Detected
				Adhesive	None Detected
		11B	FS4	Floor Tile	None Detected
				Adhesive	None Detected
		11C	FS4	Floor Tile	None Detected
				Adhesive	None Detected
12	12" x 12" Brown Floor Tile	12A	FS4	Floor Tile	3% chrysotile
				Adhesive	None Detected
		12B	FS4	Floor Tile	Positive Stop (Not Analyzed)
				Adhesive	None Detected
		12C	FS4	Floor Tile	Positive Stop (Not Analyzed)
				Adhesive	None Detected
13	2' x 4' Ceiling Tile Pinhole	13A	FS4	Ceiling Tile	None Detected
		13B	FS8	Ceiling Tile	None Detected
		13C	FS26	Ceiling Tile	None Detected

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

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HA No.	Material Description	Sample Number	Sample Location	Sample Layer Description	Lab Results
14	18" x 12" Grey Floor Tile	14A	FS5	Floor Tile	None Detected
				Adhesive	None Detected
		14B	FS5	Floor Tile	None Detected
				Adhesive	None Detected
		14C	FS5	Floor Tile	None Detected
				Adhesive	None Detected
15	2' x 2' Ceiling Tile Pinhole	15A	FS5	Ceiling Tile	None Detected
		15B	FS5	Ceiling Tile	None Detected
		15C	FS5	Ceiling Tile	None Detected
16	9" x 9" Maroon Floor Tile	16A	FS6	Floor Tile	6% Chrysotile
				Adhesive	None Detected
		16B	FS6	Floor Tile	Positive Stop (Not Analyzed)
				Adhesive	None Detected
		16C	FS6	Floor Tile	Positive Stop (Not Analyzed)
				Adhesive	None Detected
17	12" x 12" White & Brown Speckles Floor Tile	17A	FS8	Floor Tile	None Detected
				Adhesive	None Detected
		17B	FS26	Floor Tile	None Detected
				Adhesive	None Detected

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

MU - Veterinary Science Building | Columbia, Missouri
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HA No.	Material Description	Sample Number	Sample Location	Sample Layer Description	Lab Results
		17C	FS26	Floor Tile	None Detected
				Adhesive	None Detected
18	4" Ceramic Wall Tile	18A	FS8	Ceramic Tile	None Detected
				White Grout	None Detected
		18B	FS8	Ceramic Tile	None Detected
				White Grout	None Detected
18C	FS8	Ceramic Tile	None Detected		
19	Sink Coating - White	19A	FS9	White Coating	None Detected
		19B	FS9	White Coating	None Detected
		19C	FS9	White Coating	None Detected
20	Sink Coating - Grey	20A	FS21	Grey Coating	None Detected
		20B	FS21	Grey Coating	None Detected
		20C	FS21	Grey Coating	None Detected
21	9" x 9" Beige with Brown Specks Floor Tile	21A	FS11	Floor Tile	4% Chrysotile
				Orange Adhesive	None Detected
		21B	FS11	Floor Tile	Positive Stop (Not Analyzed)
				Orange Adhesive	None Detected
21C	FS11	Floor Tile	Positive Stop (Not Analyzed)		
		Orange Adhesive	None Detected		

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

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HA No.	Material Description	Sample Number	Sample Location	Sample Layer Description	Lab Results
22	12" x 12" White with Grey Streaks Floor Tile	22A	FS14	Floor Tile	None Detected
				Black Adhesive	8% Chrysotile
		22B	FS15	Floor Tile	None Detected
				Black Adhesive	Positive Stop (Not Analyzed)
		22C	FS15	Floor Tile	None Detected
				Black Adhesive	Positive Stop (Not Analyzed)
23	4" Cove Base Brown	23A	FS15	Brown Cove Base	None Detected
				Gray Adhesive	None Detected
		23B	FS15	Brown Cove Base	None Detected
				Gray Adhesive	None Detected
		23C	FS15	Brown Cove Base	None Detected
24	Fiberglass Sealant	24A	FS15	Fiberglass	None Detected
				Sealant	None Detected
		24B	FS27	Fiberglass	None Detected
				Sealant	None Detected
		24C	FS27	Sealant	None Detected
25	6" Grey Cove Base	25A	FS18	Grey Cove Base	None Detected
				Brown Adhesive	None Detected
		25B	FS18	Grey Cove Base	None Detected

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

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HA No.	Material Description	Sample Number	Sample Location	Sample Layer Description	Lab Results
				Brown Adhesive	None Detected
				Leveler	None Detected
		25C	FS18	Grey Cove Base	None Detected
				Brown Adhesive	None Detected
26	Transite Wallboard Panels	26A	FS27	Transite	17% Chrysotile
		26B	FS27	Transite	Positive Stop (Not Analyzed)
		26C	FS27	Transite	Positive Stop (Not Analyzed)
27	Transite Fume Hood	27A	FS18	Transite	18% Chrysotile
		27B	FS20	Transite	Positive Stop (Not Analyzed)
		27C	FS20	Transite	Positive Stop (Not Analyzed)
28	Carpet Adhesive	28A	FS19	Tan Adhesive	None Detected
		28B	FS19	Tan Adhesive	None Detected
		28C	FS19	Tan Adhesive	None Detected
29	2' x 2' Ceiling Tile (Small Pinhole)	29A	FS19	Ceiling Tile	None Detected
		29B	FS19	Ceiling Tile	None Detected
		29C	FS19	Ceiling Tile	None Detected
30	12" x 12" Beige with Brown Specks Floor Tile	30A	FS18	Floor Tile	None Detected
				Black Adhesive	None Detected

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HA No.	Material Description	Sample Number	Sample Location	Sample Layer Description	Lab Results
		30B	FS18	Grey Leveler	None Detected
				Floor Tile	None Detected
				Black Adhesive	None Detected
		30C	FS18	Grey Leveler	None Detected
				Floor Tile	None Detected
				Black Adhesive	None Detected
31	12" x 12" White with Brown Specks Floor Tile	31A	FS25	Grey Leveler	None Detected
				Floor Tile	None Detected
				Tan Adhesive	None Detected
		31B	FS25	White Leveler	None Detected
				Floor Tile	None Detected
				Tan Adhesive	None Detected
		31C	FS25	White Leveler	None Detected
				Floor Tile	None Detected
		32	2' x 2' Rubber Flooring	32A	FS26
32B	FS26			Flooring	None Detected
32C	FS26			Flooring	None Detected
33		33A	FS27	Wrap	None Detected

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

MU - Veterinary Science Building | Columbia, Missouri
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HA No.	Material Description	Sample Number	Sample Location	Sample Layer Description	Lab Results
	Mudded Fittings			Insulation	88% Chrysotile
				Insulation	None Detected
		33B	FS27	Insulation	Positive Stop (Not Analyzed)
		33C	FS27	Insulation	Positive Stop (Not Analyzed)
34	TSI	34A	FS27	Insulation	29% Amosite
		34B	FS27	Insulation	Positive Stop (Not Analyzed)
		34C	FS27	Insulation	Positive Stop (Not Analyzed)
35	Tank Insulation	35A	FS27	Wrap	None Detected
				Insulation	86% Chrysotile
				Insulation	None Detected
		35B	FS27	Insulation	Positive Stop (Not Analyzed)
		35C	FS27	Insulation	Positive Stop (Not Analyzed)
36	CMU Block Wall	36A	FS29	Plaster	None Detected
				Plaster	None Detected
				Block	None Detected
		36B	FS29	Plaster	None Detected
				Plaster	None Detected
				Block	None Detected

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

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HA No.	Material Description	Sample Number	Sample Location	Sample Layer Description	Lab Results
		36C	FS29	Block	None Detected
37	Drywall Walls	37A	FS15	Joint Compound	None Detected
				Drywall	None Detected
		37B	FS1	Joint Compound	None Detected
				Drywall	None Detected
		37C	FS3	Joint Compound	None Detected
				Drywall	None Detected
		37D	FS15	Joint Compound	None Detected
				Drywall	None Detected
		37E	FS8	Joint Compound	None Detected
				Drywall	None Detected
37F	FS6	Joint Compound	None Detected		
		Drywall	None Detected		
37G	FS6	Drywall	None Detected		
38	Drywall Ceilings	38A	FS5	Drywall	None Detected
		38B	FS7	Drywall	None Detected
		38C	FS1	Drywall	None Detected
		38D	FS4	Drywall	None Detected
		38E	FS11	Drywall	None Detected

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

MU - Veterinary Science Building | Columbia, Missouri
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HA No.	Material Description	Sample Number	Sample Location	Sample Layer Description	Lab Results
		38F	FS12	Drywall	None Detected
		38G	FS15	Drywall	None Detected
39	Brown Caulk on Duct	39A	Exterior	Brown Caulk	None Detected
		39B	Exterior	Brown Caulk	None Detected
		39C	Exterior	Brown Caulk	None Detected
40	Exterior Door Caulk	40A	Exterior	Grey Caulk	None Detected
		40B	Exterior	Grey Caulk	None Detected
		40C	Exterior	Grey Caulk	None Detected
41	Exterior Window Caulk	41A	Exterior	Grey Caulk	None Detected
		41B	Exterior	Grey Caulk	None Detected
		41C	Exterior	Grey Caulk	None Detected
42	Exterior Stucco	42A	Exterior	Stucco	None Detected
				Insulation	None Detected
		42B	Exterior	Stucco	None Detected
				Insulation	None Detected
		42C	Exterior	Stucco	None Detected
				Insulation	None Detected
43	Exterior Concrete Wall	43A	Exterior	Concrete	None Detected
		43B	Exterior	Concrete	None Detected

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

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HA No.	Material Description	Sample Number	Sample Location	Sample Layer Description	Lab Results
		43C	Exterior	Concrete	None Detected

Bold – Asbestos Containing Materials

Italics – Materials containing 1% or less asbestos



APPENDIX C

ASBESTOS LABORATORY ANALYTICAL DATA



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EMSL Order: 392400113
 Customer ID: TERR57
 Customer PO: 15237334
 Project ID:

Attention: Nick Eilerman
 Terracon Consultants, Inc.
 11600 Lilburn Park Road
 Saint Louis, MO 63146

Phone: (314) 692-8811
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 Received Date: 01/05/2024 4:14 PM
 Analysis Date: 01/09/2024 - 01/10/2024
 Collected Date:

Project: 15237334

**Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E
 Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy**

Sample	Description	Appearance	Non-Asbestos		Asbestos % Type
			% Fibrous	% Non-Fibrous	
1A-Shingle 392400113-0001		Various Non-Fibrous Heterogeneous	28% Synthetic	72% Non-fibrous (Other)	None Detected
1A-Shingle 392400113-0001A		Brown Non-Fibrous Heterogeneous	29% Synthetic	71% Non-fibrous (Other)	None Detected
1A-Tar Paper 392400113-0001B		Black Non-Fibrous Homogeneous	48% Glass	52% Non-fibrous (Other)	None Detected
1A-Tar 392400113-0001C		Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
1A-Insulation 392400113-0001D		Various Non-Fibrous Heterogeneous	5% Cellulose 3% Glass	92% Non-fibrous (Other)	None Detected
1A-Insulation 392400113-0001E		Various Fibrous Homogeneous	58% Cellulose	36% Perlite 4% Non-fibrous (Other)	None Detected
1B-Shingle 392400113-0002		Various Non-Fibrous Heterogeneous	29% Synthetic	71% Non-fibrous (Other)	None Detected
1B-Shingle 392400113-0002A		Brown Non-Fibrous Homogeneous	29% Synthetic	71% Non-fibrous (Other)	None Detected
1B-Tar Paper 392400113-0002B		Black Non-Fibrous Homogeneous	48% Glass	51% Non-fibrous (Other)	None Detected
1B-Tar 392400113-0002C		Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
1B-Insulation 392400113-0002D		Various Non-Fibrous Heterogeneous	5% Cellulose 3% Glass	92% Non-fibrous (Other)	None Detected
1B-Insulation 392400113-0002E		Various Fibrous Homogeneous	58% Cellulose	36% Perlite 2% Non-fibrous (Other)	None Detected
1C-Shingle 392400113-0003		Various Non-Fibrous Heterogeneous	28% Synthetic	72% Non-fibrous (Other)	None Detected
1C-Shingle 392400113-0003A		Brown Non-Fibrous Heterogeneous	29% Synthetic	71% Non-fibrous (Other)	None Detected
1C-Tar Paper 392400113-0003B		Black Non-Fibrous Homogeneous	45% Glass	55% Non-fibrous (Other)	None Detected
1C-Tar 392400113-0003C		Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

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Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
1C-Insulation 392400113-0003D		Various Non-Fibrous Heterogeneous	5% Cellulose 4% Glass	91% Non-fibrous (Other)	None Detected
1C-Insulation 392400113-0003E		Various Fibrous Homogeneous	60% Cellulose	33% Perlite 7% Non-fibrous (Other)	None Detected
2A-Coating 392400113-0004		Silver Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
2A-Flashing 392400113-0004A		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
2A-Tar 392400113-0004B		Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
2B-Coating 392400113-0005		Silver Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
2B-Flashing 392400113-0005A		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
2B-Tar 392400113-0005B		Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
2C-Coating 392400113-0006		Silver Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
2C-Flashing 392400113-0006A		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
2C-Tar 392400113-0006B		Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
3A 392400113-0007		Various Non-Fibrous Heterogeneous	26% Synthetic	74% Non-fibrous (Other)	None Detected
3B 392400113-0008		Various Non-Fibrous Heterogeneous	27% Synthetic	73% Non-fibrous (Other)	None Detected
3C 392400113-0009		Various Non-Fibrous Heterogeneous	28% Synthetic	72% Non-fibrous (Other)	None Detected
4A-Floor Tile 392400113-0010		Various Non-Fibrous Homogeneous		97% Non-fibrous (Other)	3% Chrysotile
4A-Mastic 392400113-0010A		Black Non-Fibrous Homogeneous		92% Non-fibrous (Other)	8% Chrysotile
4B-Floor Tile 392400113-0011					Positive Stop (Not Analyzed)
4B-Mastic 392400113-0011A					Positive Stop (Not Analyzed)
4C-Floor Tile 392400113-0012					Positive Stop (Not Analyzed)

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Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
4C-Mastic					Positive Stop (Not Analyzed)
392400113-0012A					
5A-Cove Base		Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
392400113-0013					
5A-Adhesive		Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
392400113-0013A					
5B-Cove Base		Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
392400113-0014					
5B-Adhesive		Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
392400113-0014A					
5C-Cove Base		Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
392400113-0015					
5C-Adhesive		Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
392400113-0015A					
6A		Various Fibrous Homogeneous	29% Cellulose 38% Min. Wool	29% Perlite 4% Non-fibrous (Other)	None Detected
392400113-0016					
6B		Various Fibrous Homogeneous	26% Cellulose 35% Min. Wool	26% Perlite 13% Non-fibrous (Other)	None Detected
392400113-0017					
6C		Various Fibrous Homogeneous	27% Cellulose 38% Min. Wool	25% Perlite 10% Non-fibrous (Other)	None Detected
392400113-0018					
7A		Various Fibrous Homogeneous	27% Cellulose 36% Min. Wool	27% Perlite 10% Non-fibrous (Other)	None Detected
392400113-0019					
7B		Various Fibrous Homogeneous	28% Cellulose 37% Min. Wool	28% Perlite 7% Non-fibrous (Other)	None Detected
392400113-0020					
7C		Various Fibrous Homogeneous	28% Cellulose 37% Min. Wool	25% Perlite 10% Non-fibrous (Other)	None Detected
392400113-0021					
8A		Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
392400113-0022					
8B		Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
392400113-0023					
8C		Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
392400113-0024					
9A		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
392400113-0025					
9B		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
392400113-0026					
9C		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
392400113-0027					

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Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
10A <small>392400113-0028</small>		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
10B <small>392400113-0029</small>		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
10C <small>392400113-0030</small>		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
11A-Floor Tile <small>392400113-0031</small>		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
11A-Adhesive <small>392400113-0031A</small>		Orange Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
11B-Floor Tile <small>392400113-0032</small>		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
11B-Adhesive <small>392400113-0032A</small>		Orange Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
11C-Floor Tile <small>392400113-0033</small>		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
11C-Adhesive <small>392400113-0033A</small>		Orange Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
12A-Floor Tile <small>392400113-0034</small>		Various Non-Fibrous Homogeneous		97% Non-fibrous (Other)	3% Chrysotile
12A-Adhesive <small>392400113-0034A</small>		Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
12B-Floor Tile <small>392400113-0035</small>					Positive Stop (Not Analyzed)
12B-Adhesive <small>392400113-0035A</small>		Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
12C-Floor Tile <small>392400113-0036</small>					Positive Stop (Not Analyzed)
12C-Adhesive <small>392400113-0036A</small>		Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
13A <small>392400113-0037</small>		Various Fibrous Homogeneous	26% Cellulose 35% Min. Wool	26% Perlite 13% Non-fibrous (Other)	None Detected
13B <small>392400113-0038</small>		Various Fibrous Homogeneous	27% Cellulose 36% Min. Wool	27% Perlite 10% Non-fibrous (Other)	None Detected
13C <small>392400113-0039</small>		Various Fibrous Homogeneous	28% Cellulose 37% Min. Wool	25% Perlite 10% Non-fibrous (Other)	None Detected
14A-Floor Tile <small>392400113-0040</small>		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

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Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
14A-Adhesive 392400113-0040A		Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
14B-Floor Tile 392400113-0041		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
14B-Adhesive 392400113-0041A		Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
14C-Floor Tile 392400113-0042		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
14C-Adhesive 392400113-0042A		Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
15A 392400113-0043		Various Fibrous Homogeneous	28% Cellulose 37% Min. Wool	28% Perlite 7% Non-fibrous (Other)	None Detected
15B 392400113-0044		Various Fibrous Homogeneous	29% Cellulose 38% Min. Wool	29% Perlite 4% Non-fibrous (Other)	None Detected
15C 392400113-0045		Various Fibrous Homogeneous	28% Cellulose 37% Min. Wool	25% Perlite 10% Non-fibrous (Other)	None Detected
16A-Floor Tile 392400113-0046		Various Non-Fibrous Homogeneous		94% Non-fibrous (Other)	6% Chrysotile
16A-Adhesive 392400113-0046A		Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
16B-Floor Tile 392400113-0047					Positive Stop (Not Analyzed)
16B-Adhesive 392400113-0047A		Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
16C-Floor Tile 392400113-0048					Positive Stop (Not Analyzed)
16C-Adhesive 392400113-0048A		Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
17A-Floor Tile 392400113-0049		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
17A-Adhesive 392400113-0049A		Orange Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
17B-Floor Tile 392400113-0050		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
17B-Adhesive 392400113-0050A		Orange Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
17C-Floor Tile 392400113-0051		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

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Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
17C-Adhesive 392400113-0051A		Orange Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
18A-Ceramic Tile 392400113-0052		Various Non-Fibrous Heterogeneous		100% Non-fibrous (Other)	None Detected
18A-Grout 392400113-0052A		White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
18B-Ceramic Tile 392400113-0053		Various Non-Fibrous Heterogeneous		100% Non-fibrous (Other)	None Detected
18B-Grout 392400113-0053A		White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
18C 392400113-0054		Various Non-Fibrous Heterogeneous		100% Non-fibrous (Other)	None Detected
19A 392400113-0055		Gray Non-Fibrous Homogeneous		17% Mica 83% Non-fibrous (Other)	None Detected
19B 392400113-0056		Gray Non-Fibrous Homogeneous		18% Mica 82% Non-fibrous (Other)	None Detected
19C 392400113-0057		Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
20A 392400113-0058		Gray Non-Fibrous Homogeneous		19% Mica 81% Non-fibrous (Other)	None Detected
20B 392400113-0059		Gray Non-Fibrous Homogeneous		16% Mica 84% Non-fibrous (Other)	None Detected
20C 392400113-0060		Gray Non-Fibrous Homogeneous	5% Cellulose	95% Non-fibrous (Other)	None Detected
21A-Floor Tile 392400113-0061		Various Non-Fibrous Homogeneous		96% Non-fibrous (Other)	4% Chrysotile
21A-Adhesive 392400113-0061A		Orange Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
21B-Floor Tile 392400113-0062					Positive Stop (Not Analyzed)
21B-Adhesive 392400113-0062A		Orange Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
21C-Floor Tile 392400113-0063					Positive Stop (Not Analyzed)
21C-Adhesive 392400113-0063A		Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
22A-Floor Tile 392400113-0064		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

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Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
22A-Adhesive 392400113-0064A		Black Non-Fibrous Homogeneous		92% Non-fibrous (Other)	8% Chrysotile
22B-Floor Tile 392400113-0065		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
22B-Adhesive 392400113-0065A					Positive Stop (Not Analyzed)
22C-Floor Tile 392400113-0066		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
22C-Adhesive 392400113-0066A					Positive Stop (Not Analyzed)
23A-Cove Base 392400113-0067		Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
23A-Adhesive 392400113-0067A		Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
23B-Cove Base 392400113-0068		White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
23B-Adhesive 392400113-0068A		Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
23C 392400113-0069		Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
24A-Sealant 392400113-0070		White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
24A-Insulation 392400113-0070A		Yellow Fibrous Homogeneous	96% Min. Wool	4% Non-fibrous (Other)	None Detected
24B-Sealant 392400113-0071		White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
24B-Insulation 392400113-0071A		Yellow Fibrous Homogeneous	93% Min. Wool	7% Non-fibrous (Other)	None Detected
24C 392400113-0072		White Non-Fibrous Homogeneous	39% Cellulose	61% Non-fibrous (Other)	None Detected
25A-Cove Base 392400113-0073		Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
25A-Adhesive 392400113-0073A		Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
25A-Leveler 392400113-0073B		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
25B-Cove Base 392400113-0074		Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

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			% Fibrous	% Non-Fibrous	% Type
25B-Adhesive 392400113-0074A		Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
25B-Leveler 392400113-0074B		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
25C-Cove Base 392400113-0075		Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
25C-Adhesive 392400113-0075A		Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
26A 392400113-0076		Various Non-Fibrous Homogeneous		83% Non-fibrous (Other)	17% Chrysotile
26B 392400113-0077					Positive Stop (Not Analyzed)
26C 392400113-0078					Positive Stop (Not Analyzed)
27A 392400113-0079		Various Non-Fibrous Homogeneous		82% Non-fibrous (Other)	18% Chrysotile
27B 392400113-0080					Positive Stop (Not Analyzed)
27C 392400113-0081					Positive Stop (Not Analyzed)
28A 392400113-0082		Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
28B 392400113-0083		Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
28C 392400113-0084		Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
29A 392400113-0085		Various Fibrous Homogeneous	9% Cellulose 68% Min. Wool	19% Perlite 4% Non-fibrous (Other)	None Detected
29B 392400113-0086		Various Fibrous Homogeneous	6% Cellulose 65% Min. Wool	16% Perlite 13% Non-fibrous (Other)	None Detected
29C 392400113-0087		Various Fibrous Homogeneous	70% Min. Wool	30% Non-fibrous (Other)	None Detected
30A-Floor Tile 392400113-0088		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
30A-Adhesive 392400113-0088A		Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
30A-Leveler 392400113-0088B		Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

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Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
30B-Floor Tile 392400113-0089		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
30B-Adhesive 392400113-0089A		Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
30B-Leveler 392400113-0089B		Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
30C-Floor Tile 392400113-0090		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
30C-Adhesive 392400113-0090A		Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
30C-Leveler 392400113-0090B		Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
31A-Floor Tile 392400113-0091		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
31A-Adhesive 392400113-0091A		Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
31A-Leveler 392400113-0091B		White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
31B-Floor Tile 392400113-0092		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
31B-Adhesive 392400113-0092A		Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
31B-Leveler 392400113-0092B		White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
31C-Floor Tile 392400113-0093		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
31C-Adhesive 392400113-0093A		Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
32A 392400113-0094		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
32B 392400113-0095		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
32C 392400113-0096		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
33A-Wrap 392400113-0097		Gray Fibrous Homogeneous	68% Fibrous (Other)	32% Non-fibrous (Other)	None Detected
33A-Insulation 392400113-0097A		Gray Fibrous Homogeneous		12% Non-fibrous (Other)	88% Chrysotile

Initial report from: 01/11/2024 10:58:06



EMSL Analytical, Inc.
 100 Green Park Industrial Court Saint Louis, MO 63123
 Tel/Fax: (314) 577-0150 / (314) 776-3313
<http://www.EMSL.com> / saintlouislabs@emsl.com

EMSL Order: 392400113
 Customer ID: TERR57
 Customer PO: 15237334
 Project ID:

**Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E
 Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy**

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
33A-Insulation 392400113-0097B		Gray Non-Fibrous Homogeneous	38% Min. Wool	62% Non-fibrous (Other)	None Detected
33B 392400113-0098					Positive Stop (Not Analyzed)
33C 392400113-0099					Positive Stop (Not Analyzed)
34A 392400113-0100		White Non-Fibrous Homogeneous		71% Non-fibrous (Other)	29% Amosite
34B 392400113-0101					Positive Stop (Not Analyzed)
34C 392400113-0102					Positive Stop (Not Analyzed)
35A-Wrap 392400113-0103		Various Fibrous Homogeneous	66% Fibrous (Other)	34% Non-fibrous (Other)	None Detected
35A-Insulation 392400113-0103A		Gray Fibrous Homogeneous		14% Non-fibrous (Other)	86% Chrysotile
35A-Insulation 392400113-0103B		Gray Non-Fibrous Homogeneous	36% Min. Wool	64% Non-fibrous (Other)	None Detected
35B 392400113-0104					Positive Stop (Not Analyzed)
35C 392400113-0105					Positive Stop (Not Analyzed)
36A-Plaster 392400113-0106		White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
36A-Plaster 392400113-0106A		Various Non-Fibrous Homogeneous		17% Quartz 83% Non-fibrous (Other)	None Detected
36A-Block 392400113-0106B		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
36B-Plaster 392400113-0107		White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
36B-Plaster 392400113-0107A		Various Non-Fibrous Homogeneous		18% Quartz 82% Non-fibrous (Other)	None Detected
36B-Block 392400113-0107B		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
36C 392400113-0108		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
37A-Joint Compound 392400113-0109		White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

Initial report from: 01/11/2024 10:58:06



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 100 Green Park Industrial Court Saint Louis, MO 63123
 Tel/Fax: (314) 577-0150 / (314) 776-3313
<http://www.EMSL.com / saintlouislabs@emsl.com>

EMSL Order: 392400113
Customer ID: TERR57
Customer PO: 15237334
Project ID:

Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E
Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
37A-Drywall <small>392400113-0109A</small>		Various Non-Fibrous Homogeneous	19% Cellulose	81% Non-fibrous (Other)	None Detected
37B-Joint Compound <small>392400113-0110</small>		White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
37B-Drywall <small>392400113-0110A</small>		Various Non-Fibrous Homogeneous	16% Cellulose	84% Non-fibrous (Other)	None Detected
37C-Joint Compound <small>392400113-0111</small>		White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
37C-Drywall <small>392400113-0111A</small>		Various Non-Fibrous Homogeneous	17% Cellulose	83% Non-fibrous (Other)	None Detected
37D-Joint Compound <small>392400113-0112</small>		White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
37D-Drywall <small>392400113-0112A</small>		Various Non-Fibrous Homogeneous	18% Cellulose	82% Non-fibrous (Other)	None Detected
37E-Joint Compound <small>392400113-0113</small>		White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
37E-Drywall <small>392400113-0113A</small>		Various Non-Fibrous Homogeneous	19% Cellulose	81% Non-fibrous (Other)	None Detected
37F-Joint Compound <small>392400113-0114</small>		White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
37F-Drywall <small>392400113-0114A</small>		Various Non-Fibrous Homogeneous	19% Cellulose	81% Non-fibrous (Other)	None Detected
37G <small>392400113-0115</small>		Various Non-Fibrous Homogeneous	17% Cellulose	83% Non-fibrous (Other)	None Detected
38A <small>392400113-0116</small>		Various Non-Fibrous Homogeneous	20% Cellulose	80% Non-fibrous (Other)	None Detected
38B <small>392400113-0117</small>		Various Non-Fibrous Homogeneous	21% Cellulose	79% Non-fibrous (Other)	None Detected
38C <small>392400113-0118</small>		Various Non-Fibrous Homogeneous	22% Cellulose	78% Non-fibrous (Other)	None Detected
38D <small>392400113-0119</small>		Various Non-Fibrous Homogeneous	19% Cellulose	81% Non-fibrous (Other)	None Detected
38E <small>392400113-0120</small>		Various Non-Fibrous Homogeneous	20% Cellulose	80% Non-fibrous (Other)	None Detected
38F <small>392400113-0121</small>		Various Non-Fibrous Homogeneous	21% Cellulose	79% Non-fibrous (Other)	None Detected
38G <small>392400113-0122</small>		Various Non-Fibrous Homogeneous	18% Cellulose	82% Non-fibrous (Other)	None Detected

Initial report from: 01/11/2024 10:58:06



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<http://www.EMSL.com / saintlouislabs@emsl.com>

EMSL Order: 392400113
 Customer ID: TERR57
 Customer PO: 15237334
 Project ID:

Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E
Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos		Asbestos % Type
			% Fibrous	% Non-Fibrous	
39A 392400113-0123		Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
39B 392400113-0124		Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
39C 392400113-0125		Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
40A 392400113-0126		Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
40B 392400113-0127		Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
40C 392400113-0128		Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
41A 392400113-0129		Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
41B 392400113-0130		Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
41C 392400113-0131		Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
42A-Stucco 392400113-0132		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
42A-Insulation 392400113-0132A		Various Fibrous Homogeneous	100% Glass		None Detected
42B-Stucco 392400113-0133		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
42B-Insulation 392400113-0133A		Various Fibrous Homogeneous	100% Glass		None Detected
42C-Stucco 392400113-0134		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
42C-Insulation 392400113-0134A		Various Fibrous Homogeneous	100% Glass		None Detected
43A 392400113-0135		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
43B 392400113-0136		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
43C 392400113-0137		Various Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

Initial report from: 01/11/2024 10:58:06

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

MU - Veterinary Science Building | Columbia, Missouri

February 16, 2024 | Terracon Project No. 15237334



EMSL Analytical, Inc.

100 Green Park Industrial Court Saint Louis, MO 63123

Tel/Fax: (314) 577-0150 / (314) 776-3313

<http://www.EMSL.com> / saintlouislabs@emsl.com

EMSL Order: 392400113
Customer ID: TERR57
Customer PO: 15237334
Project ID:

Analyst(s)

Clayton Summers (53)
Sue Ferrario (149)

Jeff Siria, Laboratory Manager
or Other Approved Signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M4-82-020 "Interim Method") but augmented with procedures outlined in the 1993 ("final") version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.

Samples analyzed by EMSL Analytical, Inc. Saint Louis, MO NVLAP Lab Code 200742-0

Initial report from: 01/11/2024 10:58:06

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

MU - Veterinary Science Building | Columbia, Missouri
 February 16, 2024 | Terracon Project No. 15237334



OrderID: 392400113



Asbestos Chain of Custody (Air, Bulk, Soil)

EMSL Order Number / Lab Use Only

392400113

EMSL Analytical, Inc.
 100 Green Park Industrial Ct
 St. Louis, MO 63123

PHONE: (314)-577-0150

EMAIL: saintlouislab@EMSL.com

EMSL ANALYTICAL, INC.
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Customer Information		Billing Information	
Customer ID:		Billing ID:	15237334
Company Name:	Terracon	Company Name:	
Contact Name:	Nick Eiterman	Billing Contact:	
Street Address:	11600 Gilburn Park Road	Street Address:	
City, State, Zip:	St. Louis, MO 63116	City, State, Zip:	
Country:	US	Country:	
Phone:	314-692-9175	Phone:	
Email(s) for Report:	nick.eiterman@terracon.com	Email(s) for Invoice:	

Project Information		Purchase Order	
Project Name/No:			
EMSL LIMS Project ID:		US State where samples collected:	MO
State of Connecticut (CT) must select:		Commercial (Taxable)	<input type="checkbox"/>
		Residential (Non-Taxable)	<input type="checkbox"/>
Sampled By Name:	Daniel McFarlane	Sampled By Signature:	<i>[Signature]</i>
No. of Samples in Shipment:	137		
Turn-Around-Time (TAT)			
<input type="checkbox"/> 3 Hour	<input type="checkbox"/> 4-4.5 Hour	<input type="checkbox"/> 6 Hour	<input type="checkbox"/> 24 Hour
<input type="checkbox"/> 32 Hour	<input type="checkbox"/> 48 Hour	<input type="checkbox"/> 72 Hour	<input type="checkbox"/> 96 Hour
<input checked="" type="checkbox"/> 1 Week	<input type="checkbox"/> 2 Week		

PCM Air		TEM - Air		TEM - Settled Dust	
<input type="checkbox"/> NIOSH 7400	<input type="checkbox"/> AHERA 40 CFR, Part 763	<input type="checkbox"/> Microvac - ASTM D6755			
<input type="checkbox"/> NIOSH 7400 w/ 8hr. TWA	<input type="checkbox"/> NIOSH 7402	<input type="checkbox"/> Wipe - ASTM D6480			
PLM - Bulk (reporting limit)		<input type="checkbox"/> EPA Level II	<input type="checkbox"/> Qualitative via Filtration Prep		
<input checked="" type="checkbox"/> PLM EPA 600/R-93/116 (<1%)	<input type="checkbox"/> ISO 10312*	<input type="checkbox"/> ISO 10312*	<input type="checkbox"/> Qualitative via Drop Mount Prep		
<input type="checkbox"/> PLM EPA NOB (<1%)	TEM - Bulk				
<input type="checkbox"/> POINT COUNT	<input type="checkbox"/> TEM EPA NOB	Soil - Rock - Vermiculite (reporting limit)*			
<input type="checkbox"/> 400 (<0.25%)	<input type="checkbox"/> NYS NOB 198.4 (Non-Friable-NY)	<input type="checkbox"/> PLM EPA 600/R-93/116 with milling prep (<0.25%)			
<input type="checkbox"/> 1,000 (<0.1%)	<input type="checkbox"/> TEM EPA 600/R-93/116 w Milling Prep (0.1%)	<input type="checkbox"/> PLM EPA 600/R-93/116 with milling prep (<0.1%)			
POINT COUNT w/ GRAVIMETRIC		<input type="checkbox"/> TEM EPA 600/R-93/116 with milling prep (<0.1%)			
<input type="checkbox"/> 400 (<0.25%)		<input type="checkbox"/> TEM Qualitative via Filtration Prep			
<input type="checkbox"/> 1,000 (<0.1%)		<input type="checkbox"/> TEM Qualitative via Drop Mount Prep			
<input type="checkbox"/> NIOSH 9002 (<1%)	Other Test (please specify)				
<input type="checkbox"/> NYS 198.1 (Friable - NY)					
<input type="checkbox"/> NYS 198.6 NOB (Non-Friable - NY)					
<input type="checkbox"/> NYS 198.8 (Vermiculite SM-V)					

Positive Stop - Clearly Identified Homogeneous Areas (HA) Filter Pore Size (Air Samples) 0.8um 0.45um

Sample Number	Sample Location / Description	Volume, Area or Homogeneous Area	Date / Time Sampled (Air Monitoring Only)
1A	Roof core	1	
1B	↓	↓	
1C	↓	↓	
2A	Drain tar	2	
2B	↓	↓	
2C	↓	↓	
3A	Flashing - HVAC unit	3	
3B	↓	↓	

Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

Method of Shipment:	W/	Sample Condition Upon Receipt:	
Relinquished by:	Daniel McFarlane	Received by:	Nanjou
Date/Time:	1/5/24	Date/Time:	1/5/24 16:14
Relinquished by:		Received by:	
Date/Time:		Date/Time:	

AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature.)
 EMSL Analytical, Inc.'s Laboratory Terms and Conditions are incorporated into this Chain of Custody by reference in their entirety. Submission of samples to EMSL Analytical, Inc. constitutes acceptance and acknowledgment of all terms and conditions by Customer.

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

MU - Veterinary Science Building | Columbia, Missouri
 February 16, 2024 | Terracon Project No. 15237334



OrderID: 392400113



EMSL ANALYTICAL, INC.
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Asbestos Chain of Custody (Air, Bulk, Soil)

EMSL Order Number / Lab Use Only

3924 00 113

EMSL Analytical, Inc.
 100 Green Park Industrial Ct
 St. Louis, MO 63123

PHONE: (314)-577-0160
 EMAIL: saintlouislab@EMSL.com

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information.

Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

Sample Number	Sample Location / Description	Volume, Area or Homogeneous Area	Date / Time Sampled (Air Monitoring Only)
3C	Flashing - HVAC unit	3	
4A	9" x 9" grey floor tile	4	
4B	↓	↓	
4C	↓	↓	
5A	4" black core base	5	
5B	↓	↓	
5C	↓	↓	
6A	2' x 2' ceiling tile (P/HF)	6	
6B	↓	↓	
6C	↓	↓	
7A	2' x 4' ceiling tile (P/HF)	7	
7B	↓	↓	
7C	↓	↓	
8A	Poured Floor - grey	8	
8B	↓	↓	
8C	↓	↓	
9A	Poured Floor - yellow	9	
9B	↓	↓	
9C	↓	↓	
10A	Poured Floor - beige	10	
10B	↓	↓	
10C	↓	↓	
11A	12" x 12" floor tile - white to blue specks	11	
11B	↓	↓	
11C	↓	↓	

Method of Shipment		Sample Condition Upon Receipt	
Relinquished by:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Date/Time:	Received by:	Date/Time:

Controlled Document - C02-05 Asbestos R16 10/23/2021

AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature.)

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Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

MU - Veterinary Science Building | Columbia, Missouri
 February 16, 2024 | Terracon Project No. 15237334



OrderID: 392400113



Asbestos Chain of Custody (Air, Bulk, Soil)

EMSL Order Number / Lab Use Only

392400113

EMSL Analytical, Inc.
 100 Green Park Industrial Ct
 St. Louis, MO 63123

PHONE: (314)-577-0150
 EMAIL: saintlouislab@EMSL.com

EMSL ANALYTICAL, INC.
 TESTING LABS - PRODUCTS - TRAINING

If Bill-To is the same as Report-To leave this section blank. Third-party billing requires written authorization.

Customer ID: _____		Billing ID: <u>15237334</u>	
Company Name: <u>Terracon</u>		Company Name: _____	
Contact Name: <u>Nick Eilerman</u>		Billing Contact: _____	
Street Address: _____		Street Address: _____	
City, State, Zip: _____	Country: _____	City, State, Zip: _____	Country: _____
Phone: <u>314-692-9175</u>		Phone: _____	
Email(s) for Report: <u>nick.eilerman@terracon.com</u>		Email(s) for Invoice: _____	

Project Information

Project Name/No: <u>15237334</u>	Purchase Order: _____
EMSL LIMS Project ID: _____ <small>(If applicable, EMSL will provide)</small>	US State where samples collected: <u>MO</u>
	State of Connecticut (CT) must select project location: <input type="checkbox"/> Commercial (Taxable) <input type="checkbox"/> Residential (Non-Taxable)

Sampled By Name: <u>Daniel McFarlane</u>	Sampled By Signature: <u>[Signature]</u>	No. of Samples in Shipment: <u>137</u>
--	--	--

Turn-Around-Time (TAT)

3 Hour
 4-4.5 Hour AHERA ONLY
 6 Hour
 24 Hour
 32 Hour
 48 Hour
 72 Hour
 96 Hour
 1 Week
 2 Week

TEM Air 34 Hour, please call ahead to schedule. 32 Hour TAT available for select tests only; samples must be submitted by 11:30 am.

<p>PCM Air</p> <input type="checkbox"/> NIOSH 7400 <input type="checkbox"/> NIOSH 7400 w/ 8hr. TWA <p>PLM - Bulk (reporting limit)</p> <input checked="" type="checkbox"/> PLM EPA 600/R-93/116 (<1%) <input type="checkbox"/> PLM EPA NOB (<1%) <p>POINT COUNT</p> <input type="checkbox"/> 400 (<0.25%) <input type="checkbox"/> 1,000 (<0.1%) <input type="checkbox"/> POINT COUNT w/ GRAVIMETRIC <input type="checkbox"/> 400 (<0.25%) <input type="checkbox"/> 1,000 (<0.1%) <input type="checkbox"/> NIOSH 9002 (<1%) <input type="checkbox"/> NYS 198.1 (Friable - NY) <input type="checkbox"/> NYS 198.6 NOB (Non-Friable - NY) <input type="checkbox"/> NYS 198.8 (Vermiculite SM-V)	<p>Test Selection</p> <p>TEM - Air</p> <input type="checkbox"/> AHERA 40 CFR, Part 763 <input type="checkbox"/> NIOSH 7402 <input type="checkbox"/> EPA Level II <input type="checkbox"/> ISO 10312* <p>TEM - Bulk</p> <input type="checkbox"/> TEM EPA NOB <input type="checkbox"/> NYS NOB 198.4 (Non-Friable-NY) <input type="checkbox"/> TEM EPA 600/R-93/116 w/ Milling Prep (0.1%) <p>Other Test (please specify)</p>	<p>TEM - Settled Dust</p> <input type="checkbox"/> Microvac - ASTM D5755 <input type="checkbox"/> Wipe - ASTM D6480 <input type="checkbox"/> Qualitative via Filtration Prep <input type="checkbox"/> Qualitative via Drop Mount Prep <p>Soil - Rock - Vermiculite (reporting limit)*</p> <input type="checkbox"/> PLM EPA 600/R-93/116 with milling prep (<0.25%) <input type="checkbox"/> PLM EPA 600/R-93/116 with milling prep (<0.1%) <input type="checkbox"/> TEM EPA 600/R-93/116 with milling prep (<0.1%) <input type="checkbox"/> TEM Qualitative via Filtration Prep <input type="checkbox"/> TEM Qualitative via Drop Mount Prep
--	--	--

*Please call with your project-specific requirements.

Positive Step - Clearly Identified Homogeneous Areas (HA) Filter Pore Size (Air Samples) 0.8um 0.45um

Sample Number	Sample Location / Description	Volume, Area or Homogeneous Area	Date / Time Sampled (Air Monitoring Only)
12A	12"x12" Floortile - brown	12	
12B	↓	↓	
12C	↓	↓	
13A	2'x4' Ceiling tile Pinhole	13	
13B	↓	↓	
13C	↓	↓	
14A	18"x12" floor tile grey	14	
14B	↓	↓	

Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc)

Method of Shipment: _____	Sample Condition Upon Receipt: _____
Relinquished by: <u>Daniel McFarlane</u>	Received by: _____
Date/Time: <u>1/16/24</u>	Date/Time: _____
Relinquished by: _____	Received by: _____
Date/Time: _____	Date/Time: _____

Controlled Document - C00-05 Asbestos R19 10/29/2021 AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature.)

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Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

MU - Veterinary Science Building | Columbia, Missouri
 February 16, 2024 | Terracon Project No. 15237334



OrderID: 392400113



Asbestos Chain of Custody (Air, Bulk, Soil)
 EMSL Order Number / Lab Use Only

392400113

EMSL Analytical, Inc.
 100 Green Park Industrial Ct
 St. Louis, MO 63123

PHONE: (314)-577-0150
 EMAIL: saintlouislab@EMSL.com

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Additional Pages of the Chain of Custody are only necessary if needed for additional sample information
 Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

Sample Number	Sample Location / Description	Volume, Area or Homogeneous Area	Date / Time Sampled (Air Monitoring Only)
14C	18"x12" floor tile grey	14	
15A	2'x2' ceiling tile pinkhole	15	
15B	↓	↓	
15C	↓	↓	
16A	9"x9" floor tile maroon	16	
16B	↓	↓	
16C	↓	↓	
17A	12"x12" floor tile (white and brown speckles)	17	
17B	↓	↓	
17C	↓	↓	
18A	4" ceramic wall tile (white)	18	
18B	↓	↓	
18C	↓	↓	
19A	Sink coating - white	19	
19B	↓	↓	
19C	↓	↓	
20A	Sink coating - grey	20	
20B	↓	↓	
20C	↓	↓	
21A	9"x9" floor tile (beige w/brown specks)	21	
21B	↓	↓	
21C	↓	↓	
22A	12"x12" floor tile (white w/grey streaks)	22	
22B	↓	↓	
22C	↓	↓	

Method of Shipment:		Sample Condition Upon Receipt:	
Relinquished by:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Date/Time:	Received by:	Date/Time:

Controlled Document - COC-05 Asbestos R16 10/26/2021 **AGREE TO ELECTRONIC SIGNATURE** (By checking, I consent to signing this Chain of Custody document by electronic signature.)
 EMSL Analytical, Inc.'s Laboratory Terms and Conditions are incorporated into this Chain of Custody by reference, in their entirety. Submission of samples to EMSL Analytical, Inc. constitutes acceptance and acknowledgment of all terms and conditions by Customer.

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

MU - Veterinary Science Building | Columbia, Missouri
 February 16, 2024 | Terracon Project No. 15237334



OrderID: 392400113



EMSL ANALYTICAL, INC.
 TESTING LABS • PRODUCTS • TRAINING

Asbestos Chain of Custody (Air, Bulk, Soil)

EMSL Order Number / Lab Use Only

392400113

EMSL Analytical, Inc.
 100 Green Park Industrial Ct
 St. Louis, MO 63123

PHONE: (314)-577-0150
 EMAIL: saintoussab@EMSL.com

If Bill-To is the same as Report-To leave this section blank. Third-party billing requires written authorization.

Customer Information Customer ID: _____ Company Name: <u>Terracon</u> Contact Name: <u>Nick Eiterman</u> Street Address: _____ City, State, Zip: _____ Country: _____ Phone: <u>314-692-9175</u> Email(s) for Report: <u>nick.eiterman@terracon.com</u>		Billing Information Billing ID: <u>15237334</u> Company Name: _____ Billing Contact: _____ Street Address: _____ City, State, Zip: _____ Country: _____ Phone: _____ Email(s) for Invoice: _____																																					
Project Information Project Name/No: <u>15237334</u> Purchase Order: _____ EMSL LIMS Project ID: _____ (If applicable EMSL will process) US State where samples collected: <u>MO</u> State of Connecticut (CT) must select project location: _____ Sampled By Name: <u>Daniel McFarlane</u> Sampled By Signature: <u>[Signature]</u> Commercial (Taxable) <input type="checkbox"/> Residential (Non-Taxable) <input type="checkbox"/> No. of Samples in Shipment: <u>137</u>																																							
Turn-Around-Time (TAT) <input type="checkbox"/> 3 Hour <input type="checkbox"/> 4-4.5 Hour <input type="checkbox"/> 6 Hour <input type="checkbox"/> 24 Hour <input type="checkbox"/> 32 Hour <input type="checkbox"/> 48 Hour <input type="checkbox"/> 72 Hour <input type="checkbox"/> 96 Hour <input checked="" type="checkbox"/> 1 Week <input type="checkbox"/> 2 Week <small>TEM Air 3-6 Hour, please call ahead to schedule. 32 Hour TAT available for select tests only; samples must be submitted by 11:30 am.</small>																																							
Test Selection <table border="0"> <tr> <td> PCM Air <input type="checkbox"/> NIOSH 7400 <input type="checkbox"/> NIOSH 7400 w/ 8hr. TWA PLM - Bulk (reporting limit) <input checked="" type="checkbox"/> PLM EPA 600/R-93/116 (<1%) <input type="checkbox"/> PLM EPA NOB (<1%) <input type="checkbox"/> POINT COUNT <input type="checkbox"/> 400 (<0.25%) <input type="checkbox"/> 1,000 (<0.1%) <input type="checkbox"/> POINT COUNT w/ GRAVIMETRIC <input type="checkbox"/> 400 (<0.25%) <input type="checkbox"/> 1,000 (<0.1%) <input type="checkbox"/> NIOSH 9002 (<1%) <input type="checkbox"/> NYS 198.1 (Friable - NY) <input type="checkbox"/> NYS 198.6 NOB (Non-Friable - NY) <input type="checkbox"/> NYS 198.8 (Vermiculite SM-V) </td> <td> TEM - Air <input type="checkbox"/> AHERA 40 CFR, Part 763 <input type="checkbox"/> NIOSH 7402 <input type="checkbox"/> EPA Level II <input type="checkbox"/> ISO 10312* TEM - Bulk <input type="checkbox"/> TEM EPA NOB <input type="checkbox"/> NYS NOB 198.4 (Non-Friable-NY) <input type="checkbox"/> TEM EPA 600/R-93/116 w/ Milling Prep (0.1%) </td> <td> TEM - Settled Dust <input type="checkbox"/> Microvac - ASTM D5755 <input type="checkbox"/> Wipe - ASTM D6480 <input type="checkbox"/> Qualitative via Filtration Prep <input type="checkbox"/> Qualitative via Drop Mount Prep Soil - Rock - Vermiculite (reporting limit)* <input type="checkbox"/> PLM EPA 600/R-93/116 with milling prep (<0.25%) <input type="checkbox"/> PLM EPA 600/R-93/116 with milling prep (<0.1%) <input type="checkbox"/> TEM EPA 600/R-93/116 with milling prep (<0.1%) <input type="checkbox"/> TEM Qualitative via Filtration Prep <input type="checkbox"/> TEM Qualitative via Drop Mount Prep </td> </tr> </table> <p style="text-align: center;"><small>*Please call with your project-specific requirements.</small></p>				PCM Air <input type="checkbox"/> NIOSH 7400 <input type="checkbox"/> NIOSH 7400 w/ 8hr. TWA PLM - Bulk (reporting limit) <input checked="" type="checkbox"/> PLM EPA 600/R-93/116 (<1%) <input type="checkbox"/> PLM EPA NOB (<1%) <input type="checkbox"/> POINT COUNT <input type="checkbox"/> 400 (<0.25%) <input type="checkbox"/> 1,000 (<0.1%) <input type="checkbox"/> POINT COUNT w/ GRAVIMETRIC <input type="checkbox"/> 400 (<0.25%) <input type="checkbox"/> 1,000 (<0.1%) <input type="checkbox"/> NIOSH 9002 (<1%) <input type="checkbox"/> NYS 198.1 (Friable - NY) <input type="checkbox"/> NYS 198.6 NOB (Non-Friable - NY) <input type="checkbox"/> NYS 198.8 (Vermiculite SM-V)	TEM - Air <input type="checkbox"/> AHERA 40 CFR, Part 763 <input type="checkbox"/> NIOSH 7402 <input type="checkbox"/> EPA Level II <input type="checkbox"/> ISO 10312* TEM - Bulk <input type="checkbox"/> TEM EPA NOB <input type="checkbox"/> NYS NOB 198.4 (Non-Friable-NY) <input type="checkbox"/> TEM EPA 600/R-93/116 w/ Milling Prep (0.1%)	TEM - Settled Dust <input type="checkbox"/> Microvac - ASTM D5755 <input type="checkbox"/> Wipe - ASTM D6480 <input type="checkbox"/> Qualitative via Filtration Prep <input type="checkbox"/> Qualitative via Drop Mount Prep Soil - Rock - Vermiculite (reporting limit)* <input type="checkbox"/> PLM EPA 600/R-93/116 with milling prep (<0.25%) <input type="checkbox"/> PLM EPA 600/R-93/116 with milling prep (<0.1%) <input type="checkbox"/> TEM EPA 600/R-93/116 with milling prep (<0.1%) <input type="checkbox"/> TEM Qualitative via Filtration Prep <input type="checkbox"/> TEM Qualitative via Drop Mount Prep																																	
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<table border="1"> <thead> <tr> <th>Sample Number</th> <th>Sample Location / Description</th> <th>Volume, Area or Homogeneous Area</th> <th>Date / Time Sampled (Air Monitoring Only)</th> </tr> </thead> <tbody> <tr> <td>23A</td> <td>4" covebase brown</td> <td>23</td> <td></td> </tr> <tr> <td>23B</td> <td>↓</td> <td>↓</td> <td></td> </tr> <tr> <td>23C</td> <td>↓</td> <td>↓</td> <td></td> </tr> <tr> <td>24A</td> <td>Fiberglass sealant</td> <td>24</td> <td></td> </tr> <tr> <td>24B</td> <td>↓</td> <td>↓</td> <td></td> </tr> <tr> <td>24C</td> <td>↓</td> <td>↓</td> <td></td> </tr> <tr> <td>25A</td> <td>6" grey covebase</td> <td>25</td> <td></td> </tr> <tr> <td>25B</td> <td>↓</td> <td>↓</td> <td></td> </tr> </tbody> </table>	Sample Number	Sample Location / Description	Volume, Area or Homogeneous Area	Date / Time Sampled (Air Monitoring Only)	23A	4" covebase brown	23		23B	↓	↓		23C	↓	↓		24A	Fiberglass sealant	24		24B	↓	↓		24C	↓	↓		25A	6" grey covebase	25		25B	↓	↓		Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)		
Sample Number	Sample Location / Description	Volume, Area or Homogeneous Area	Date / Time Sampled (Air Monitoring Only)																																				
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23B	↓	↓																																					
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24B	↓	↓																																					
24C	↓	↓																																					
25A	6" grey covebase	25																																					
25B	↓	↓																																					
Method of Shipment: _____		Sample Condition Upon Receipt: _____																																					
Requisitioned by: <u>Daniel McFarlane</u> Date/Time: <u>1/15/24</u>	Received by: _____ Date/Time: _____	Requisitioned by: _____ Date/Time: _____	Received by: _____ Date/Time: _____																																				

Controlled Document - COC-05 Asbestos R16 10/29/2021

AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature.)

EMSL Analytical, Inc.'s Laboratory Terms and Conditions are incorporated into this Chain of Custody by reference in their entirety. Submission of samples to EMSL Analytical, Inc. constitutes acceptance and acknowledgment of all terms and conditions by Customer.

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

MU - Veterinary Science Building | Columbia, Missouri
 February 16, 2024 | Terracon Project No. 15237334



OrderID: 392400113



Asbestos Chain of Custody (Air, Bulk, Soil)
 EMSL Order Number / Lab Use Only

392400113

EMSL Analytical, Inc.
 100 Green Park Industrial Ct.
 St. Louis, MO 63123

PHONE: (314)-577-0150
 EMAIL: saintlouislab@EMSL.com

EMSL ANALYTICAL, INC.
 TESTING LABS - PRODUCTS - TRAINING

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information.
 Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

Sample Number	Sample Location / Description	Volume, Area or Homogeneous Area	Date / Time Sampled (Air Monitoring Only)
25C	6" corebase gray	25	
26A	Transite wall	26	
26B	↓	↓	
26C	↓	↓	
27A	Transite fume hood	27	
27B	↓	↓	
27C	↓	↓	
28A	Carpet adhesive	28	
28B	↓	↓	
28C	↓	↓	
29A	2'x2' ceiling tile (small pinhole)	29	
29B	↓	↓	
29C	↓	↓	
30A	2"x12" floor tile (Beige w/brown specks)	30	
30B	↓	↓	
30C	↓	↓	
31A	12"x12" floor tile (white w/ brown specks)	31	
31B	↓	↓	
31C	↓	↓	
32A	2'x2' rubber flooring	32	
32B	↓	↓	
32C	↓	↓	
33A	Attended Fittings	33	
33B	↓	↓	
33C	↓	↓	

Method of Shipment:		Sample Condition Upon Receipt:	
Relinquished by:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Date/Time:	Received by:	Date/Time:

Controlled Document - C00-05 Asbestos R15 10/25/2021 AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature.)
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Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

MU - Veterinary Science Building | Columbia, Missouri
 February 16, 2024 | Terracon Project No. 15237334



OrderID: 392400113



Asbestos Chain of Custody (Air, Bulk, Soil)

EMSL Order Number / Lab Use Only

392400113

EMSL Analytical, Inc.
 100 Green Park Industrial Ct
 St Louis, MO 63123

PHONE: (314)-577-0150
 EMAIL: saintlouislab@EMSL.com

EMSL ANALYTICAL, INC.
 TESTING LABS • PRODUCTS • TRAINING

If Bill-To is the same as Report-To leave this section blank. Third-party billing requires written authorization.

Customer Information	Customer ID:	Billing ID:
	Company Name: Terracon	Company Name: 15237334
	Contact Name: Nick Eitenman	Billing Contact:
	Street Address:	Street Address:
	City, State, Zip:	City, State, Zip:
	Country:	Country:
Phone: 314-692-9175	Phone:	
Email(s) for Report: nick.eitenman@terracon.com	Email(s) for Invoice:	

Project Information	
Project Name/No: 15237334	Purchase Order:

EMSL LIMS Project ID: (if applicable, EMSL will invoice)	US State where samples collected: MO	State of Connecticut (CT) must select project location: <input type="checkbox"/> Commercial (Taxable) <input type="checkbox"/> Residential (Non-Taxable)
--	--------------------------------------	--

Sampled By Name: Daniel McFarlane	Sampled By Signature: [Signature]	No. of Samples in Shipment: 07
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Turn-Around-Time (TAT)

3 Hour 4-4.5 Hour (AHERA ONLY) 6 Hour 24 Hour 32 Hour 48 Hour 72 Hour 96 Hour 1 Week 2 Week

TEM Air 3-6 Hour, please call ahead to schedule. 32 Hour TAT available for select tests only, samples must be submitted by 11:30 am.

<p>PCM Air</p> <p><input type="checkbox"/> NIOSH 7400</p> <p><input type="checkbox"/> NIOSH 7400 w/ 8hr. TWA</p> <p>PLM - Bulk (reporting limit)</p> <p><input checked="" type="checkbox"/> PLM EPA 600/R-93/116 (<1%)</p> <p><input type="checkbox"/> PLM EPA NOB (<1%)</p> <p><input type="checkbox"/> POINT COUNT</p> <p><input type="checkbox"/> 400 (<0.25%) <input type="checkbox"/> 1,000 (<0.1%)</p> <p>POINT COUNT w/ GRAVIMETRIC</p> <p><input type="checkbox"/> 400 (<0.25%) <input type="checkbox"/> 1,000 (<0.1%)</p> <p><input type="checkbox"/> NIOSH 9002 (<1%)</p> <p><input type="checkbox"/> NYS 198.1 (Friable - NY)</p> <p><input type="checkbox"/> NYS 198.6 NOB (Non-Friable - NY)</p> <p><input type="checkbox"/> NYS 198.8 (Vermiculite SM-V)</p>	<p>TEM - Air</p> <p><input type="checkbox"/> AHERA 40 CFR, Part 783</p> <p><input type="checkbox"/> NIOSH 7402</p> <p><input type="checkbox"/> EPA Level II</p> <p><input type="checkbox"/> ISO 10312*</p> <p>TEM - Bulk</p> <p><input type="checkbox"/> TEM EPA NOB</p> <p><input type="checkbox"/> NYS NOB 198.4 (Non-Friable-NY)</p> <p><input type="checkbox"/> TEM EPA 600/R-93/116 w/ Milling Prep (0.1%)</p> <p>Other Test (please specify)</p>	<p>TEM - Settled Dust</p> <p><input type="checkbox"/> Microvac - ASTM D5755</p> <p><input type="checkbox"/> Wipe - ASTM D6480</p> <p><input type="checkbox"/> Qualitative via Filtration Prep</p> <p><input type="checkbox"/> Qualitative via Drop Mount Prep</p> <p>Soil - Rock - Vermiculite (reporting limit)*</p> <p><input type="checkbox"/> PLM EPA 600/R-93/116 with milling prep (<0.25%)</p> <p><input type="checkbox"/> PLM EPA 600/R-93/116 with milling prep (<0.1%)</p> <p><input type="checkbox"/> TEM EPA 600/R-93/116 with milling prep (<0.1%)</p> <p><input type="checkbox"/> TEM Qualitative via Filtration Prep</p> <p><input type="checkbox"/> TEM Qualitative via Drop Mount Prep</p>
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*Please call with your project-specific requirements

Positive Stop - Clearly Identified Homogeneous Areas (HA) Filter Pore Size (Air Samples) 0.8um 0.45um

Sample Number	Sample Location / Description	Volume, Area or Homogeneous Area	Date / Time Sampled (Air Monitoring Only)
34A	TSI	34	
34B	↓	↓	
34C	↓	↓	
35A	Tank Insulation	35	
35B	↓	↓	
35C	↓	↓	
36A	CMU Block Walls	36	
36B	↓	↓	

Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

Method of Shipment:	Sample Condition Upon Receipt:
Relinquished by: Daniel McFarlane	Received by:
Date/Time: 1/5/24	Date/Time:
Relinquished by:	Received by:
Date/Time:	Date/Time:

Controlled Document - COC-05 Asbestos R16 10/24/2021 AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature)

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Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

MU - Veterinary Science Building | Columbia, Missouri
 February 16, 2024 | Terracon Project No. 15237334



OrderID: 392400113



Asbestos Chain of Custody (Air, Bulk, Soil)
EMSL Order Number / Lab Use Only

392400113

EMSL Analytical, Inc.
 100 Green Park Industrial Ct
 St. Louis, MO 63123

PHONE: (314)-577-0160
 EMAIL: saintlouislab@EMSL.com

EMSL ANALYTICAL, INC.
TESTING LABS • PRODUCTS • TRAINING

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information.
 Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

Sample Number	Sample Location / Description	Volume, Area or Homogeneous Area	Date / Time Sampled (Air Monitoring Only)
36C	CMU Block Walls	36	
37A	Drywall walls	37	
37B	↓	↓	
37C			
37D			
37E			
37F			
37G	↓	↓	
38A	Drywall Ceilings	38	
38B	↓	↓	
38C			
38D			
38E			
38F			
38G	↓	↓	
39A	Brown caulk on duct	39	
39B	↓	↓	
39C			
40A	Exterior Door caulk	40	
40B	↓	↓	
40C			
41A	Exterior Window Caulk	41	
41B	↓	↓	
41C			
42A	Exterior Stucco	42	

Method of Shipment:		Sample Condition Upon Receipt:	
Relinquished by:	Date/Time:	Received by:	Date/Time:
Relinquished by:	Date/Time:	Received by:	Date/Time:


Controlled Document - CDD-05 Asbestos R16 1/28/2021 **AGREE TO ELECTRONIC SIGNATURE** (By checking, I consent to signing this Chain of Custody document by electronic signature.)
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Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

MU - Veterinary Science Building | Columbia, Missouri
 February 16, 2024 | Terracon Project No. 15237334



OrderID: 392400113



Asbestos Chain of Custody (Air, Bulk, Soil)
 EMSL Order Number / Lab Use Only

392400113

EMSL Analytical, Inc.
 100 Green Park Industrial Ct
 St Louis, MO 63123
 PHONE: (314)-577-0150
 EMAIL: sales@emsl.com

EMSL ANALYTICAL, INC.
 TESTING LABS • PRODUCTS • TRAINING

* Bill-To is the same as Report-To leave this section blank. Third-party billing requires written authorization.

<p>Customer Information</p> <p>Customer ID: _____</p> <p>Company Name: <u>Terracon</u></p> <p>Contact Name: <u>Nick Filerman</u></p> <p>Street Address: _____</p> <p>City, State, Zip: _____ Country: _____</p> <p>Phone: <u>314-697-9175</u></p> <p>Email(s) for Report: <u>nik.filerman@terracon.com</u></p>	<p>Billing Information</p> <p>Billing ID: <u>15237334</u></p> <p>Company Name: _____</p> <p>Billing Contact: _____</p> <p>Street Address: _____</p> <p>City, State, Zip: _____ Country: _____</p> <p>Phone: _____</p> <p>Email(s) for Invoice: _____</p>
---	---

Project Information

Project Name/No: 15237334 Purchase Order: _____

EMSL LIMS Project ID: _____ US State where samples collected: MO State of Connecticut (CT) must select project location: _____

Commercial (Taxable) Residential (Non-Taxable)

Sampled By Name: Daniel McFarlane Sampled By Signature: [Signature] No. of Samples in Shipset: 137

Turn-Around-Time (TAT)

3 Hour 4-4.5 Hour 6 Hour 24 Hour 32 Hour 48 Hour 72 Hour 96 Hour 1 Week 2 Week

TEM Air 3-6 Hour, please call ahead to schedule. 32 Hour TAT available for select tests only, samples must be submitted by 11:30 a.m.

<p>PCM Air</p> <p><input type="checkbox"/> NIOSH 7400</p> <p><input type="checkbox"/> NIOSH 7400 w/ 8hr. TWA</p> <p>PLM - Bulk (reporting limit)</p> <p><input checked="" type="checkbox"/> PLM EPA 600/R-93/116 (<1%)</p> <p><input type="checkbox"/> PLM EPA NOB (<1%)</p> <p><input type="checkbox"/> POINT COUNT</p> <p><input type="checkbox"/> 400 (<0.25%) <input type="checkbox"/> 1,000 (<0.1%)</p> <p>POINT COUNT w/ GRAMMETRIC</p> <p><input type="checkbox"/> 400 (<0.25%) <input type="checkbox"/> 1,000 (<0.1%)</p> <p><input type="checkbox"/> NIOSH 9002 (<1%)</p> <p><input type="checkbox"/> NYS 198.1 (Friable - NY)</p> <p><input type="checkbox"/> NYS 198.6 NOB (Non-Friable - NY)</p> <p><input type="checkbox"/> NYS 198.8 (Vermiculite SM-V)</p>	<p>TEM - Air</p> <p><input type="checkbox"/> AHERA 40 CFR, Part 763</p> <p><input type="checkbox"/> NIOSH 7402</p> <p><input type="checkbox"/> EPA Level II</p> <p><input type="checkbox"/> ISO 10312*</p> <p>TEM - Bulk</p> <p><input type="checkbox"/> TEM EPA NOB</p> <p><input type="checkbox"/> NYS NOB 198.4 (Non-Friable-NY)</p> <p><input type="checkbox"/> TEM EPA 600/R-93/116 w/ Milling Prep (0.1%)</p> <p>Other Test (please specify)</p>	<p>TEM - Settled Dust</p> <p><input type="checkbox"/> Microvac - ASTM D6755</p> <p><input type="checkbox"/> Wipe - ASTM D6480</p> <p><input type="checkbox"/> Qualitative via Filtration Prep</p> <p><input type="checkbox"/> Qualitative via Drop Mount Prep</p> <p>Soil - Rock - Vermiculite (reporting limit)*</p> <p><input type="checkbox"/> PLM EPA 600/R-93/116 with milling prep (<0.25%)</p> <p><input type="checkbox"/> PLM EPA 600/R-93/116 with milling prep (<0.1%)</p> <p><input type="checkbox"/> TEM EPA 600/R-93/116 with milling prep (<0.1%)</p> <p><input type="checkbox"/> TEM Qualitative via Filtration Prep</p> <p><input type="checkbox"/> TEM Qualitative via Drop Mount Prep</p>
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*Please call with your project-specific requirements

Positive Stop - Clearly Identified Homogeneous Areas (HA) Filter Pore Size (Air Samples) 0.8um 0.45um

Sample Number	Sample Location / Description	Volume, Area or Homogeneous Area	Date / Time Sampled (Air Monitoring Only)
42B	Exterior Stucco	42	
42C	↓	↓	
43A	Exterior Concrete Walls	43	
43B	↓	↓	
43C	↓	↓	

Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

Method of Shipment: _____	Sample Condition Upon Receipt: _____
Requisitioned by: <u>Daniel McFarlane</u> Date/Time: <u>1/5/24</u>	Received by: _____ Date/Time: _____
Requisitioned by: _____ Date/Time: _____	Received by: _____ Date/Time: _____

Controlled Document - OCC-05 Asbestos R16 10/29/2021 **AGREE TO ELECTRONIC SIGNATURE** (By checking, I consent to signing this Chain of Custody document by electronic signature.)

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APPENDIX D

TOXICITY CHARACTERISTIC LEACHING PROCEDURE ANALYTICAL DATA



EMSL Analytical, Inc.
6340 CastlePlace Dr., Indianapolis, IN 46250
Phone/Fax: (317) 803-2997 / (317) 803-3047
<http://www.EMSL.com> indianapolislab@emsl.com

EMSL Order: 162400513
CustomerID: TERR57
CustomerPO: 15237334
ProjectID:

Attn: **Nick Eilerman**
Terracon Consultants, Inc.
11600 Lilburn Park Road
Saint Louis, MO 63146

Phone: (314) 692-8811
Fax: (314) 692-8810
Received: 1/9/2024 09:49 AM
Collected: 1/5/2024

Project: MU-VETERINARY SCIENCE BUILDING-15237334

Test Report: Toxicity Characteristic Leachate Procedure (1311/7000B)

Client SampleDescription	Collected	Analyzed	RDL	Lead Concentration
1 162400513-0001	1/5/2024	1/12/2024	0.40 mg/L	<0.40 mg/L
		Site: MU VETERINARY BUILDING Desc: THROUGHOUT		

Aleksandra Kuchenbrod, Inorganic Chemistry
Lab Manager
or other approved signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. Definitions of modifications are available upon request.
Samples analyzed by EMSL Analytical, Inc. Indianapolis, IN

Initial report from 01/16/2024 08:21:27

Test Report PB w/RDL-2.0.0.0 Printed: 1/16/2024 8:21:27 AM

Page 1 of 1

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory

MU - Veterinary Science Building | Columbia, Missouri
 February 16, 2024 | Terracon Project No. 15237334



OrderID: 162400513



Lead Chain of Custody

EMSL Order Number / Lab Use Only

162400513

EMSL Analytical, Inc.
 100 Green Park Industrial Court
 Saint Louis, MO 63123

PHONE: (314) 577-0150

EMAIL: SaintLouisLab@emsl.com

Customer Information		Billing Information	
Customer ID	Company Name: Terracon	Billing ID: 15237334	Company Name:
Contact Name: Nick Eilerman	Street Address: 11600 Lilburn Park Road	Billing Contact:	Street Address:
City, State, Zip: St. Louis, MO 63146	Country: US	City, State, Zip:	Country:
Phone: 314-692-9175	Email(s) for Report: nick.eilerman@terracon.com	Phone:	Email(s) for Invoice:

Project Information

Project Name/No: MU - Veterinary Science Building - 15237334

EMSL LIMS Project ID: (blank)

U.S. State where samples collected: (blank)

State of Connecticut (CT) must select project location: Commercial (Taxable) Residential (Non-Taxable)

Sampled By Name: Daniel McFarlane

Sampled By Signature: [Signature]

No. of Samples in Shipment: 1

Turn-Around-Time (TAT)

3 Hour 6 Hour 24 Hour 32 Hour 48 Hour 72 Hour 96 Hour 1 Week 2 Week

MATRIX	METHOD	INSTRUMENT	REPORTING LIMIT	SELECTION
CHIPS <input type="checkbox"/> % by wt. <input type="checkbox"/> ppm (mg/kg) <input type="checkbox"/> mg/cm ² *Reporting Limit based on a minimum 0.25g sample weight. **Not appropriate for Ceramic Tiles - XRF is recommended	SW 846-7000B	Flame Atomic Absorption	0.008% (80ppm)	<input type="checkbox"/>
	SW 846-6010D*	ICP-OES	0.0004% (4ppm)	<input type="checkbox"/>
	NIOSH 7082	Flame Atomic Absorption	4µg/filter	<input type="checkbox"/>
AIR	NIOSH 7300M / NIOSH 7303M	ICP-OES	0.5µg/filter	<input type="checkbox"/>
	NIOSH 7300M / NIOSH 7303M	ICP-MS	0.05µg/filter	<input type="checkbox"/>
WIPE <input type="checkbox"/> ASTM <input type="checkbox"/> NON-ASTM *If no box is checked, non-ASTM Wipe is assumed	SW 846-7000B	Flame Atomic Absorption	10µg/wipe	<input type="checkbox"/>
	SW 846-6010D*	ICP-OES	1.0µg/wipe	<input type="checkbox"/>
TCLP	SW 846-1311 / 7000B / SM 3111B	Flame Atomic Absorption	0.4 mg/L (ppm)	<input checked="" type="checkbox"/>
	SW 846-1311 / SW 846-6010D*	ICP-OES	0.1 mg/L (ppm)	<input type="checkbox"/>
SPLP	SW 846-1312 / 7000B / SM 3111B	Flame Atomic Absorption	0.4 mg/L (ppm)	<input type="checkbox"/>
	SW 846-1312 / SW 846-6010D*	ICP-OES	0.1 mg/L (ppm)	<input type="checkbox"/>
TTLC	22 CCR App. II, 7000B	Flame Atomic Absorption	40mg/kg (ppm)	<input type="checkbox"/>
	22 CCR App. II, SW 846-6010D*	ICP-OES	2mg/kg (ppm)	<input type="checkbox"/>
STLC	22 CCR App. II, 7000B	Flame Atomic Absorption	0.4 mg/L (ppm)	<input type="checkbox"/>
	22 CCR App. II, SW 846-6010D*	ICP-OES	0.1 mg/L (ppm)	<input type="checkbox"/>
Soil	SW 846-7000B	Flame Atomic Absorption	40mg/kg (ppm)	<input type="checkbox"/>
	SW 846-6010D*	ICP-OES	2mg/kg (ppm)	<input type="checkbox"/>
Wastewater Unpreserved <input type="checkbox"/> Preserved with HNO3 <input type="checkbox"/> PH<2	SM 3111B / SW 846-7000B	Flame Atomic Absorption	0.4 mg/L (ppm)	<input type="checkbox"/>
	EPA 200.7	ICP-OES	0.020 mg/L (ppm)	<input type="checkbox"/>
Drinking Water Unpreserved <input type="checkbox"/> Preserved with HNO3 <input type="checkbox"/> PH<2	EPA 200.5	ICP-OES	0.003 mg/L (ppm)	<input type="checkbox"/>
	EPA 200.8	ICP-MS	0.001 mg/L (ppm)	<input type="checkbox"/>
TSP/SPM Filter	40 CFR Part 50	ICP-OES	12 µg/filter	<input type="checkbox"/>
Other:				<input type="checkbox"/>

Sample Number	Sample Location	Volume / Area	Date / Time Sampled
1	MU Veterinary Building	Throughout	1/5/24 1:30 PM

Method of Shipment: wli

Sample Condition Upon Receipt: (blank)

Relinquished by: Dan McFarlane Date/Time: 1/5/24

Received by: [Signature] Date/Time: 1/5/24 16:14

Relinquished by: [Signature] Date/Time: 1/9/24 9:40am

Controlled Document - CDC-15 Lead R17 (5/09/2022)

AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature.)

EMSL Analytical, Inc.'s Laboratory Terms and Conditions are incorporated into this Chain of Custody by reference in the entirety. Submission of samples to EMSL Analytical, Inc. constitutes acceptance and acknowledgment of all terms and conditions by Customer.

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory
MU - Veterinary Science Building | Columbia, Missouri
February 16, 2024 | Terracon Project No. 15237334



APPENDIX E

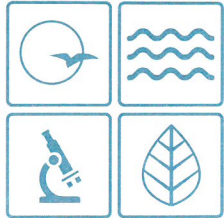
INSPECTOR CERTIFICATIONS

Pre-Demolition Asbestos, Lead TCLP & Hazardous Materials Inventory
MU - Veterinary Science Building | Columbia, Missouri
February 16, 2024 | Terracon Project No. 15237334



APPENDIX E

INSPECTOR CERTIFICATIONS



MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Michael L. Parson
Governor

Dru Buntin
Director

December 20, 2023

Jacob C Louis
707 Penina St
Pinckneyville, IL 62274

RE: Missouri Asbestos Occupation Certification Card

Enclosed is your certification card for Asbestos Inspector, as issued by the Asbestos Unit of the Missouri Department of Natural Resources' Air Pollution Control Program.

Missouri Certification Number: 7118112123MOIR20827
Course Training Date: November 21, 2023
Missouri Certification Approval Date: December 20, 2023
Missouri Certification Expiration Date: December 20, 2024

Note:

- All Missouri-certified asbestos personnel must comply with the following statutes and regulations:
 - Sections 643.225 to 643.250, RSMo;
 - 10 CSR 10-6.241 *Asbestos Projects-Registration, Abatement, Notification, Inspection, Demolition, and Performance Requirements; and*
 - 10 CSR 10-6.250 *Asbestos Projects-Certification, Accreditation and Business Exemption Requirements.*
- To keep your occupation certification up-to-date, you must complete an annual refresher course and submit a renewal application each year.
- In order to be eligible to renew your certification, you must successfully complete a refresher course with a Missouri-accredited training provider within 12 months of the expiration date of your current training certificate. If you exceed this grace period, you will be required to retake a Missouri-accredited initial course in order to be eligible for Missouri certification.

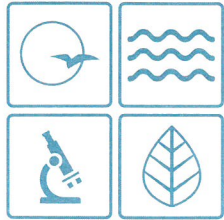
To obtain a copy of the certification renewal application, or review regulations and requirements, please visit our website at <http://dnr.mo.gov/env/apcp/asbestos/index.htm>.

If you have any questions please call the Air Pollution Control Program at 573-751-4817.

AIR POLLUTION CONTROL PROGRAM

Director of Air Pollution Control Program





MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Michael L. Parson
Governor

Dru Buntin
Director

December 20, 2023

Jacob C Louis
707 Penina St
Pinckneyville, IL 62274

RE: Missouri Asbestos Occupation Certification Card

Enclosed is your certification card for Asbestos Air Sampling Professional, as issued by the Asbestos Unit of the Missouri Department of Natural Resources' Air Pollution Control Program.

Missouri Certification Number: 7000122023MOAS20827
Missouri Certification Approval Date: December 20, 2023

Note:

- All Missouri-certified asbestos personnel must comply with the following statutes and regulations:
 - Sections 643.225 to 643.250, RSMo;
 - 10 CSR 10-6.241 *Asbestos Projects-Registration, Abatement, Notification, Inspection, Demolition, and Performance Requirements; and*
 - 10 CSR 10-6.250 *Asbestos Projects-Certification, Accreditation and Business Exemption Requirements.*

If you have any questions please call the Air Pollution Control Program at 573-751-4817.

AIR POLLUTION CONTROL PROGRAM

Director of Air Pollution Control Program



CERTIFICATION NUMBER:
7000122023MOAS20827

THIS CERTIFIES
Jacob C Louis
HAS COMPLETED THE CERTIFICATION
REQUIREMENTS FOR
Air Sampling Professional



APPROVED: **12/20/2023**


Director of Air Pollution Control Program

CERTIFICATION NUMBER:
7118112123MOIR20827

THIS CERTIFIES
Jacob C Louis
HAS COMPLETED THE CERTIFICATION
REQUIREMENTS FOR
Inspector



APPROVED: **12/20/2023**

EXPIRES: **12/20/2024**

TRAINING DATE: **11/21/2023**


Director of Air Pollution Control Program



MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Michael L. Parson
Governor

Dru Buntin
Director

August 11, 2023

Daniel J McFarlane
2413 Leslie Ave
St. Louis , MO 63114

RE: Missouri Asbestos Occupation Certification Card

Enclosed is your certification card for Asbestos Inspector, as issued by the Asbestos Unit of the Missouri Department of Natural Resources' Air Pollution Control Program.

Missouri Certification Number: 7011081123MOIR19645
Course Training Date: August 11, 2023
Missouri Certification Approval Date: August 11, 2023
Missouri Certification Expiration Date: August 11, 2024

Note:

- All Missouri-certified asbestos personnel must comply with the following statutes and regulations:
 - Sections 643.225 to 643.250, RSMo;
 - 10 CSR 10-6.241 *Asbestos Projects-Registration, Abatement, Notification, Inspection, Demolition, and Performance Requirements; and*
 - 10 CSR 10-6.250 *Asbestos Projects-Certification, Accreditation and Business Exemption Requirements.*
- To keep your occupation certification up-to-date, you must complete an annual refresher course and submit a renewal application each year.
- In order to be eligible to renew your certification, you must successfully complete a refresher course with a Missouri-accredited training provider within 12 months of the expiration date of your current training certificate. If you exceed this grace period, you will be required to retake a Missouri-accredited initial course in order to be eligible for Missouri certification.

To obtain a copy of the certification renewal application, or review regulations and requirements, please visit our website at <http://dnr.mo.gov/env/apcp/asbestos/index.htm>.

If you have any questions please call the Air Pollution Control Program at 573-751-4817.

AIR POLLUTION CONTROL PROGRAM

Director of Air Pollution Control Program





MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Michael L. Parson
Governor

Dru Buntin
Director

August 11, 2023

Daniel J McFarlane
2413 Leslie Ave
St. Louis , MO 63114

RE: Missouri Asbestos Occupation Certification Card

Enclosed is your certification card for Asbestos Supervisor, as issued by the Asbestos Unit of the Missouri Department of Natural Resources' Air Pollution Control Program.

Missouri Certification Number: 7011081123MOSR19645
Course Training Date: August 11, 2023
Missouri Certification Approval Date: August 11, 2023
Missouri Certification Expiration Date: August 11, 2024

Note:

- All Missouri-certified asbestos personnel must comply with the following statutes and regulations:
 - Sections 643.225 to 643.250, RSMo;
 - 10 CSR 10-6.241 *Asbestos Projects-Registration, Abatement, Notification, Inspection, Demolition, and Performance Requirements; and*
 - 10 CSR 10-6.250 *Asbestos Projects-Certification, Accreditation and Business Exemption Requirements.*
- To keep your occupation certification up-to-date, you must complete an annual refresher course and submit a renewal application each year.
- In order to be eligible to renew your certification, you must successfully complete a refresher course with a Missouri-accredited training provider within 12 months of the expiration date of your current training certificate. If you exceed this grace period, you will be required to retake a Missouri-accredited initial course in order to be eligible for Missouri certification.

To obtain a copy of the certification renewal application, or review regulations and requirements, please visit our website at <http://dnr.mo.gov/env/apcp/asbestos/index.htm>.

If you have any questions please call the Air Pollution Control Program at 573-751-4817.

AIR POLLUTION CONTROL PROGRAM

Director of Air Pollution Control Program



CERTIFICATION NUMBER:
7011081123MOIR19645

THIS CERTIFIES
Daniel J McFarlane
HAS COMPLETED THE CERTIFICATION
REQUIREMENTS FOR
Inspector



APPROVED: **08/11/2023**
EXPIRES: **08/11/2024**

TRAINING DATE: **08/11/2023**

Stephen M. Hall
Director of Air Pollution Control Program

CERTIFICATION NUMBER:
7011081123MOSR19645

THIS CERTIFIES
Daniel J McFarlane
HAS COMPLETED THE CERTIFICATION
REQUIREMENTS FOR
Supervisor



APPROVED: **08/11/2023**
EXPIRES: **08/11/2024**


TRAINING DATE: **08/11/2023**

Stephen M. Hall
Director of Air Pollution Control Program

University of Missouri VSB & VMDL Final Status Survey Report

NRC Broad Scope
Radioactive Material License
No. 24-00513-32

March 4, 2024

Prepared:  Project Manager Date: 3-4-24
Mike Culp

Approved:  Field Services Manager Date: 3-10-24
Dave Culp



Prepared by:
Chase Environmental Group, Inc.
200 Sam Rayburn Parkway
Lenoir City, TN 37771
865-816-6015

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APPENDICES

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ACRONYMS

ALARA	As Low As Reasonably Achievable
CFR	Code of Federal Regulations
Chase	Chase Environmental Group
DCGL	Derived Concentration Guideline Level
DCGL _{EMC}	Derived Concentration Guideline Level – Elevated Measurement Comparison
DCGL _w	Derived Concentration Guideline Level – Wilcoxon Rank Sum
DWP	Decommissioning Work Plan
DQO	Data Quality Objective
DSV	Default Screening Value
FSS	Final Status Survey
FSSR	Final Status Survey Report
LBGR	Lower Bound of the Gray Region
LSC	Liquid Scintillation Counter
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	Minimum Detectable Concentration
MU	University of Missouri
NRC	U.S. Nuclear Regulatory Commission
NIST	National Institute of Standards and Technology
QA	Quality Assurance
TEDE	Total Effective Dose Equivalent
VMDL	Veterinary Medical Diagnostic Laboratory
VSB	Veterinary Science Building

1.0 INTRODUCTION

The University of Missouri (MU) has ceased licensed activities under US Nuclear Regulatory Commission (NRC) broad scope radioactive materials license No. 24-00513-32 at the Veterinary Medical Diagnostic Laboratory Building (VMDL) located at 901 E Campus Loop, Columbia, MO 65211 and at the Veterinary Science Building (VSB) located at 1509 Rollins St, Columbia, MO 65201 in preparation for demolition. MU contracted Chase Environmental Group (Chase) to perform final status surveys (FSS) to demonstrate that the buildings meet the NRC radiological criteria for unrestricted use. A site satellite photo is presented in Appendix A.¹

Decommissioning survey activities were conducted under the MU broad scope radioactive materials license number 24-00513-32, and in accordance with a Decommissioning Work Plan (DWP). The DWP was developed using the guidance provided in NUREG 1757, Volume 1, Revision 2, "*Consolidated NMSS Decommissioning Guidance*" and NUREG 1575, Revision 1, "*Multi-Agency Radiation Survey and Site Investigation Manual*" (MARSSIM). Final status surveys (FSS) were designed to implement the protocols and guidance provided in MARSSIM to demonstrate compliance with NRC default screening values (DSVs). These methods ensured technically defensible data were generated to aid in determining whether or not the buildings meet the release criteria for unrestricted use specified in 10 CFR 20 Subpart E.

Onsite survey activities were conducted from January 9-11, 2024. A small quantity of C-14 stock solution in sealed containers was present in the VSB during survey activities. This report presents sufficient data to conclude that, once the stock solutions are removed and MU has verified no contents have been released from the containers, the facilities are suitable for unrestricted release in accordance with NRC requirements. Final status surveys demonstrate that building structural surfaces and systems included in the scope of this report are below release criteria and are suitable for unrestricted release. All final status surface activity measurement results were a small fraction of the DSVs. Based on the Building Occupancy Scenario of NRC DandD dose modeling software Version 2.4, **the Total Effective Dose Equivalent (TEDE) to an average member of the critical group does not exceed 0.009 mrem/year (0.036% of the NRC release criterion of 25 mrem/yr)** based on the survey unit with the highest survey results.

2.0 FACILITY DESCRIPTION AND OPERATING HISTORY

MU performed a Historical Site Assessment (HSA) to determine the current status of the facilities including potential, likely, or known sources of radioactive contamination by gathering data from various sources. This data includes physical characteristics and location of the site as well as information found in site operating records, including radiological surveys.

¹ The satellite photo does not reflect recent construction, particularly the construction of a building east of and adjacent to the VMDL.

The single-story VSB is approximately 20,300 ft² and contains office, laboratory, animal, and support areas. Most laboratories have some history of radioactive materials usage and have had previous closeout surveys performed. Rooms with recent radioactive materials usage authorization that have not been closed out are 7, 13B, 17, and 21. A small quantity of C-14 stock solution in sealed containers was present in the VSB during survey activities.

The 11,623 ft² VMDL is a two-story building with a basement mechanical room and contains two incinerators and office, laboratory, and support areas. Radioactive materials usage consisted primarily of sealed sources and short-lived radioactivity. Long-lived C-14 and H-3 were used in the necropsy room. The VMDL contains a large incinerator within the basement that was deactivated in the late 1990s or early 2000s and a smaller incinerator on the first floor that is currently in use. C-14 and H-3, as well as short-lived radionuclides, were incinerated in the basement incinerator. The first-floor incinerator was never used to incinerate radioactive materials. The basement incinerator room is a top-loading design with a motor-operated rolling hatch to the burn chamber. When the basement incinerator was deactivated, a concrete floor was poured above the incinerator loading hatch to match the existing first floor grade, making the incinerator internals inaccessible from the loading hatch. The incinerator is divided into an upper burn chamber and a bottom ash chamber. Access to the chambers from the sides of the incinerator is via (6) 12" x 18" hatches. Residual ash and loose refractory materials are present inside and there is significant degradation of the internal refractory brick structure. Due to the size of the accessible openings and interference caused by the added flooring, there is limited access to the incinerator internals; the only safe access is via the hatches on the sides.

Facility floor plans for both facilities are presented in Appendix B.

3.0 RELEASE CRITERIA

The NRC release criteria for unrestricted use are specified in 10 CFR 20.1402, "Radiological Criteria for Unrestricted Use."

"A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 25 mrem (0.25 mSv) per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of the levels which are ALARA must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal."

4.0 NUCLIDES OF CONCERN

After considering the dates of usage and half-lives, C-14, Cl-36, and H-3 are the only nuclides of concern for decommissioning for the VSB and C-14 and H-3 are the only nuclides of concern for decommissioning for the VMDL.

5.0 DERIVED CONCENTRATION GUIDELINE LEVELS

A Derived Concentration Guideline Level (DCGL) is a radionuclide-specific surface activity concentration that could result in a dose equal to the release criterion. Derived Concentration Guideline Level – Wilcoxon Rank Sum (DCGL_W) is the concentration limit if the residual activity is evenly distributed over a large area. In the case of non-uniform contamination, MARSSIM allows for evaluation of higher levels of activity over small areas using the Derived Concentration Guideline Level – Elevated Measurement Comparison (DCGL_{EMC}). However, the DCGL_{EMC} was not used.

The NRC has published Default Screening Values (DSVs) in NUREG-1757, Volume 1, Revision 2, Appendix B for commonly used radionuclides. The DSVs are the basis for developing the DCGLs. MU implemented a removable surface activity DCGL of 10% of the DSV. The DCGLs are provided in the table below.

Table 5-1: DCGLs for Nuclides of Concern

Nuclide	Half-life (years)	Predominant Emissions	Total Surface Activity DCGL (dpm/100 cm ²)	Removable Surface Activity DCGL (dpm/100 cm ²)
C-14	5.7E+03	Low Energy Beta	3.7E+06	3.7E+05
Cl-36	3.0E+05	Beta	5.0E+05	5.0E+04
H-3	1.2E+01	Low Energy Beta	1.2E+08	1.2E+07

The DSV for Cl-36 is used as the DCGL for the VSB as it is the most restrictive of the potential nuclides of concern. The DSV for C-14 is used as the DCGL for the VMDL.

An important assumption of the dose model is that removable contamination is <10% of total contamination. Routine, characterization, final status, and quality assurance (QA) survey results confirm that removable contamination levels are very low and meet this assumption. H-3 cannot be accurately detected directly by field instrumentation due to its low energy; therefore, H-3 contamination was evaluated by removable contamination measurements only. Additionally, due to the conservative investigation levels and the minor dose contribution of H-3 relative to C-14, application of the unity rule for multiple radionuclides is not required to demonstrate compliance with the release criteria.

6.0 ALARA GOALS (INVESTIGATION LEVELS)

MU established conservative investigation levels for all impacted surfaces. Specifically, the following investigation levels were used:

- 5,000 dpm/100 cm² total surface contamination
- 200 dpm/100 cm² removable surface contamination in any LSC channel

Because of the conservatism of the investigation levels, these criteria were applied to gross beta measurements and the unity rule was not applied. The number of measurements required

by MARSSIM to demonstrate compliance with the release criteria was calculated using the $DCGL_W$.

7.0 DATA QUALITY OBJECTIVES (DQO)

The following is a list of the major DQOs for the survey design:

- Static measurements were taken to achieve an MDC_{static} of less than 5,000 dpm/100 cm^2 .
- Scanning was conducted at a rate to achieve an MDC_{scan} of less than 5,000 dpm/100 cm^2 .
- Removable contamination measurements were counted to achieve an MDC_{smear} of less than 200 dpm/100 cm^2 .
- Individual measurements were made to a 95% confidence interval.
- Decision error probability rates were set at 0.05 for both α and β .
- The null hypothesis (H_0) and alternative hypothesis (H_A) are that of NUREG 1505 scenario A:
 - H_0 is that the survey unit does not meet the release criteria
 - H_A is that the survey unit meets the release criteria
- Characterization and remedial action support surveys were conducted under the same quality assurance criteria as final status surveys such that the data was used as final status survey data to the maximum extent possible.
- Quality Assurance Surveys were conducted at a rate of 5%.

8.0 PROJECT MANAGEMENT AND ORGANIZATION

Decommissioning activities were performed under MU broad scope license number 24-00513-32, and in accordance with the DWP. MU oversaw decommissioning activities and maintained responsibility for building maintenance, fire, and security functions.

9.0 RADIOACTIVE WASTE MANAGEMENT

No radioactive waste was generated from project activities.

10.0 SURVEY INSTRUMENTATION

10.1 Instrument Calibration

Laboratory and portable field instruments were calibrated within the previous year with National Institute of Standards and Technology (NIST) traceable sources to radiation emission types and energies to provide detection capabilities similar to the nuclides of concern. Portable instrument calibration records are included as Appendix C.

10.2 Functional Checks

Functional checks were performed at least daily when in use. The background, source check, and field measurement count times for radiation detection instrumentation were specified by procedure to ensure measurements were statistically valid. Background readings were taken as part of the daily instrument check and compared with the acceptance range for instrument and site conditions.

Daily functional checks of the liquid scintillation counter consisted of performing the instrument's automatic quality assurance protocol that utilizes H-3 and C-14 sources as well as a background standard.

10.3 Efficiency Determination

ISO 7503-1 methods were used to determine field concentrations for final status data and calculation of resultant doses from residual radioactivity. Efficiencies for total surface activity measurements were conservatively based on the nuclide of concern with the lowest efficiency (C-14). MARSSIM protocols for building structures use ISO-7503-1 methodology that takes into account the texture of the surface and the 2π detector efficiency. Under MARSSIM, the default surface efficiency for beta emitters with maximum energies less than 400 keV is conservatively set at 0.25.

10.4 Background Determination

For building structural surfaces, the use of background reference areas or paired background comparisons was not necessary. Material and ambient background values were not significant compared to DCGLs or investigation levels. For direct measurements, an ambient background was determined for each survey, was subtracted from gross measurements, and was used to calculate the actual survey minimum detectable concentrations (MDC) and associated count errors. Material-specific background determinations were not performed.

For incinerator internal surfaces, refractory material contains naturally occurring radioactive material (NORM) that causes increased background count rates for direct measurements. Because there is not a suitable background reference area at the site and the gamma background is variable due to refractory geometry, Chase performed shielded and unshielded static measurements at each sample location to establish the background count rate. Shielded measurements were performed by covering the detector active area with a sufficient thickness of Poly Methyl Methacrylate (PMMA) to shield all C-14 beta emissions. The net count rate for each measurement on refractory was calculated by subtracting the shielded measurement (background) result at each location from the unshielded measurement (background + C-14) result at the same location. Because the background count rate increased, the static measurement count time was increased to one minute to ensure the MDC met the DQO.

Background was subtracted from removable activity measurements and results are reported in net dpm/100 cm² for H-3 and C-14, and Channel 3 (>256 keV).

10.5 Minimum Detectable Concentrations

Minimum counting times for background determinations and measurement of total and removable contamination were chosen to provide MDCs that met the DQOs. MARSSIM equations relative to building surfaces have been modified to convert to units of dpm/100 cm². Count times and scanning rates are determined using the following equations:

10.5.1 Static Counting

Static counting MDC at a 95% confidence level is calculated using the following equation, which is an expansion of NUREG 1507, Revision 1, “Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions”, Table 3-1 (Strom & Stansbury, 1992):

$$MDC_{static} = \frac{3 + 3.29 \sqrt{B_r \cdot t_s \cdot \left(1 + \frac{t_s}{t_b}\right)}}{t_s \cdot E_{tot} \cdot \frac{A}{100cm^2}}$$

Where:

- MDC_{static} = minimum detectable concentration (dpm/100 cm²)
- B_r = background count rate (counts per minute)
- t_b = background count time (minutes)
- t_s = sample count time (minutes)
- E_{tot} = total detector efficiency for radionuclide emission of interest (cpm/dpm)
- A = detector probe area (cm²)

A typical static MDC calculation for C-14 using the Ludlum Model 43-68 gas flow proportional detector is shown below:

$$MDC_{static} = \frac{3 + 3.29 \sqrt{(500)(0.1) \left(1 + \frac{0.1}{0.1}\right)}}{(0.1)(0.075) \left(\frac{126}{100cm^2}\right)} = 3,799 \text{ dpm}/100cm^2$$

10.5.2 Ratemeter Scanning

Scanning MDC is calculated using the following equation, which is a combination of MARSSIM equations 6-8, 6-9, and 6-10:

$$MDC_{scan} = \frac{d' \sqrt{b_i} \left(\frac{60}{i}\right)}{\sqrt{p} \cdot E_{tot} \cdot \frac{A}{100cm^2}}$$

Where:

- MDC_{scan} = minimum detectable concentration (dpm/100 cm²)
- d' = desired performance variable (1.38)
- b_i = background counts during the residence interval (counts)
- i = residence interval (seconds)
- p = surveyor efficiency (0.5)
- E_{tot} = total detector efficiency for radionuclide emission of interest (cpm/dpm)
- A = detector probe area (cm²)

A typical MDC_{SCAN} calculation for C-14 using the Ludlum 43-37 gas flow proportional detector is shown below:

$$i = 13.3 \text{ cm} \cdot \frac{\text{inch}}{2.54 \text{ cm}} \cdot \frac{\text{sec}}{20 \text{ inch}} = 0.262 \text{ sec}$$

$$b_i = 0.262 \text{ sec} \cdot \frac{1500 \text{ counts}}{\text{minute}} \cdot \frac{\text{minute}}{60 \text{ sec}} = 6.55 \text{ counts}$$

$$MDC_{scan} = \frac{1.38\sqrt{6.55}\left(\frac{60}{0.262}\right)}{(\sqrt{0.5})(0.075)\left(\frac{584}{100\text{cm}^2}\right)} = 2,612 \text{ dpm/100 cm}^2$$

10.5.3 Removable Surface Activity

Removable surface activity measurement (smear) counting MDC at a 95% confidence level is calculated using the following equation, which is NUREG 1507, Revision 1, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions", Table 3-1 (Strom & Stansbury, 1992):

$$MDC_{smear} = \frac{3 + 3.29\sqrt{B_r \cdot t_s \cdot \left(1 + \frac{t_s}{t_b}\right)}}{t_s \cdot E}$$

Where:

- MDC_{smear} = minimum detectable concentration level (dpm/smear)
- B_r = background count rate (counts per minute)
- t_b = background count time (minutes)
- t_s = sample count time (minutes)
- E = instrument efficiency for radionuclide emission of interest (cpm/dpm)

The liquid scintillation counter was setup to count samples in three channels as described in Section 12.3. The MDC calculation for each LSC channel using conservative parameters is shown below.

$${}^3\text{H } MDC_{smear} = \frac{3+3.29 \sqrt{(25)(1) \left(1+\frac{1}{1}\right)}}{(1)(0.60)} = 44 \text{ dpm}$$

$${}^{14}\text{C } MDC_{smear} = \frac{3+3.29 \sqrt{(15)(1) \left(1+\frac{1}{1}\right)}}{(1)(0.80)} = 26 \text{ dpm}$$

$$\text{Channel 3 } MDC_{smear} = \frac{3+3.29 \sqrt{(50)(1) \left(1+\frac{1}{1}\right)}}{(1)(0.98)} = 37 \text{ dpm}$$

Because the counting efficiency is different for each LSC measurement depending on quench characteristics, and in consideration of the errors associated with wipe counting (i.e., area wiped, wiping pressure, etc.), the *a priori* estimates of smear MDCs calculated above are applied to all removable contamination measurements.

10.6 Uncertainty

The uncertainty for each static measurement is calculated using equation 6-15 from MARSSIM:

$$\sigma = 1.96 \sqrt{\frac{C_{s+b}}{T_{s+b}^2} + \frac{C_b}{T_b^2}}$$

where:

- σ = uncertainty
- 1.96 = multiplier to achieve a 95% confidence level
- C_{s+b} = gross sample counts
- T_{s+b} = sample count time (min.)
- C_b = gross background counts
- T_b = background count time (min.)

Uncertainties presented with total surface activity results are additionally corrected for detection efficiency and probe area for presentation in the same units as total surface activity results.

10.7 Instrumentation Specifications

The instrumentation used for facility decommissioning surveys is summarized in the following tables. The first table lists the standard features of each instrument such as probe size and efficiency. The second table lists the typical operational parameters such as scan rate, count time, and the associated MDCs. These parameters are typical for the instrumentation; actual instrument-specific parameter values were used for each measurement to verify that DQOs were met.

Table 10-1: Instrumentation Specifications

Detector Model	Detector Type	Detector Area	Meter Model	Window Thickness	Typical Efficiency ²
Ludlum 43-68	Gas Flow Proportional	126 cm ²	Ludlum 2241-3	0.8 mg/cm ²	7.5 % (C-14)
Ludlum 43-37	Gas Flow Proportional	584 cm ²	Ludlum 2241-3	0.8 mg/cm ²	7.5 % (C-14)
Packard TriCarb	Liquid Scintillation	N/A	N/A	N/A	60% (H-3) 80% (C-14) 98% (Channel 3)

Table 10-2: Typical Instrument Operating Parameters and Sensitivities

Measurement Type	Detector Model	Max. Scan Rate ³	Count Time	Background (cpm)	MDC (dpm/100 cm ²)
Surface Scans	Ludlum 43-68	5 in./sec.	N/A	500	4,297
Surface Scans	Ludlum 43-37	20 in./sec.	N/A	1,500	2,612
Total Surface Activity	Ludlum 43-68	N/A	6 sec.	500	3,799
Total Surface Activity	Ludlum 43-37	N/A	6 sec.	1,500	1,370
Removable Activity	Packard TriCarb	N/A	60 sec.	25 (H-3) 15 (C-14) 50 (Channel 3)	44 (H-3) 26 (C-14) 37 (Channel 3)

10.8 Datalogging

Structural surface scans and static measurements were performed using datalogging instrumentation. While scanning, in addition to the surveyor listening to the audible output, integrated counts were recorded. Logged data was downloaded and processed using data management software to perform data analyses and reporting. Reporting includes graphical (4-plot) presentation of scan data as well as summary statistics functions. The 4-Plot is described in the NIST e-Handbook of Statistical Methods.

(<http://www.itl.nist.gov/div898/handbook/index.htm>)

² The efficiency for each smear sample is automatically determined by the liquid scintillation counter for the H-3 and C-14 channels, depending on the quench characteristics of the sample. The values presented are typical values for samples that are not highly quenched as would be expected in a research facility. The efficiency for Channel 3 (>256 keV) is based on the manufacturer's published value for CI-36.

³ Maximum scan rates are calculated based on the instrument MDC DQOs. Actual scan rates were slower.

A 4-plot consists of the following:

- A run **sequence plot** presents logged data in chronological order, providing a time history of the survey data.
- A **lag plot** checks whether a data set or time series is random or not. Random data should not exhibit any identifiable structure in the lag plot. Non-random structure in the lag plot indicates that the underlying data are not random.
- A **histogram plot** graphically summarizes the distribution of a univariate data set, showing center (i.e., the location) of the data, spread (i.e., the scale) of the data, skewness of the data, presence of outliers, and presence of multiple modes.
- A **probability plot** is a test used to verify the distributional model. The normal probability plot is a graphical technique for assessing whether or not a data set is approximately normally distributed. The data are plotted against a theoretical normal distribution in such a way that the points should form an approximate straight line. Departures from this straight line indicate departures from normality.

11.0 AREA CLASSIFICATIONS

Based on the historical site assessment and previous survey results, facility areas were classified as impacted or non-impacted.

11.1 Non-Impacted Area

Non-impacted areas were areas without residual radioactivity from licensed activities and were not surveyed during final status surveys. The following areas were classified as non-impacted:

- Structural surfaces above a two-meter height.
- Building exterior surfaces, except the VMDL roof
- Internal surfaces of positively pressurized systems (air, gas, water, etc.)
- Locations outside the scope of this project (impacted buildings to be demolished)

11.2 Impacted Areas

Impacted areas were those areas that had potential residual radioactivity from licensed activities. Impacted areas are subdivided into Class 1, Class 2, or Class 3 areas. Class 1 areas have the greatest potential for contamination and therefore receive the highest degree of survey effort for the final status survey using a graded approach, followed by Class 2, and then by Class 3. Impacted sub-classifications are defined as follows:

11.2.1 Class 1 Area

Areas with the highest potential for contamination and meet the following criteria: (1) impacted; (2) potential for delivering a dose above the release criterion; (3) potential for small areas of elevated activity; and (4) insufficient evidence to support classification as Class 2 or Class 3.

There were no Class 1 areas.

11.2.2 Class 2 Area

Areas that meet the following criteria: (1) impacted; (2) low potential for delivering a dose above the release criterion; and (3) little or no potential for small areas of elevated activity.

Rooms with a history of radioactive material usage that had not undergone MU closeout procedures were classified as Class 2 areas.

11.2.3 Class 3 Area

Areas that meet the following criteria: (1) impacted; (2) little or no potential for delivering a dose above the release criterion; and (3) little or no potential for small areas of elevated activity.

The VMDL roof and all building interior areas not classified as Class 2 were classified as Class 3 areas.

11.3 Survey Units

A survey unit is a geographical area of specified size and shape for which a separate decision is made whether or not that area meets the release criteria. A survey unit is normally a portion of a building or site that is surveyed, evaluated, and released as a single unit. Areas of similar construction and composition were grouped together as a survey unit and tested individually against the DCGLs and the null hypothesis to show compliance with the release criteria. Survey Units were homogeneous in construction, contamination potential, and contamination distribution.

The number of discrete sampling locations needed to determine if a uniform level of residual radioactivity exists within a survey unit does not depend on the survey unit size. However, the sampling density should reflect the potential for small elevated areas of residual radioactivity. Survey units were sized according to the potential for small elevated areas of residual radioactivity. Recommended maximum survey unit sizes for building structures, based on floor area, is Class 1: up to 100 m². Class 2: 100 m² to 1,000 m² and Class 3: no limit.

Survey Unit Numbering Protocol

Each survey unit is assigned a unique number consisting of the building number followed by a dash and a four-digit identifier. The four-digit identifier consists of one digit for the elevation, one digit for the classification, and two digits as a numerical identifier using the format below:

Building Number – Elevation/Classification/Numerical Identifier

The default numeric identifier is 01

Buildings:

VSB = Veterinary Sciences Building

VMD = Veterinary Medical Diagnostic Lab Building

Elevations:

B = Basement

1 = 1st Floor

2 = 2nd Floor

R = Roof

Building systems survey units were arranged by building and system type. There are three types of systems – drain, vacuum, and ventilation. Each system survey unit encompasses all of a certain type within the building.

System Components:

DR = Drain

IN = Incinerator Internal Surfaces

VA = Vacuum

VE = Ventilation

Examples:

VSB-1201 is Veterinary Sciences Building, First Floor, Class 2

VMD-DR01 is Veterinary Medical Diagnostic Lab Building, Impacted Area Drains

VMD-IN01 is Veterinary Medical Diagnostic Lab Building, Incinerator Internal Surfaces

Survey unit classifications and designations were determined from the historical site assessment and characterization survey results and are listed in the tables below. Survey unit designations are identified on the building floor plan presented in Appendix B and summarized in the table below.

Table 11-1: VSB Building Structural Survey Units

Survey Unit	Room(s)
VSB-1201	7, 13B, 17, and 21
VSB-1301	Remaining rooms not classified as Class 2

Table 11-2: VMDL Building Structural Survey Units

Survey Unit	Room(s)
VMD-B201	D001
VMD-1201	D131, D133, Exterior Dock
VMD-1301	Remaining first floor rooms not classified as Class 2
VMD-2301	All second-floor rooms
VMD-R301	Roof surfaces

Table 11-3: VSB Building Systems Survey Units

Survey Unit	Description
VSB-DR01	Laboratory Drain System
VSB-VE01	Laboratory Fume Hood Ventilation System
VSB-VA01	Laboratory Vacuum System

Table 11-4: VMDL Building Systems Survey Units

Survey Unit	Description
VMD-DR01	Laboratory and Roof Drain System
VMD-IN01	Incinerator Internal Surfaces
VMD-VE01	Laboratory Fume Hood Ventilation System

12.0 FINAL STATUS SURVEY DESIGN

Final status surveys were performed using the DQO process to demonstrate that residual radioactivity in each survey unit satisfied the predetermined criteria for release for unrestricted use. Final status surveys were conducted by performing the appropriate combination of scan surveys, total activity measurements and removable activity measurements as discussed further in this section. All final status surveys were performed according to written instructions. Survey data were documented on survey maps and/or associated data information sheets.

12.1 Surface Scans

Scanning was used to identify locations within the survey unit that exceed the investigation level. The table below summarizes the minimum scan percentage of accessible building structural surfaces based on classification.

Table 12-1: Scan Survey Coverage by Classification

Structure	Class 2	Class 3
Floors	75%	20%
Other Structures	25%	10%

For surfaces that received less than 100% scan survey, the surfaces scanned were those with the highest potential to contain residual radioactivity at the discretion of the surveyor. Floor areas near room entrances and exits received a 100% scan survey regardless of the area classification. These surveys would provide indications of potential migration of residual contamination to areas outside of the historical usage areas.

12.2 Total Surface Activity Measurements

Direct surveys (static measurements) for total surface activity were taken on building surfaces in impacted areas utilizing instrumentation of the best geometry based on the surface at the survey location. Scaler count times were determined to achieve the detection sensitivities stated in the DQOs. Field measurements were converted to activity concentrations using the following equation:

$$Activity (dpm/100 \text{ cm}^2) = \frac{R_{s+b} - R_b}{E_{total} \times \frac{A}{100 \text{ cm}^2}}$$

Where:

- R_{s+b} = The gross count rate of the measurement (cpm)
- R_b = The background count rate (cpm)
- E_{total} = Total efficiency (cpm/dpm)
- A = Area of the detector window (cm^2)

Survey unit VMD-IN01 consists of the incinerator internal structure which is lined with refractory. The naturally occurring radioactive material in refractory combined with the incinerator geometry creates a highly variable instrument background which makes quantifying C-14 activity extremely difficult using a fixed value for background. By comparing shielded and unshielded static measurements at each final status location, it was possible to reduce the interference due to NORM. This method is inherently conservative because the shield also attenuates some of the emissions due to NORM in addition to all the emissions from C-14.

12.2.1 Determining the Number of Samples

The minimum number of samples required for the Sign Test was calculated using equations in Section 5 of MARSSIM. A conservative standard deviation of total surface activity measurements was used (the highest of any survey unit). The LBGR was set at one half of the DCGL. The calculations performed to determine the required numbers of samples are provided below.

Determination of the Relative Shift

The number of required samples depends on the ratio involving the activity level to be measured relative to the variability in the concentration. The ratio to be used is called the Relative Shift, Δ/σ_S , and is defined in MARSSIM as:

$$\Delta/\sigma_S = \frac{DCGL - LBGR}{\sigma_S}$$

Where:

- DCGL = derived concentration guideline level (dpm/100 cm^2)
- LBGR = concentration at the lower bound of the gray region. The LBGR is the average concentration to which the survey unit should be cleaned in order to have an acceptable probability of passing the test (dpm/100 cm^2)
- σ_S = the standard deviation of the residual radioactivity in the survey unit (dpm/100 cm^2)

The actual calculation, based on the nuclide with the lowest DSV (Cl-36) and the survey unit with the highest standard deviation is provided below:

$$\Delta/\sigma_s = \frac{5.0 E5 - 2.5 E5}{1,115} = 224.2$$

Determination of Acceptable Decision Errors

A decision error is the probability of making an error in the decision on a survey unit by passing a unit that should fail (α decision error) or failing a unit that should pass (β decision error). The decision errors are 0.05 for both α and β .

Determination of Number of Data Points (Sign Test)

The number of direct measurements for a particular survey unit, employing the Sign Test, is determined from MARSSIM Table 5.5, which is based on the following equation (MARSSIM equation 5-2):

$$N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(\text{SignP} - 0.5)^2}$$

Where:

- N = number of samples needed in the survey unit
- $Z_{1-\alpha}$ = percentile represented by the decision error α
- $Z_{1-\beta}$ = percentile represented by the decision error β
- SignP* = estimated probability that a random measurement will be less than the DCGL when the survey unit median is actually at the LBGR

Note: SignP is determined from MARSSIM Table 5.4

MARSSIM recommends increasing the calculated number of measurements by 20% to ensure sufficient power of the statistical tests and to allow for possible data losses. MARSSIM Table 5.5 values include an increase of 20% of the calculated value. The following calculations were made to determine this number:

$$N = \frac{(1.645 + 1.645)^2}{4(1.0 - 0.5)^2} = 11$$

$Z_{1-\alpha}$ and $Z_{1-\beta}$ are equal to 1.645 using the error rate of 0.05 from MARSSIM Table 5.2. *SignP* is equal to 1.0 from MARSSIM Table 5.4. Adding an additional 20% to account for data losses resulted in a value of 14.

Therefore, the determined number of samples per survey unit for the final status surveys for planning purposes was **14**.

12.2.2 Determination of Sample Locations

Determination of survey unit sample locations was accomplished by first determining sample spacing and then systematically plotting the sample locations from a randomly generated start location. The random starting point of the grid provides an unbiased method for obtaining measurement locations to be used in the statistical tests. The use of a systematic grid allows the decision-maker to draw conclusions about the size of the potential areas of elevated activity based on the area between measurement locations. MARSSIM recommends random sampling (random x, random y) for Class 3 areas. However, in this survey design, Class 3 areas are sampled on a systematic grid pattern in the same manner as MARSSIM recommends for Class 1 and Class 2 areas.

Sampling locations were established in a square grid pattern beginning with the random start location and the determined sample spacing. After determining the number of samples needed in the survey unit, sample spacing was determined from MARSSIM equation 5-8:

$$L = \sqrt{\frac{A}{N}} \text{ for a square grid}$$

Where:

- L : sample spacing interval
- A : the survey unit area
- N : number of samples needed in the survey unit

Maps were generated of the survey unit's permanent surfaces included in the statistical tests (floors, walls, ceilings, fixed cabinetry, etc.). A random starting point was determined using computer-generated random numbers coinciding with the x and y coordinates of the total survey unit. A grid was plotted across the survey unit surfaces based on the random start point and the determined sample spacing. A measurement location was plotted at each intersection of the grid plot.

In laboratory areas, permanent counter tops, and other horizontal surfaces that block floor surfaces, were used as replacements to block floor surfaces. Likewise, fixed cabinetry faces and other permanent equipment replaced blocked wall surfaces. Internal surfaces of permanent furnishings (i.e., drawer or cabinetry interior surfaces) are not included in the systematic measurement location placement. However, these surfaces were included in the scan surveys.

Class 2 and Class 3 survey units generally consist of multiple rooms; therefore, the survey unit floor and wall surfaces are not contiguous and difficult to represent on two dimensional maps. For Class 2 and Class 3 areas where there is low potential for elevated residual radioactivity, there are two predominant mechanisms of potential contamination; tracking/spills/splashing that are more likely to impact horizontal surfaces, and cross-contamination from occupants touching discrete

surfaces areas such as door pushes, light switches, drawer pulls, valve handles, etc. that are more likely to impact vertical surfaces. Therefore, the systematic and random sample measurement locations (i.e., static measurements and smears) determined by MARSSIM for Class 2 and Class 3 survey units were determined on horizontal surfaces as determined on floor plans. This protocol increases the sample density on the surfaces with the highest probability for residual contamination (floors, benchtops, fume hood working surfaces, etc.). As part of characterization to compensate for excluding wall surfaces in MARSSIM sample measurement locations, the survey technician judgmentally selected 10 locations with the highest probability of contamination on vertical surfaces for a static measurement and smear. The ten additional sample locations on vertical surfaces were selected to focus on surfaces with the highest potential for contamination such as door pushes, light switches, fume hood valve handles, locations of staining, etc. This results in a survey design that includes a minimum of 21 sample locations per survey unit, while the minimum number of samples per MARSSIM is 11. The additional 10 judgmental locations are not included in the statistical analysis of the locations selected by MARSSIM protocols. However, results were compared directly to the investigation levels. The appropriate percentage of all survey unit surfaces (including vertical surfaces) were scanned according to the survey unit classification with a detection sensitivity that was an extremely small fraction of the DCGLs, ensuring that significant elevated residual radioactivity did not go undetected.

Maps of final status survey locations for all survey units are included in Appendix D.

12.3 Removable Surface Activity Measurements

Removable surface activity measurements were collected by wiping an area of approximately 100 cm² on building structural surfaces. The smears were counted to achieve the detection sensitivities stated in the DQOs. The MU standard LSC setup was used consisting of three channels with background subtraction at the following energies:

Channel 1 (³ H dpm):	2 – 18.6 keV
Channel 2 (¹⁴ C dpm):	18.6 – 256 keV
Channel 3 (>256 keV):	256 – 2,000 keV

Channel 3 results were used to verify that H-3 and C-14 are the only nuclides of concern for the VMDL and to account for higher energy emissions from Cl-36 for the VSB.

Cl-36 was only authorized in VSB Room 10 in 1993; C-14 and H-3 were used extensively throughout the building; therefore, the standard LSC setup was maintained. Cl-36 emissions would be detected in multiple channels with this LSC setup. The restrictive investigation levels for removable surface activity (200 dpm/100 cm² in each channel) ensures that Cl-36 removable surface activity is an extremely small fraction of its DCGL and that detection of Cl-36 emissions above 256 keV would be properly investigated.

12.4 Surveys of Building Mechanical Systems Internals

Surveys of the internal surfaces of various building system components were performed. Survey design for these systems is out of the scope of MARSSIM. For the purpose of identifying potential residual contamination within these systems, a survey protocol was established and is presented in the table below.

Table 12-2: System Survey Coverage

System Component	Survey Frequency
Laboratory Vacuum Nozzles	50%
Laboratory Fume Hood Vent Ducts	50%
Laboratory Drain Openings/Traps	50%
VMDL Roof Drain Openings/Traps	50%

Surveys of building systems consisted of scan surveys, total activity measurements and removable contamination measurements of accessible openings. Scan surveys and static measurements were not possible at drainpipe and vacuum nozzle internals due to small geometry. There were no vacuum systems in the VMDL.

12.5 Surveys of Incinerator System Internals

Survey design for the incinerator system internals is out of the scope of MARSSIM. Due to the mechanisms of potential contamination, a homogeneous spatial distribution is expected within the incinerator systems that would require a small percentage of survey coverage to gain sufficient confidence in the average residual radioactivity concentration. There is limited accessibility without complete disassembly or placing personnel at unnecessary safety risk. Therefore, a 100% scan was performed of accessible surfaces (inside the burn chambers via the access hatches).

For incinerator internal surfaces, NORM in refractory materials causes increased background count rates for direct measurements. Because there is not a suitable background reference area at the site and gamma count rate variability due to varying geometries, Chase performed shielded and unshielded static measurements at each sample location to establish the background count rate. Shielded measurements were performed by covering the detector active area with a sufficient thickness of polyethylene to shield all C-14 beta emissions. The net count rate for each measurement on refractory was calculated by subtracting the shielded measurement (background) result at each location from the unshielded measurement (background + C-14) result at the same location.

12.6 Survey Documentation

A survey package was developed for each survey unit containing the following:

- Survey Unit number (e.g., Building and Room Number, etc.)
- General survey requirements
- Survey Instruction Sheets
- Percentage of surfaces requiring scan surveys
- Number of total and removable contamination measurements required
- Instrument requirements with associated MDCs, count times and scan rates
- Maps of the survey unit surfaces detailing survey locations and placement methodology
- Any additional specific survey instruction
- Survey Data Sheets
- Signature of Data Collector and Reviewer

To ensure proper data management and organization, a unique location code system was used so that survey data could be properly entered and organized in the Final Status Survey Database. A breakdown of the location code and specific code components are provided in the table below.

Table 12-3: Location Code Description

<p>A unique location code was assigned to each individual survey location to ensure proper data management of the survey results. The following format was used to ensure consistency throughout the final status survey process:</p> <p style="text-align: center;">BBB-RRRR-SS-M-LLL</p> <p>Where:</p>	
<p>BBB: = Building Code. This field represents the building number. (3 characters)</p>	<p>VMD = Veterinary Medical Diagnostic Lab Building VSB = Veterinary Sciences Building</p>
<p>RRRR: = Survey Unit Number. This is the assigned survey unit number. (4 characters)</p>	
<p>SS: = Structural Surface Code. This field represents the structural surface such as floor, wall, ceiling, etc. (2 characters)</p> <p style="margin-left: 40px;"> B1 = Benchtop D2 = Floor Drain E1 = Fume Hood Ventilation F1 = Floor D3 = Sink Drain V1 = Vacuum Nozzle O1 = Other D4 = Drain Sump V2 = Vacuum System Component D1 = Fume Hood Drain D5 = Roof Drain </p>	
<p>M: = Structural Material Code. This field represents the type of structural material on which a particular measurement is taken. (1 character)</p> <p style="margin-left: 40px;"> C = Concrete M = Miscellaneous R = Refractory V = Vinyl Tile/Sheet </p>	
<p>LLL: = Numerical Identifier. This field represents the survey location number. The field "001" means survey point location number 1. Numerical identifiers are unique within a survey unit. (3-characters)</p>	

13.0 INCINERATOR PREPARATION

Incinerator access hatches were available at locations where ash could collect; these accesses are inherent to the incinerator design to facilitate routine maintenance and ash removal. Prior to surveying incinerator internal surfaces, Chase removed residual ash materials at accessible locations to provide better data quality and access to incinerator surfaces. Residual ash materials were removed from internal portions of the incinerator through the available access hatches using a HEPA-filtered vacuum system fitted with a cyclone separator and drum collection system. Waste materials from incinerator sampling and survey activities were sealed in plastic bags and placed within the incinerator side openings pending laboratory analysis. Ash removal activities were conducted under a Radiation Work Permit (RWP) that required air sampling. The highest air sample result collected during ash removal activities

was less than the MDC of 1.5E-12 $\mu\text{Ci/ml}$, 0.0001% of the most limiting Derived Air Concentration (DAC) value of 1E-6 $\mu\text{Ci/ml}$ (C-14).

14.0 CHARACTERIZATION SURVEYS

The survey protocol for building surfaces consisted of performing the scanning portion of the final status survey protocol with judgmental smears and static measurements on areas of highest probability for residual radioactivity. Judgmental static measurements and smears were taken on vertical surfaces as part of the Class 2 and Class 3 final status survey protocols described in Section 12.2.2.

The purpose of scanning was to identify locations of elevated activity. The minimum scan percentages are presented in Section 12.1. Scanning was performed by moving the probe over surfaces at a distance of approximately 0.5 cm or less and at a rate less than the maximum allowable scan rate necessary to achieve DQOs.

The survey protocol for building system surveys consisted of performing total and removable contamination measurements of accessible internal surfaces of the incinerator and fume hood exhaust ventilation. Only removable contamination measurements of accessible internal surfaces of building drain systems and vacuum systems were performed due to the small geometry of the openings; however, the drain and vacuum openings were scanned during structural surface scans of the laboratories and fixtures.

No elevated activity was identified above investigation levels during facility structural characterization surveys or building mechanical systems surveys.

Characterization surveys of incinerator internal surfaces identified elevated radioactivity due to NORM in refractory materials. Chase collected ash samples in the upper chamber, lower chamber, and stack cleanout ports for external laboratory analysis. No detectable C-14 or H-3 was identified. NORM nuclides associated with the uranium and thorium decay chains were identified in expected concentrations of up to a few pCi/g, but K-40 was unexpectedly high with results up to 143 pCi/g. For comparison, the K-40 concentration in pure KCl that is used as food salt substitute, is 439 pCi/g. Because K-40 is naturally occurring and was never possessed under the radioactive materials license, no action was taken. The incinerator ash sample analytical results are presented in Appendix I and summarized in the table below.

Table 14-1: Incinerator Ash Sample Results

Location	Activity Concentration (pCi/g)		
	C-14	H-3	K-40
Upper Chamber	<0.832	<0.999	66.1
Lower Chamber	<0.800	<0.961	110
Stack	<0.757	<0.909	143

Outside grounds were outside the scope of the project; however, Chase collected soil samples in the west, south, and northeast directions for MU records. Very limited areas of soil were available due to the extensive presence of buildings, parking lots, and sidewalks. All soil

sample results were less than the MDC for C-14 and H-3 except for a sample from within a small bermed planting bed south of the building at 3.81 pCi/g C-14; this is less than 32% of the C-14 soil screening value of 12 pCi/g that is conservatively based on a resident farmer scenario. Soil sample analytical results are presented in Appendix I and sample locations are presented in Appendix J. The satellite photo in Appendix J does not reflect recent construction, particularly the construction of a building east of and adjacent to the VMDL.

Solid samples were sent to Teledyne Brown Engineering using an approved chain of custody (COC) procedure. The COC maintains the integrity of the sample; that is, there is an accurate record of sample collection, transport, and analysis. This ensures that samples are neither lost nor tampered with, and that the sample analyzed in the laboratory is actually and verifiably the sample taken from a specific location in the field.

15.0 REMEDIATION

No remediation of building structural surfaces was required; all impacted surfaces were below investigation levels.

16.0 FINAL STATUS SURVEY RESULTS

The statistical guidance contained in Section 8 of MARSSIM was used to determine if areas are acceptable for unrestricted release and whether additional surveys were required.

16.1 Data Validation

Field data were reviewed by the Project Manager and validated to ensure:

- Completeness of forms
- Proper types of surveys were performed
- The MDCs for measurements met the established data quality objectives
- Independent calculations were performed on a representative sample of data sheets
- Satisfactory instrument calibrations and daily functionality checks were performed as required

Additionally, all final status survey data were entered into the Final Status Survey Database. This provided the means to sort survey data, verify activity calculations, and to compute the associated MDC and counting errors. Once data entry for a survey unit was complete, a verification report was printed and compared to original data sheets to ensure correct data entry.

16.2 Preliminary Data Review

A preliminary data review was performed for each survey unit to identify any patterns, relationships, or anomalies. Additionally, measurement data were reviewed and compared with the DCGLs and investigation levels to confirm the correct classification of the survey units.

The following preliminary data reviews were performed:

- Review of the 4-Plot graphs of scan data
- Calculations of the survey unit mean, median, maximum, minimum, and standard deviation for each type of reading
- Comparison of the actual standard deviation to the assumed standard deviation used for calculating the number of measurements
- Comparison of survey data with applicable investigation levels

The relative shift was calculated using the survey unit with the highest standard deviation, resulting in a minimum number of measurements required of 11. Therefore, an adequate number of samples were collected.

16.3 Building Structural Surfaces Scan Data

A 4-Plot of scan data was produced for each survey instrument used within each survey unit. No elevated activity attributed to licensed radioactive materials was identified by listening to the audible detector response.

The 4-Plot graphs for building structural surfaces survey units indicate that the scan data is approximately normally distributed. However, some distributions appear bimodal, likely because measurements are not corrected for naturally-occurring radioactivity in building materials. For example, populations that consist primarily of concrete floors should have a normal distribution around a net positive mean due to natural radioactivity in concrete, while a population that consists primarily of metal walls would have a normal distribution around a mean near zero. When a population contains a significant fraction of each type of material, a bimodal distribution is evident in the 4-plot. Building materials encountered during this survey included concrete floors, metal fume hoods, wooden cabinets and drawers and concrete block wall. Additionally, several isolated one-second scan data results associated with 43-68 probes exceed the investigation level. This is a statistical anomaly resulting from the short sample interval. Each one-second count is converted from counts per second to dpm/100 cm² for presentation in the 4-Plot graphs. In the conversion process, the one-second counts are multiplied by a relatively large factor resulting in amplification of the data variability with an occasional investigation level exceedance. This effect is more apparent in 43-68 probes than 43-37 probes because the lower 43-37 probe area correction factor mitigates the effect. The surveyor did not encounter sustained elevated audible count rates at these locations. Based on the peak one second count rate, scan speed and the local average of the count rate, the data is consistent with surface contamination levels less than 5,000 dpm/100 cm².

The 4-Plot for survey unit VMD-IN01 interior surfaces indicates highly variable results with some results above the investigation level, but below the DCGL. This is due to NORM in refractory combined with irregular geometries inside the incinerator. To mitigate the effects of NORM activity in refractory, Chase used shielded measurements to determine

the background on incinerator interior surfaces as described in Section 12.2. Using static measurement data, custom backgrounds were applied to the areas for each access hatch. However, the surveyor still noted that higher counts were consistently observed in areas where the refractory was in a concentrated geometry. Based on the 4-Plots and surveyor notes, the scan data is consistent with residual surface activity less than the DCGL.

The 4-Plot graphs of the scan results are provided in Appendix E.

16.4 Data Summary Tables

All calculations of means, standard deviations, minimum and maximum values and comparisons between survey data and investigation levels are presented in the following tables. Building structural surface activity reports for each survey unit are included in Appendix F. Reports for building systems surveys are presented in Appendix G.

Table 16-1: Structural Surfaces Total Beta Surface Activity Summary

Survey Unit	# of Sample Locations	Mean	MDC	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
		(net dpm/100 cm ²)						
VMD-B201	18	1,258	3,449	922	109	3,484	5,000	NO
VMD-1201	13	687	3,449	963	-435	2,504	5,000	NO
VMD-1301	14	1,314	2,859	1,115	0	3,375	5,000	NO
VMD-2301	15	306	2,838	474	-627	940	5,000	NO
VMD-R301	15	383	2,930	570	-418	1,462	5,000	NO
VSF-1201	13	161	2,643	326	-209	731	5,000	NO
VSF-1301	14	351	2,694	656	-522	1,775	5,000	NO

Table 16-2: Building Structural Surfaces Removable H-3 Summary

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
		(net dpm/100 cm ²)					
VMD-B201	18	4	7	0	19	200	NO
VMD-1201	13	5	5	0	15	200	NO
VMD-1301	14	14	23	0	87	200	NO
VMD-2301	15	4	5	0	15	200	NO
VMD-R301	15	4	8	0	29	200	NO
VSF-1201	13	4	5	0	13	200	NO
VSF-1301	14	4	7	0	22	200	NO

Table 16-3: Building Structural Surfaces Removable C-14 Summary

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
VMD-B201	18	6	6	0	20	200	NO
VMD-1201	13	4	4	0	11	200	NO
VMD-1301	14	3	3	0	9	200	NO
VMD-2301	15	6	6	0	17	200	NO
VMD-R301	15	3	5	0	13	200	NO
VSB-1201	13	5	6	0	16	200	NO
VSB-1301	14	3	4	0	11	200	NO

Table 16-4: Building Structural Surfaces Removable Channel 3 Summary

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
VMD-B201	18	2	2	0	9	200	NO
VMD-1201	13	2	3	0	8	200	NO
VMD-1301	14	2	2	0	5	200	NO
VMD-2301	15	3	3	0	9	200	NO
VMD-R301	15	2	3	0	10	200	NO
VSB-1201	13	1	1	0	4	200	NO
VSB-1301	14	1	1	0	4	200	NO

Table 16-5: Building Systems Total Beta Surface Activity Summary ⁴

Survey Unit	# of Sample Locations	Mean	MDC	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
VMD-VE01	6	261	2,838	755	-1,149	1,044	5,000	NO
VMD-IN01	8	5,551	1,607 ⁵	2,228	2,698	8,919	5,000	YES ⁶
VSB-VE01	12	-148	2,694	407	-627	731	5,000	NO

⁴ Direct measurements were not possible in drain and vacuum system openings due to the small geometry of the openings.

⁵ A background was determined for each measurement location; therefore, the most conservative (highest) MDC is presented.

⁶ Some measurements exceeded the investigation level due to refractory materials. No action was taken because these locations are a small fraction of the DCGL, and the measurement result included emissions from NORM in refractory materials. C-14 was not detectable from laboratory analysis of solid samples of incinerator ash and refractory materials.

Table 16-6: Building Systems Removable H-3 Summary

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
VMD-DR01	41	4	7	0	32	200	NO
VMD-VE01	6	11	11	0	24	200	NO
VMD-IN01	8	4	6	0	16	200	NO
VSB-DR01	33	4	7	0	33	200	NO
VSB-VE01	12	6	8	0	28	200	NO
VSB-VA01	34	7	7	0	32	200	NO

Table 16-7: Building Systems Removable C-14 Summary

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
VMD-DR01	41	4	5	0	15	200	NO
VMD-VE01	6	4	2	0	7	200	NO
VMD-IN01	8	5	4	0	11	200	NO
VSB-DR01	33	4	4	0	15	200	NO
VSB-VE01	12	7	6	0	17	200	NO
VSB-VA01	34	4	4	0	14	200	NO

Table 16-8: Building Systems Removable Channel 3 Summary

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
VMD-DR01	41	2	2	0	7	200	NO
VMD-VE01	6	2	2	0	6	200	NO
VMD-IN01	8	1	2	0	5	200	NO
VSB-DR01	33	1	2	0	10	200	NO
VSB-VE01	12	2	3	0	9	200	NO
VSB-VA01	34	2	2	0	9	200	NO

16.5 Determining Compliance for Building Structural Surfaces

Final status survey results were initially compared to the investigation levels. All total and removable surface activity measurements were below the investigation levels and well below the applicable DCGLs.

The results of the data quality assessment and calculations of the dose from the structural surface survey unit based on MARSSIM grid locations are presented in the table below.

Table 16-9: Structural Surfaces Total Beta Surface Activity Dose Calculations

Survey Unit	Standard Deviation (dpm/100 cm ²)	# Samples Required	Actual # of Samples	Adequate # of Samples?	Mean (dpm/100 cm ²)	Calculated Annual TEDE ⁷ (mrem/yr)
VMD-B201	922	11	18	YES	1,258	0.009
VMD-1201	963	11	13	YES	687	0.005
VMD-1301	1,115	11	14	YES	1,314	0.009
VMD-2301	474	11	15	YES	306	0.002
VMD-R301	570	11	15	YES	383	0.003
VSB-1201	326	11	13	YES	161	0.008
VSB-1301	656	11	14	YES	351	0.018
					Maximum	0.018

16.6 Determining Compliance for Building Mechanical Systems

All total and removable surface activity results on building mechanical systems were less than the investigation levels and well below the applicable DCGLs; therefore, all systems survey units meet the release criteria and are suitable for release.

16.7 Determining Compliance for Incinerator Systems

Incinerator internal total surface activity measurements had elevated results above the investigation level, but at a small fraction of the DCGLs due to NORM in refractory materials as confirmed by laboratory analysis of ash and refractory materials. All removable surface activity results on incinerator internals were less than the investigation levels; therefore, all systems survey units meet the release criteria and are suitable for release.

17.0 QUALITY ASSURANCE SURVEYS

17.1 QA Survey Methods

Quality assurance surveys consisted of re-performing the FSS protocol for building structural surfaces to achieve a minimum of 5% duplication of scans, static measurements, and smears. The Project Manager implemented QA surveys by re-performing judgmentally selected survey locations as survey units VSB-QA01 and VMD-QA01. The locations of QA survey total and removable surface activity measurements are presented in the table below.

⁷ The TEDE shown is conservatively calculated by multiplying 25 mrem/yr by the ratio of the mean total surface activity to the CI-36 DSV of 5.0E5 dpm/100cm² for VSB survey units and the C-14 DSV of 3.7E6 dpm/100 cm² for VMDL survey units.

Table 17-1: QA Survey Locations

QA Survey Location	FSS Location
VSF-QA01-F1-V-001	VSF-1301-F1-V-004
VSF-QA01-F1-V-002	VSF-1201-F1-V-011
VMD-QA01-F1-V-001	VMD-2301-F1-V-015
VMD-QA01-F1-C-002	VMD-1201-F1-C-011
VMD-QA01-F1-V-003	VMD-1301-F1-V-011
VMD-QA01-F1-C-004	VMD-B201-F1-C-007
VMD-QA01-F1-M-005	VMD-R301-F1-M-003

17.2 QA Survey Results

All QA survey results were similar to FSS data and the conclusions were the same as those based on the initial surveys. QA survey results are presented in Appendix H and are summarized in the tables below.

Table 17-2: QA Building Structural Surfaces Total Activity Summary

Survey Unit	# of Sample Locations	Mean	MDC	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
		(net dpm/100 cm ²)						
VMD-QA01	5	1,062	3,530	1,280	-218	2,395	5,000	NO
VSF-QA01	2	708	3,192	385	435	980	5,000	NO

Table 17-3: QA Building Structural Surfaces Removable H-3 Summary

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
		(net dpm/100 cm ²)					
VMD-QA01	5	2	4	0	9	200	NO
VSF-QA01	2	8	11	0	15	200	NO

Table 17-4: QA Building Structural Surfaces Removable C-14 Summary

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
		(net dpm/100 cm ²)					
VMD-QA01	5	5	6	0	13	200	NO
VSF-QA01	2	2	2	0	3	200	NO

Table 17-5: QA Building Structural Surfaces Removable Channel 3 Summary

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
VMD-QA01	5	1	1	0	2	200	NO
VSB-QA01	2	1	1	1	2	200	NO

18.0 ALARA ANALYSIS

Due to the extremely low doses associated with residual radioactivity at the facility, a quantitative ALARA analysis was not required. Default screening values were used to establish DCGLs. NUREG 1757, Volume 2, Appendix N states in part: “For ALARA during decommissioning, all licensees should use typical good-practice efforts such as floor and wall washing, removal of readily removable radioactivity in buildings or in soil areas, and other good housekeeping practices. In addition, licensees should provide a description in the Final Status Survey Report (FSSR) of how these practices were employed to achieve the final activity levels. In light of the conservatism in the building surface and surface soil generic screening levels developed by NRC, NRC staff presumes, absent information to the contrary, that licensees who remediate building surfaces or soil to the generic screening levels do not need to provide analyses to demonstrate that these screening levels are ALARA.”

19.0 CONCLUSION

Radiological surveys demonstrate that building structural surfaces and systems included in the scope of this report are below release criteria and are suitable for release for unrestricted use. A sufficient number of samples were taken in each survey unit, and all total and removable surface activity results were less than the investigation levels (except for incinerator internal surfaces due to NORM in refractory material) and significantly less than the applicable DCGL, so no further statistical tests are required.

Conclusion: The null hypothesis is rejected; all survey units pass the statistical tests and are suitable for release for unrestricted use.

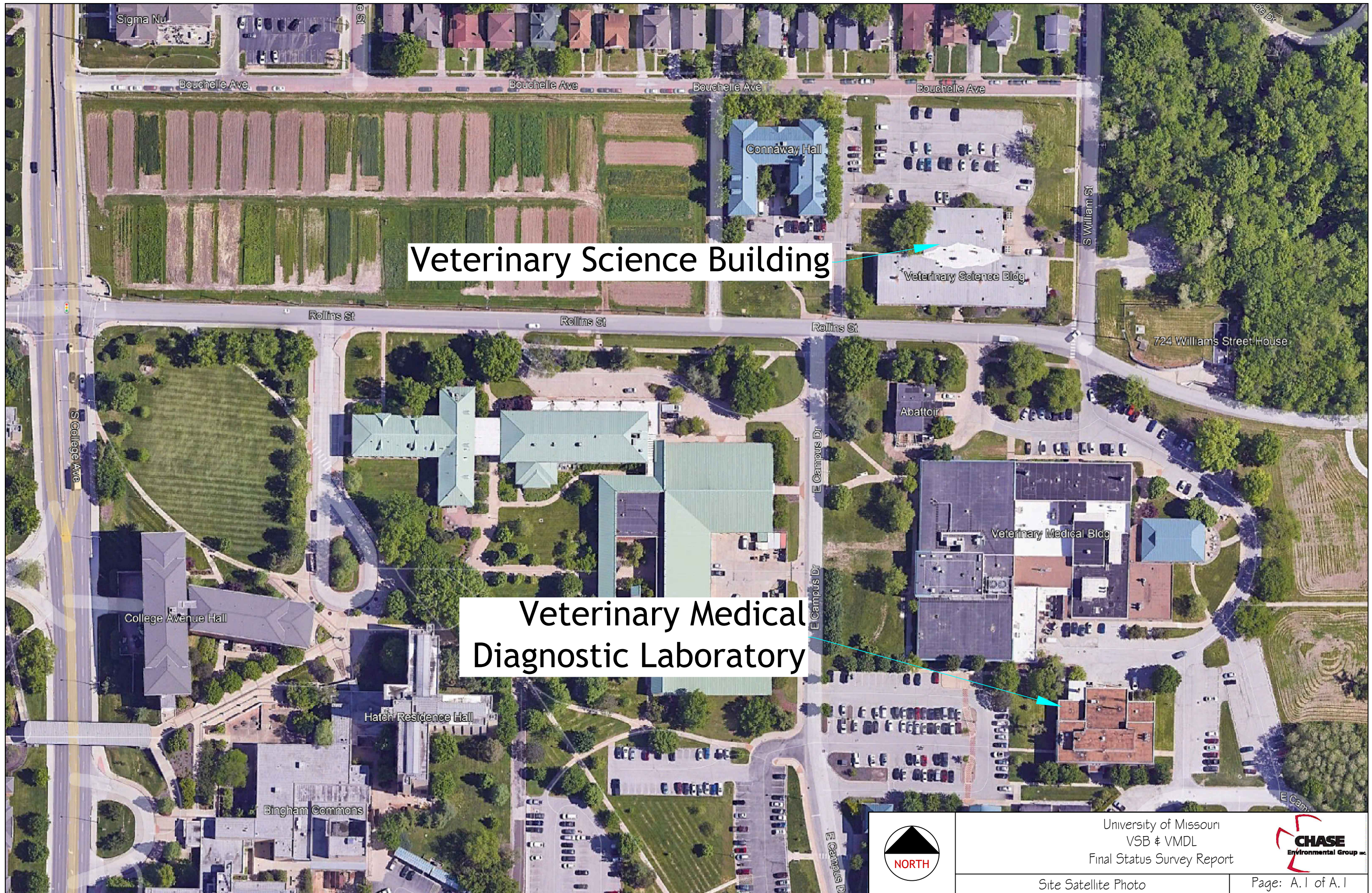
20.0 REFERENCES

- MU Radioactive Materials License Number 24-00513-32
- NRC Regulations 10 CFR 20 Subpart E
- “University of Missouri VSB & VMDL Decommissioning Work Plan,” January 2024
- NUREG-1757, Volume 1, Revision 2, “Consolidated NMSS Decommissioning Guidance: Decommissioning Process for Materials Licensees,” September 2006
- NUREG-1757, Volume 2, Revision 1, “Consolidated NMSS Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria,” September 2006

- NUREG-1575, Revision 1, “Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM),” August 2000
- NUREG 1507, Revision 1 “Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions,” August 2020
- ISO-7503-1, “Evaluation of Surface Contamination – Part 1: Beta Emitters and Alpha Emitters,” 1988

Appendix A

Site Satellite Photo



Veterinary Science Building

Veterinary Medical Diagnostic Laboratory



University of Missouri
VSB & VMDL
Final Status Survey Report

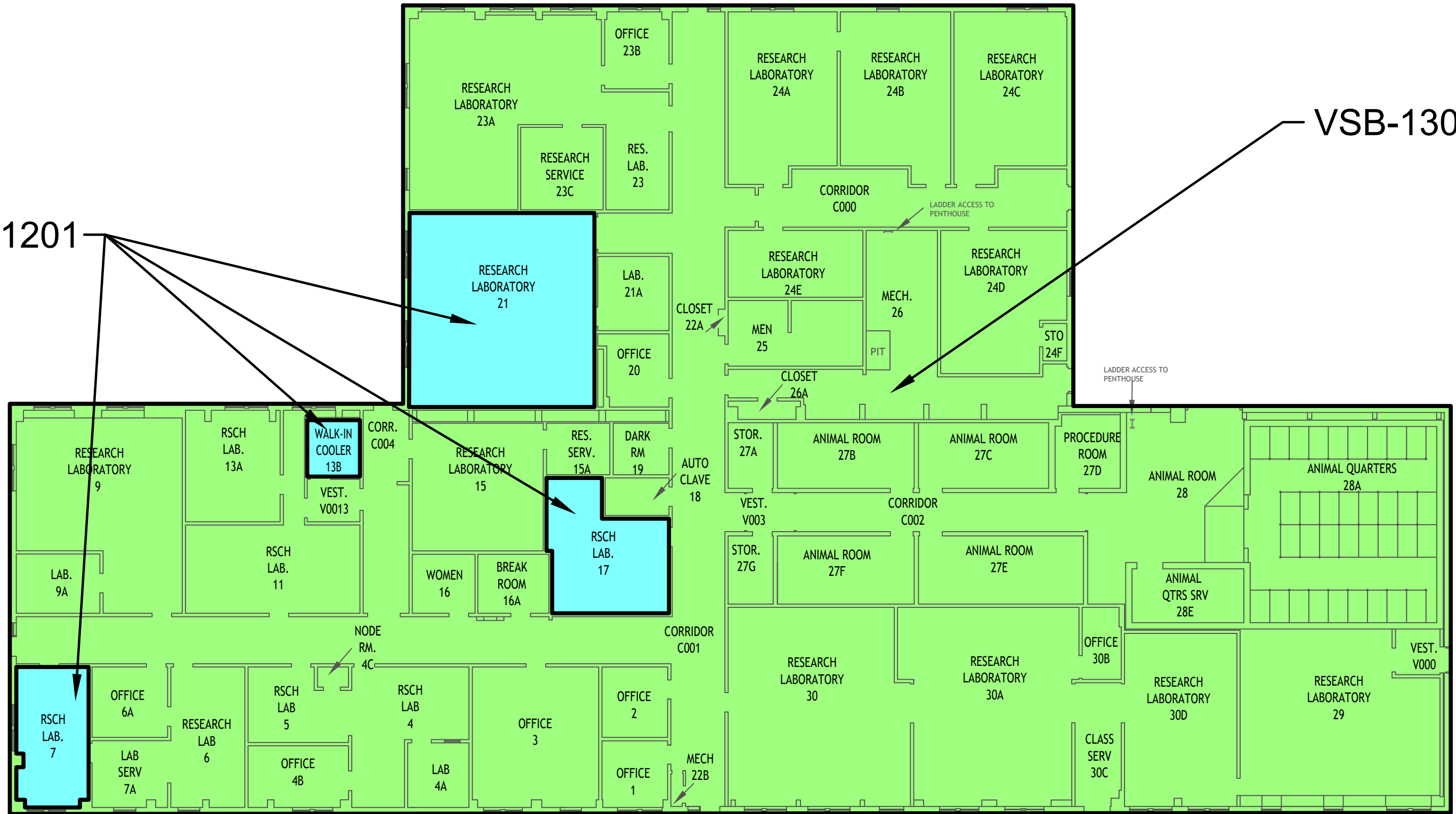


Appendix B

Building Floor Plan

VSB-1201

VSB-1301



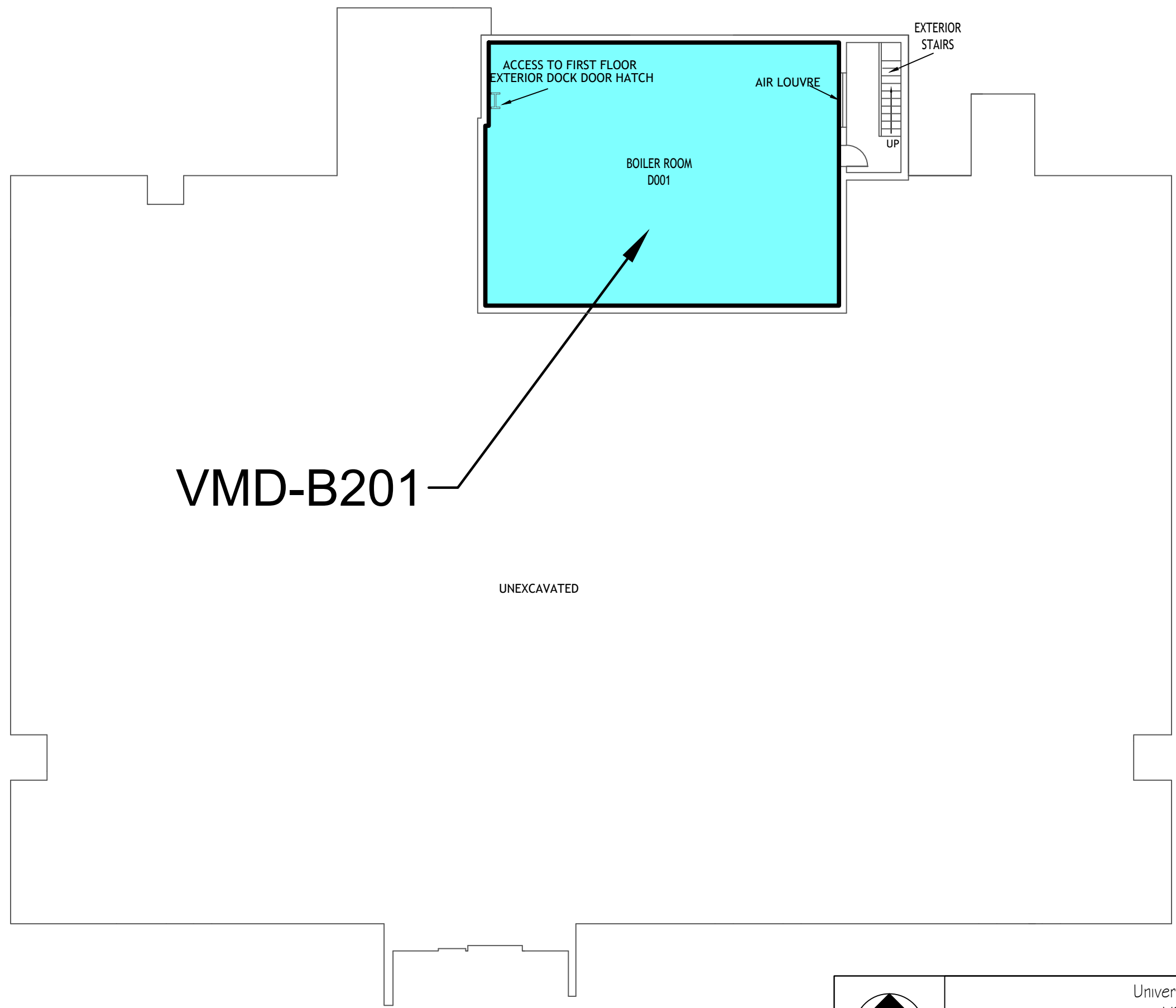
Class 2

Class 3



University of Missouri
 VSB & VMDL
 Final Status Survey Report





 Class 2

 Class 3



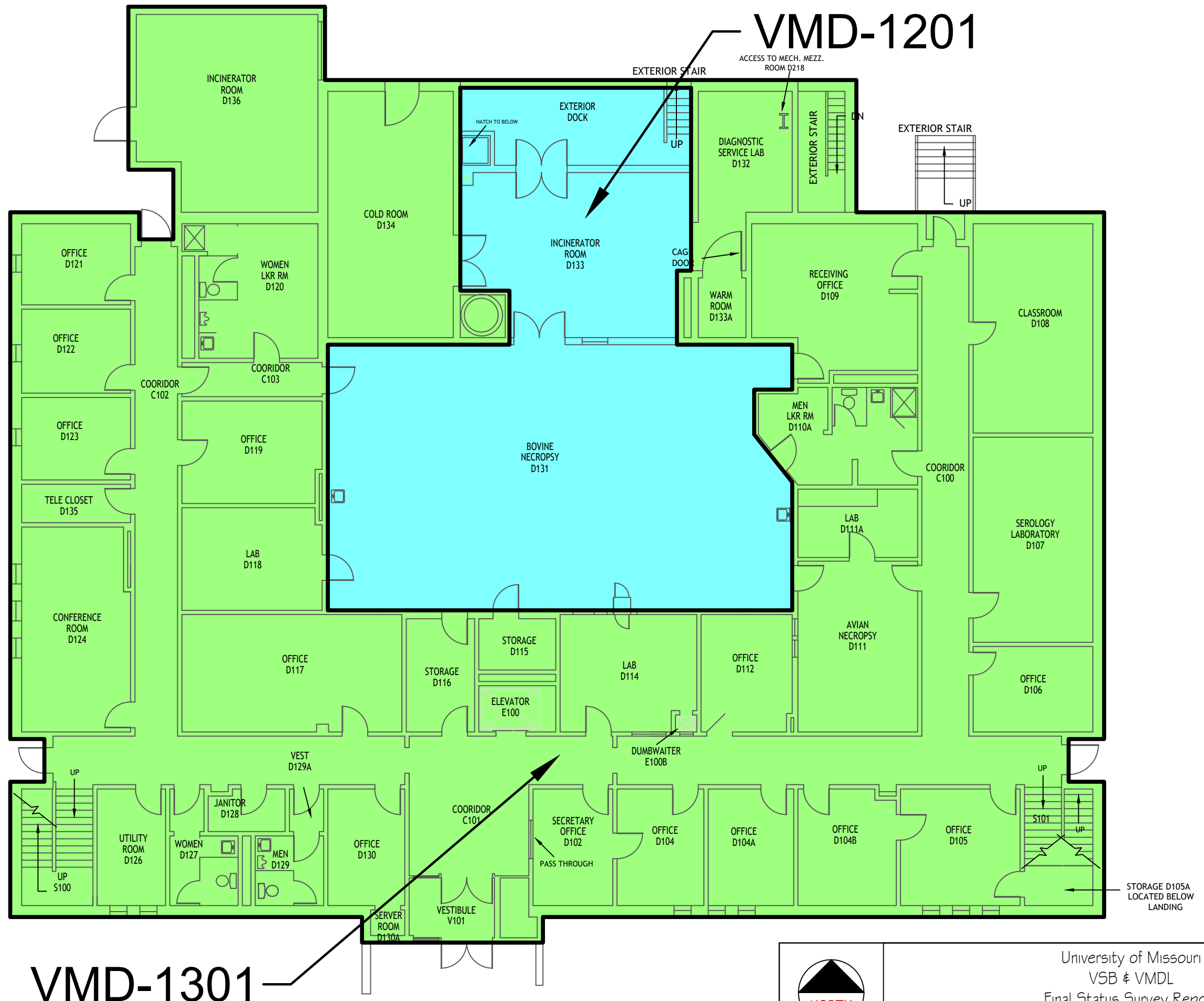
University of Missouri
 VSB & VMDL
 Final Status Survey Report



Building: VMD

Elevation: Basement

Page: B.2 of B.5



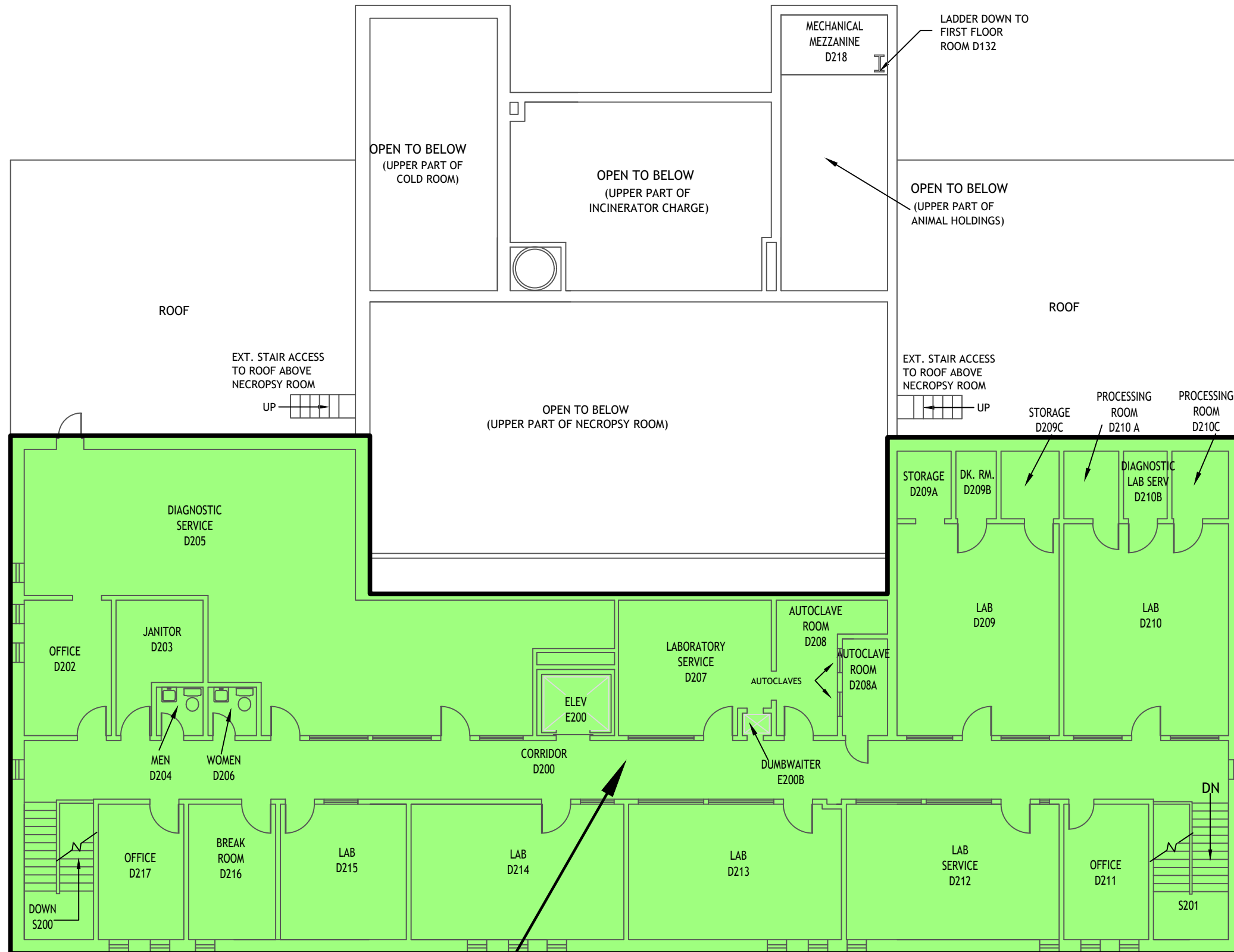
Class 2

Class 3

VMD-1301

VMD-1201

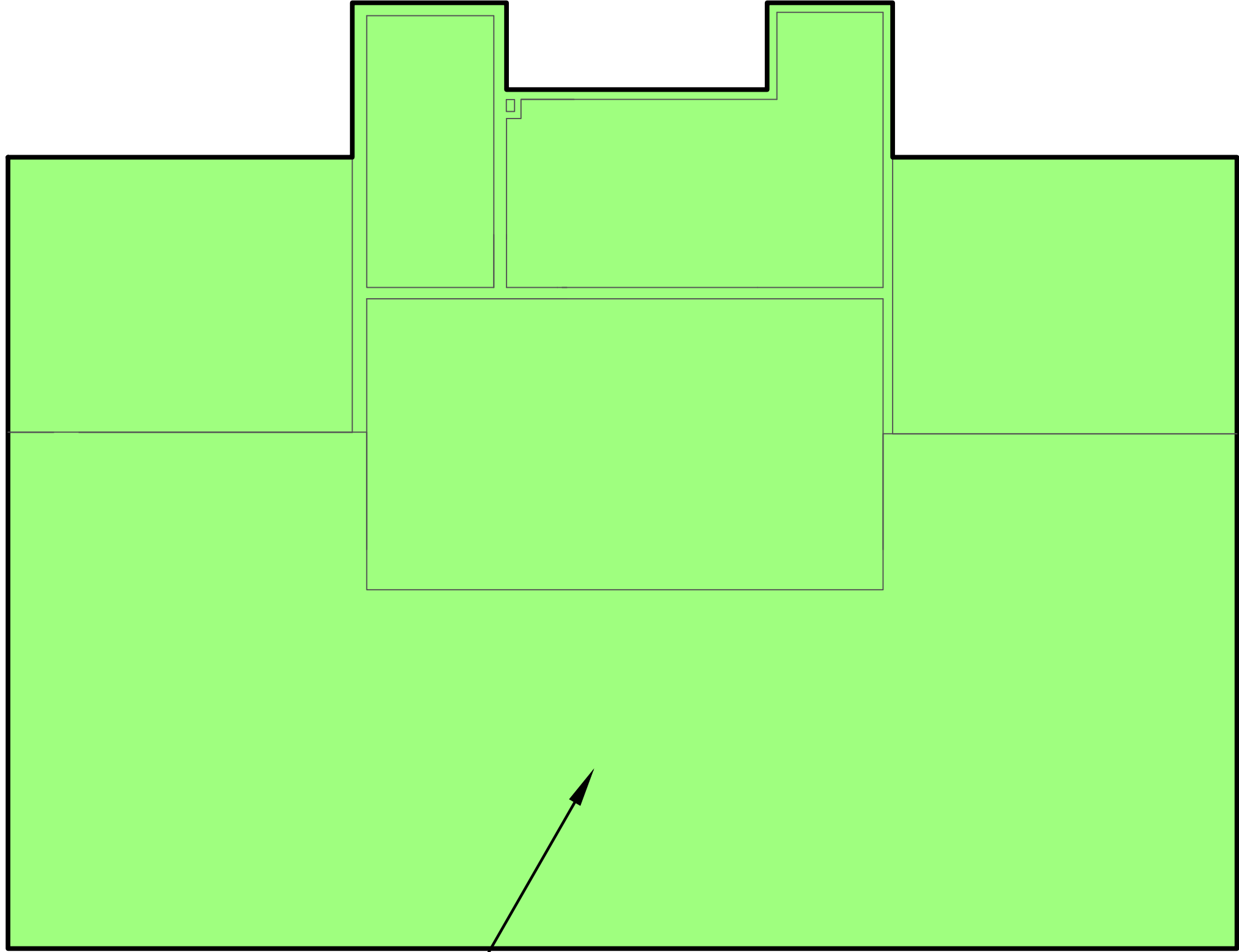




VMD-2301

- Class 2
- Class 3





Class 2

Class 3

VMD-R301



University of Missouri
VSB & VMDL
Final Status Survey Report

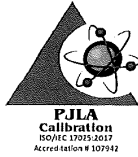


Building: VMD

Elevation: Roof

Page: B.5 of B.5

Appendix C
Instrument Calibration Records



Safety and Ecology Corporation
 10512 Lexington Drive, Suite 200
 Knoxville, TN 37932
Calibration Certificate

Procedure # SEC-IS-422

Instrument Manufacturer:	Ludlum Instruments	Date:	11/2/2023
Model:	2241-3	Customer Name:	Chase
Serial Number:	253351	Technician:	Jacob Galyon
Bar Code Number:		Reason:	Due for Cal

Instrument Model:	500-2	Serial Number:	268940	Due Date:	7/3/2024
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Instrument Condition		Threshold		Battery Indicator																													
As Found	As Left	As Found	As Left	SAT																													
OK	OK	4.0	4.0	SAT																													
				SCA/RATE Switch																													
				SAT																													
Detector #	Set Voltage		High Voltage Range		<table border="1"> <thead> <tr> <th colspan="3">Reproducibility</th> </tr> <tr> <th colspan="3">x.1 or x1 Scale</th> </tr> <tr> <td>250</td> <td>250</td> <td>250</td> </tr> <tr> <th colspan="3">x1 or x10 Scale</th> </tr> <tr> <td>2500</td> <td>2500</td> <td>2500</td> </tr> <tr> <th colspan="3">x10 or x100 Scale</th> </tr> <tr> <td>25K</td> <td>25K</td> <td>25K</td> </tr> <tr> <th colspan="3">x100 or x1000 Scale</th> </tr> <tr> <td>250K</td> <td>250K</td> <td>250K</td> </tr> </thead></table>		Reproducibility			x.1 or x1 Scale			250	250	250	x1 or x10 Scale			2500	2500	2500	x10 or x100 Scale			25K	25K	25K	x100 or x1000 Scale			250K	250K	250K
	Reproducibility																																
x.1 or x1 Scale																																	
250	250	250																															
x1 or x10 Scale																																	
2500	2500	2500																															
x10 or x100 Scale																																	
25K	25K	25K																															
x100 or x1000 Scale																																	
250K	250K	250K																															
As Found	As Left	As Found	As Left																														
1	1675	1675	SAT	SAT																													
2	1800	1800	SAT	SAT																													
3	1325	1325	SAT	SAT																													
4	1350	1350	SAT	SAT																													
Digital Scaler																																	
Target	As Found	%Error	As Left	%Error																													
250	249	0.40%	249	0.40%																													
2,500	2,494	0.24%	2,494	0.24%																													
25,000	24,939	0.24%	24,939	0.24%																													
250,000	249,390	0.24%	249,390	0.24%																													

OK	Is the As Found Data within 20% of the set point?	OK	Audio Response
OK	Are the individual counts within 10% of the average?	OK	Push Buttons
OK	Fast / Slow response switch functions properly?	OK	RESET
OK	Does Instrument meet final Acceptance Criteria?	OK	Audio Switch
OK	Calibration sticker attached?	OK	Light

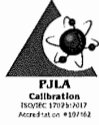
Married with:	1675V	DET 1	Model:	43-68	Serial Number:	PR216394
	1800V	DET 2	Model:	43-37	Serial Number:	PR178300
	1325V	DET 3	Model:	43-68	Serial Number:	PR216394
	1350V	DET 4	Model:	43-37	Serial Number:	PR178300

Comments/Remarks: **Repaired broken count switch.**
 5 foot cable used for the 43-68
 10 foot cable used for the 43-37
 Calibration done with N.I.S.T. traceable source(s) and/or calibrated test equipment.
 Calibration acceptance criteria +/- 10% of actual exposure or input rate.
 If 'As Found' readings are greater than +/- 20% then values are circled in red and customer is contacted.

Date Instrument is due for Next Calibration: 11/2/2024

Performed by:
 Printed Name: Jacob Galyon

Reviewed by:
 Date Reviewed: 11/2/23



Safety and Ecology Corporation SEC PROCEDURE # SEC-IS-417 Rev 5
 10512 Lexington Drive, Suite 200, Knoxville, TN 37932

Calibration Certificate

Calibration Certificate for 43-68, Serial # PR216394, Bar Code # Blue, Property # Chase108

Date: 11/02/23 Date Last Cal. Expires: 07/18/23 Technician: Jacob Galyon Reason For Calibration: Due for Calibration
 Temp RelHum: BP: CableLength 5 Ft

EQUIPMENT USED DURING CALIBRATION MODEL: 2241-3 SERIAL #: 253351 CAL DUE 11/02/24

NIST TRACEABLE SOURCES USED	SOURCE	ISOTOPE	ACTIVITY	2π	ASSAY DATE
Efficiencies from last calibration	99PU470-0268	Pu-239	14196 dpm	7,188 cpm	1/30/2023
Pu-239: 21.63 %	4050-02	Tc-99	36799 dpm	22,999 cpm	1/30/2023
Tc-99: 22.61 %	4049-02	Th-230	30197 dpm	15,298 cpm	1/30/2023
Th-230: 19.40 %	4052-02	Sr-90	14194 dpm	9,898 cpm	1/30/2023
SrY-90: 37.69 %					

AS FOUND DATA AS FOUND Instrument Condition: SAT
 Calibration Setpoints

Back ground:	Alpha	Beta	AF 4 π Efficiencies
1	CPM	285	CPM
Pu-239:	3001	N/A	21.13%
Tc-99:	N/A	9769	25.77%
Th-230:	6072	N/A	20.10%
SrY-90:	N/A	5675	37.97%

AS LEFT Instrument Condition: SAT
 AS LEFT DATA after repair, HV adjust or Plateau

Back ground:	Alpha	Beta	AL 4 π Efficiencies
1	CPM	285	CPM
Pu-239:	3001	N/A	21.13%
Tc-99:	N/A	9769	25.77%
Th-230:	6072	N/A	20.10%
SrY-90:	N/A	5675	37.97%

Is the As Found Data within 20% of the efficiency from the last cal.?

"AF" in the AL Efficiency fields means to refer to the AF Efficiencies in the AS FOUND DATA Section

Reproducibility : Isotope: Sr-90 5915 5707 5778 Average: 5800.0 Are the individual counts within 10% of the average?

If the As Found data (even after repair) is within 10% of the last calibration, then the technician may N/A Plateau Data and go directly to Comments. Geometry of source = flush to surface, except gas proportional probes = 1/8" from surface unless otherwise specified.

Alpha Source: Th-230
 Response Background

HV (Alpha)	CPM A ch.	CPM B ch.	Net 4π Eff.
N/A			

PLATEAU DATA

Beta Source: Tc-99
 Response Background

HV (Beta)	CPM B ch.	CPM C ch.	Net 4π Eff.
N/A			

2 Pi Efficiencies:

Pu-239	Tc-99	Th-230	SrY-90
41.74%	41.24%	39.68%	54.46%

Comments: Married as a set with: Model: 2241-3 Serial #: 253351 Bar Code #: Blue

Does Instrument Meet Final Acceptance Criteria? Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 11/02/24

All instrumentation is calibrated in accordance with the QAP to meet the criteria of ANSI N323AB-2013
 The results in this report relate only to the item calibrated or tested.

Performed by: Jacob Galyon
 Printed Name: Jacob Galyon

Reviewed by: [Signature] Issue Date: 11/2/23





Safety and Ecology Corporation

10512 Lexington Drive
Suite 200
Knoxville, TN 37932

C-14 SOURCE CALIBRATION FORM

Probe Model Number : 43-68 Customer Name : Chase Environmental
Probe Serial Number : PR216394 Technician : Jacob Galyon
Date of Calibration : 11/2/2023

Instruments used during calibration					
Model Number:	<u>2241-3</u>	Serial Number:	<u>253351</u>	Calibration Due Date:	<u>11/2/2024</u>
Model Number:		Serial Number:		Calibration Due Date:	

NIST Traceable Source(s) used : Activity(s)

	Source S/N	Emission Rate	2 Pi (cpm)	uCi	4Pi (dpm)	Assay Date	
1 >	C-14	<u>DX 295</u>	<u>432</u>	<u>25,920</u>	<u>0.0305405</u>	<u>67,800</u>	<u>5/3/1994</u>

Data

Instrument condition : Sat

High Voltage: 1675

Background: 285

C-14 Count: 8164

2π Efficiency: 30.40%

4π Efficiency: 11.62%

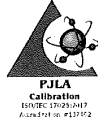
Calibration sticker attached? Yes

Comments : Married as a set with : Model : 2241-3 Serial # : 253351
Calibrated with plastic standoffs attached.

Date Instrument is due for Next Calibration: 11/2/2024

Performed by: Jacob Galyon
Printed Name: Jacob Galyon

Reviewed by: [Signature]
Date Reviewed: 11/2/23



Safety and Ecology Corporation SEC PROCEDURE # SEC-IS-417 Rev 5
 10512 Lexington Drive, Suite 200, Knoxville, TN 37932

Calibration Certificate

Calibration Certificate for 43-37, Serial # PR178300, Bar Code # Blue, Property # Chase107

Date: 11/02/23 Date Last Cal. Expires: 07/18/23 Technician: Jacob Galyon Reason For Calibration: Due for Calibration
 Temp RelHum: BP: CableLength 10 Ft

EQUIPMENT USED DURING CALIBRATION MODEL: 2241-3 SERIAL #: 253351 CAL DUE 11/02/24

NIST TRACEABLE SOURCES USED	SOURCE	ISOTOPE	ACTIVITY	2π	ASSAY DATE
Efficiencies from last calibration	99PU470-0268	Pu-239	14196 dpm	7,188 cpm	1/30/2023
Pu-239: 20.39 %	4050-02	Tc-99	36799 dpm	22,999 cpm	1/30/2023
Tc-99: 24.55 %	4049-02	Th-230	30197 dpm	15,298 cpm	1/30/2023
Th-230: 19.11 %	4052-02	Sr-90	14194 dpm	9,898 cpm	1/30/2023
SrY-90: 32.46 %					

AS FOUND DATA AS FOUND Instrument Condition: SAT
 Calibration Setpoints

HV (Alpha):	1350 V	HV (Beta):	1800 V	Threshold:	4 mV
Back ground:	Alpha 3 CPM	Beta 815 CPM	AF 4 π Efficiencies		
Pu-239:	2581 CPM	N/A	18.16%		
Tc-99:	N/A	9771 CPM	24.34%		
Th-230:	5797 CPM	N/A	19.19%		
SrY-90:	N/A	5828 CPM	35.32%		

AS LEFT DATA after repair, HV adjust or Plateau
 AS LEFT Instrument Condition: SAT

HV (Alpha):	1350 V	HV (Beta):	1800 V	Threshold:	4 mV
Back ground:	Alpha 3 CPM	Beta 815 CPM	AL 4 π Efficiencies		
Pu-239:	2581 CPM	N/A	18.16%		
Tc-99:	N/A	9771 CPM	24.34%		
Th-230:	5797 CPM	N/A	19.19%		
SrY-90:	N/A	5828 CPM	35.32%		

Is the As Found Data within 20% of the efficiency from the last cal.?

"AF" in the AL Efficiency fields means to refer to the AF Efficiencies in the AS FOUND DATA Section

Reproducibility : Isotope: Sr-90 5895 5912 5781 Average: 5862.7 Are the individual counts within 10% of the average?

If the As Found data (even after repair) is within 10% of the last calibration, then the technician may N/A Plateau Data and go directly to Comments. Geometry of source = flush to surface, except gas proportional probes = 1/8" from surface unless otherwise specified.

Alpha Source: Th-230

HV (Alpha)	CPM A ch.	CPM A ch.	Net 4π Eff.
N/A			

PLATEAU DATA

Beta Source: Tc-99

HV (Beta)	CPM B ch.	CPM B ch.	Net 4π Eff.
N/A			

2 Pi Efficiencies: Pu-239 35.87% Tc-99 38.94% Th-230 37.87% SrY-90 50.65%

Comments: Married as a set with: Model: 2241-3 Serial #: 253351 Bar Code #: Blue

Does Instrument Meet Final Acceptance Criteria?

Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 11/02/24

All instrumentation is calibrated in accordance with the QAP to meet the criteria of ANSI N323AB-2013
 The results in this report relate only to the item calibrated or tested.

Performed by: Jacob Galyon
 Printed Name: Jacob Galyon

Reviewed by: [Signature] Issue Date: 11/2/23





Safety and Ecology Corporation

10512 Lexington Drive
 Suite 200
 Knoxville, TN 37932

C-14 SOURCE CALIBRATION FORM

Probe Model Number : 43-37 Customer Name : Chase Environmental
 Probe Serial Number : PR178300 Technician : Jacob Galyon
 Date of Calibration : 11/2/2023

Instruments used during calibration		
Model Number: 2241-3	Serial Number: 253363	Calibration Due Date: 11/2/2024
Model Number:	Serial Number:	Calibration Due Date:

NIST Traceable Source(s) used : Activity(s)

	Source S/N	Emission Rate	2 Pi (cpm)	uCi	4Pi (dpm)	Assay Date
1 > C-14	DX 295	432	25,920	0.0305405	67,800	5/3/1994

Data

Instrument condition : Sat
 High Voltage: 1800
 Background: 815
 C-14 Count: 9342

2π Efficiency: 32.90%
4π Efficiency: 12.58%

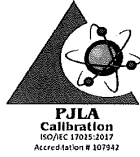
Calibration sticker attached? Yes

Comments : Married as a set with : **Model :** 2241-3 **Serial # :** 253363
Calibrated with plastic standoffs attached.

Date Instrument is due for Next Calibration: 11/2/2024

Performed by: Jacob Galyon
 Printed Name: Jacob Galyon

Reviewed by: [Signature]
 Date Reviewed: 11/2/23



Safety and Ecology Corporation
 10512 Lexington Drive, Suite 200
 Knoxville, TN 37932
Calibration Certificate

Procedure # SEC-IS-422

Instrument Manufacturer:	Ludlum Instruments	Date:	12/6/2023
Model:	2241-3	Customer Name:	Chase
Serial Number:	267161	Technician:	Jacob Galyon
Bar Code Number:		Reason:	Due for Cal

Instrument Model:	500-2	Serial Number:	268940	Due Date:	7/3/2024
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Instrument Condition		Threshold		Battery Indicator		
As Found	As Left	As Found	As Left	SAT		
OK	OK	4.0	4.0			
				SCA/RATE Switch		
				SAT		
				Reproducibility		
				x.1 or x1 Scale		
				250	250	250
				x1 or x10 Scale		
				2500	2500	2500
				x10 or x100 Scale		
				25K	25K	25K
				x100 or x1000 Scale		
				250K	250K	250K

OK	Is the As Found Data within 20% of the set point?	OK	Audio Response
OK	Are the individual counts within 10% of the average?	OK	Push Buttons
OK	Fast / Slow response switch functions properly?	OK	RESET
OK	Does Instrument meet final Acceptance Criteria?	OK	Audio Switch
OK	Calibration sticker attached?	OK	Light

Married with:	1700V	DET 1	Model:	43-68	Serial Number:	PR289347
	1825V	DET 2	Model:	43-37	Serial Number:	PR148503
	1175V	DET 3	Model:	43-68	Serial Number:	PR289347
	1250V	DET 4	Model:	43-37	Serial Number:	PR148503

Comments/Remarks:
 5 foot cable used for the 43-68
 10 foot cable used for the 43-37
 Calibration done with N.I.S.T. traceable source(s) and/or calibrated test equipment.
 Calibration acceptance criteria +/- 10% of actual exposure or input rate.
 If 'As Found' readings are greater than +/- 20% then values are circled in red and customer is contacted.

Date Instrument is due for Next Calibration: 12/6/2024

Performed by: Jacob Galyon
 Printed Name: Jacob Galyon

Reviewed by: [Signature]
 Date Reviewed: 12/6/23



Safety and Ecology Corporation SEC PROCEDURE # SEC-IS-417 Rev 5
 10512 Lexington Drive, Suite 200, Knoxville, TN 37932

Calibration Certificate

Calibration Certificate for 43-68, Serial # PR289347, Bar Code # Purple, Property # Chase99

Date: 12/06/23 Date Last Cal. Expires: 11/07/23 Technician: Jacob Galyon Reason For Calibration: Due for Calibration
 Temp RelHum: BP: CableLength 5 Ft

EQUIPMENT USED DURING CALIBRATION MODEL: 2241-3 SERIAL #: 267161 CAL DUE 12/06/24

NIST TRACEABLE SOURCES USED	SOURCE	ISOTOPE	ACTIVITY	2π	ASSAY DATE
Efficiencies from last calibration	99PU470-0268	Pu-239	14196 dpm	7,188 cpm	1/30/2023
Pu-239: 19.34 %	4050-02	Tc-99	36799 dpm	22,999 cpm	1/30/2023
Tc-99: 25.54 %	4049-02	Th-230	30197 dpm	15,298 cpm	1/30/2023
Th-230: 18.87 %	4052-02	Sr-90	14194 dpm	9,898 cpm	1/30/2023
SrY-90: 41.72 %					

AS FOUND DATA

AS FOUND Instrument Condition: UNSA
 Calibration Setpoints

HV (Alpha): 1175 V HV (Beta): 1700 V Threshold: 4 mV

Back ground:	Alpha	CPM	Beta	CPM	AF 4 π Efficiencies
Pu-239:	2833	CPM	N/A		19.95%
Tc-99:	N/A		9888	CPM	26.36%
Th-230:	5820	CPM	N/A		19.27%
SrY-90:	N/A		6063	CPM	41.38%

AS LEFT Instrument Condition: SAT

AS LEFT DATA after repair, HV adjust or Plateau

HV (Alpha): 1175 V HV (Beta): 1700 V Threshold: 4 mV

Back ground:	Alpha	CPM	Beta	CPM	AL 4 π Efficiencies
Pu-239:	2833	CPM	N/A		19.95%
Tc-99:	N/A		9888	CPM	26.36%
Th-230:	5820	CPM	N/A		19.27%
SrY-90:	N/A		6063	CPM	41.38%

Is the As Found Data within 20% of the efficiency from the last cal.?

"AF" in the AL Efficiency fields means to refer to the AF Efficiencies in the AS FOUND DATA Section

Reproducibility : Isotope: Sr-90 5949 6056 6097 Average: 6034.0 Are the individual counts within 10% of the average?

If the As Found data (even after repair) is within 10% of the last calibration, then the technician may N/A Plateau Data and go directly to Comments. Geometry of source = flush to surface, except gas proportional probes = 1/8" from surface unless otherwise specified.

Alpha Source: Th-230
 Response Background

HV (Alpha)	CPM A ch.	CPM B ch.	Net 4π Eff.
N/A			

PLATEAU DATA

Beta Source: Tc-99
 Response Background

HV (Beta)	CPM B ch.	CPM C ch.	Net 4π Eff.
N/A			

2 Pi Efficiencies: Pu-239 39.40% Tc-99 42.17% Th-230 38.04% SrY-90 59.35%

Comments: Married as a set with: Model: 2241-3 Serial #: 267161 Bar Code #: Purple

Replaced damaged mylar.

Does Instrument Meet Final Acceptance Criteria? Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 12/06/24

All instrumentation is calibrated in accordance with the QAP to meet the criteria of ANSI N323AB-2013
 The results in this report relate only to the item calibrated or tested.

Performed by: Jacob Galyon
 Printed Name: Jacob Galyon

Reviewed by: [Signature] Issue Date: 12/6/23





Safety and Ecology Corporation

10512 Lexington Drive
 Suite 200
 Knoxville, TN 37932

C-14 SOURCE CALIBRATION FORM

Probe Model Number : 43-68 Customer Name : Chase Environmental
 Probe Serial Number : PR289347 Technician : Jacob Galyon
 Date of Calibration : 12/6/2023

Instruments used during calibration			
Model Number:	2241-3	Serial Number:	267161
Calibration Due Date:	12/6/2024		
Model Number:		Serial Number:	
Calibration Due Date:			

NIST Traceable Source(s) used : Activity(s)

	Source S/N	Emission Rate	2 Pi (cpm)	uCi	4Pi (dpm)	Assay Date
1> C-14	DX 295	432	25,920	0.0305405	67,800	5/3/1994

Data

Instrument condition : Sat
 High Voltage: 1700

Background: 189

C-14 Count: 8373

2π Efficiency: 31.57%

4π Efficiency: 12.07%

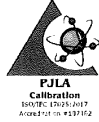
Calibration sticker attached? Yes

Comments : Married as a set with : Model : 2241-3 Serial # : 267161
 Calibrated with plastic standoffs attached.

Date Instrument is due for Next Calibration: 12/6/2024

Performed by: Jacob Galyon
 Printed Name: Jacob Galyon

Reviewed by: [Signature]
 Date Reviewed: 12/6/23



Safety and Ecology Corporation SEC PROCEDURE # SEC-IS-417 Rev 5
 10512 Lexington Drive, Suite 200, Knoxville, TN 37932

Calibration Certificate

Calibration Certificate for 43-37, Serial # PR148503, Bar Code # Purple, Property # Chase100

Date: 12/06/23 Date Last Cal. Expires: 11/07/23 Technician: Jacob Galyon Reason For Calibration: Due for Calibration
 Temp RelHum: BP: CableLength 10 Ft

EQUIPMENT USED DURING CALIBRATION MODEL: 2241-3 SERIAL #: 267161 CAL DUE 12/06/24

NIST TRACEABLE SOURCES USED	SOURCE	ISOPE	ACTIVITY	2π	ASSAY DATE
Efficiencies from last calibration	99PU470-0268	Pu-239	14196 dpm	7,188 cpm	1/30/2023
Pu-239: 19.64 %	4050-02	Tc-99	36799 dpm	22,999 cpm	1/30/2023
Tc-99: 25.01 %	4049-02	Th-230	30197 dpm	15,298 cpm	1/30/2023
Th-230: 19.10 %	4052-02	Sr-90	14194 dpm	9,898 cpm	1/30/2023
SrY-90: 38.72 %					

AS FOUND DATA

AS FOUND Instrument Condition: UNSA
 Calibration Setpoints

HV (Alpha): 1375 V HV (Beta): 1825 V Threshold: 4 mV

Back ground:	Alpha	CPM	Beta	CPM	AF 4 π Efficiencies
Pu-239:	2821	CPM	N/A		19.58%
Tc-99:	N/A		10321	CPM	25.60%
Th-230:	5985	CPM	N/A		19.68%
SrY-90:	N/A		6579	CPM	40.00%

AS LEFT Instrument Condition: SAT

AS LEFT DATA after repair, HV adjust or Plateau

HV (Alpha): 1250 V HV (Beta): 1825 V Threshold: 4 mV

Back ground:	Alpha	CPM	Beta	CPM	AL 4 π Efficiencies
Pu-239:	2428	CPM	N/A		17.07%
Tc-99:	N/A		10190	CPM	25.18%
Th-230:	5727	CPM	N/A		18.95%
SrY-90:	N/A		6398	CPM	38.57%

Is the As Found Data within 20% of the efficiency from the last cal.?

"AF" in the AL Efficiency fields means to refer to the AF Efficiencies in the AS FOUND DATA Section

Reproducibility : Isotope: Sr-90 6567 6470 6533 Average: 6523.3 Are the individual counts within 10% of the average?

If the As Found data (even after repair) is within 10% of the last calibration, then the technician may N/A Plateau Data and go directly to Comments. Geometry of source = flush to surface, except gas proportional probes = 1/8" from surface unless otherwise specified.

Alpha Source: Pu-239
 Response Background

HV (Alpha)	CPM A ch.	CPM B ch.	Net 4π Eff.
1100	456	3	3.19%
1150	2083	4	14.64%
1200	2263	5	15.91%
1250	2428	5	17.07%
1300	2622	9	18.41%
1350	2863	6	20.13%

PLATEAU DATA

Beta Source: Tc-99
 Response Background

HV (Beta)	CPM B ch.	CPM B ch.	Net 4π Eff.
N/A			

2 Pi Efficiencies: Pu-239 33.71% Tc-99 40.29% Th-230 37.40% SrY-90 55.31%

Comments: Married as a set with: Model: 2241-3 Serial #: 267161 Bar Code #: Purple

Replaced damaged mylar and screen.

Does Instrument Meet Final Acceptance Criteria? Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 12/06/24

All instrumentation is calibrated in accordance with the QAP to meet the criteria of ANSI N323AB-2013
 The results in this report relate only to the item calibrated or tested.

Performed by: Jacob Galyon
 Printed Name: Jacob Galyon

Reviewed by: [Signature] Issue Date: 12/16/23





Safety and Ecology Corporation

10512 Lexington Drive
 Suite 200
 Knoxville, TN 37932

C-14 SOURCE CALIBRATION FORM

Probe Model Number : 43-37 Customer Name : Chase Environmental
 Probe Serial Number : PR148503 Technician : Jacob Galyon
 Date of Calibration : 12/6/2023

Instruments used during calibration			
Model Number:	<u>2241-3</u>	Serial Number:	<u>267161</u> Calibration Due Date: <u>12/6/2024</u>
Model Number:		Serial Number:	

NIST Traceable Source(s) used : Activity(s)

	Source S/N	Emission Rate	2 Pi (cpm)	uCi	4Pi (dpm)	Assay Date
1 >	C-14 DX 295	432	25,920	0.0305405	67,800	5/3/1994

Data

Instrument condition : Sat
 High Voltage: 1825

Background: 923

C-14 Count: 9681

2π Efficiency: 33.79%

4π Efficiency: 12.92%

Calibration sticker attached? Yes

Comments : Married as a set with : Model : 2241-3 Serial # : 267161
 Calibrated with plastic standoffs attached.

Date Instrument is due for Next Calibration: 12/6/2024

Performed by: Jacob Galyon

Printed Name: Jacob Galyon

Reviewed by: [Signature]

Date Reviewed: 12/6/23



Safety and Ecology Corporation
 10512 Lexington Drive, Suite 200
 Knoxville, TN 37932
Calibration Certificate

Procedure # SEC-IS-422

Instrument Manufacturer:	Ludlum Instruments	Date:	11/2/2023
Model:	2241-3	Customer Name:	Chase Environmental
Serial Number:	337988	Technician:	Jacob Galyon
Bar Code Number:		Reason:	Due for Cal

Instrument Model:	500-2	Serial Number:	268940	Due Date:	7/3/2024
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Instrument Condition		Threshold		Battery Indicator																												
As Found	As Left	As Found	As Left	SAT																												
OK	OK	4.0	4.0	SAT																												
				SCA/RATE Switch																												
				SAT																												
Set Voltage		High Voltage Range		<table border="1"> <thead> <tr> <th colspan="3">Reproducibility</th> </tr> <tr> <th colspan="3">x.1 or x1 Scale</th> </tr> <tr> <td>250</td> <td>250</td> <td>250</td> </tr> <tr> <th colspan="3">x1 or x10 Scale</th> </tr> <tr> <td>2500</td> <td>2500</td> <td>2500</td> </tr> <tr> <th colspan="3">x10 or x100 Scale</th> </tr> <tr> <td>25K</td> <td>25K</td> <td>25K</td> </tr> <tr> <th colspan="3">x100 or x1000 Scale</th> </tr> <tr> <td>250K</td> <td>250K</td> <td>250K</td> </tr> </thead></table>		Reproducibility			x.1 or x1 Scale			250	250	250	x1 or x10 Scale			2500	2500	2500	x10 or x100 Scale			25K	25K	25K	x100 or x1000 Scale			250K	250K	250K
Reproducibility																																
x.1 or x1 Scale																																
250	250	250																														
x1 or x10 Scale																																
2500	2500	2500																														
x10 or x100 Scale																																
25K	25K	25K																														
x100 or x1000 Scale																																
250K	250K	250K																														
Detector #	As Found	As Left	As Found	As Left																												
1	1750	1750	SAT	SAT																												
2	1850	1850	SAT	SAT																												
3	1300	1300	SAT	SAT																												
4	1350	1350	SAT	SAT																												
Digital Scaler																																
Target	As Found	%Error	As Left	%Error																												
250	250	0.00%	250	0.00%																												
2,500	2,495	0.20%	2,495	0.20%																												
25,000	24,945	0.22%	24,945	0.22%																												
250,000	249,453	0.22%	249,453	0.22%																												

OK	Is the As Found Data within 20% of the set point?	OK	Audio Response
OK	Are the individual counts within 10% of the average?	OK	Push Buttons
OK	Fast / Slow response switch functions properly?	OK	RESET
OK	Does Instrument meet final Acceptance Criteria?	OK	Audio Switch
OK	Calibration sticker attached?	OK	Light

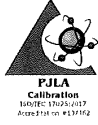
Married with:	1750V	DET 1	Model:	43-68	Serial Number:	PR140514
	1850V	DET 2	Model:	43-37	Serial Number:	PR216875
	1300V	DET 3	Model:	43-68	Serial Number:	PR140514
	1350V	DET 4	Model:	43-37	Serial Number:	PR216875

Comments/Remarks:
 5 foot cable used for the 43-68
 10 foot cable used for the 43-37
 Calibration done with N.I.S.T. traceable source(s) and/or calibrated test equipment.
 Calibration acceptance criteria +/- 10% of actual exposure or input rate.
 If 'As Found' readings are greater than +/- 20% then values are circled in red and customer is contacted.

Date Instrument is due for Next Calibration: 11/2/2024

Performed by: Jacob Galyon
 Printed Name: Jacob Galyon

Reviewed by: [Signature]
 Date Reviewed: 11/2/23



Safety and Ecology Corporation SEC PROCEDURE # SEC-IS-417 Rev 5
 10512 Lexington Drive, Suite 200, Knoxville, TN 37932

Calibration Certificate

Calibration Certificate for 43-68, Serial # PR140514, Bar Code # Brown, Property # Chase221

Date: 11/02/23 Date Last Cal. Expires: 04/28/22 Technician: Jacob Galyon Reason For Calibration: Due for Calibration
 Temp RelHum: BP: CableLength 5 Ft

EQUIPMENT USED DURING CALIBRATION MODEL: 2241-3 SERIAL #: 337988 CAL DUE 11/02/24

NIST TRACEABLE SOURCES USED	SOURCE	ISOTOPE	ACTIVITY	2π	ASSAY DATE
Efficiencies from last calibration	99PU470-0268	Pu-239	14196 dpm	7,188 cpm	1/30/2023
Pu-239: 18.71 %	4050-02	Tc-99	36799 dpm	22,999 cpm	1/30/2023
Tc-99: 23.80 %	4049-02	Th-230	30197 dpm	15,298 cpm	1/30/2023
Th-230: 17.05 %	4052-02	Sr-90	14194 dpm	9,898 cpm	1/30/2023
SrY-90: 38.64 %					

AS FOUND DATA

AS FOUND Instrument Condition: SAT
 Calibration Setpoints

HV (Alpha): 1300 V HV (Beta): 1750 V Threshold: 4 mV

Back ground:	Alpha	Beta	AF 4 π Efficiencies
9 CPM	304 CPM	304 CPM	18.46%
Pu-239: 2629 CPM	N/A	9390 CPM	24.69%
Tc-99: N/A	N/A	N/A	18.36%
Th-230: 5554 CPM	N/A	5865 CPM	39.18%
SrY-90: N/A	N/A		

Is the As Found Data within 20% of the efficiency from the last cal.?

AS LEFT Instrument Condition: SAT

AS LEFT DATA after repair, HV adjust or Plateau

HV (Alpha): 1300 V HV (Beta): 1750 V Threshold: 4 mV

Back ground:	Alpha	Beta	AL 4 π Efficiencies
9 CPM	304 CPM	304 CPM	18.46%
Pu-239: 2629 CPM	N/A	9390 CPM	24.69%
Tc-99: N/A	N/A	N/A	18.36%
Th-230: 5554 CPM	N/A	5865 CPM	39.18%
SrY-90: N/A	N/A		

"AF" in the AL Efficiency fields means to refer to the AF Efficiencies in the AS FOUND DATA Section

Reproducibility : Isotope: Sr-90 5882 5970 5760 Average: 5870.7 Are the individual counts within 10% of the average?

If the As Found data (even after repair) is within 10% of the last calibration, then the technician may N/A Plateau Data and go directly to Comments. Geometry of source = flush to surface, except gas proportional probes = 1/8" from surface unless otherwise specified.

Alpha Source: Th-230

PLATEAU DATA

Beta Source: Tc-99

HV (Alpha)	Response	Background	Net 4π Eff.
CPM	CPM	CPM	
A ch.	A ch.		
N/A			

HV (Beta)	Response	Background	Net 4π Eff.
CPM	CPM	CPM	
B ch.	B ch.	B ch.	
N/A			

2 Pi Efficiencies: Pu-239 36.45% Tc-99 39.51% Th-230 36.25% SrY-90 56.18%

Comments: Married as a set with: Model: 2241-3 Serial #: 337988 Bar Code #: Brown

Does Instrument Meet Final Acceptance Criteria? Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 11/02/24

All instrumentation is calibrated in accordance with the QAP to meet the criteria of ANSI N323AB-2013
 The results in this report relate only to the item calibrated or tested.

Performed by:
 Printed Name: Jacob Galyon

Reviewed by:
 Issue Date: 11/2/23





Safety and Ecology Corporation

10512 Lexington Drive
 Suite 200
 Knoxville, TN 37932

C-14 SOURCE CALIBRATION FORM

Probe Model Number : 43-68 Customer Name : Chase Environmental
 Probe Serial Number : PR140514 Technician : Jacob Galyon
 Date of Calibration : 11/2/2023

Instruments used during calibration			
Model Number:	2241-3	Serial Number:	337988
Calibration Due Date:	11/2/2024		
Model Number:		Serial Number:	
Calibration Due Date:			

NIST Traceable Source(s) used : Activity(s)

	Source S/N	Emission Rate	2 Pi (cpm)	uCi	4Pi (dpm)	Assay Date
1 > C-14	DX 295	432	25,920	0.0305405	67,800	5/3/1994

Data

Instrument condition : Sat
 High Voltage: 1750

Background: 304

C-14 Count: 7856

2π Efficiency: 29.14%

4π Efficiency: 11.14%

Calibration sticker attached? Yes

Comments : Married as a set with : Model : 2241-3 Serial # : 337988
 Calibrated with plastic standoffs attached.

Date Instrument is due for Next Calibration: 11/2/2024

Performed by: Jacob Galyon
 Printed Name: Jacob Galyon

Reviewed by: [Signature]
 Date Reviewed: 11/2/23



Safety and Ecology Corporation SEC PROCEDURE # SEC-IS-417 Rev 5
 10512 Lexington Drive, Suite 200, Knoxville, TN 37932

Calibration Certificate

Calibration Certificate for 43-37, Serial # PR216875, Bar Code # Brown, Property # Chase220

Date: 11/02/23 Date Last Cal. Expires: 04/28/22 Technician: Jacob Galyon Reason For Calibration: Due for Calibration
 Temp RelHum: BP: CableLength 10 Ft

EQUIPMENT USED DURING CALIBRATION MODEL: 2241-3 SERIAL #: 337988 CAL DUE 11/02/24

NIST TRACEABLE SOURCES USED	SOURCE	ISOTOPE	ACTIVITY	2π	ASSAY DATE
Efficiencies from last calibration	99PU470-0268	Pu-239	14196 dpm	7,188 cpm	1/30/2023
Pu-239: 19.58 %	4050-02	Tc-99	36799 dpm	22,999 cpm	1/30/2023
Tc-99: 25.16 %	4049-02	Th-230	30197 dpm	15,298 cpm	1/30/2023
Th-230: 17.73 %	4052-02	Sr-90	14194 dpm	9,898 cpm	1/30/2023
SrY-90: 39.61 %					

AS FOUND DATA

AS FOUND Instrument Condition: SAT
 Calibration Setpoints

HV (Alpha): 1350 V HV (Beta): 1850 V Threshold: 4 mV

Back ground:	Alpha	Beta	AF 4 π Efficiencies
6 CPM	967 CPM	N/A	19.35%
Pu-239: 2753 CPM	N/A	10051 CPM	24.69%
Tc-99: N/A	N/A	N/A	19.13%
Th-230: 5782 CPM	N/A	6494 CPM	38.94%
SrY-90: N/A			

AS LEFT Instrument Condition: SAT

AS LEFT DATA after repair, HV adjust or Plateau

HV (Alpha): 1350 V HV (Beta): 1850 V Threshold: 4 mV

Back ground:	Alpha	Beta	AL 4 π Efficiencies
6 CPM	967 CPM	N/A	19.35%
Pu-239: 2753 CPM	N/A	10051 CPM	24.69%
Tc-99: N/A	N/A	N/A	19.13%
Th-230: 5782 CPM	N/A	6494 CPM	38.94%
SrY-90: N/A			

Is the As Found Data within 20% of the efficiency from the last cal.?

"AF" in the AL Efficiency fields means to refer to the AF Efficiencies in the AS FOUND DATA Section

Reproducibility : Isotope: Sr-90 6582 6551 6502 Average: 6545.0 Are the individual counts within 10% of the average?

If the As Found data (even after repair) is within 10% of the last calibration, then the technician may N/A Plateau Data and go directly to Comments. Geometry of source = flush to surface, except gas proportional probes = 1/8" from surface unless otherwise specified.

Alpha Source: Th-230

PLATEAU DATA

Beta Source: Tc-99

HV (Alpha)	Response	Background	Net 4π Eff.
CPM	CPM	CPM	
A ch.	A ch.	B ch.	
N/A			

HV (Beta)	Response	Background	Net 4π Eff.
CPM	CPM	CPM	
B ch.	B ch.	B ch.	
N/A			

2 Pi Efficiencies: Pu-239 38.22% Tc-99 39.50% Th-230 37.76% SrY-90 55.84%

Comments: Married as a set with: Model: 2241-3 Serial #: 337988 Bar Code #: Brown

Does Instrument Meet Final Acceptance Criteria? Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 11/02/24

All instrumentation is calibrated in accordance with the QAP to meet the criteria of ANSI N323AB-2013
 The results in this report relate only to the item calibrated or tested.

Performed by: Jacob Galyon
 Printed Name: Jacob Galyon

Reviewed by: [Signature] Issue Date: 11/21/23





Safety and Ecology Corporation

10512 Lexington Drive
 Suite 200
 Knoxville, TN 37932

C-14 SOURCE CALIBRATION FORM

Probe Model Number : 43-37 Customer Name : Chase Environmental
 Probe Serial Number : PR216875 Technician : Jacob Galyon
 Date of Calibration : 11/2/2023

Instruments used during calibration			
Model Number:	2241-3	Serial Number:	337988
Calibration Due Date:	11/2/2024		
Model Number:		Serial Number:	
Calibration Due Date:			

NIST Traceable Source(s) used : Activity(s)

	Source S/N	Emission Rate	2 Pi (cpm)	uCi	4Pi (dpm)	Assay Date
1 > C-14	DX 295	432	25,920	0.0305405	67,800	5/3/1994

Data

Instrument condition : Sat
 High Voltage: 1850

Background: 967

C-14 Count: 9613

2π Efficiency: 33.36%

4π Efficiency: 12.75%

Calibration sticker attached? Yes

Comments : Married as a set with : Model : 2241-3 Serial # : 337988
 Calibrated with plastic standoffs attached.

Date Instrument is due for Next Calibration: 11/2/2024

Performed by: Jacob Galyon
 Printed Name: Jacob Galyon

Reviewed by: [Signature]
 Date Reviewed: 11/2/23

SEC INSTRUMENTATION SERVICES

10512 Lexington Drive
 Suite 200
 Knoxville, TN 37932

Perma-Fix Environmental Services, Inc.
 1093 Commerce Park Dr., Suite 300
 Oak Ridge, TN 37830



Model 2241-3 CALIBRATION FORM

Serial number :	238400	Customer Name :	Chase
Previous due date :	8/23/2023	P.O Number :	
Date :	9/6/2023	Technician :	Carl Hall
Reason For Calibration : Due for Calibration			

INSTRUMENT(S) USED DURING CALIBRATION		
Model Number:	500-2	Serial Number: 132896 Calibration Due date: 7/3/2024
Model Number:		Serial Number: Calibration Due date:

Instrument Condition	
As Found	As Left
SAT	SAT

Threshold	
As Found	As Left
4.0	4.0

Battery Indicator
SAT

SCA/RATE Switch
SAT

Detector #	Set Voltage		High Voltage Range	
	As Found	As Left	As Found	As Left
1	1747	1750	SAT	SAT
2	1873	1875	SAT	SAT
3	1396	1300	SAT	SAT
4	1395	1400	SAT	SAT

Reproducibility		
x.1 or x1 Scale		
250	250	250
x1 or x10 Scale		
2500	2500	2500
x10 or x100 Scale		
25K	25K	25K
x100 or x1000 Scale		
250K	250K	250K

Digital Scaler				
Target	As Found	%Error	As Left	%Error
250	250	0.00%	250	0.00%
2,500	2,498	0.08%	2,498	0.08%
25,000	24,983	0.07%	24,983	0.07%
250,000	249,834	0.07%	249,834	0.07%

- | | |
|--|--|
| <input type="checkbox"/> OK Is the As Found Data within 20% of the set point? | <input type="checkbox"/> OK Audio Response |
| <input type="checkbox"/> OK Are the individual counts within 10% of the average? | <input type="checkbox"/> OK Push Buttons |
| <input type="checkbox"/> OK Fast / Slow response switch functions properly? | <input type="checkbox"/> OK RESET |
| <input type="checkbox"/> OK Does Instrument meet final Acceptance Criteria? | <input type="checkbox"/> OK Audio Switch |
| <input type="checkbox"/> OK Calibration sticker attached? | <input type="checkbox"/> OK Light |

Married with:	1750V DET 1	Model:	43-68	Serial Number:	PR148820
	1875V DET 2	Model:	43-37	Serial Number:	PR147972
	1300V DET 3	Model:	43-68	Serial Number:	PR148820
Comments :	1400V DET 4	Model:	43-37	Serial Number:	PR147972

Instrument calibrated per SEC-IS-423.
 5 foot cable used for the 43-68
 10 foot cable used for the 43-37

Date instrument is due for next calibration : **9/6/2024**
 Performed by : Carl Hall Date: 9/6/23 Reviewed by: Janell S. [Signature] Date: 09/06/23
 Printed name : Carl Hall



Safety and Ecology Corporation SEC PROCEDURE # SEC-IS-417 Rev 5
 10512 Lexington Drive, Suite 200, Knoxville, TN 37932

Calibration Certificate

Calibration Certificate for 43-68, Serial # PR148820, Bar Code # Black, Property # Chase96

Date: 09/06/23 Date Last Cal. Expires: 08/23/23 Technician: Carl Hall Reason For Calibration: Due for Calibration
 Temp RelHum: BP: CableLength 5 Ft

EQUIPMENT USED DURING CALIBRATION MODEL: 2241-3 SERIAL #: 238400 CAL DUE 09/06/24

NIST TRACEABLE SOURCES USED	SOURCE	ISOTOPE	ACTIVITY	2π	ASSAY DATE
Efficiencies from last calibration					
Pu-239: 18.72 %	4079-02	Pu-239	28990 dpm	14,695 cpm	1/30/2023
Tc-99: 25.50 %	4072-02	Tc-99	28299 dpm	17,699 cpm	1/30/2023
Th-230: 19.62 %	4071-02	Th-230	40296 dpm	20,498 cpm	1/30/2023
SrY-90: 40.44 %	4076-02	Sr-90	9085 dpm	6,375 cpm	1/30/2023

AS FOUND DATA AS FOUND Instrument Condition: SAT
 Calibration Setpoints

HV (Alpha): 1400 V HV (Beta): 1750 V Threshold: 4 mV

Back ground:	Alpha	Beta	AF 4 π Efficiencies
13 CPM	305 CPM	N/A	20.34%
Pu-239: 5911 CPM	N/A	7406 CPM	25.09%
Tc-99: N/A	N/A	N/A	18.58%
Th-230: 7498 CPM	N/A	3809 CPM	38.57%
SrY-90: N/A	N/A	N/A	

AS LEFT DATA after repair, HV adjust or Plateau
 AS LEFT Instrument Condition: SAT

HV (Alpha): 1300 V HV (Beta): 1750 V Threshold: 4 mV

Back ground:	Alpha	Beta	AL 4 π Efficiencies
1 CPM	198 CPM	N/A	19.98%
Pu-239: 5794 CPM	N/A	7259 CPM	24.95%
Tc-99: N/A	N/A	N/A	18.15%
Th-230: 7316 CPM	N/A	3697 CPM	38.51%
SrY-90: N/A	N/A	N/A	

Is the As Found Data within 20% of the efficiency from the last cal.?

"AF" in the AL Efficiency fields means to refer to the AF Efficiencies in the AS FOUND DATA Section

Reproducibility : Isotope: Sr-90 3641 3652 3724 Average: 3672.3 Are the individual counts within 10% of the average?

If the As Found data (even after repair) is within 10% of the last calibration, then the technician may N/A Plateau Data and go directly to Comments. Geometry of source = flush to surface, except gas proportional probes = 1/8" from surface unless otherwise specified.

Alpha Source: Th-230

HV (Alpha)	Response		Net 4π Eff.
	CPM A ch.	CPM B ch.	
N/A			

PLATEAU DATA

Beta Source: Tc-99

HV (Beta)	Response		Net 4π Eff.
	CPM B ch.	CPM B ch.	
N/A			

2 Pi Efficiencies:

Pu-239	Tc-99	Th-230	SrY-90
39.42%	39.89%	35.69%	54.89%

Comments: Married as a set with: Model: 2241-3 Serial #: 238400 Bar Code #: Black

Does Instrument Meet Final Acceptance Criteria? Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 09/06/24

All instrumentation is calibrated in accordance with the QAP to meet the criteria of ANSI N323AB-2013
 The results in this report relate only to the item calibrated or tested.

Performed by:
 Printed Name: Carl Hall

Reviewed by: Issue Date: 09/06/23





SEC INSTRUMENTATION SERVICES

10512 Lexington Drive
Suite 200
Knoxville, TN 37932

C-14 SOURCE CALIBRATION FORM

Probe Model Number : 43-68 Customer Name : Chase Environmental
Probe Serial Number : PR148820 Technician : Carl Hall
Date of Calibration : 9/6/2023

Instruments used during calibration			
Model Number:	<u>2241-3</u>	Serial Number:	<u>238400</u> Calibration Due Date: <u>9/6/2024</u>
Model Number:		Serial Number:	
		Calibration Due Date:	

NIST Traceable Source(s) used : Activity(s)

	Source S/N	Emission Rate	2 Pi (cpm)	uCi	4Pi (dpm)	Assay Date
1 >	C-14	<u>DX 295</u>	<u>432</u>	<u>25,920</u>	<u>0.0305405</u>	<u>67,800</u> <u>5/3/1994</u>

Data

Instrument condition : Sat
High Voltage: 1750

Background: 198

C-14 Count: 8063

2 π Efficiency: 30.34%

4 π Efficiency: 11.60%

Calibration sticker attached? Yes

Comments : Married as a set with : Model : 2241-3 Serial # : 238400
Calibrated with plastic standoffs attached.

Date instrument is due for next calibration : 9/6/2024

Performed by :  Reviewed by :  Date : 09/06/23
Printed Name : Carl Hall



Safety and Ecology Corporation SEC PROCEDURE # SEC-IS-417 Rev 5
 10512 Lexington Drive, Suite 200, Knoxville, TN 37932

Calibration Certificate

Calibration Certificate for 43-37, Serial # PR147972, Bar Code # Black, Property # Chase97

Date: 09/06/23 Date Last Cal. Expires: 08/23/23 Technician: Carl Hall Reason For Calibration: Due and Repair
 Temp RelHum: BP: CableLength 10 Ft

EQUIPMENT USED DURING CALIBRATION MODEL: 2241-3 SERIAL #: 238400 CAL DUE 09/06/24

NIST TRACEABLE SOURCES USED	SOURCE	ISOTOPE	ACTIVITY	2π	ASSAY DATE
Efficiencies from last calibration	4079-02	Pu-239	28990 dpm	14,695 cpm	1/30/2023
Pu-239: 19.01 %	4072-02	Tc-99	28299 dpm	17,699 cpm	1/30/2023
Tc-99: 24.47 %	4071-02	Th-230	40296 dpm	20,498 cpm	1/30/2023
Th-230: 18.49 %	4076-02	Sr-90	9085 dpm	6,375 cpm	1/30/2023
SrY-90: 38.49 %					

AS FOUND DATA

AS FOUND Instrument Condition: SAT
 Calibration Setpoints

HV (Alpha): 1400 V HV (Beta): 1875 V Threshold: 4 mV

Back ground:	Alpha	CPM	Beta	CPM	AF 4 π Efficiencies
Pu-239:	6123	CPM	N/A		21.12%
Tc-99:	N/A		8368	CPM	26.64%
Th-230:	8213	CPM	N/A		20.38%
SrY-90:	N/A		4304	CPM	38.25%

AS LEFT Instrument Condition: SAT

AS LEFT DATA after repair, HV adjust or Plateau

HV (Alpha): 1400 V HV (Beta): 1875 V Threshold: 4 mV

Back ground:	Alpha	CPM	Beta	CPM	AL 4 π Efficiencies
Pu-239:	6123	CPM	N/A		21.12%
Tc-99:	N/A		8368	CPM	26.64%
Th-230:	8213	CPM	N/A		20.38%
SrY-90:	N/A		4304	CPM	38.25%

Is the As Found Data within 20% of the efficiency from the last cal.?

"AF" in the AL Efficiency fields means to refer to the AF Efficiencies in the AS FOUND DATA Section

Reproducibility : Isotope: Sr-90 4325 4371 4268 Average: 4321.3 Are the individual counts within 10% of the average?

If the As Found data (even after repair) is within 10% of the last calibration, then the technician may N/A Plateau Data and go directly to Comments. Geometry of source = flush to surface, except gas proportional probes = 1/8" from surface unless otherwise specified.

Alpha Source: Th-230

PLATEAU DATA

Beta Source: Tc-99

HV (Alpha)	CPM A ch.	CPM B ch.	Net 4π Eff.
N/A			

HV (Beta)	CPM B ch.	CPM B ch.	Net 4π Eff.
N/A			

2 Pi Efficiencies: Pu-239 41.66% Tc-99 42.60% Th-230 40.06% SrY-90 54.51%

Comments: Married as a set with: Model: 2241-3 Serial #: 238400 Bar Code #: Black

Does Instrument Meet Final Acceptance Criteria? Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 09/06/24

All instrumentation is calibrated in accordance with the QAP to meet the criteria of ANSI N323AB-2013
 The results in this report relate only to the item calibrated or tested.

Performed by:
 Printed Name: Carl Hall

Reviewed by:
 Issue Date: 09/06/23





SEC INSTRUMENTATION SERVICES

10512 Lexington Drive
Suite 200
Knoxville, TN 37932

C-14 SOURCE CALIBRATION FORM

Probe Model Number : 43-37 Customer Name : Chase Environmental
Probe Serial Number : PR147972 Technician : Carl Hall
Date of Calibration : 9/6/2023

Instruments used during calibration					
Model Number:	<u>2241-3</u>	Serial Number:	<u>238400</u>	Calibration Due Date:	<u>9/6/2024</u>
Model Number:		Serial Number:		Calibration Due Date:	

NIST Traceable Source(s) used : Activity(s)

	Source S/N	Emission Rate	2 Pi (cpm)	uCi	4Pi (dpm)	Assay Date
1 >	C-14 DX 295	432	25,920	0.0305405	67,800	5/3/1994

Data

Instrument condition : Sat
High Voltage: 1875

Background: 829

C-14 Count: 9705

2π Efficiency: 34.24%

4π Efficiency: 13.09%

Calibration sticker attached? Yes

Comments : Married as a set with : Model : 2241-3 Serial # : 238400
Calibrated with plastic standoffs attached.

Date instrument is due for next calibration : 9/6/2024
Performed by : [Signature] Reviewed by : [Signature] Date : 01/06/23
Printed Name : Carl Hall
Entered in computer inventory by : [Signature] Date : _____

[Signature]



Safety and Ecology Corporation SEC PROCEDURE # SEC-IS-406 Rev 3
 10512 Lexington Drive, Suite 200, Knoxville, TN 37932

Calibration Certificate

Calibration Certificate for 2929, Serial # 160013, Bar Code # ,Property # Chase44

Date: 10/06/23 Date Last Cal. Expires: 09/27/23 Technician: Jacob Galyon
 Temp RelHum: BP: Reason For Calibration: Due for Calibration

NIST EQUIPMENT USED DURING CALIBRATION

MODEL: 500-2 SERIAL #: 209797 CAL DUE: 07/03/24
 MODEL: SERIAL #: CAL DUE:

AS FOUND DATA

AS FOUND Instrument Condition: SAT AS LEFT Instrument Condition: SAT
 AS FOUND Mechanical Zero: 0 AS LEFT Mechanical Zero: 0

Scaler Function Check	AS FOUND	AS LEFT
Beta Channel Window (4-50 mV):	4-47.2 mV	4-50 mV
Alpha Channel Threshold (175 mV):	164 mV	175 mV
Alpha Counts w/Pulsar @ 10,000 CPM:	9,997 CPM	AF CPM % Error: 0.03%
Beta Counts w/Pulsar @ 10,000 CPM:	9,997 CPM	AF CPM % Error: 0.03%

If AS FOUND data in Scaler Function Check is within 10%, the technician may place AF in AS LEFT section and proceed to High Voltage power supply section.

HIGH VOLTAGE POWER SUPPLY CALIBRATION	AS FOUND	AS LEFT
Vernier Setting:	3.42	AF
HV Setpoints:	850 V	AF V
500 V Reading:	500 V	AF V
1000 V Reading:	1000 V	AF V
1500 V Reading:	1500 V	AF V
Max HV (1500 V +):		

DIGITAL SCALER	AF	% ERR	AL	% ERR
AF 250: 250	250	0.00%	AL 250: AF	0.00%
AF 2500: 2497	2497	0.12%	AL 2500: AF	0.12%
AF 25K: 24.98 K	24.98 K	0.08%	AL 25K: AF K	0.08%
AF 250K: 249.7 K	249.7 K	0.12%	AL 250K: AF K	0.12%

Is the As Found Data Within 20% of the Set Point?

Comments: Married as a set with: Model: 43-10-1 Serial #: PR167231 Bar Code #:

Does Instrument Meet Final Acceptance Criteria? Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 10/06/24

Performed by: Jacob Galyon Reviewed by: [Signature] Issue Date: 10/6/23
 Printed Name: Jacob Galyon

All instrumentation is calibrated in accordance with the QAP to meet the criteria of ANSI N323AB-2013
 The results in this report relate only to the item calibrated or tested.





Safety and Ecology Corporation SEC PROCEDURE # SEC-IS-414 Rev 4
 10512 Lexington Drive, Suite 200, Knoxville, TN 37932
Calibration Certificate

Calibration Certificate for 43-10-1, Serial # PR167231, Bar Code #, Property # Chase45

Date: 10/06/23 Date Last Cal. Expires: 09/27/23 Technician: Jacob Galyon
 Temp RelHum: BP: CableLength 3 Ft Reason For Calibration: Due for Calibration

NIST EQUIPMENT USED DURING CALIBRATION MODEL: 2929 SERIAL #: 160013 CAL DUE: 10/06/24

NIST TRACEABLE SOURCES USED		SOURCE	ISOTOPE	ACTIVITY	2π	ASSAY DATE
Efficiencies from last calibration		99PU470-0268	Pu-239	14196 dpm	7,188 cpm	1/30/2023
Pu-239:	36.16 %	4050-02	Tc-99	36799 dpm	22,999 cpm	1/30/2023
Tc-99:	22.73 %	4049-02	Th-230	30197 dpm	15,298 cpm	1/30/2023
Th-230:	35.3 %	4052-02	Sr-90	14194 dpm	9,898 cpm	1/30/2023
SrY-90:	39.58 %					

AS FOUND DATA AS FOUND Instrument Condition: SAT

HV: Calibration Setpoints Threshold
 850 V Vernier: 3.42 Beta: 4 - 50 mV
 Alpha: 175 mV

Back ground:	Alpha		Beta		AF Efficiencies	
	CPM	CPM	CPM	CPM	A-B XTLK	B-A XTLK
Pu-239:	4944	CPM	165	CPM	34.81%	2.3%
Tc-99:	1	CPM	8563	CPM	23.14%	
Th-230:	10559	CPM	N/A		34.96%	0.0%
SrY-90:	N/A		6058	CPM	42.33%	

AS LEFT Instrument Condition: SAT

AS LEFT DATA after repair, HV adjust, or Plateau
 HV: 850 V Vernier: 3.42

Back ground:	Alpha		Beta		AL Efficiencies	
	CPM	CPM	CPM	CPM	A-B XTLK	B-A XTLK
Pu-239:	4944	CPM	165	CPM	34.81%	2.3%
Tc-99:	1	CPM	8563	CPM	23.14%	
Th-230:	10559	CPM	N/A		34.96%	0.0%
SrY-90:	N/A		6058	CPM	42.33%	

Is the As Found Data Within 20% of the efficiency from the last cal.?

"AF" in the AL Efficiency fields means to refer to the AF Efficiencies in the AS FOUND DATA Section

Reproducibility: Isotope: 6007 5986 6020 Average: 6004.3 Are the individual counts within 10% of the average?

If the As Found data (even after repair) is within 10% of the last calibration and the B-A Xtalk is <1% and the A-B Xtalk is <10%, then the technician may N/A the Plateau Data and go directly to Comments. Geometry = NaI probes are 4 1/2" from source. All other probes are in contact with surface unless otherwise specified.

PLATEAU DATA

High Voltage	Source 1: Tc-99			Source 2: Th-230			Background (CPM)		Net A to B	Net B to A
	Response (CPM)			Response (CPM)					Xtalk: <10%	Xtalk: <1%
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.		
N/A									N/A	N/A
									N/A	N/A
									N/A	N/A
									N/A	N/A
									N/A	N/A

2 Pi Efficiencies: Pu-239: 68.74% Tc-99: 37.02% Th-230: 69.00% SrY-90: 60.71%

Comments: Married as a set with: Model: 2929 Serial #: 160013 Bar Code #:

Does Instrument Meet Final Acceptance Criteria? Calibration Sticker Attached?

Date Instrument is Due For Next Calibration:

All instrumentation is calibrated in accordance with the QAP to meet the criteria of ANSI N323AB-2013

Performed by: Jacob Galyon
 Printed Name: Jacob Galyon

Reviewed by: [Signature] Issue Date: 10/6/23





SEC INSTRUMENTATION SERVICES

10512 Lexington Drive
Suite 200
Knoxville, TN 37932

C-14 SOURCE CALIBRATION FORM

Probe Model Number : 43-10-1 Customer Name : Chase Environmental
Probe Serial Number : PR167231 Technician : Jacob Galyon
Date of Calibration : 10/6/2023

Instruments used during calibration					
Model Number:	<u>2929</u>	Serial Number:	<u>160013</u> Calibration Due Date: <u>10/6/2024</u>		
Model Number:		Serial Number:		Calibration Due Date:	

NIST Traceable Source(s) used : Activity(s)

	Source S/N	2 Pi (cpm)	4Pi (dpm)	Assay Date
1> C-14	<u>77173-513</u>	<u>19,066</u>	<u>30,546</u>	<u>1/30/2023</u>

Data

Instrument condition : Sat
High Voltage: 850

Background: 49

C-14 Count: 3543

2π Efficiency: 18.33%

4π Efficiency: 11.44%

Calibration sticker attached? Yes

Comments : Married as a set with : Model : 2929 Serial # : 160013

Date instrument is due for next calibration : 10/6/2024

Performed by : Jacob Galyon
Printed Name : Jacob Galyon

Reviewed by : [Signature] Date : 10/16/23



Safety and Ecology Corporation
 10512 Lexington Drive, Suite 200
 Knoxville, TN 37932
Calibration Certificate

Procedure # SEC-IS-425

Instrument Manufacturer:	Ludlum Instruments	Date:	2/20/2023
Meter Model:	2241-3	Customer Name:	Chase
Meter Serial Number:	181301	Technician:	Jacob Galyon
Bar Code Number:		Reason:	Due for Cal

M&TE Used			
Instrument Model Number :	500-2	Serial Number:	209797
		Cal Due:	6/13/2023

Calibration Data											
As Found Instrument Condition					As Left Instrument Condition						
SAT					SAT						
Meter											
Probe Settings											
Probe 1											
Model Number:					44-9						
Serial Number:					PR171793						
Threshold		HV Check 400V - 1500V			Pass		Model Number:		43-5		
AF	AL						Serial Number:		PR089621		
35mV	35mV						HV		As Found		
Digital Scaler						HV		As Found		As Left	
Target	As Found	%Error	As Left	%Error	900V		HV		900V		
250	250	0.00%	250	0.00%	0uSec		Dead Time		0uSec		
2,500	2,497	0.12%	2,497	0.12%	1.00E+00		CC		1.00E+00		
25,000	24,972	0.11%	24,972	0.11%	Probe Settings						
250,000	249,558	0.18%	249,558	0.18%	Probe 2						
Rate Meter											
As Found					As Found						
100	100	0.00%	100	0.00%	Model Number:		44-38				
250	250	0.00%	250	0.00%	Serial Number:		PR192339				
400	400	0.00%	400	0.00%	HV		As Found		As Left		
1,000	1,000	0.00%	1,000	0.00%	900V		HV		900V		
2,500	2,500	0.00%	2,500	0.00%	0uSec		Dead Time		113uSec		
4,000	4,000	0.00%	4,000	0.00%	1.00E+00		CC		7.45E+07		
10,000	10,000	0.00%	10000	0.00%	Probe Settings						
25,000	25,000	0.00%	25000	0.00%	Probe 3						
40,000	40,000	0.00%	40000	0.00%	Model Number:		N/A				
100,000	100,000	0.00%	100000	0.00%	Serial Number:		N/A				
250,000	250,000	0.00%	250000	0.00%	HV		As Found		As Left		
400,000	400,000	0.00%	400000	0.00%	900V		HV		900V		
					0uSec		Dead Time		90uSec		
					1.00E+00		CC		2.80E+08		
					Alarm						
					Lamp						
					Response						
					Reproducible						
					Sticker Attached						

Comments/Remarks:
 Calibration done with N.I.S.T. traceable source(s) and/or calibrated test equipment.
 Calibration acceptance criteria +/- 10% of actual exposure rate.
 If 'As Found' readings are greater than +/- 20% then values are circled in red and customer is contacted.

Date Instruments are due for Next Calibration: **2/20/2024**

Performed by: Jacob Galyon
 Printed Name: Jacob Galyon

Reviewed by: [Signature]
 Date Reviewed: 2/20/23



Safety and Ecology Corporation SEC PROCEDURE # SEC-IS-407 Rev 3
 10512 Lexington Drive, Suite 200, Knoxville, TN 37932
Calibration Certificate

Calibration Certificate for 44-9, Serial # PR171793, Bar Code # ,Property # Chase7

Date: 02/20/23 Date Last Cal. Expires: 02/25/23 Technician: Jacob Galyon Reason For Calibration: Due for Calibration
 Temp: RelHum: BP: CableLength 5 Ft

NIST EQUIPMENT USED DURING CALIBRATION

MODEL: 2241-3 SERIAL # 181301 CAL DUE: 02/20/24
 MODEL: SERIAL # CAL DUE:

NIST TRACEABLE SOURCES USED

SOURCE	ISOTOPE	ACTIVITY	2π	ASSAY DATE
4050-02	Tc-99	36799 dpm	22,999 cpm	1/30/2023
4052-02	Sr-90	14194 dpm	9,898 cpm	1/30/2023

Geometry = in contact with surface unless otherwise specified.

PREVIOUS Tc-99 EFFICIENCY: 14.88 % Calibration Voltage: 900 V Calibration Threshold: 35 mV

AS FOUND Instrument Condition: SAT

AS LEFT Instrument Condition: SAT

AS FOUND DATA

1 MINUTE COUNTS (CPM)

AF Background: 69
 Tc-99 Count: 5873 5871 5695 AVERAGE 5813.0
 Sr-90 Count: 4748

4 π Efficiencies

Tc-99 EFF: 15.61% Sr-90 EFF: 32.98%

AS LEFT DATA

1 MINUTE COUNTS (CPM)

AL Background: 38
 Tc-99 Count: 5165 5199 5039 AVERAGE 5134.3
 Sr-90 Count: 4037

4 π Efficiencies

Tc-99 EFF: 13.85% Sr-90 EFF: 28.17%

"AF" in the AL Efficiency fields means to refer to the AF Efficiencies in the AS FOUND DATA Section

- Is the AS FOUND efficiency within 20% of efficiency from last calibration?
- Reproducibility: Are the individual counts within 10% of the average?
- Does the probe meet final acceptance criteria?
- Calibration sticker attached?

Comments: Married as a set with: Model: 2241-3 Serial #: 181301 Bar Code #:

Replaced GM tube to lower background readings.

Date Instrument is Due For Next Calibration: 02/20/24

Performed by: Jacob Galyon

Reviewed by: [Signature] Issue Date: 2/20/23

Printed Name: Jacob Galyon

All instrumentation is calibrated in accordance with the QAP to meet the criteria of ANSI N323AB-2013
 The results in this report relate only to the item calibrated or tested.





SEC INSTRUMENTATION SERVICES

10512 Lexington Drive
 Suite 200
 Knoxville, TN 37932

C-14 SOURCE CALIBRATION FORM

Probe Model Number : 44-9 Customer Name : Chase Environmental
 Probe Serial Number : PR171793 Technician : Jacob Galyon
 Date of Calibration : 2/20/2023

Instruments used during calibration			
Model Number:	<u>2241-3</u>	Serial Number:	<u>181301</u> Calibration Due Date: <u>2/20/2024</u>
Model Number:		Serial Number:	

	NIST Traceable Source(s) used :		Activity(s)		
	Source S/N		2 Pi (cpm)	4Pi (dpm)	Assay Date
1> C-14	<u>77173-513</u>		<u>19,066</u>	<u>30,546</u>	<u>1/30/2023</u>

Data

Instrument condition : Sat
 High Voltage: 900

Background: 38

C-14 Count: 2581

2π Efficiency: 13.34%

4π Efficiency: 8.33%

Calibration sticker attached? Yes

Comments : Married as a set with : Model : 2241-3 Serial # : 181301

Date instrument is due for next calibration : 2/20/2024

Performed by : Jacob Galyon
 Printed Name : Jacob Galyon

Reviewed by : [Signature] Date : 2/20/23



Safety and Ecology Corporation SEC PROCEDURE # SEC-IS-408 Rev 4
 10512 Lexington Drive, Suite 200, Knoxville, TN 37932
Calibration Certificate

Calibration Certificate for 43-5, Serial # PR089621, Bar Code # ,Property # Chase8

Date: 02/20/23 Date Last Cal. Expires: 02/25/23 Technician: Jacob Galyon Reason For Calibration: Due for Ca
 CableLength 5

NIST EQUIPMENT USED DURING CALIBRATION

MODEL: 2241-3 SERIAL #: 181301 CAL DUE: 02/20/24
 MODEL: SERIAL #: CAL DUE:

NIST TRACEABLE SOURCES USED

SOURCE	ISOTOPE	ACTIVITY	2π	ASSAY DATE
99PU470-0268	Pu-239	14196 dpm	7,188 cpm	1/30/2023
4049-02	Th-230	30197 dpm	15,298 cpm	1/30/2023

Efficiency from Last Calibration: 11.81 % HV From Last Calibration: 700 V Calibration Threshold: 35 mV

AS FOUND DATA

AS FOUND Instrument Condition: SAT
 HV: 700 V
 Heel: 1711
 Center: 1577
 Toe: 1622
 Background: 1
 Uniformity: 4.54 %
 Probe Efficiency: Pu-239 **11.52%**

1 MINUTE COUNTS (CPM)

AS LEFT DATA after repair of HV adjust

AS LEFT Instrument Condition: SAT
 HV: 700 V
 Heel: 1711
 Center: 1577
 Toe: 1622
 Background: 1
 Uniformity: 4.54 %
 Probe Efficiency: Pu-239 **11.52%**

"AF" in the AL Efficiency fields means to refer to the AF Efficiencies in the AS FOUND DATA Section

Is the As Found Efficiency Within 20% of the efficiency from the last cal.?

Reproducibility: Isotope: Pu-239 1639 1639 1687 Average: 1655 Are the individual counts within 10% of the average?

* If As Found Efficiency (even after repair) is within 10% of the last calibration and uniformity is <10%, the technician may N/A the Plateau Data and proceed to Comments. Geometry = Nal probes are 4 1/2" from source. All other probes are in contact with surface unless otherwise specified.

PLATEAU AND SET POINT DATA (CPM)

High Voltage	Source Response	Background	HV	HEEL	CENTER	TOE	Background	Uniformity	Efficiency
N/A			700 V					%	Pu-239
				3438	3443	3373	1		Th-230 11.32%

Comments: Married as a set with: Model: 2241-3 Serial #: 181301 Bar Code #:

Does Instrument Meet Final Acceptance Criteria? Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: **02/20/24**

Performed by: Jacob Galyon

Reviewed by: [Signature] Issue Date: 2/20/23

Printed Name: Jacob Galyon



All instrumentation is calibrated in accordance with the QAP to meet the criteria of ANSI N323AB-2013
 The results in this report relate only to the item calibrated or tested.



Safety and Ecology Corporation
 10512 Lexington Drive, Suite 200
 Knoxville, TN 37932
Calibration Certificate

Procedure # SEC-IS-425

Instrument Manufacturer:	Ludlum Instruments	Date:	2/20/2023
Meter Model:	2241-3	Customer Name:	Chase
Meter Serial Number:	181301	Technician:	Jacob Galyon
Probe Model:	44-38	Reason:	Due for Cal
Probe Serial Number:	PR192339	Bar Code Number:	

M&TE		
Model	Serial No.	Cal Due
Ludlum 500-2	209797	6/13/2023

N.I.S.T. Source(s)			
Material	Serial No.	Activity	Due
Cs137	KR-4097	130 mCi	2/13/2024
Cs137	0300-GY	400 Ci	2/13/2024

Calibration Data								
High Voltage	As Found	As Left	Cal Constant	As Found	As Left	Repair and Service Record		
	900V	900V		6.55E+07	7.45E+07			Routine Service:
Threshold	35mV	35mV	Dead Time	90uSEC	113uSEC	Check batteries.		
Scale	Exposure	Instrument Reading		Percent Error		Check reset button.		
	Rate	As Found	As Left	As Found	As Left	Check fast/slow response.		
Digital	0.5 mR/hr	0.533	0.517	6.60%	3.40%	Check audio.		
	1 mR/hr	0.923	0.925	-7.70%	-7.50%	Check meter zero.		
	5 mR/hr	5.612	5.138	12.24%	2.76%	Precision		
	10 mR/hr	10.76	10.38	7.60%	3.80%	Exposure	Readings	% Dev.
	50 mR/hr	54.46	50.74	8.92%	1.48%	100 mR/hr	99	-1.00%
	100 mR/hr	110.2	100.6	10.20%	0.60%		101	1.00%
500 mR/hr	463.6	505.4	-7.28%	1.08%	100		0.00%	

Comments/Remarks:
 Calibration done with N.I.S.T. traceable source(s) and/or calibrated test equipment.
 Calibration acceptance criteria +/- 10% of actual exposure or input rate.
 If 'As Found' readings are greater than +/- 20% then values are circled in red and customer is contacted.
 *Indicate pulsed scales due to naturally occurring background radiation.

Date Instruments are due for Next Calibration: 2/20/2024

Performed by: Jacob Galyon
 Printed Name: Jacob Galyon

Reviewed by: [Signature]
 Date Reviewed: 2/20/23

1/15/2024 8:31:22 AM

QuantaSmart (TM) - 2.03 - Serial# 060707

Page # 1

SNC Protocol

Calibration Information

Software Version IC: 2.12

Software Version EC: 2.03

Instrument Model: Tri-Carb 3100TR

Instrument Serial Number: 060707

3H Chi Square: 18.65 Date Processed: 1/15/2024 6:30:46 AM

14C Chi Square: 21.04 Date Processed: 1/15/2024 6:30:46 AM

3H E²/B (1-18.6 keV): 292.21 Date Processed: 1/15/2024 6:30:46 AM

14C E²/B (4-156 keV): 551.12 Date Processed: 1/15/2024 6:30:46 AM

3H Efficiency (0-18.6 keV): 62.32 Date Processed: 1/15/2024 6:30:46 AM

14C Efficiency (0-156 keV): 95.51 Date Processed: 1/15/2024 6:30:46 AM

IPA Background Date Processed: 1/15/2024 6:30:46 AM

3H Background CPM (0-18.6 keV): 13.15 Date Processed: 1/15/2024 6:30:46 AM

14C Background CPM (0-156 keV): 20.20 Date Processed: 1/15/2024 6:30:46 AM

3H Calibration DPM: 213200

3H Reference Date: 10/8/2018

14C Calibration DPM: 101000

Calibration Information

Software Version IC: 2.12

Software Version EC: 2.03

Instrument Model: Tri-Carb 3100TR

Instrument Serial Number: 060707

3H Chi Square: 28.21 Date Processed: 1/17/2024 10:06:22 AM

14C Chi Square: 17.00 Date Processed: 1/17/2024 10:06:22 AM

3H E²/B (1-18.6 keV): 292.64 Date Processed: 1/17/2024 10:06:22 AM

14C E²/B (4-156 keV): 518.94 Date Processed: 1/17/2024 10:06:22 AM

3H Efficiency (0-18.6 keV): 62.59 Date Processed: 1/17/2024 10:06:22 AM

14C Efficiency (0-156 keV): 95.91 Date Processed: 1/17/2024 10:06:22 AM

IPA Background Date Processed: 1/17/2024 10:06:22 AM

3H Background CPM (0-18.6 keV): 13.08 Date Processed: 1/17/2024 10:06:22 AM

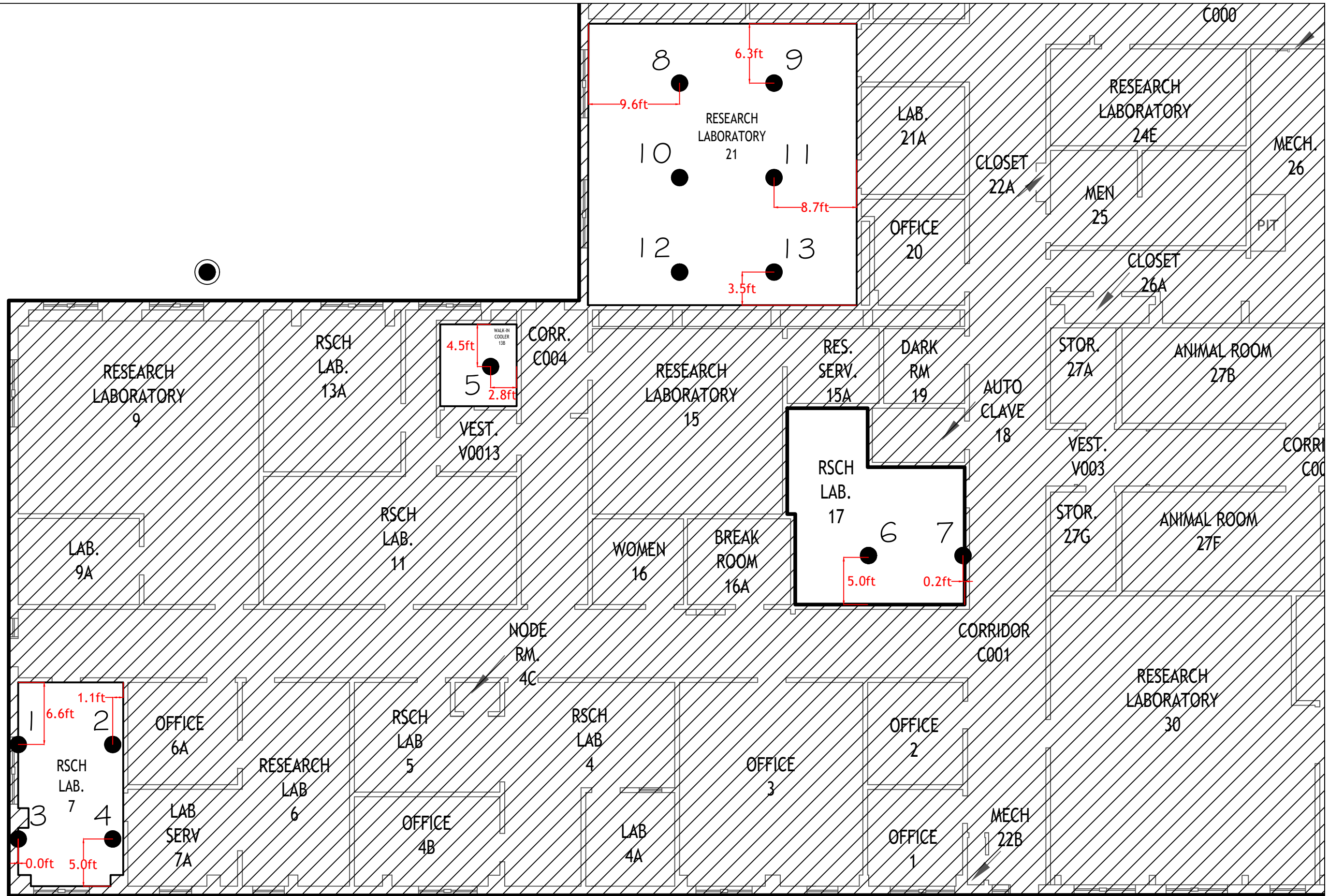
14C Background CPM (0-156 keV): 21.00 Date Processed: 1/17/2024 10:06:22 AM

3H Calibration DPM: 213200

3H Reference Date: 10/8/2018

14C Calibration DPM: 101000

Appendix D
Final Status Survey
Location Maps

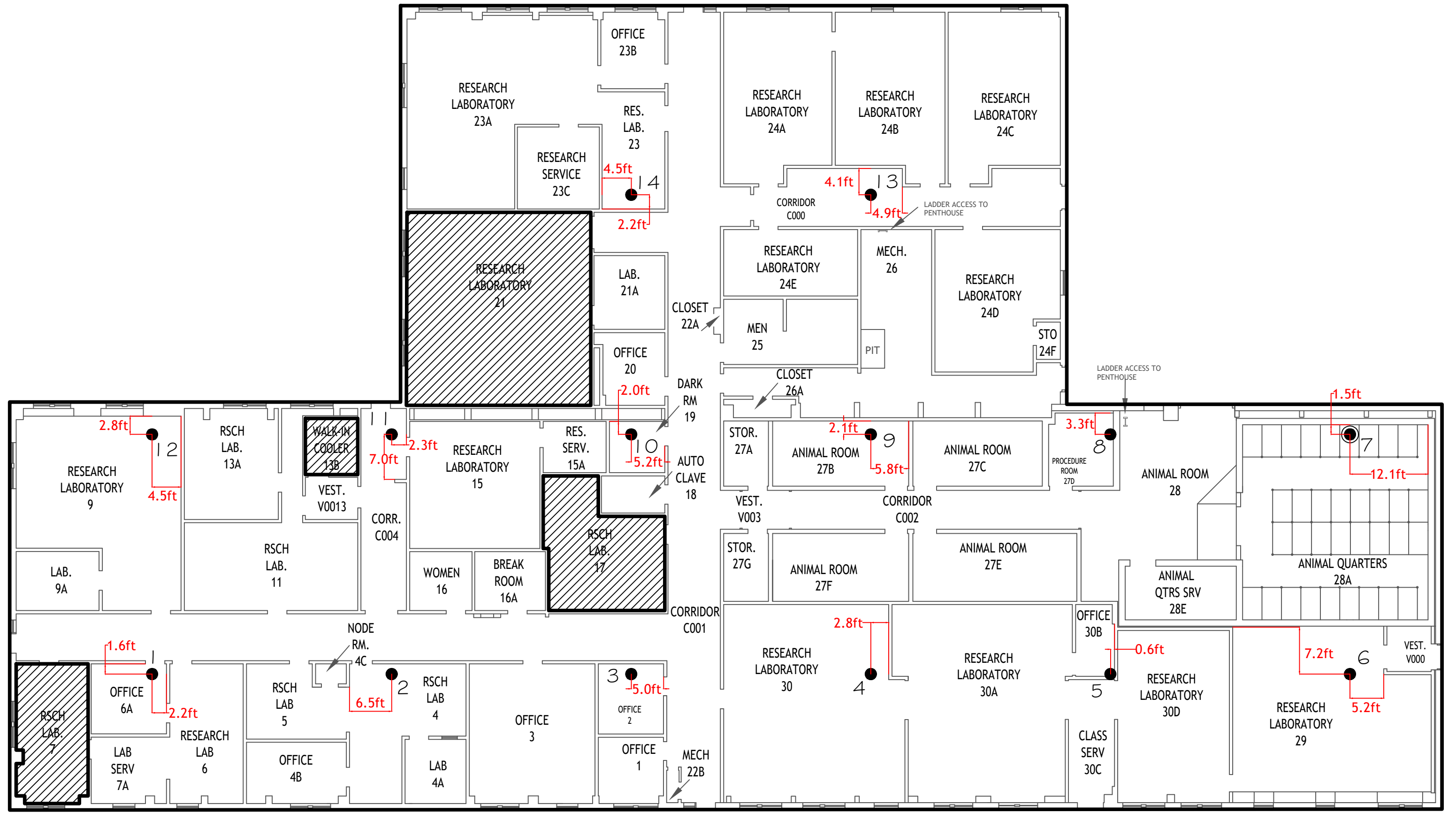


● Random Start Location
Spacing = 10ft



University of Missouri
VSB & VMDL
Final Status Survey Report



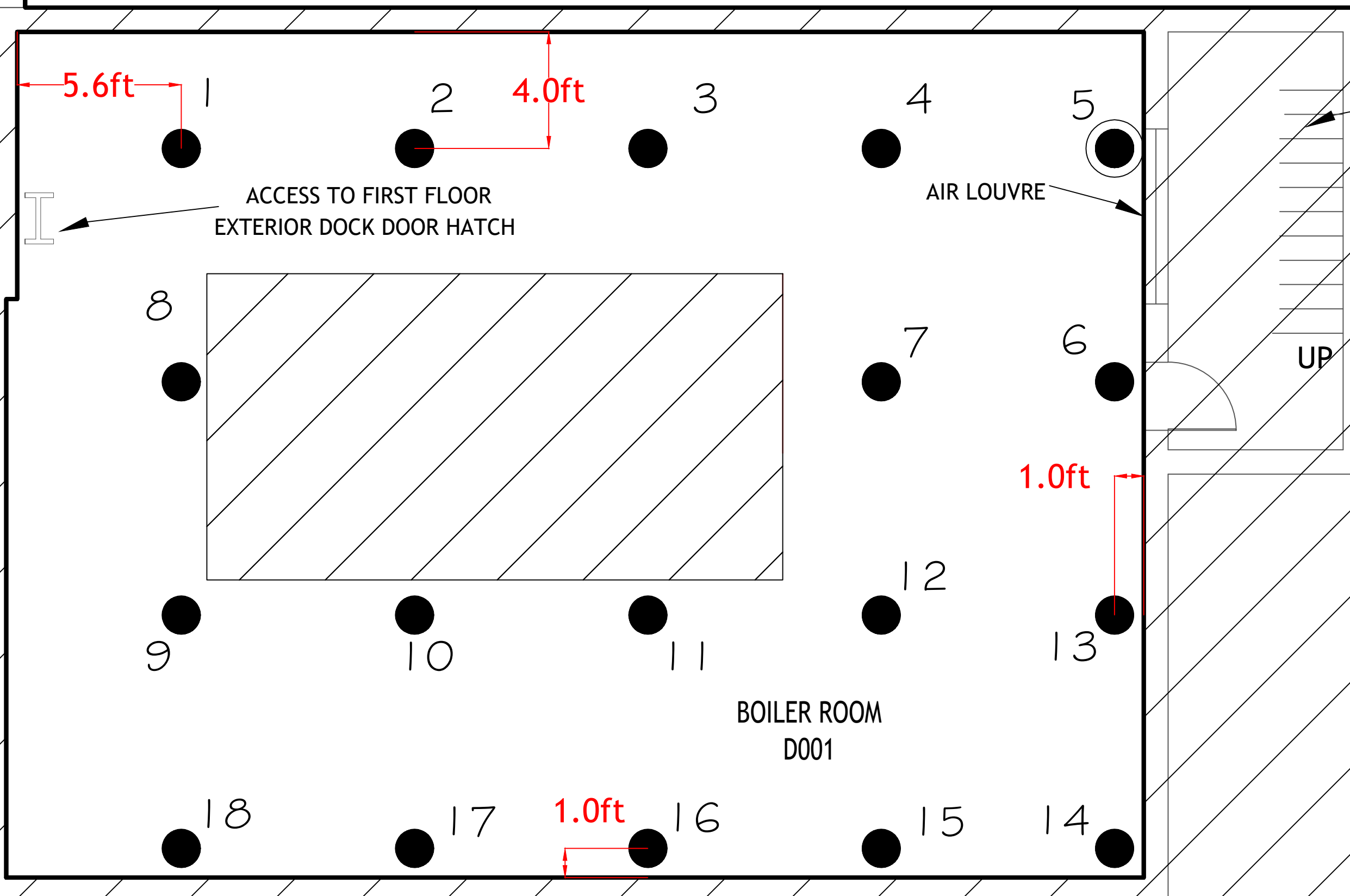


● Random Start Location
Spacing = 37ft



University of Missouri
VSB & VMDL
Final Status Survey Report





EXTERIOR STAIRS

● Random Start Location
Spacing = 8ft



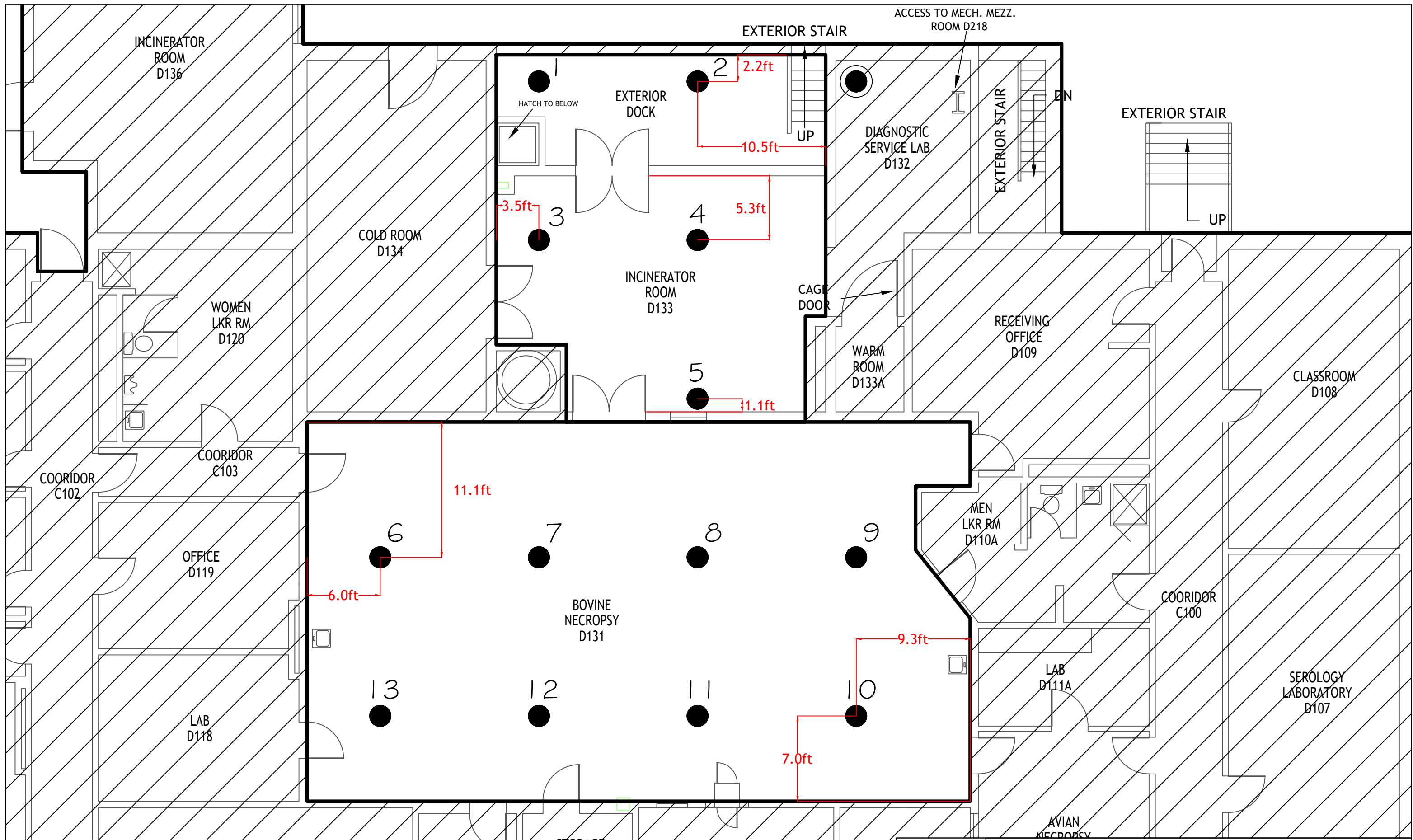
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Final Status Survey Report



Building: VMD

Survey Unit: B201

Page: D.3 of D.7

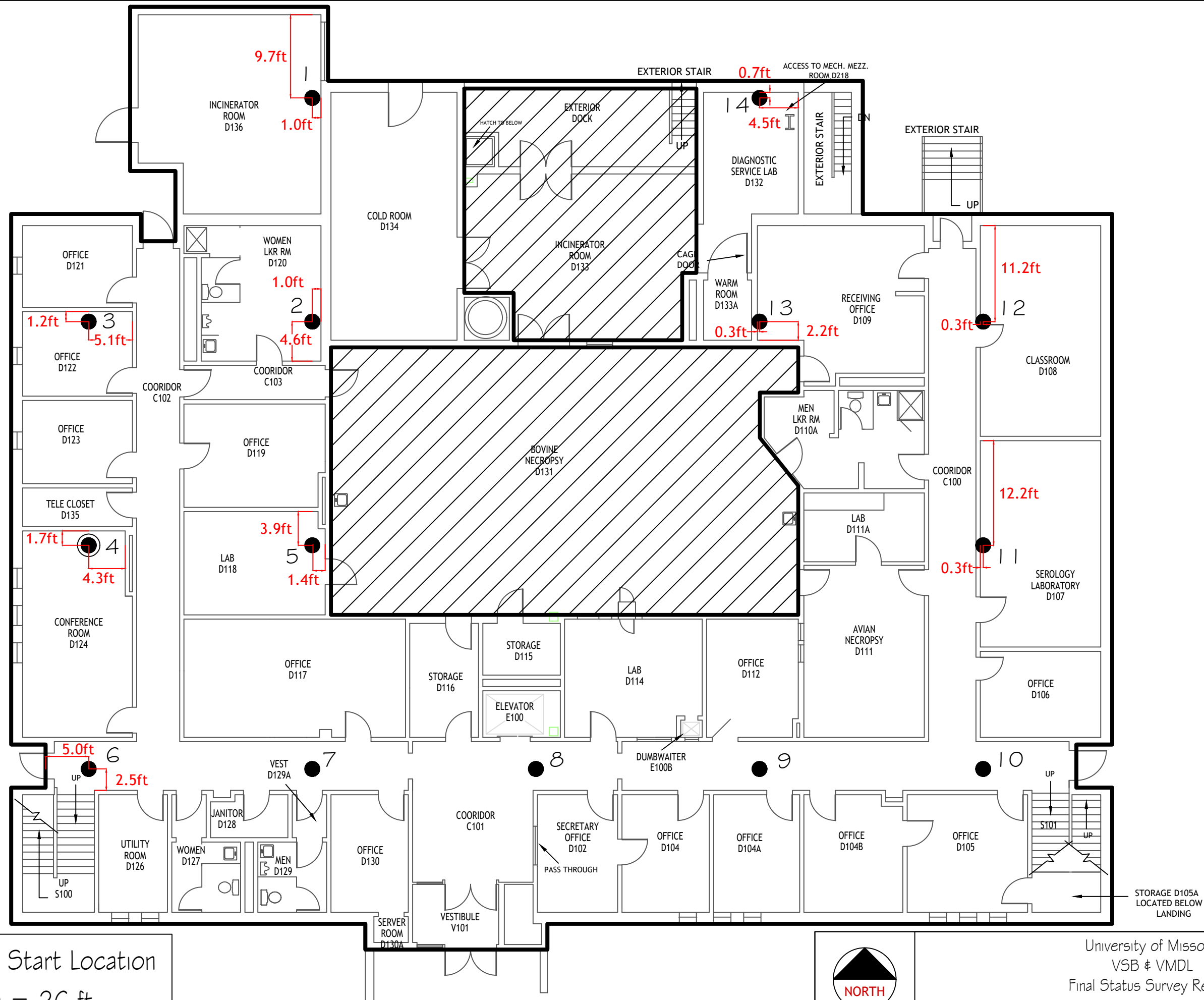


● Random Start Location
Spacing = 13 ft



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Final Status Survey Report



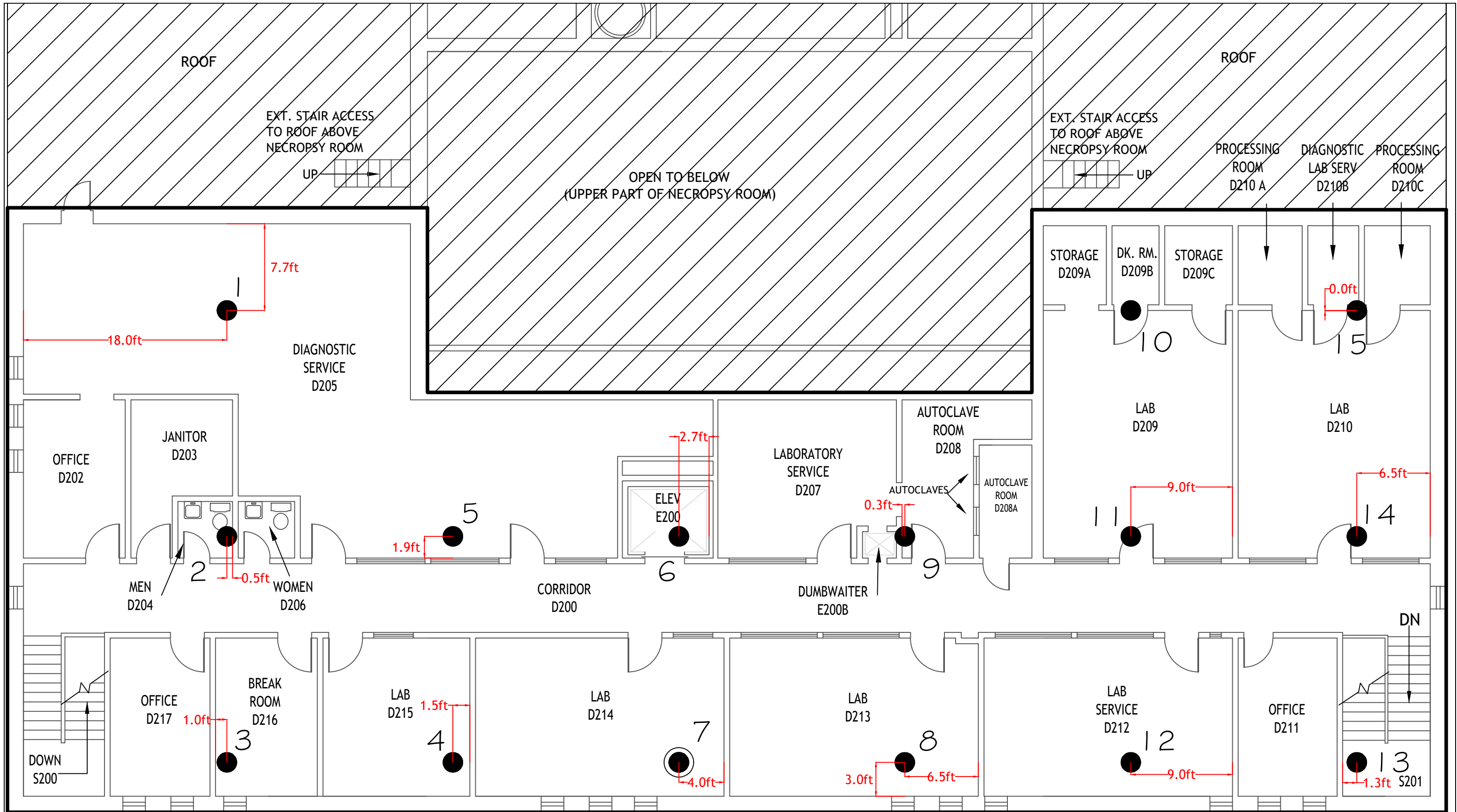


● Random Start Location
Spacing = 26 ft



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Final Status Survey Report



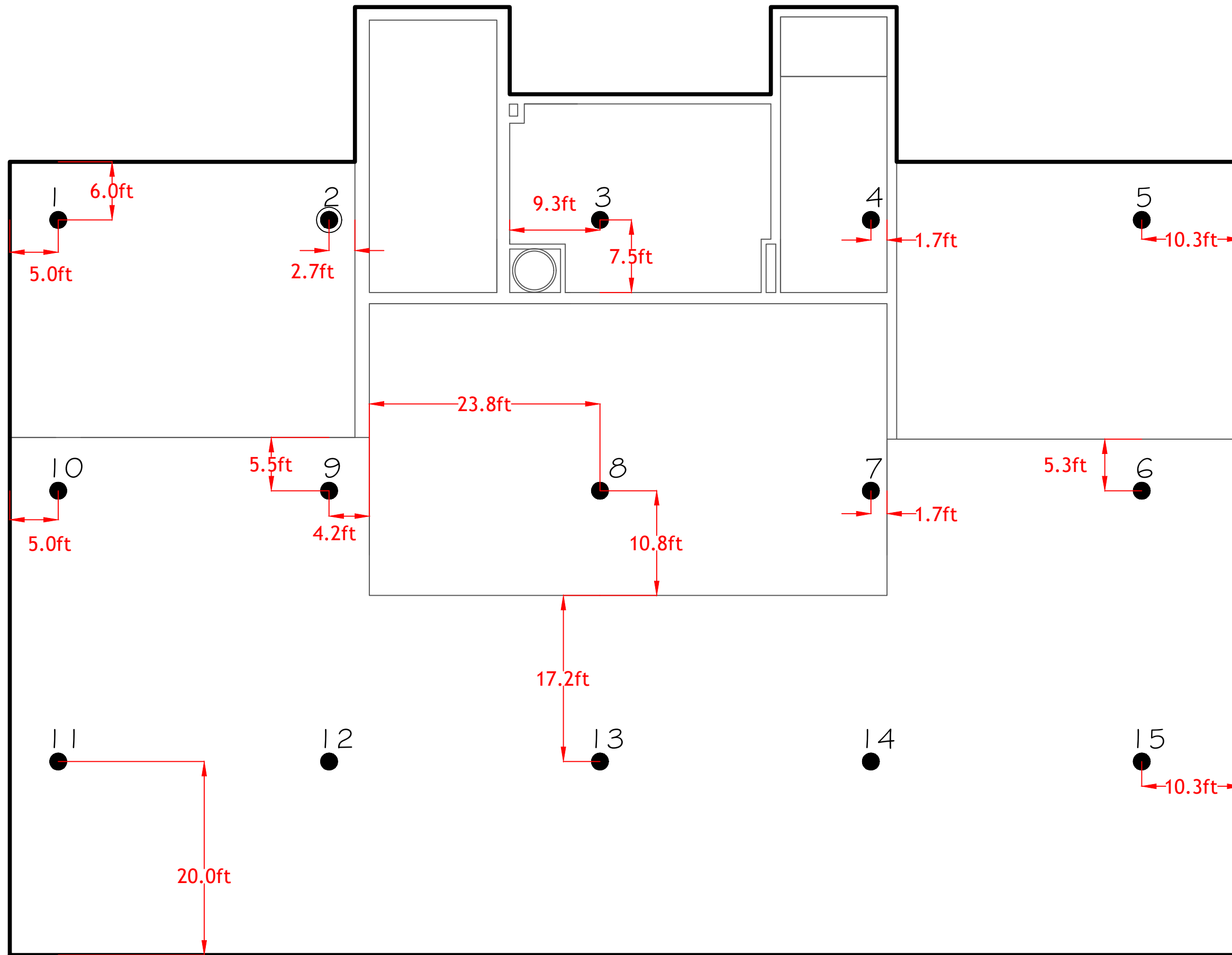


● Random Start Location
Spacing = 20ft



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Final Status Survey Report





● Random Start Location
Spacing = 28ft



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Final Status Survey Report



Building: VMD

Survey Unit: R301

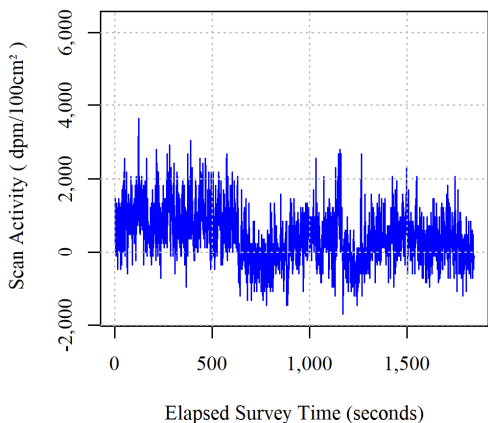
Page: D.7 of D.7

Appendix E

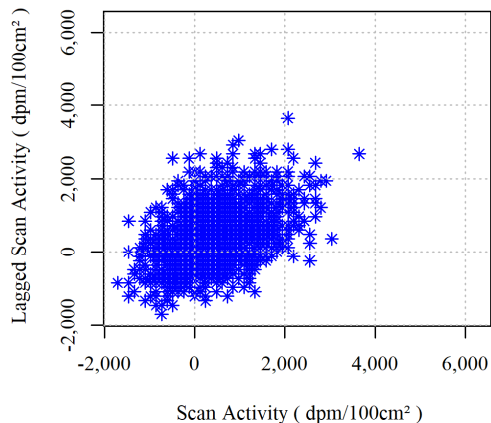
4-Plot Graphs

Survey Unit: VMD-B201 Probe: PR148503_Beta (43-37)

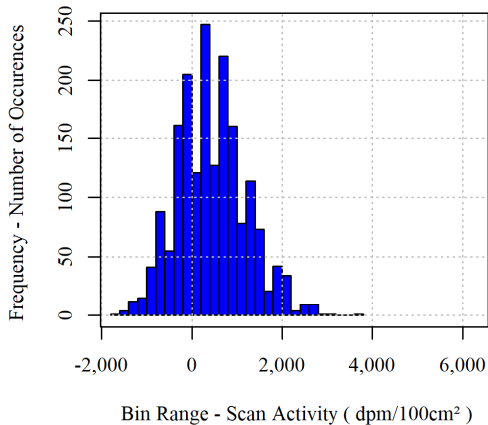
Scan Data



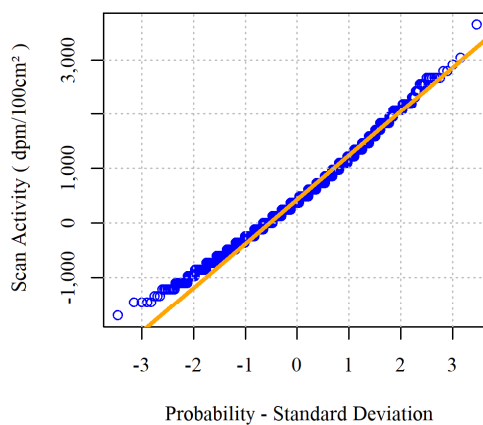
Lagged Scan Data



Histogram of Scan Data

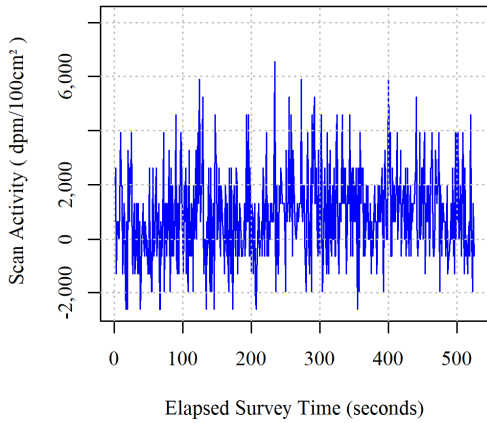


Normal Probability Plot of Data

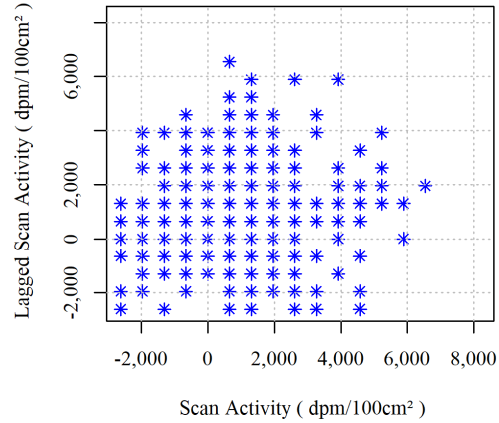


Survey Unit: VMD-1201 Probe: PR140514_Beta (43-68)

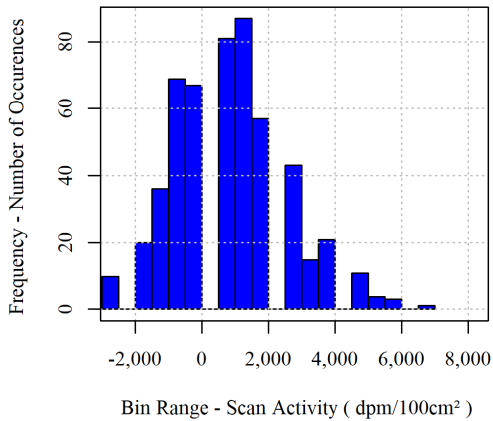
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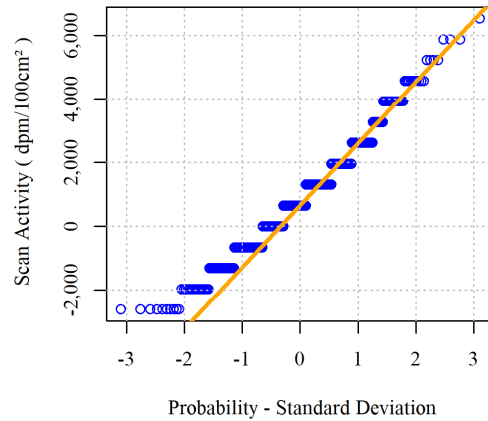
Lagged Scan Data



Histogram of Scan Data

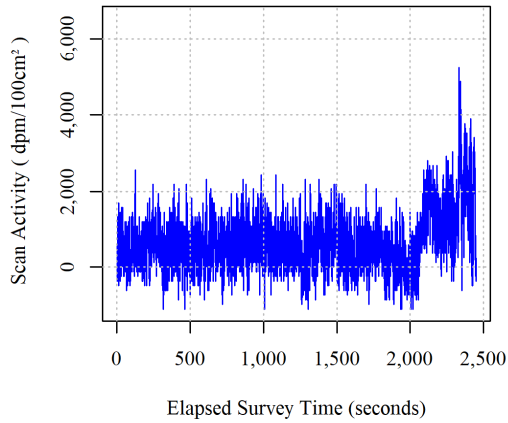


Normal Probability Plot of Data

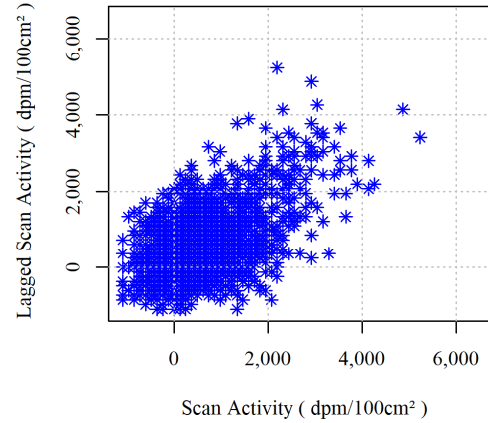


Survey Unit: VMD-1201 Probe: PR148503_Beta (43-37)

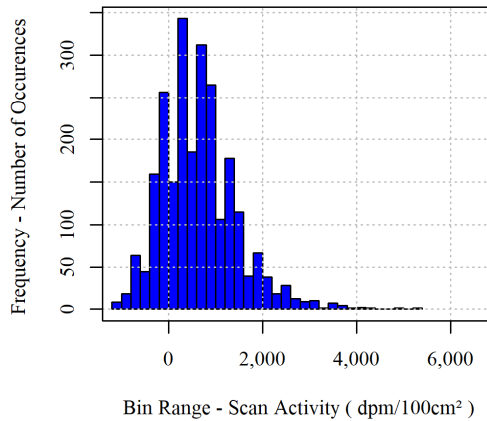
Scan Data



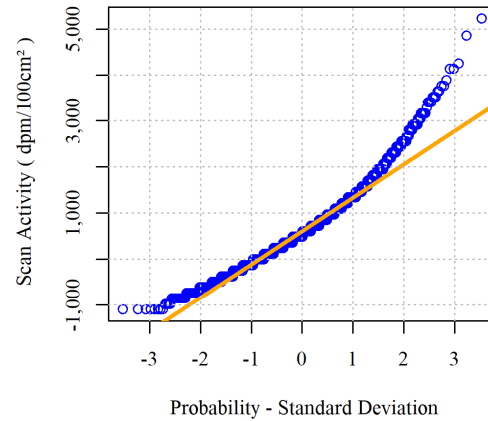
Lagged Scan Data



Histogram of Scan Data

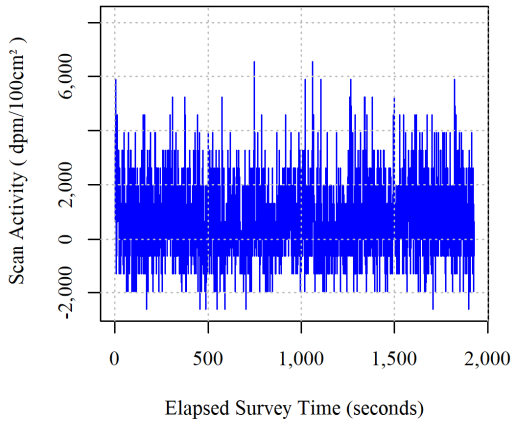


Normal Probability Plot of Data

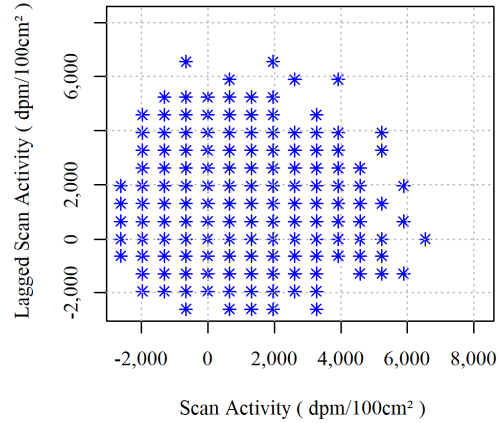


Survey Unit: VMD-1301 Probe: PR140514_Beta (43-68)

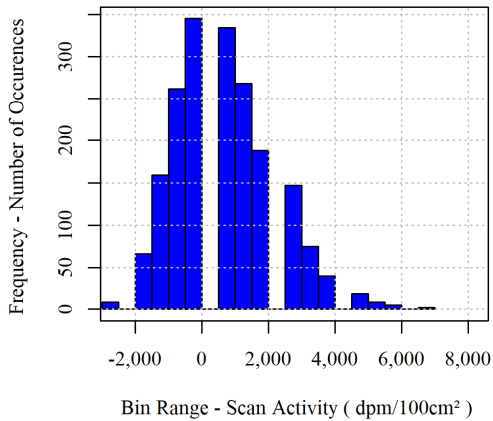
Scan Data



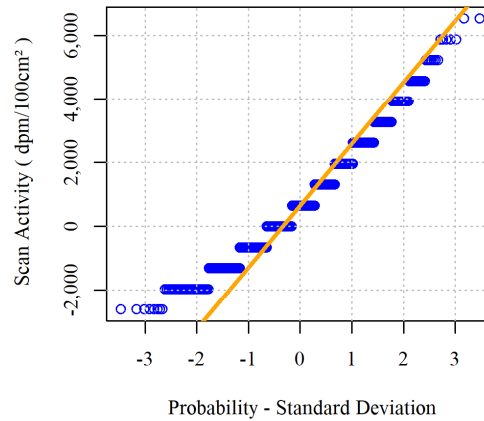
Lagged Scan Data



Histogram of Scan Data

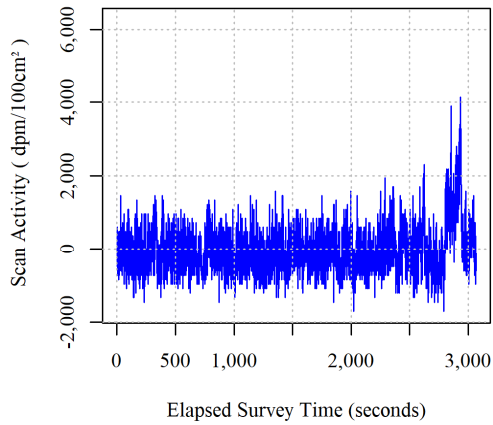


Normal Probability Plot of Data

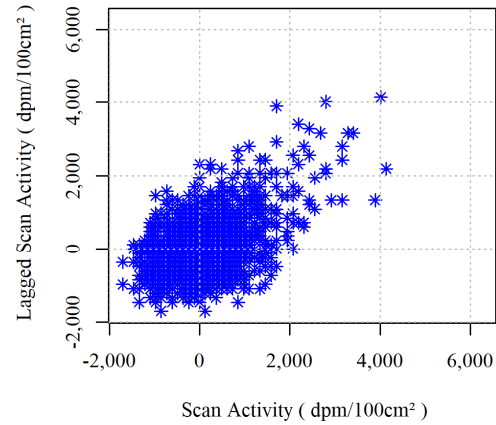


Survey Unit: VMD-1301 Probe: PR148503_Beta (43-37)

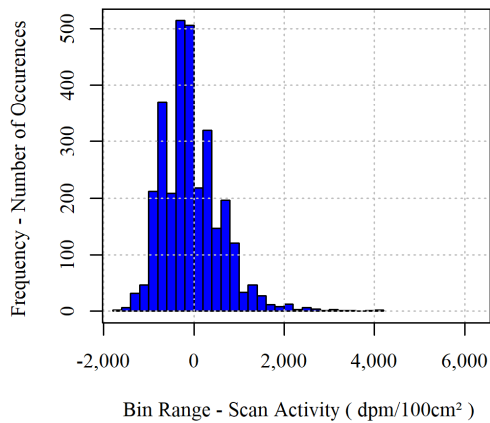
Scan Data



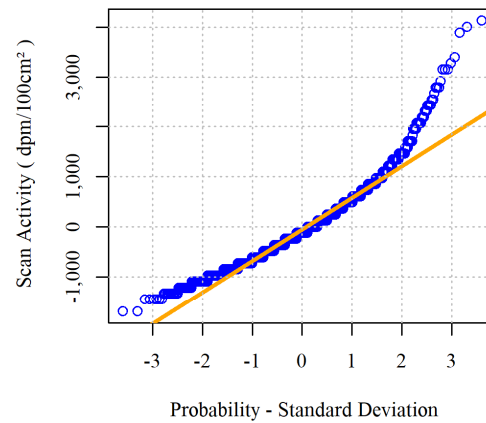
Lagged Scan Data



Histogram of Scan Data

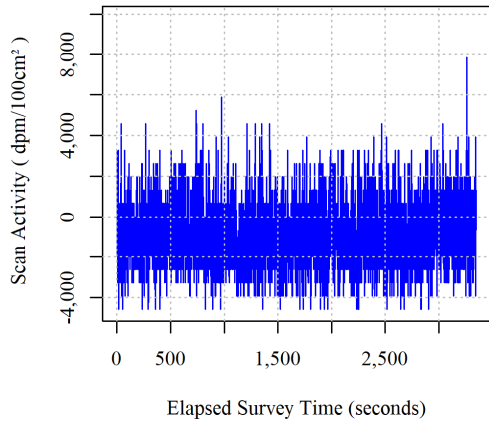


Normal Probability Plot of Data

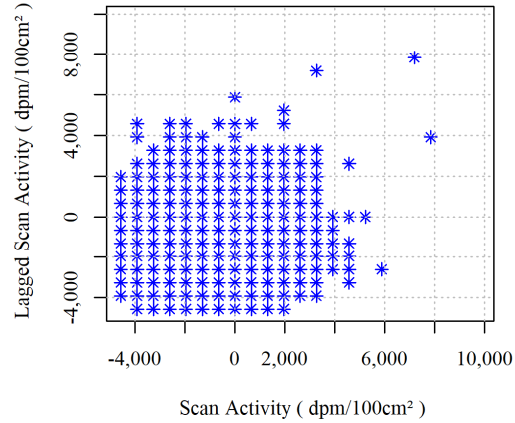


Survey Unit: VMD-2301 Probe: PR140514_Beta (43-68)

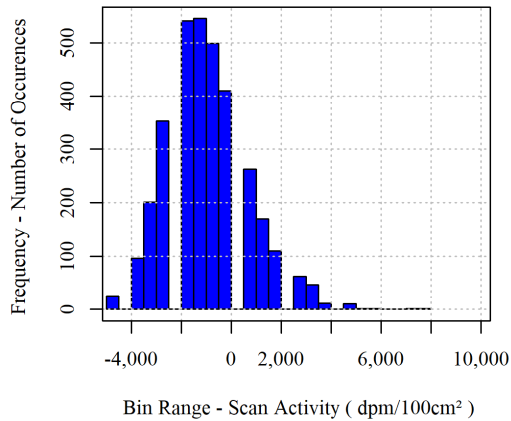
Scan Data



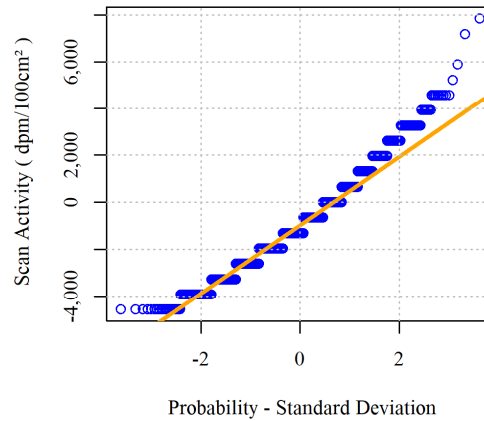
Lagged Scan Data



Histogram of Scan Data

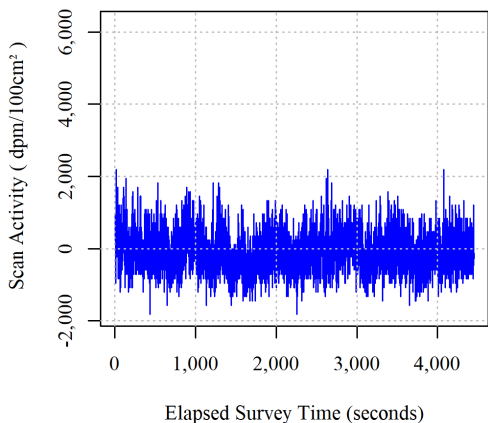


Normal Probability Plot of Data

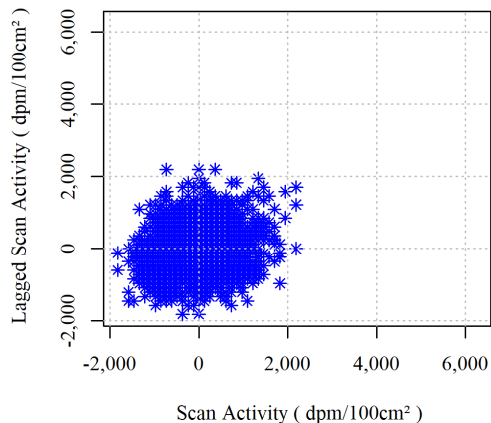


Survey Unit: VMD-2301 Probe: PR148503_Beta (43-37)

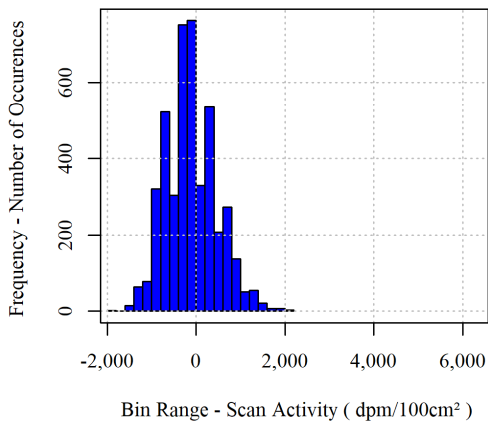
Scan Data



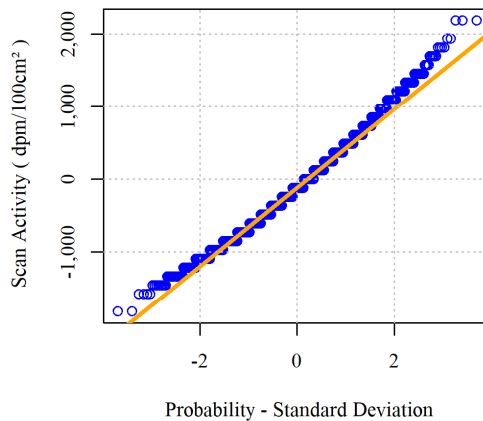
Lagged Scan Data



Histogram of Scan Data

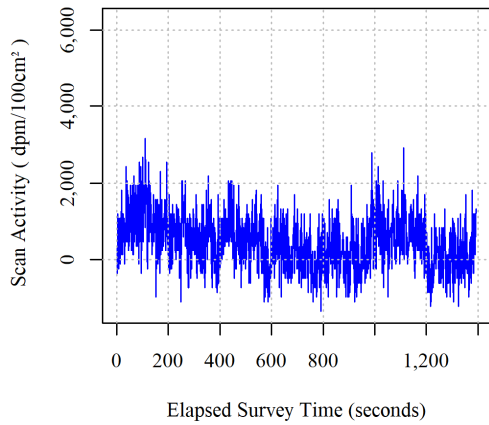


Normal Probability Plot of Data

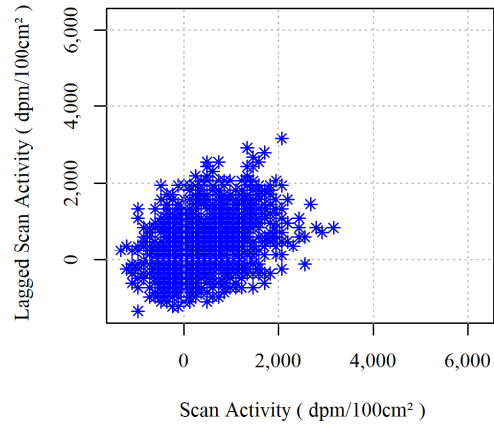


Survey Unit: VMD-R301 Probe: PR148503_Beta (43-37)

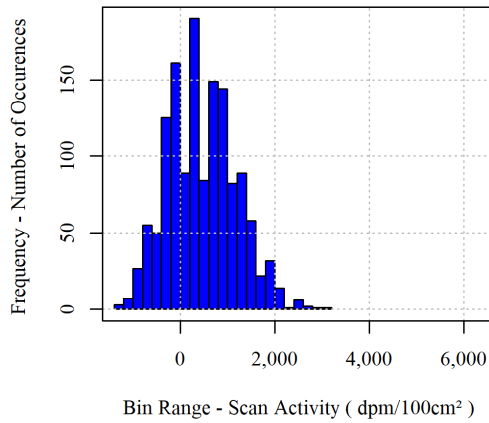
Scan Data



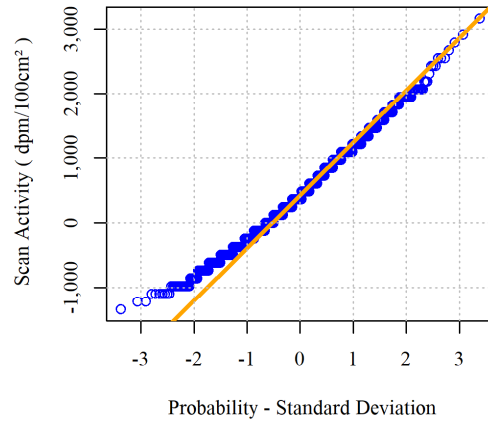
Lagged Scan Data



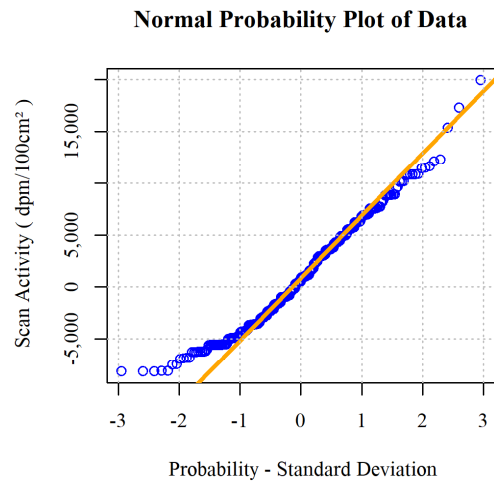
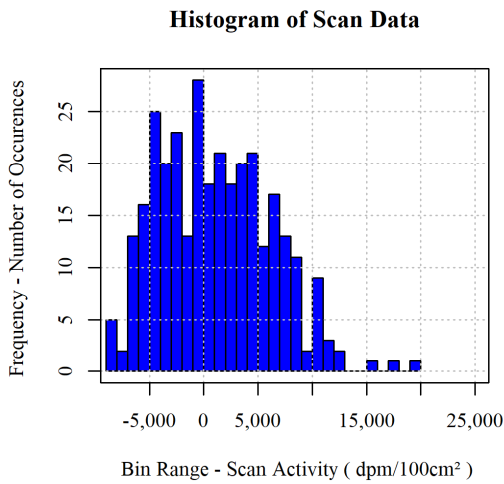
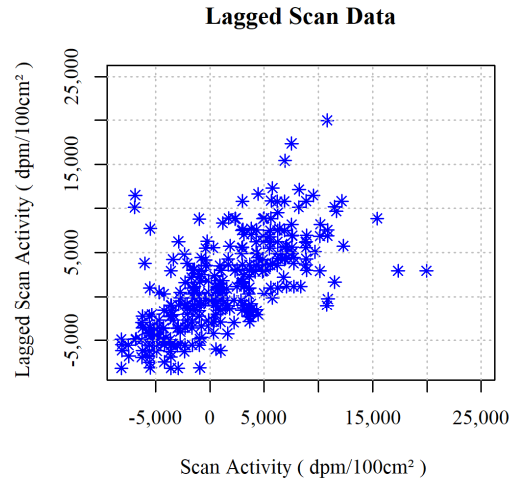
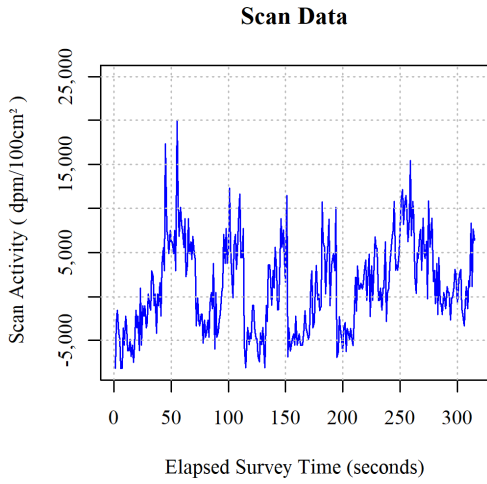
Histogram of Scan Data



Normal Probability Plot of Data

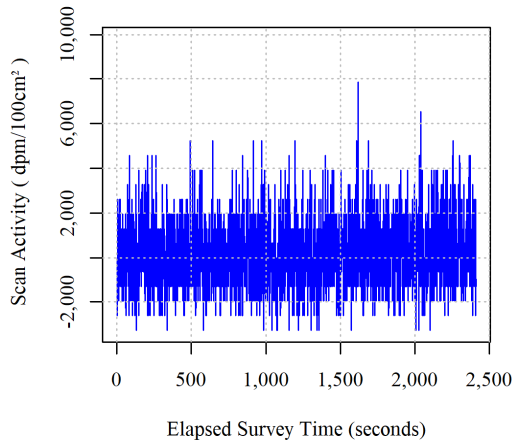


Survey Unit: VMD-IN01(Interior) Probe: PR140514_Beta (43-68)

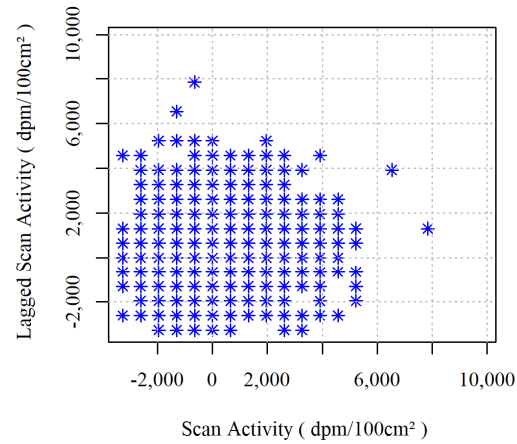


Survey Unit: VSB-1201 Probe: PR140514_Beta (43-68)

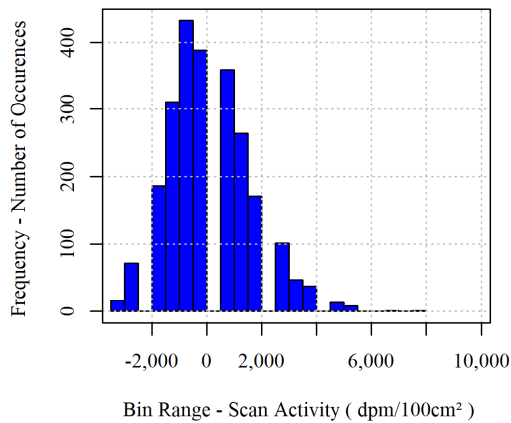
Scan Data



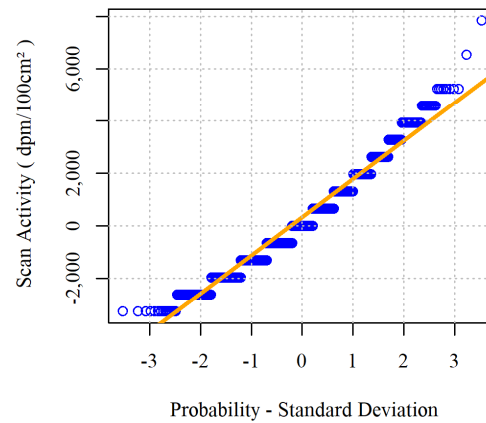
Lagged Scan Data



Histogram of Scan Data

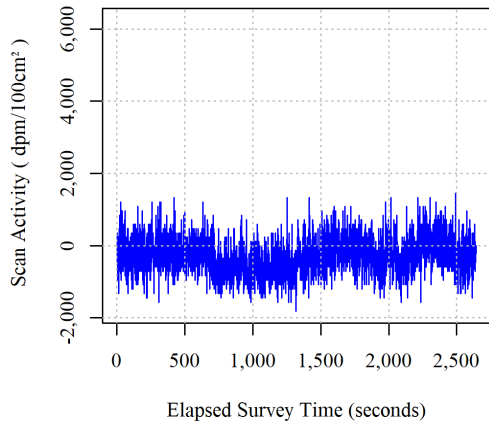


Normal Probability Plot of Data

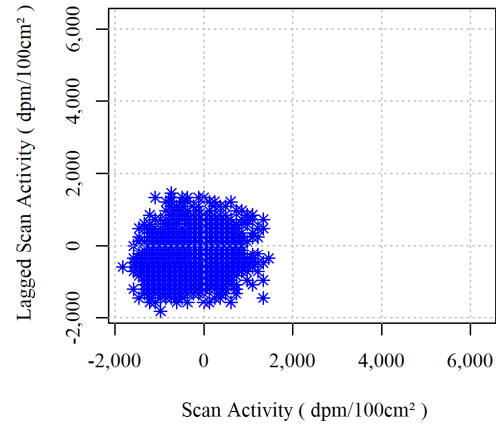


Survey Unit: VSB-1201 Probe: PR148503_Beta (43-37)

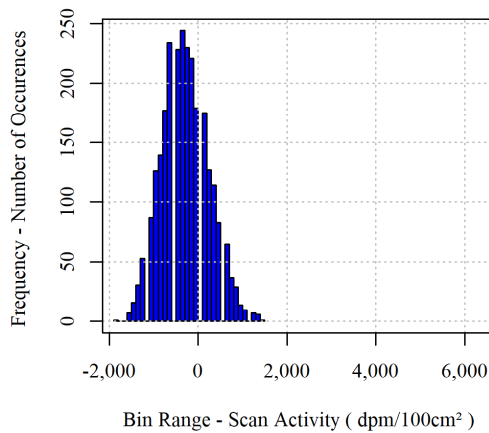
Scan Data



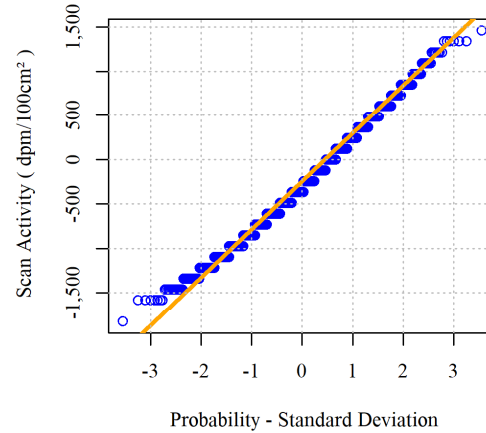
Lagged Scan Data



Histogram of Scan Data

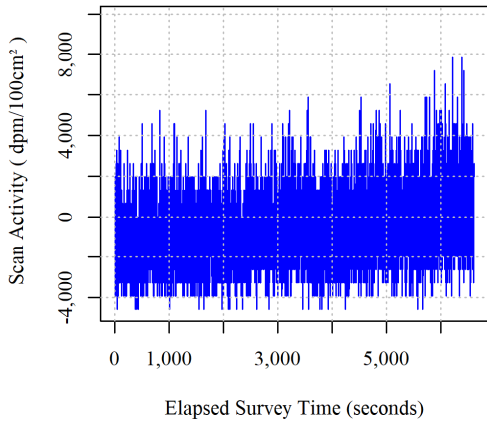


Normal Probability Plot of Data

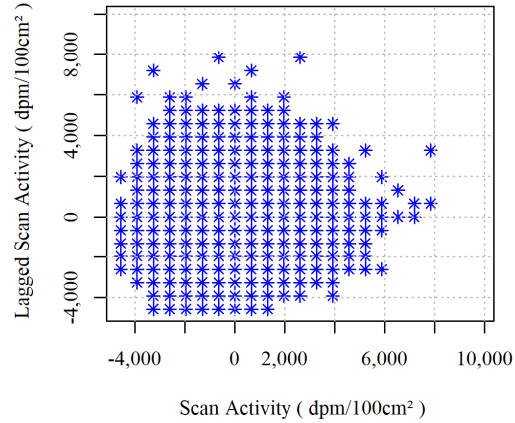


Survey Unit: VSB-1301 Probe: PR140514_Beta (43-68)

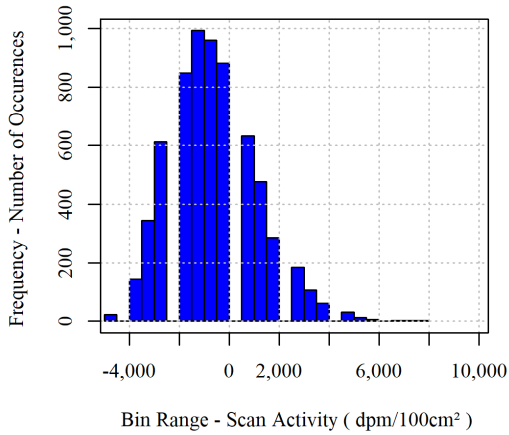
Scan Data



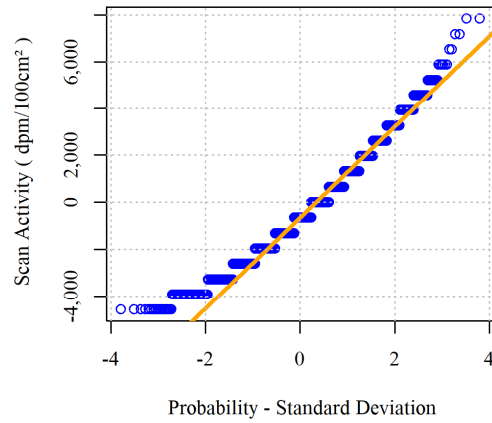
Lagged Scan Data



Histogram of Scan Data

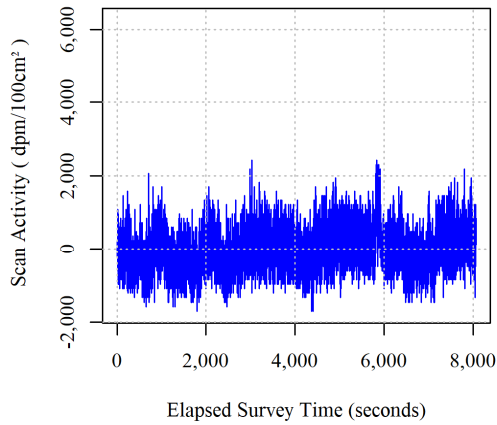


Normal Probability Plot of Data

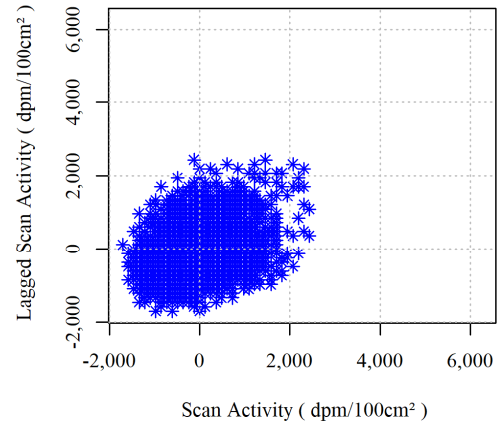


Survey Unit: VSB-1301 Probe: PR148503_Beta (43-37)

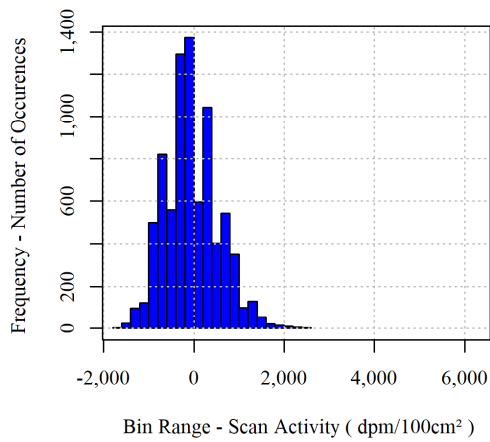
Scan Data



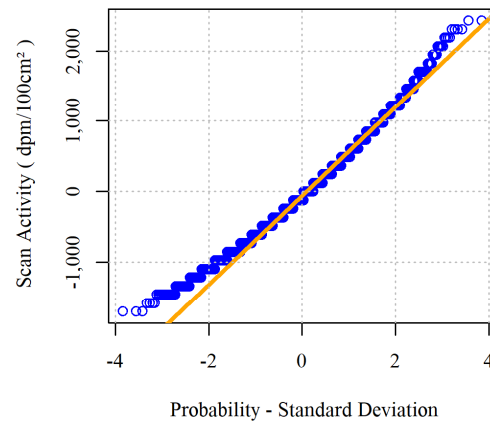
Lagged Scan Data



Histogram of Scan Data



Normal Probability Plot of Data



Appendix F
Structural Surfaces Final Status
Survey Results

Survey Results

Building: VMD Survey Unit: B201 Survey Type: Structural Class: 2

<u>Location Code</u>	<u>Total Activity Measurements</u>		<u>Removable Activity Measurements</u>					
	<u>Activity</u>	<u>MDC</u>	<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>CH3</u>	<u>MDC</u>
VMD-B201-F1-C-001	871 +/- 1,956	3,449	7	44	0	26	0	37
VMD-B201-F1-C-002	109 +/- 1,872	3,449	12	44	3	26	0	37
VMD-B201-F1-C-003	980 +/- 1,967	3,449	0	44	20	26	6	37
VMD-B201-F1-C-004	218 +/- 1,885	3,449	3	44	4	26	0	37
VMD-B201-F1-C-005	435 +/- 1,909	3,449	19	44	6	26	0	37
VMD-B201-F1-C-006	980 +/- 1,967	3,449	1	44	12	26	1	37
VMD-B201-F1-C-007	2,177 +/- 2,091	3,449	0	44	3	26	4	37
VMD-B201-F1-C-008	544 +/- 1,920	3,449	3	44	14	26	4	37
VMD-B201-F1-C-009	1,742 +/- 2,047	3,449	0	44	2	26	9	37
VMD-B201-F1-C-010	1,742 +/- 2,047	3,449	0	44	5	26	0	37
VMD-B201-F1-C-011	1,198 +/- 1,990	3,449	0	44	7	26	0	37
VMD-B201-F1-C-012	762 +/- 1,944	3,449	0	44	3	26	2	37
VMD-B201-F1-C-013	762 +/- 1,944	3,449	0	44	8	26	0	37
VMD-B201-F1-C-014	327 +/- 1,897	3,449	1	44	0	26	3	37
VMD-B201-F1-C-015	1,742 +/- 2,047	3,449	16	44	4	26	1	37
VMD-B201-F1-C-016	1,742 +/- 2,047	3,449	16	44	8	26	0	37
VMD-B201-F1-C-017	3,484 +/- 2,218	3,449	0	44	15	26	1	37
VMD-B201-F1-C-018	2,831 +/- 2,155	3,449	0	44	0	26	3	37
Static Count			Sample Count					
Average	18		18		18		18	
Minimum	1,258		4		6		2	
Maximum	109		0		0		0	
Standard Deviation	3,484		19		20		9	
	922		7		6		2	

Total surface activity results are reported in net dpm/100 cm²

H-3, C-14 and CH3 Removable results reported in net dpm/100 cm².

Results above MDC are in bold print. Results above Investigation Levels are in red bold print.

Removable Activity: H-3 =2-18.6 keV, C-14 = 18.6-256 keV, Channel 3 = 256-2,000 keV.

Static measurements not performed inside drain and vacuum openings due to small geometry.

Survey Results

Building: VMD Survey Unit: 1201 Survey Type: Structural Class: 2

<u>Location Code</u>	<u>Total Activity Measurements</u>		<u>Removable Activity Measurements</u>					
	<u>Activity</u>	<u>MDC</u>	<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>CH3</u>	<u>MDC</u>
VMD-1201-F1-C-001	2,504 +/- 2,123	3,449	2	44	5	26	8	37
VMD-1201-F1-C-002	1,960 +/- 2,069	3,449	15	44	2	26	5	37
VMD-1201-F1-C-003	653 +/- 1,932	3,449	0	44	0	26	5	37
VMD-1201-F1-C-004	0 +/- 1,860	3,449	2	44	0	26	0	37
VMD-1201-F1-C-005	980 +/- 1,967	3,449	7	44	8	26	0	37
VMD-1201-F1-C-006	762 +/- 1,944	3,449	12	44	11	26	0	37
VMD-1201-F1-C-007	2,177 +/- 2,091	3,449	0	44	1	26	0	37
VMD-1201-F1-C-008	0 +/- 1,860	3,449	2	44	5	26	1	37
VMD-1201-F1-C-009	-327 +/- 1,823	3,449	11	44	4	26	7	37
VMD-1201-F1-C-010	218 +/- 1,885	3,449	6	44	1	26	0	37
VMD-1201-F1-C-011	218 +/- 1,885	3,449	0	44	2	26	0	37
VMD-1201-F1-C-012	218 +/- 1,885	3,449	9	44	0	26	2	37
VMD-1201-F1-C-013	-435 +/- 1,811	3,449	0	44	9	26	1	37
Static Count	13	Sample Count	13		13		13	
Average	687		5		4		2	
Minimum	-435		0		0		0	
Maximum	2,504		15		11		8	
Standard Deviation	963		5		4		3	

Total surface activity results are reported in net dpm/100 cm²

H-3, C-14 and CH3 Removable results reported in net dpm/100 cm².

Results above MDC are in bold print. Results above Investigation Levels are in red bold print.

Removable Activity: H-3 = 2-18.6 keV, C-14 = 18.6-256 keV, Channel 3 = 256-2,000 keV.

Static measurements not performed inside drain and vacuum openings due to small geometry.

Survey Results

Building: VMD Survey Unit: 1301 Survey Type: Structural Class: 3

<u>Location Code</u>	<u>Total Activity Measurements</u>		<u>Removable Activity Measurements</u>					
	<u>Activity</u>	<u>MDC</u>	<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>CH3</u>	<u>MDC</u>
VMD-1301-F1-C-001	2,286 +/- 1,798	2,859	1	44	9	26	3	37
VMD-1301-F1-C-002	2,395 +/- 1,811	2,859	8	44	1	26	2	37
VMD-1301-F1-V-003	762 +/- 1,611	2,859	3	44	0	26	0	37
VMD-1301-F1-M-004	109 +/- 1,524	2,859	7	44	0	26	0	37
VMD-1301-F1-C-005	3,375 +/- 1,920	2,859	5	44	2	26	5	37
VMD-1301-F1-V-006	2,286 +/- 1,798	2,859	87	44	4	26	4	37
VMD-1301-F1-V-007	218 +/- 1,539	2,859	32	44	8	26	5	37
VMD-1301-F1-V-008	1,415 +/- 1,694	2,859	0	44	3	26	0	37
VMD-1301-F1-V-009	327 +/- 1,553	2,859	2	44	1	26	5	37
VMD-1301-F1-V-010	1,415 +/- 1,694	2,859	3	44	3	26	0	37
VMD-1301-F1-V-011	109 +/- 1,524	2,859	22	44	0	26	0	37
VMD-1301-F1-V-012	1,089 +/- 1,653	2,859	20	44	3	26	2	37
VMD-1301-B1-M-013	0 +/- 1,509	2,859	10	44	1	26	3	37
VMD-1301-F1-C-014	2,613 +/- 1,836	2,859	0	44	1	26	0	37

Static Count	14	Sample Count	14	14	14
Average	1,314		14	3	2
Minimum	0		0	0	0
Maximum	3,375		87	9	5
Standard Deviation	1,115		23	3	2

Total surface activity results are reported in net dpm/100 cm²
 H-3, C-14 and CH3 Removable results reported in net dpm/100 cm².
 Results above MDC are in bold print. Results above Investigation Levels are in red bold print.
 Removable Activity: H-3 =2-18.6 keV, C-14 = 18.6-256 keV, Channel 3 = 256-2,000 keV.
 Static measurements not performed inside drain and vacuum openings due to small geometry.

Survey Results

Building: VMD Survey Unit: 2301 Survey Type: Structural Class: 3

<u>Location Code</u>	<u>Total Activity Measurements</u>		<u>Removable Activity Measurements</u>					
	<u>Activity</u>	<u>MDC</u>	<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>CH3</u>	<u>MDC</u>
VMD-2301-F1-V-001	522 +/- 1,572	2,838	5	44	2	26	0	37
VMD-2301-F1-V-002	313 +/- 1,545	2,838	6	44	1	26	3	37
VMD-2301-F1-M-003	940 +/- 1,625	2,838	0	44	4	26	0	37
VMD-2301-F1-V-004	104 +/- 1,518	2,838	1	44	0	26	3	37
VMD-2301-B1-M-005	418 +/- 1,559	2,838	2	44	0	26	8	37
VMD-2301-F1-V-006	835 +/- 1,612	2,838	0	44	14	26	8	37
VMD-2301-F1-V-007	-313 +/- 1,462	2,838	13	44	8	26	0	37
VMD-2301-F1-V-008	418 +/- 1,559	2,838	3	44	2	26	0	37
VMD-2301-F1-V-009	-104 +/- 1,490	2,838	4	44	6	26	1	37
VMD-2301-F1-V-010	104 +/- 1,518	2,838	6	44	1	26	4	37
VMD-2301-F1-V-011	-627 +/- 1,418	2,838	15	44	3	26	0	37
VMD-2301-F1-V-012	731 +/- 1,599	2,838	9	44	0	26	0	37
VMD-2301-F1-M-013	940 +/- 1,625	2,838	0	44	17	26	2	37
VMD-2301-F1-V-014	-209 +/- 1,476	2,838	0	44	15	26	7	37
VMD-2301-F1-V-015	522 +/- 1,572	2,838	0	44	10	26	9	37
Static Count	15	Sample Count	15		15		15	
Average	306		4		6		3	
Minimum	-627		0		0		0	
Maximum	940		15		17		9	
Standard Deviation	474		5		6		3	

Total surface activity results are reported in net dpm/100 cm²

H-3, C-14 and CH3 Removable results reported in net dpm/100 cm².

Results above MDC are in bold print. Results above Investigation Levels are in red bold print.

Removable Activity: H-3 =2-18.6 keV, C-14 = 18.6-256 keV, Channel 3 = 256-2,000 keV.

Static measurements not performed inside drain and vacuum openings due to small geometry.

Survey Results

Building: VMD Survey Unit: R301 Survey Type: Structural Class: 3

<u>Location Code</u>	<u>Total Activity Measurements</u>		<u>Removable Activity Measurements</u>					
	<u>Activity</u>	<u>MDC</u>	<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>CH3</u>	<u>MDC</u>
VMD-R301-F1-M-001	940 +/- 1,675	2,930	0	44	0	26	0	37
VMD-R301-F1-M-002	1,462 +/- 1,737	2,930	29	44	0	26	1	37
VMD-R301-F1-M-003	522 +/- 1,625	2,930	4	44	11	26	0	37
VMD-R301-F1-M-004	-313 +/- 1,518	2,930	0	44	0	26	1	37
VMD-R301-F1-M-005	209 +/- 1,585	2,930	9	44	0	26	0	37
VMD-R301-F1-M-006	418 +/- 1,612	2,930	0	44	6	26	0	37
VMD-R301-F1-M-007	940 +/- 1,675	2,930	9	44	6	26	1	37
VMD-R301-F1-M-008	731 +/- 1,650	2,930	0	44	7	26	10	37
VMD-R301-F1-M-009	-418 +/- 1,504	2,930	0	44	13	26	2	37
VMD-R301-F1-M-010	940 +/- 1,675	2,930	14	44	0	26	8	37
VMD-R301-F1-M-011	-418 +/- 1,504	2,930	0	44	0	26	2	37
VMD-R301-F1-M-012	0 +/- 1,559	2,930	0	44	0	26	1	37
VMD-R301-F1-M-013	418 +/- 1,612	2,930	0	44	0	26	4	37
VMD-R301-F1-M-014	-209 +/- 1,532	2,930	0	44	0	26	4	37
VMD-R301-F1-M-015	522 +/- 1,625	2,930	0	44	0	26	0	37
Static Count	15	Sample Count	15		15		15	
Average	383		4		3		2	
Minimum	-418		0		0		0	
Maximum	1,462		29		13		10	
Standard Deviation	570		8		5		3	

Total surface activity results are reported in net dpm/100 cm²

H-3, C-14 and CH3 Removable results reported in net dpm/100 cm².

Results above MDC are in bold print. Results above Investigation Levels are in red bold print.

Removable Activity: H-3 =2-18.6 keV, C-14 = 18.6-256 keV, Channel 3 = 256-2,000 keV.

Static measurements not performed inside drain and vacuum openings due to small geometry.

Survey Results

Building: VSB Survey Unit: 1201 Survey Type: Structural Class: 2

<u>Location Code</u>	<u>Total Activity Measurements</u>		<u>Removable Activity Measurements</u>					
	<u>Activity</u>	<u>MDC</u>	<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>CH3</u>	<u>MDC</u>
VSB-1201-F1-V-001	313 +/- 1,433	2,643	0	44	12	26	1	37
VSB-1201-B1-M-002	104 +/- 1,403	2,643	0	44	2	26	1	37
VSB-1201-F1-V-003	522 +/- 1,462	2,643	2	44	11	26	2	37
VSB-1201-B1-M-004	731 +/- 1,490	2,643	0	44	3	26	0	37
VSB-1201-F1-M-005	-209 +/- 1,358	2,643	7	44	0	26	4	37
VSB-1201-F1-V-006	-104 +/- 1,373	2,643	0	44	16	26	1	37
VSB-1201-F1-V-007	104 +/- 1,403	2,643	12	44	3	26	0	37
VSB-1201-B1-M-008	-209 +/- 1,358	2,643	2	44	9	26	0	37
VSB-1201-F1-V-009	627 +/- 1,476	2,643	0	44	7	26	0	37
VSB-1201-F1-V-010	-209 +/- 1,358	2,643	3	44	0	26	2	37
VSB-1201-F1-V-011	209 +/- 1,418	2,643	13	44	0	26	0	37
VSB-1201-F1-V-012	-104 +/- 1,373	2,643	0	44	0	26	1	37
VSB-1201-F1-V-013	313 +/- 1,433	2,643	10	44	0	26	3	37
Static Count	13	Sample Count	13		13		13	
Average	161		4		5		1	
Minimum	-209		0		0		0	
Maximum	731		13		16		4	
Standard Deviation	326		5		6		1	

Total surface activity results are reported in net dpm/100 cm²

H-3, C-14 and CH3 Removable results reported in net dpm/100 cm².

Results above MDC are in bold print. Results above Investigation Levels are in red bold print.

Removable Activity: H-3 =2-18.6 keV, C-14 = 18.6-256 keV, Channel 3 = 256-2,000 keV.

Static measurements not performed inside drain and vacuum openings due to small geometry.

Survey Results

Building: VSB Survey Unit: 1301 Survey Type: Structural Class: 3

<u>Location Code</u>	<u>Total Activity Measurements</u>		<u>Removable Activity Measurements</u>					
	<u>Activity</u>	<u>MDC</u>	<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>CH3</u>	<u>MDC</u>
VSB-1301-F1-V-001	0 +/- 1,418	2,694	4	44	0	26	3	37
VSB-1301-F1-V-002	-313 +/- 1,373	2,694	0	44	0	26	1	37
VSB-1301-F1-M-003	1,775 +/- 1,650	2,694	0	44	0	26	2	37
VSB-1301-F1-V-004	-209 +/- 1,388	2,694	0	44	10	26	0	37
VSB-1301-F1-V-005	940 +/- 1,545	2,694	6	44	10	26	0	37
VSB-1301-F1-V-006	313 +/- 1,462	2,694	0	44	3	26	0	37
VSB-1301-F1-C-007	-104 +/- 1,403	2,694	5	44	0	26	0	37
VSB-1301-B1-M-008	418 +/- 1,476	2,694	8	44	0	26	2	37
VSB-1301-F1-C-009	313 +/- 1,462	2,694	0	44	5	26	0	37
VSB-1301-F1-C-010	313 +/- 1,462	2,694	0	44	6	26	0	37
VSB-1301-F1-V-011	1,358 +/- 1,599	2,694	13	44	2	26	4	37
VSB-1301-F1-V-012	-104 +/- 1,403	2,694	0	44	0	26	1	37
VSB-1301-F1-V-013	731 +/- 1,518	2,694	0	44	11	26	0	37
VSB-1301-F1-V-014	-522 +/- 1,342	2,694	22	44	1	26	0	37
Static Count	14	Sample Count	14		14		14	
Average	351		4		3		1	
Minimum	-522		0		0		0	
Maximum	1,775		22		11		4	
Standard Deviation	656		7		4		1	

Total surface activity results are reported in net dpm/100 cm²

H-3, C-14 and CH3 Removable results reported in net dpm/100 cm².

Results above MDC are in bold print. Results above Investigation Levels are in red bold print.

Removable Activity: H-3 =2-18.6 keV, C-14 = 18.6-256 keV, Channel 3 = 256-2,000 keV.

Static measurements not performed inside drain and vacuum openings due to small geometry.

Appendix G

Systems Final Status Survey Results

Survey Results

Building: VMD Survey Unit: DR01 Survey Type: System Class: System

<u>Location Code</u>	<u>Activity</u>	<u>MDC</u>	<u>Total Activity Measurements</u>		<u>Removable Activity Measurements</u>			
			<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>CH3</u>	<u>MDC</u>
VMD-DR01-D2-M-001	+/-		0	44	0	26	4	37
VMD-DR01-D1-M-002	+/-		0	44	4	26	0	37
VMD-DR01-D3-M-003	+/-		4	44	2	26	7	37
VMD-DR01-D3-M-004	+/-		6	44	0	26	1	37
VMD-DR01-D3-M-005	+/-		0	44	0	26	1	37
VMD-DR01-D2-M-006	+/-		0	44	5	26	0	37
VMD-DR01-D2-M-007	+/-		0	44	7	26	0	37
VMD-DR01-D2-M-008	+/-		0	44	0	26	4	37
VMD-DR01-D2-M-009	+/-		0	44	12	26	3	37
VMD-DR01-D3-M-010	+/-		12	44	7	26	1	37
VMD-DR01-D3-M-011	+/-		32	44	2	26	0	37
VMD-DR01-D3-M-012	+/-		7	44	0	26	0	37
VMD-DR01-D3-M-013	+/-		0	44	2	26	0	37
VMD-DR01-D3-M-014	+/-		0	44	1	26	7	37
VMD-DR01-D3-M-015	+/-		0	44	3	26	0	37
VMD-DR01-D2-M-016	+/-		6	44	0	26	2	37
VMD-DR01-D2-M-017	+/-		0	44	0	26	0	37
VMD-DR01-D2-M-018	+/-		15	44	0	26	2	37
VMD-DR01-D3-M-019	+/-		11	44	0	26	1	37
VMD-DR01-D2-M-020	+/-		12	44	0	26	0	37
VMD-DR01-D3-M-021	+/-		6	44	3	26	0	37
VMD-DR01-D2-M-022	+/-		13	44	3	26	4	37
VMD-DR01-D2-M-023	+/-		6	44	6	26	0	37
VMD-DR01-D2-M-024	+/-		0	44	6	26	2	37
VMD-DR01-D3-M-025	+/-		0	44	3	26	1	37
VMD-DR01-D3-M-026	+/-		0	44	0	26	0	37

Total surface activity results are reported in net dpm/100 cm²

H-3, C-14 and CH3 Removable results reported in net dpm/100 cm².

Results above MDC are in bold print. Results above Investigation Levels are in red bold print.

Removable Activity: H-3 =2-18.6 keV, C-14 = 18.6-256 keV, Channel 3 = 256-2,000 keV.

Static measurements not performed inside drain and vacuum openings due to small geometry.

Survey Results

Building: VMD Survey Unit: DR01 Survey Type: System Class: System

<u>Location Code</u>	<u>Activity</u>	<u>MDC</u>	<u>Total Activity Measurements</u>			<u>Removable Activity Measurements</u>			
			<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>CH3</u>	<u>MDC</u>	
VMD-DR01-D2-M-027	+/-		0	44	14	26	1	37	
VMD-DR01-D4-M-028	+/-		0	44	3	26	1	37	
VMD-DR01-D4-M-029	+/-		7	44	0	26	2	37	
VMD-DR01-D2-M-030	+/-		6	44	0	26	1	37	
VMD-DR01-D2-M-031	+/-		8	44	1	26	4	37	
VMD-DR01-D2-M-032	+/-		17	44	1	26	0	37	
VMD-DR01-D5-M-033	+/-		0	44	1	26	0	37	
VMD-DR01-D5-M-034	+/-		0	44	15	26	3	37	
VMD-DR01-D5-M-035	+/-		0	44	11	26	0	37	
VMD-DR01-D5-M-036	+/-		0	44	7	26	0	37	
VMD-DR01-D5-M-037	+/-		0	44	9	26	6	37	
VMD-DR01-D5-M-038	+/-		0	44	11	26	0	37	
VMD-DR01-D5-M-039	+/-		0	44	5	26	0	37	
VMD-DR01-D5-M-040	+/-		0	44	15	26	0	37	
VMD-DR01-D5-M-041	+/-		0	44	13	26	6	37	
Static Count			0	Sample Count			41		
Average						4			
Minimum						0			
Maximum						32			
Standard Deviation						7			

Total surface activity results are reported in net dpm/100 cm²

H-3, C-14 and CH3 Removable results reported in net dpm/100 cm².

Results above MDC are in bold print. Results above Investigation Levels are in red bold print.

Removable Activity: H-3 =2-18.6 keV, C-14 = 18.6-256 keV, Channel 3 = 256-2,000 keV.

Static measurements not performed inside drain and vacuum openings due to small geometry.

Survey Results

Building: VMD **Survey Unit:** VE01 **Survey Type:** System **Class:** System

<u>Location Code</u>	<u>Total Activity Measurements</u>		<u>Removable Activity Measurements</u>					
	<u>Activity</u>	<u>MDC</u>	<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>CH3</u>	<u>MDC</u>
VMD-VE01-E1-M-001	418 +/- 1,559	2,838	24	44	4	26	0	37
VMD-VE01-E1-M-002	209 +/- 1,532	2,838	9	44	4	26	2	37
VMD-VE01-E1-M-003	313 +/- 1,545	2,838	0	44	5	26	4	37
VMD-VE01-E1-M-004	-1,149 +/- 1,342	2,838	24	44	0	26	6	37
VMD-VE01-E1-M-005	1,044 +/- 1,476	2,540	8	44	7	26	3	37
VMD-VE01-E1-M-006	731 +/- 1,433	2,540	0	44	5	26	0	37
Static Count	6	Sample Count	6		6		6	
Average	261		11		4		2	
Minimum	-1,149		0		0		0	
Maximum	1,044		24		7		6	
Standard Deviation	755		11		2		2	

Total surface activity results are reported in net dpm/100 cm²

H-3, C-14 and CH3 Removable results reported in net dpm/100 cm².

Results above MDC are in bold print. Results above Investigation Levels are in red bold print.

Removable Activity: H-3 = 2-18.6 keV, C-14 = 18.6-256 keV, Channel 3 = 256-2,000 keV.

Static measurements not performed inside drain and vacuum openings due to small geometry.

Survey Results

Building: VMD Survey Unit: IN01 Survey Type: System Class: System

<u>Location Code</u>	<u>Total Activity Measurements</u>		<u>Removable Activity Measurements</u>					
	<u>Activity</u>	<u>MDC</u>	<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>CH3</u>	<u>MDC</u>
VMD-IN01-O1-R-001	8,919 +/- 1,113	1,607	16	44	1	26	0	37
VMD-IN01-O1-R-002	7,288 +/- 1,053	1,547	0	44	1	26	0	37
VMD-IN01-O1-R-003	3,932 +/- 1,018	1,604	10	44	11	26	0	37
VMD-IN01-O1-R-004	2,698 +/- 970	1,563	6	44	0	26	5	37
VMD-IN01-O1-R-005	2,729 +/- 947	1,520	0	44	6	26	2	37
VMD-IN01-O1-R-006	6,201 +/- 1,038	1,559	0	44	11	26	3	37
VMD-IN01-O1-R-007	6,483 +/- 826	1,121	0	44	3	26	0	37
VMD-IN01-O1-R-008	6,159 +/- 813	1,111	0	44	5	26	0	37
Static Count	8	Sample Count	8		8		8	
Average	5,551		4		5		1	
Minimum	2,698		0		0		0	
Maximum	8,919		16		11		5	
Standard Deviation	2,228		6		4		2	

Total surface activity results are reported in net dpm/100 cm²

H-3, C-14 and CH3 Removable results reported in net dpm/100 cm².

Results above MDC are in bold print. Results above Investigation Levels are in red bold print.

Removable Activity: H-3 = 2-18.6 keV, C-14 = 18.6-256 keV, Channel 3 = 256-2,000 keV.

Static measurements not performed inside drain and vacuum openings due to small geometry.

Survey Results

Building: VSB Survey Unit: DR01 Survey Type: System Class: System

<u>Location Code</u>	<u>Activity</u>	<u>MDC</u>	<u>Total Activity Measurements</u>		<u>Removable Activity Measurements</u>			
			<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>CH3</u>	<u>MDC</u>
VSF-DR01-D3-M-001	+/-		3	44	3	26	0	37
VSF-DR01-D3-M-002	+/-		0	44	5	26	0	37
VSF-DR01-D3-M-003	+/-		9	44	0	26	0	37
VSF-DR01-D3-M-004	+/-		0	44	2	26	2	37
VSF-DR01-D3-M-005	+/-		0	44	0	26	0	37
VSF-DR01-D3-M-006	+/-		9	44	2	26	0	37
VSF-DR01-D3-M-007	+/-		0	44	9	26	3	37
VSF-DR01-D1-M-008	+/-		5	44	0	26	5	37
VSF-DR01-D2-M-009	+/-		0	44	15	26	4	37
VSF-DR01-D1-M-010	+/-		14	44	0	26	4	37
VSF-DR01-D3-M-011	+/-		0	44	0	26	0	37
VSF-DR01-D3-M-012	+/-		0	44	1	26	6	37
VSF-DR01-D3-M-013	+/-		0	44	5	26	0	37
VSF-DR01-D3-M-014	+/-		0	44	6	26	5	37
VSF-DR01-D1-M-015	+/-		5	44	6	26	0	37
VSF-DR01-D3-M-016	+/-		14	44	1	26	0	37
VSF-DR01-D1-M-017	+/-		1	44	5	26	0	37
VSF-DR01-D3-M-018	+/-		19	44	0	26	0	37
VSF-DR01-D3-M-019	+/-		4	44	4	26	1	37
VSF-DR01-D3-M-020	+/-		33	44	3	26	0	37
VSF-DR01-D1-M-021	+/-		0	44	5	26	4	37
VSF-DR01-D3-M-022	+/-		1	44	0	26	0	37
VSF-DR01-D2-M-023	+/-		0	44	2	26	1	37
VSF-DR01-D2-M-024	+/-		8	44	0	26	1	37
VSF-DR01-D3-M-025	+/-		2	44	8	26	10	37
VSF-DR01-D3-M-026	+/-		3	44	1	26	0	37

Total surface activity results are reported in net dpm/100 cm²

H-3, C-14 and CH3 Removable results reported in net dpm/100 cm².

Results above MDC are in bold print. Results above Investigation Levels are in red bold print.

Removable Activity: H-3 = 2-18.6 keV, C-14 = 18.6-256 keV, Channel 3 = 256-2,000 keV.

Static measurements not performed inside drain and vacuum openings due to small geometry.

Survey Results

Building: VSB **Survey Unit:** DR01 **Survey Type:** System **Class:** System

<u>Location Code</u>	<u>Total Activity Measurements</u>		<u>Removable Activity Measurements</u>					
	<u>Activity</u>	<u>MDC</u>	<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>CH3</u>	<u>MDC</u>
VSB-DR01-D2-M-027	+/-		7	44	0	26	0	37
VSB-DR01-D3-M-028	+/-		4	44	11	26	0	37
VSB-DR01-D1-M-029	+/-		6	44	4	26	1	37
VSB-DR01-D3-M-030	+/-		0	44	5	26	0	37
VSB-DR01-D3-M-031	+/-		0	44	15	26	2	37
VSB-DR01-D3-M-032	+/-		0	44	6	26	0	37
VSB-DR01-D3-M-033	+/-		0	44	1	26	0	37
Static Count	0	Sample Count	33		33		33	
Average			4		4		1	
Minimum			0		0		0	
Maximum			33		15		10	
Standard Deviation			7		4		2	

Total surface activity results are reported in net dpm/100 cm²

H-3, C-14 and CH3 Removable results reported in net dpm/100 cm².

Results above MDC are in bold print. Results above Investigation Levels are in red bold print.

Removable Activity: H-3 = 2-18.6 keV, C-14 = 18.6-256 keV, Channel 3 = 256-2,000 keV.

Static measurements not performed inside drain and vacuum openings due to small geometry.

Survey Results

Building: VSB Survey Unit: VE01 Survey Type: System Class: System

<u>Location Code</u>	<u>Total Activity Measurements</u>		<u>Removable Activity Measurements</u>					
	<u>Activity</u>	<u>MDC</u>	<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>CH3</u>	<u>MDC</u>
VSB-VE01-E1-M-001	-104 +/- 1,403	2,694	15	44	0	26	0	37
VSB-VE01-E1-M-002	-627 +/- 1,326	2,694	6	44	1	26	0	37
VSB-VE01-E1-M-003	-627 +/- 1,326	2,694	0	44	7	26	0	37
VSB-VE01-E1-M-004	0 +/- 1,418	2,694	0	44	11	26	1	37
VSB-VE01-E1-M-005	-104 +/- 1,403	2,694	28	44	4	26	0	37
VSB-VE01-E1-M-006	731 +/- 1,518	2,694	0	44	17	26	3	37
VSB-VE01-E1-M-007	209 +/- 1,447	2,694	0	44	13	26	2	37
VSB-VE01-E1-M-008	-627 +/- 1,326	2,694	4	44	4	26	3	37
VSB-VE01-E1-M-009	104 +/- 1,433	2,694	0	44	16	26	0	37
VSB-VE01-E1-M-010	-104 +/- 1,403	2,694	1	44	6	26	2	37
VSB-VE01-E1-M-011	-104 +/- 1,403	2,694	7	44	0	26	1	37
VSB-VE01-E1-M-012	-522 +/- 1,342	2,694	6	44	6	26	9	37
Static Count	12	Sample Count	12		12		12	
Average	-148		6		7		2	
Minimum	-627		0		0		0	
Maximum	731		28		17		9	
Standard Deviation	407		8		6		3	

Total surface activity results are reported in net dpm/100 cm²

H-3, C-14 and CH3 Removable results reported in net dpm/100 cm².

Results above MDC are in bold print. Results above Investigation Levels are in red bold print.

Removable Activity: H-3 = 2-18.6 keV, C-14 = 18.6-256 keV, Channel 3 = 256-2,000 keV.

Static measurements not performed inside drain and vacuum openings due to small geometry.

Survey Results

Building: VSB Survey Unit: VA01 Survey Type: System Class: System

<u>Location Code</u>	<u>Activity</u>	<u>MDC</u>	<u>Total Activity Measurements</u>			<u>Removable Activity Measurements</u>		
			<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>CH3</u>	<u>MDC</u>
VSB-VA01-V1-M-001	+/-		6	44	0	26	5	37
VSB-VA01-V1-M-002	+/-		0	44	2	26	4	37
VSB-VA01-V1-M-003	+/-		12	44	1	26	1	37
VSB-VA01-V1-M-004	+/-		5	44	3	26	3	37
VSB-VA01-V1-M-005	+/-		0	44	6	26	5	37
VSB-VA01-V1-M-006	+/-		1	44	0	26	2	37
VSB-VA01-V1-M-007	+/-		3	44	12	26	9	37
VSB-VA01-V1-M-008	+/-		1	44	7	26	1	37
VSB-VA01-V1-M-009	+/-		5	44	5	26	3	37
VSB-VA01-V1-M-010	+/-		6	44	0	26	0	37
VSB-VA01-V1-M-011	+/-		10	44	0	26	2	37
VSB-VA01-V1-M-012	+/-		21	44	8	26	1	37
VSB-VA01-V1-M-013	+/-		4	44	9	26	5	37
VSB-VA01-V1-M-014	+/-		0	44	8	26	1	37
VSB-VA01-V1-M-015	+/-		3	44	0	26	1	37
VSB-VA01-V1-M-016	+/-		12	44	6	26	0	37
VSB-VA01-V1-M-017	+/-		6	44	0	26	6	37
VSB-VA01-V1-M-018	+/-		5	44	3	26	0	37
VSB-VA01-V1-M-019	+/-		0	44	5	26	0	37
VSB-VA01-V1-M-020	+/-		2	44	14	26	1	37
VSB-VA01-V1-M-021	+/-		16	44	1	26	1	37
VSB-VA01-V1-M-022	+/-		12	44	0	26	5	37
VSB-VA01-V1-M-023	+/-		0	44	14	26	0	37
VSB-VA01-V1-M-024	+/-		13	44	8	26	0	37
VSB-VA01-V1-M-025	+/-		9	44	0	26	5	37
VSB-VA01-V1-M-026	+/-		0	44	0	26	0	37

Total surface activity results are reported in net dpm/100 cm²

H-3, C-14 and CH3 Removable results reported in net dpm/100 cm².

Results above MDC are in bold print. Results above Investigation Levels are in red bold print.

Removable Activity: H-3 = 2-18.6 keV, C-14 = 18.6-256 keV, Channel 3 = 256-2,000 keV.

Static measurements not performed inside drain and vacuum openings due to small geometry.

Survey Results

Building: VSB **Survey Unit:** VA01 **Survey Type:** System **Class:** System

<u>Location Code</u>	<u>Total Activity Measurements</u>		<u>Removable Activity Measurements</u>					
	<u>Activity</u>	<u>MDC</u>	<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>CH3</u>	<u>MDC</u>
VSB-VA01-V1-M-027	+/-		0	44	5	26	0	37
VSB-VA01-V1-M-028	+/-		0	44	7	26	0	37
VSB-VA01-V1-M-029	+/-		15	44	0	26	4	37
VSB-VA01-V1-M-030	+/-		5	44	4	26	5	37
VSB-VA01-V1-M-031	+/-		0	44	3	26	1	37
VSB-VA01-V1-M-032	+/-		15	44	4	26	0	37
VSB-VA01-V1-M-033	+/-		4	44	3	26	6	37
VSB-VA01-V2-M-034	+/-		32	44	0	26	3	37
Static Count	0		Sample Count	34		34		34
Average				7		4		2
Minimum				0		0		0
Maximum				32		14		9
Standard Deviation				7		4		2

Total surface activity results are reported in net dpm/100 cm²

H-3, C-14 and CH3 Removable results reported in net dpm/100 cm².

Results above MDC are in bold print. Results above Investigation Levels are in red bold print.

Removable Activity: H-3 = 2-18.6 keV, C-14 = 18.6-256 keV, Channel 3 = 256-2,000 keV.

Static measurements not performed inside drain and vacuum openings due to small geometry.

Appendix H

Quality Assurance Survey Results

Survey Results

Building: VMD Survey Unit: QA01 Survey Type: QA Class: QA

<u>Location Code</u>	<u>Total Activity Measurements</u>		<u>Removable Activity Measurements</u>					
	<u>Activity</u>	<u>MDC</u>	<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>CH3</u>	<u>MDC</u>
VMD-QA01-F1-V-001	-218 +/- 1,885	3,530	9	44	0	26	0	37
VMD-QA01-F1-C-002	1,044 +/- 1,476	2,540	0	44	2	26	0	37
VMD-QA01-F1-V-003	-209 +/- 1,294	2,540	0	44	8	26	2	37
VMD-QA01-F1-C-004	2,297 +/- 1,637	2,540	3	44	0	26	0	37
VMD-QA01-F1-M-005	2,395 +/- 1,956	3,147	0	44	13	26	1	37
Static Count	5	Sample Count	5		5		5	
Average	1,062		2		5		1	
Minimum	-218		0		0		0	
Maximum	2,395		9		13		2	
Standard Deviation	1,280		4		6		1	

Total surface activity results are reported in net dpm/100 cm²

H-3, C-14 and CH3 Removable results reported in net dpm/100 cm².

Results above MDC are in bold print. Results above Investigation Levels are in red bold print.

Removable Activity: H-3 = 2-18.6 keV, C-14 = 18.6-256 keV, Channel 3 = 256-2,000 keV.

Static measurements not performed inside drain and vacuum openings due to small geometry.

Survey Results

Building: VSB **Survey Unit:** QA01 **Survey Type:** QA **Class:** QA

<u>Location Code</u>	<u>Total Activity Measurements</u>		<u>Removable Activity Measurements</u>					
	<u>Activity</u>	<u>MDC</u>	<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>CH3</u>	<u>MDC</u>
VSB-QA01-F1-V-001	980 +/- 1,823	3,192	15	44	3	26	2	37
VSB-QA01-F1-V-002	435 +/- 1,760	3,192	0	44	0	26	1	37
Static Count	2	Sample Count	2		2		2	
Average	708		8		2		1	
Minimum	435		0		0		1	
Maximum	980		15		3		2	
Standard Deviation	385		11		2		1	

Total surface activity results are reported in net dpm/100 cm²

H-3, C-14 and CH3 Removable results reported in net dpm/100 cm².

Results above MDC are in bold print. Results above Investigation Levels are in red bold print.

Removable Activity: H-3 =2-18.6 keV, C-14 = 18.6-256 keV, Channel 3 = 256-2,000 keV.

Static measurements not performed inside drain and vacuum openings due to small geometry.

Appendix I
Laboratory Analytical Reports



Dave Culp
Chase Environmental Group, Inc.
300 Sam Rayburn Parkway

Lenoir City, TN 37771

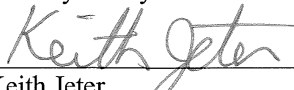
Report of Analysis/Certificate of Conformance

02/16/2024
LIMS #: L103923
Project ID#: CH085-3EMUVMDL-24
Received: 01/17/2024
Delivery Date: 02/16/2024
P.O.#: C2309046-010924
Release #:
SDG#:

This is to certify that Teledyne Brown Engineering - Environmental Services located at 2508 Quality Lane, Knoxville, Tennessee, 37931, has analyzed, tested and documented samples, as received by the laboratory, as specified in the applicable purchase order.

This also certifies that requirements of applicable codes, standards and specifications have been fully met and that any quality assurance documentation which verified conformance to the purchase order is on file and may be examined upon request.

I hereby certify that the above statements are true and correct.



Keith Jeter
Operations Manager

Cross Reference Table

Client ID	Laboratory ID	Station ID (if applicable)
VMDL-IN-UPPER	L103923-1	
VMDL-IN-LOWER	L103923-2	
VMDL-IN-STACK	L103923-3	



Method Reference Numbers

Matrix	Analysis	Method Reference
S	GAMMA	EPA 901.1

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Report of Analysis

02/16/24 14:31

L103923

Chase Environmental Group, Inc.
 CH085-3EMUVMDL-24



Dave Culp

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2002	-1.27E+00	4.31E-01	8.32E-01	pCi/g		2.0739	g wet	01/09/24 14:20	02/12/24	20	M U	
H-3	2003	3.23E-01	6.26E-01	9.99E-01	pCi/g		2.0739	g wet	01/09/24 14:20	02/12/24	30	M U	
K-40	2007	6.61E+01	4.03E+00	1.02E+00	pCi/g Dry		224.7	g dry	01/09/24 14:20	02/09/24	3600	Sec +	Yes
CO-60	2007	-1.59E-02	8.90E-02	1.47E-01	pCi/g Dry		224.7	g dry	01/09/24 14:20	02/09/24	3600	Sec U	No
CS-137	2007	3.59E-02	8.91E-02	1.50E-01	pCi/g Dry		224.7	g dry	01/09/24 14:20	02/09/24	3600	Sec U	No
TL-208	2007	1.29E+00	4.46E-01	4.07E-01	pCi/g Dry		224.7	g dry	01/09/24 14:20	02/09/24	3600	Sec +	Yes
PB-212	2007	1.76E+00	3.12E-01	2.18E-01	pCi/g Dry		224.7	g dry	01/09/24 14:20	02/09/24	3600	Sec +	Yes
BI-214	2007	1.24E+00	9.10E-01	1.64E+00	pCi/g Dry		224.7	g dry	01/09/24 14:20	02/09/24	3600	Sec U	No
BI-212	2007	1.07E+00	1.21E+00	2.09E+00	pCi/g Dry		224.7	g dry	01/09/24 14:20	02/09/24	3600	Sec U	No
PB-214	2007	1.15E+00	2.59E-01	2.81E-01	pCi/g Dry		224.7	g dry	01/09/24 14:20	02/09/24	3600	Sec +	Yes
RA-226	2007	2.96E+00	1.92E+00	3.42E+00	pCi/g Dry		224.7	g dry	01/09/24 14:20	02/09/24	3600	Sec U	No
AC-228	2007	1.57E+00	7.06E-01	5.50E-01	pCi/g Dry		224.7	g dry	01/09/24 14:20	02/09/24	3600	Sec +	Yes
RA-228	2007	1.44E+00	7.60E-01	1.40E+00	pCi/g Dry		224.7	g dry	01/09/24 14:20	02/09/24	3600	Sec U*	No
TH-228	2007	1.76E+00	3.12E-01	2.18E-01	pCi/g Dry		224.7	g dry	01/09/24 14:20	02/09/24	3600	Sec +	Yes
TH-232	2007	1.55E+00	6.98E-01	5.44E-01	pCi/g Dry		224.7	g dry	01/09/24 14:20	02/09/24	3600	Sec +	Yes
TH-234	2007	-1.34E+00	3.93E+00	6.40E+00	pCi/g Dry		224.7	g dry	01/09/24 14:20	02/09/24	3600	Sec U	No
U-235	2007	-2.60E-01	5.43E-01	8.95E-01	pCi/g Dry		224.7	g dry	01/09/24 14:20	02/09/24	3600	Sec U	No
U-238	2007	4.93E+00	1.04E+01	1.78E+01	pCi/g Dry		224.7	g dry	01/09/24 14:20	02/09/24	3600	Sec U Spec	No

Flag Values

- U = Compound/Analyte not detected (< MDC) or less than 3 sigma
- + = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- U* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- L = Low recovery
- H = High recovery

- No = Peak not identified in gamma spectrum
- Yes = Peak identified in gamma spectrum

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MDC - Minimum Detectable Concentration

Bolded text indicates reportable value.

Report of Analysis

02/16/24 14:31

L103923

Chase Environmental Group, Inc.
 CH085-3EMUVMDL-24



Dave Culp

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2002	-3.80E-01	4.65E-01	8.00E-01	pCi/g		2.1558	g wet	01/09/24 14:35	02/12/24	20	M U	
H-3	2003	3.82E-01	6.06E-01	9.61E-01	pCi/g		2.1558	g wet	01/09/24 14:35	02/12/24	30	M U	
K-40	2007	1.10E+02	5.71E+00	1.27E+00	pCi/g Dry		220.1	g dry	01/09/24 14:35	02/09/24	3600	Sec +	Yes
CO-60	2007	5.35E-02	1.05E-01	1.85E-01	pCi/g Dry		220.1	g dry	01/09/24 14:35	02/09/24	3600	Sec U	No
CS-137	2007	1.25E-01	1.03E-01	1.83E-01	pCi/g Dry		220.1	g dry	01/09/24 14:35	02/09/24	3600	Sec U	No
TL-208	2007	2.47E+00	4.34E-01	4.18E-01	pCi/g Dry		220.1	g dry	01/09/24 14:35	02/09/24	3600	Sec +	Yes
PB-212	2007	2.47E+00	2.25E-01	1.98E-01	pCi/g Dry		220.1	g dry	01/09/24 14:35	02/09/24	3600	Sec +	Yes
BI-214	2007	1.84E+00	3.95E-01	1.84E+00	pCi/g Dry		220.1	g dry	01/09/24 14:35	02/09/24	3600	Sec U	Yes
BI-212	2007	1.56E+00	1.34E+00	2.35E+00	pCi/g Dry		220.1	g dry	01/09/24 14:35	02/09/24	3600	Sec U	No
PB-214	2007	1.77E+00	2.93E-01	2.54E-01	pCi/g Dry		220.1	g dry	01/09/24 14:35	02/09/24	3600	Sec +	Yes
RA-224	2007	7.52E+00	3.16E+00	2.25E+00	pCi/g Dry		220.1	g dry	01/09/24 14:35	02/09/24	3600	Sec +	Yes
RA-226	2007	2.93E+00	1.82E+00	3.16E+00	pCi/g Dry		220.1	g dry	01/09/24 14:35	02/09/24	3600	Sec U	No
AC-228	2007	2.34E+00	6.73E-01	6.48E-01	pCi/g Dry		220.1	g dry	01/09/24 14:35	02/09/24	3600	Sec +	Yes
RA-228	2007	2.75E+00	8.43E-01	1.33E+00	pCi/g Dry		220.1	g dry	01/09/24 14:35	02/09/24	3600	Sec +	Yes
TH-228	2007	2.47E+00	2.25E-01	1.98E-01	pCi/g Dry		220.1	g dry	01/09/24 14:35	02/09/24	3600	Sec +	Yes
TH-232	2007	2.32E+00	6.66E-01	6.42E-01	pCi/g Dry		220.1	g dry	01/09/24 14:35	02/09/24	3600	Sec +	Yes
TH-234	2007	2.07E-02	4.51E+00	7.75E+00	pCi/g Dry		220.1	g dry	01/09/24 14:35	02/09/24	3600	Sec U	No
U-235	2007	-4.05E-01	4.71E-01	7.27E-01	pCi/g Dry		220.1	g dry	01/09/24 14:35	02/09/24	3600	Sec U	No
U-238	2007	2.67E+00	1.27E+01	2.11E+01	pCi/g Dry		220.1	g dry	01/09/24 14:35	02/09/24	3600	Sec U	Spec No

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- H = High recovery

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- Yes = Peak identified in gamma spectrum

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MDC - Minimum Detectable Concentration

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Report of Analysis

02/16/24 14:31

L103923

Chase Environmental Group, Inc.
 CH085-3EMUVMDL-24



Dave Culp

Sample ID: VMDL-IN-STACK	Collect Start: 01/09/2024 14:50	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 01/17/2024	% Moisture: .78	
LIMS Number: L103923-3			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2002	-4.96E-01	4.32E-01	7.57E-01	pCi/g		2.2778	g wet	01/09/24 14:50	02/12/24	20	M U	
H-3	2003	1.08E-01	5.59E-01	9.09E-01	pCi/g		2.2778	g wet	01/09/24 14:50	02/12/24	30	M U	
K-40	2007	1.43E+02	7.57E+00	1.71E+00	pCi/g Dry		159.6	g dry	01/09/24 14:50	02/09/24	3600	Sec +	Yes
CO-60	2007	8.47E-02	1.24E-01	2.27E-01	pCi/g Dry		159.6	g dry	01/09/24 14:50	02/09/24	3600	Sec U	No
CS-137	2007	4.51E-01	2.28E-01	1.53E-01	pCi/g Dry		159.6	g dry	01/09/24 14:50	02/09/24	3600	Sec +	Yes
TL-208	2007	1.29E+00	5.27E-01	5.44E-01	pCi/g Dry		159.6	g dry	01/09/24 14:50	02/09/24	3600	Sec +	Yes
PB-212	2007	1.17E+00	2.96E-01	2.52E-01	pCi/g Dry		159.6	g dry	01/09/24 14:50	02/09/24	3600	Sec +	Yes
BI-214	2007	7.22E-01	3.31E-01	2.08E+00	pCi/g Dry		159.6	g dry	01/09/24 14:50	02/09/24	3600	Sec U	Yes
BI-212	2007	1.34E+00	1.59E+00	2.85E+00	pCi/g Dry		159.6	g dry	01/09/24 14:50	02/09/24	3600	Sec U	No
PB-214	2007	5.53E-01	2.56E-01	3.04E-01	pCi/g Dry		159.6	g dry	01/09/24 14:50	02/09/24	3600	Sec +	Yes
RA-226	2007	2.60E+00	1.79E+00	3.22E+00	pCi/g Dry		159.6	g dry	01/09/24 14:50	02/09/24	3600	Sec U	No
AC-228	2007	2.03E+00	8.78E-01	7.18E-01	pCi/g Dry		159.6	g dry	01/09/24 14:50	02/09/24	3600	Sec +	Yes
RA-228	2007	1.85E+00	1.02E+00	1.92E+00	pCi/g Dry		159.6	g dry	01/09/24 14:50	02/09/24	3600	Sec U	No
TH-228	2007	1.17E+00	2.96E-01	2.52E-01	pCi/g Dry		159.6	g dry	01/09/24 14:50	02/09/24	3600	Sec +	Yes
TH-232	2007	2.01E+00	8.69E-01	7.11E-01	pCi/g Dry		159.6	g dry	01/09/24 14:50	02/09/24	3600	Sec +	Yes
TH-234	2007	5.11E-01	2.98E+00	4.78E+00	pCi/g Dry		159.6	g dry	01/09/24 14:50	02/09/24	3600	Sec U	No
U-235	2007	4.48E-01	4.66E-01	8.21E-01	pCi/g Dry		159.6	g dry	01/09/24 14:50	02/09/24	3600	Sec U	No
U-238	2007	1.02E+01	1.52E+01	2.66E+01	pCi/g Dry		159.6	g dry	01/09/24 14:50	02/09/24	3600	Sec U Spec	No

Flag Values

- U = Compound/Analyte not detected (< MDC) or less than 3 sigma
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- Spec = MDC exceeds customer technical specification
- L = Low recovery
- H = High recovery

- No = Peak not identified in gamma spectrum
- Yes = Peak identified in gamma spectrum

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MDC - Minimum Detectable Concentration

Bolded text indicates reportable value.

01/24/24 15:25
 SR #: SR82219

Teledyne Brown Engineering
 Sample Receipt Verification/Variance Report

Client: CHASE ENVIRONMENTAL GROUP INC Project #: CH085-3EMUVMDL-24 LIMS #L103923

Initiated By: KNOXLAB Init Date: 01/17/24 Receive Date: 01/17/24

Notification of Variance	
Person Notified:	Contacted By:
Notify Date:	
Notify Method:	
Notify Comment:	

Client Response	
Person Responding:	
Response Date:	
Response Method:	
Response Comment:	

Criteria	Yes No NA	Comment
1 Shipping container custody seals present and intact.	NA	
2 Sample container custody seals present and intact.	NA	
3 Sample containers received in good condition.	Y	
4 Chain of custody received with samples.	Y	
5 All samples listed on chain of custody received.	Y	
6 Sample container labels present and legible.	Y	
7 Information on container labels correspond with chain of custody.	Y	
8 Sample(s) properly preserved.	Y	
9 Sample(s) appropriate container(s).	Y	
10 Other. (Describe)	NA	
For Hazardous Materials Only:		
11 Paperwork shows TBE and shippers name, address and phone number.	NA	
12 Paperwork shows sample quantity information.	NA	



Dave Culp
Chase Environmental Group, Inc.
300 Sam Rayburn Parkway

Lenoir City, TN 37771

Report of Analysis/Certificate of Conformance

02/16/2024

LIMS #: L103922

Project ID#: CH085-3EMUVMDL-24

Received: 01/17/2024

Delivery Date: 02/16/2024

P.O.#: C2309046-011024

Release #:

SDG#:

This is to certify that Teledyne Brown Engineering - Environmental Services located at 2508 Quality Lane, Knoxville, Tennessee, 37931, has analyzed, tested and documented samples, as received by the laboratory, as specified in the applicable purchase order.

This also certifies that requirements of applicable codes, standards and specifications have been fully met and that any quality assurance documentation which verified conformance to the purchase order is on file and may be examined upon request.

I hereby certify that the above statements are true and correct.



Keith Jeter
Operations Manager

Cross Reference Table

Client ID	Laboratory ID	Station ID (if applicable)
VMDL-SO-1	L103922-1	
VMDL-SO-2	L103922-2	
VMDL-SO-3	L103922-3	



Method Reference Numbers

Matrix	Analysis	Method Reference
S	GAMMA	EPA 901.1

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Report of Analysis

02/16/24 14:31

L103922

Chase Environmental Group, Inc.
 CH085-3EMUVMDL-24



Dave Culp

Sample ID: VMDL-SO-1	Collect Start: 01/10/2024 14:50	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 01/17/2024	% Moisture: 23.53	
LIMS Number: L103922-1			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2002	5.22E-01	5.11E-01	7.97E-01	pCi/g		2.1635	g wet	01/10/24 14:50	02/12/24	20	M U	
H-3	2003	2.83E-01	5.98E-01	9.57E-01	pCi/g		2.1635	g wet	01/10/24 14:50	02/12/24	30	M U	
K-40	2007	1.46E+01	1.73E+00	7.34E-01	pCi/g Dry		249.7	g dry	01/10/24 14:50	02/09/24	3600	Sec +	Yes
CO-60	2007	1.55E-02	3.30E-02	7.07E-02	pCi/g Dry		249.7	g dry	01/10/24 14:50	02/09/24	3600	Sec U	No
CS-137	2007	4.47E-02	3.63E-02	7.80E-02	pCi/g Dry		249.7	g dry	01/10/24 14:50	02/09/24	3600	Sec U	No
TL-208	2007	1.12E+00	2.71E-01	1.36E-01	pCi/g Dry		249.7	g dry	01/10/24 14:50	02/09/24	3600	Sec +	Yes
PB-212	2007	1.15E+00	1.72E-01	1.33E-01	pCi/g Dry		249.7	g dry	01/10/24 14:50	02/09/24	3600	Sec +	Yes
BI-214	2007	6.34E-01	4.22E-01	8.63E-01	pCi/g Dry		249.7	g dry	01/10/24 14:50	02/09/24	3600	Sec U	No
BI-212	2007	4.53E-01	4.96E-01	1.01E+00	pCi/g Dry		249.7	g dry	01/10/24 14:50	02/09/24	3600	Sec U	No
PB-214	2007	1.05E+00	1.55E-01	9.99E-02	pCi/g Dry		249.7	g dry	01/10/24 14:50	02/09/24	3600	Sec +	Yes
RA-224	2007	2.49E+00	1.21E+00	1.50E+00	pCi/g Dry		249.7	g dry	01/10/24 14:50	02/09/24	3600	Sec +	Yes
RA-226	2007	9.53E-01	8.89E-01	1.70E+00	pCi/g Dry		249.7	g dry	01/10/24 14:50	02/09/24	3600	Sec U	No
AC-228	2007	1.24E+00	3.66E-01	2.13E-01	pCi/g Dry		249.7	g dry	01/10/24 14:50	02/09/24	3600	Sec +	Yes
RA-228	2007	1.11E+00	5.47E-01	4.76E-01	pCi/g Dry		249.7	g dry	01/10/24 14:50	02/09/24	3600	Sec +	Yes
TH-228	2007	1.15E+00	1.72E-01	1.33E-01	pCi/g Dry		249.7	g dry	01/10/24 14:50	02/09/24	3600	Sec +	Yes
TH-232	2007	1.23E+00	3.63E-01	2.11E-01	pCi/g Dry		249.7	g dry	01/10/24 14:50	02/09/24	3600	Sec +	Yes
TH-234	2007	8.10E-01	1.14E+00	2.21E+00	pCi/g Dry		249.7	g dry	01/10/24 14:50	02/09/24	3600	Sec U	No
U-235	2007	1.40E-01	2.08E-01	3.88E-01	pCi/g Dry		249.7	g dry	01/10/24 14:50	02/09/24	3600	Sec U	No
U-238	2007	3.10E+00	4.18E+00	8.82E+00	pCi/g Dry		249.7	g dry	01/10/24 14:50	02/09/24	3600	Sec U	Spec No

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- +
- U* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
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Report of Analysis

02/16/24 14:31

L103922

Chase Environmental Group, Inc.
 CH085-3EMUVMDL-24



Dave Culp

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2002	3.81E+00	7.06E-01	8.72E-01	pCi/g		1.9777	g wet	01/10/24 15:10	02/12/24	20	M	+
H-3	2003	1.19E-01	5.43E-01	8.85E-01	pCi/g		1.9777	g wet	01/10/24 15:10	02/12/24	50	M	U
K-40	2007	1.06E+01	1.73E+00	5.07E-01	pCi/g Dry		246.6	g dry	01/10/24 15:10	02/09/24	3600	Sec	+ Yes
CO-60	2007	-3.69E-02	5.08E-02	6.88E-02	pCi/g Dry		246.6	g dry	01/10/24 15:10	02/09/24	3600	Sec	U No
CS-137	2007	4.22E-02	6.68E-02	1.15E-01	pCi/g Dry		246.6	g dry	01/10/24 15:10	02/09/24	3600	Sec	U No
TL-208	2007	9.10E-01	2.47E-01	2.40E-01	pCi/g Dry		246.6	g dry	01/10/24 15:10	02/09/24	3600	Sec	+ Yes
PB-212	2007	9.49E-01	1.46E-01	1.67E-01	pCi/g Dry		246.6	g dry	01/10/24 15:10	02/09/24	3600	Sec	+ Yes
BI-214	2007	9.63E-01	2.42E-01	1.13E+00	pCi/g Dry		246.6	g dry	01/10/24 15:10	02/09/24	3600	Sec	U Yes
BI-212	2007	1.30E+00	7.69E-01	1.52E+00	pCi/g Dry		246.6	g dry	01/10/24 15:10	02/09/24	3600	Sec	U No
PB-214	2007	9.83E-01	1.74E-01	1.68E-01	pCi/g Dry		246.6	g dry	01/10/24 15:10	02/09/24	3600	Sec	+ Yes
RA-226	2007	1.46E+00	1.07E+00	1.98E+00	pCi/g Dry		246.6	g dry	01/10/24 15:10	02/09/24	3600	Sec	U No
AC-228	2007	1.01E+00	3.51E-01	2.23E-01	pCi/g Dry		246.6	g dry	01/10/24 15:10	02/09/24	3600	Sec	+ Yes
RA-228	2007	1.34E+00	4.80E-01	6.53E-01	pCi/g Dry		246.6	g dry	01/10/24 15:10	02/09/24	3600	Sec	+ Yes
TH-228	2007	9.49E-01	1.46E-01	1.67E-01	pCi/g Dry		246.6	g dry	01/10/24 15:10	02/09/24	3600	Sec	+ Yes
TH-232	2007	1.00E+00	3.47E-01	2.21E-01	pCi/g Dry		246.6	g dry	01/10/24 15:10	02/09/24	3600	Sec	+ Yes
TH-234	2007	3.80E-01	4.71E+00	7.87E+00	pCi/g Dry		246.6	g dry	01/10/24 15:10	02/09/24	3600	Sec	U No
U-235	2007	-1.89E-01	2.77E-01	4.52E-01	pCi/g Dry		246.6	g dry	01/10/24 15:10	02/09/24	3600	Sec	U No
U-238	2007	3.55E+00	6.92E+00	1.21E+01	pCi/g Dry		246.6	g dry	01/10/24 15:10	02/09/24	3600	Sec	U Spec No

Flag Values

- U = Compound/Analyte not detected (< MDC) or less than 3 sigma
- + = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
- U* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- L = Low recovery
- H = High recovery

- No = Peak not identified in gamma spectrum
- Yes = Peak identified in gamma spectrum

**** Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

Bolded text indicates reportable value.

Report of Analysis

02/16/24 14:31

L103922

Chase Environmental Group, Inc.
 CH085-3EMUVMDL-24



Dave Culp

Sample ID: VMDL-SO-3	Collect Start: 01/10/2024 15:25	Matrix: Soil	(S)
Station:	Collect Stop:	Volume:	
Description:	Receive Date: 01/17/2024	% Moisture: 21.96	
LIMS Number: L103922-3			

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2002	-3.22E-01	4.80E-01	8.19E-01	pCi/g		2.1055	g wet	01/10/24 15:25	02/12/24	20	M U	
H-3	2003	-6.15E-02	5.93E-01	9.83E-01	pCi/g		2.1055	g wet	01/10/24 15:25	02/12/24	30	M U	
K-40	2007	6.24E+00	8.76E-01	4.40E-01	pCi/g Dry		329.5	g dry	01/10/24 15:25	02/16/24	6198	Sec +	Yes
CO-60	2007	1.73E-02	2.58E-02	4.70E-02	pCi/g Dry		329.5	g dry	01/10/24 15:25	02/16/24	6198	Sec U	No
CS-137	2007	9.22E-03	2.60E-02	4.38E-02	pCi/g Dry		329.5	g dry	01/10/24 15:25	02/16/24	6198	Sec U	No
TL-208	2007	2.26E-01	1.01E-01	1.00E-01	pCi/g Dry		329.5	g dry	01/10/24 15:25	02/16/24	6198	Sec +	Yes
PB-212	2007	1.82E-01	6.37E-02	7.84E-02	pCi/g Dry		329.5	g dry	01/10/24 15:25	02/16/24	6198	Sec +	Yes
BI-214	2007	4.53E-01	8.46E-02	4.12E-01	pCi/g Dry		329.5	g dry	01/10/24 15:25	02/16/24	6198	Sec +	Yes
BI-212	2007	1.66E-01	3.30E-01	5.60E-01	pCi/g Dry		329.5	g dry	01/10/24 15:25	02/16/24	6198	Sec U	No
PB-214	2007	4.08E-01	8.88E-02	7.51E-02	pCi/g Dry		329.5	g dry	01/10/24 15:25	02/16/24	6198	Sec +	Yes
RA-226	2007	6.68E-01	7.81E-01	7.94E-01	pCi/g Dry		329.5	g dry	01/10/24 15:25	02/16/24	6198	Sec U	Yes
RA-228	2007	1.41E-01	1.85E-01	3.27E-01	pCi/g Dry		329.5	g dry	01/10/24 15:25	02/16/24	6198	Sec U	No
TH-232	2007	1.04E-01	1.17E-01	2.14E-01	pCi/g Dry		329.5	g dry	01/10/24 15:25	02/16/24	6198	Sec U	No
TH-234	2007	3.22E-01	5.63E-01	2.55E+00	pCi/g Dry		329.5	g dry	01/10/24 15:25	02/16/24	6198	Sec U	Yes
U-235	2007	-3.52E-02	1.47E-01	2.35E-01	pCi/g Dry		329.5	g dry	01/10/24 15:25	02/16/24	6198	Sec U	No
U-238	2007	4.63E+00	3.10E+00	5.87E+00	pCi/g Dry		329.5	g dry	01/10/24 15:25	02/16/24	6198	Sec U	Spec No

Flag Values

- U = Compound/Analyte not detected (< MDC) or less than 3 sigma
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- High = Activity concentration exceeds customer reporting value
- Spec = MDC exceeds customer technical specification
- L = Low recovery
- H = High recovery


- No = Peak not identified in gamma spectrum
- Yes = Peak identified in gamma spectrum

**** Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

Bolded text indicates reportable value.

L103922

Page: 1 of 1 Project #: C2309046 COC Number ⁽¹⁾ : C2309046-011024		 Chase Environmental Group, Inc.		Laboratory Information Name: Teledyne Brown Engineering, Inc. Street: 2508 Quality Ln City/State/Zip: Knoxville, TN 37931 Phone: (865) 690-6819		
Chase P.O.C: Dave Culp Phone: 865-207-3664 e-mail: dculp@chaseenv.com			Sample Analysis Requested ⁽⁵⁾ (Fill in the number of containers for each test)			
Project/Site Name: MU VMDL			Should this sample be considered:	Total number of containers	<-- Preservative Type (3)	
Address: University of Missouri, Columbia, MO 65201			Routine TSCA Regulated	Gamma Spectroscopy C-14 H-3	Comments Note: extra sample is required for sample specific QC	
Collected by (print/sign): Dave Culp / <i>dc</i>			Sample ID <small>* For composites - indicate start and stop date/time</small>	*Date Collected (mm-dd-yy)		*Time Collected (Military) (hhmm)
QC Code ⁽³⁾	Sample Matrix ⁽⁴⁾	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
VMDL-SO-1	01-10-24	1450	N	SO		X
VMDL-SO-2	01-10-24	1510	N	SO		X
VMDL-SO-3	01-10-24	1525	N	SO		X
TAT Requested: Normal: <input checked="" type="checkbox"/> Rush: _____ Specify: _____	Fax Results: Yes / <input checked="" type="checkbox"/> No	Circle Deliverable: C of A / QC Summary / Level 1 / Level 2 / Level 3 / Level 4				
Remarks: Are there any known hazards applicable to these samples? If so, list the hazards.						Sample Collection Time Zone Eastern Pacific Central Other _____ Mountain
Count for an MDC of ≤ 1 pCi/g C-14, H-3, and Gamma Spectroscopy. Standard TAT.						
Chain of Custody Signatures			Sample Shipping and Delivery Details			
Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time	
1 <i>dc</i>	1-15-24	0952	1 <i>mg</i>	1-15-24	0952	
2 <i>mg</i>	1-17-24	1011	2 <i>lank</i>	1-17-24	1017	
3	3	3	3	3	3	
			Laboratory PM:			
			Method of Shipment:	Date Shipped:		
			Airbill #:			
			Airbill #:			
1.) Chain of Custody Number = See Procedure 2.) QC Codes: N = Normal Sample, TB = Trip Blank, FD = Field Duplicate, EB = Equipment Blank, MS = Matrix Spike Sample, MSD = Matrix Spike Duplicate Sample, G = Grab, C = Composite 3.) Preservative Type: HA = Hydrochloric Acid, NI = Nitric Acid, SH = Sodium Hydroxide, SA = Sulfuric Acid, AA = Ascorbic Acid, HX = Hexane, ST = Sodium Thiosulfate, If no preservative is added = leave field blank 4.) Matrix Codes: DW=Drinking Water, GW=Groundwater, SW=Surface Water, WW=Waste Water, W=Water, ML=Misc Liquid, SO=Soil, SD=Sediment, SL=Sludge, SS=Solid Waste, O=Oil, F=Filter, P=Wipe, U=Urine, F=Fecal, N=Nasal 5.) Sample Analysis Requested: Analytical method requested (i.e. 8260B, 6010B/7470A) and number of containers provided for each (i.e. 8260B - 3, 6010B/7470A - 1).					For Lab Receiving Use Only Custody Seal Intact? YES NO Cooler Temp:	

01/24/24 15:24
 SR #: SR82218

Teledyne Brown Engineering
 Sample Receipt Verification/Variance Report

Client: CHASE ENVIRONMENTAL GROUP INC Project #: CH085-3EMUVMDL-24 LIMS #L103922

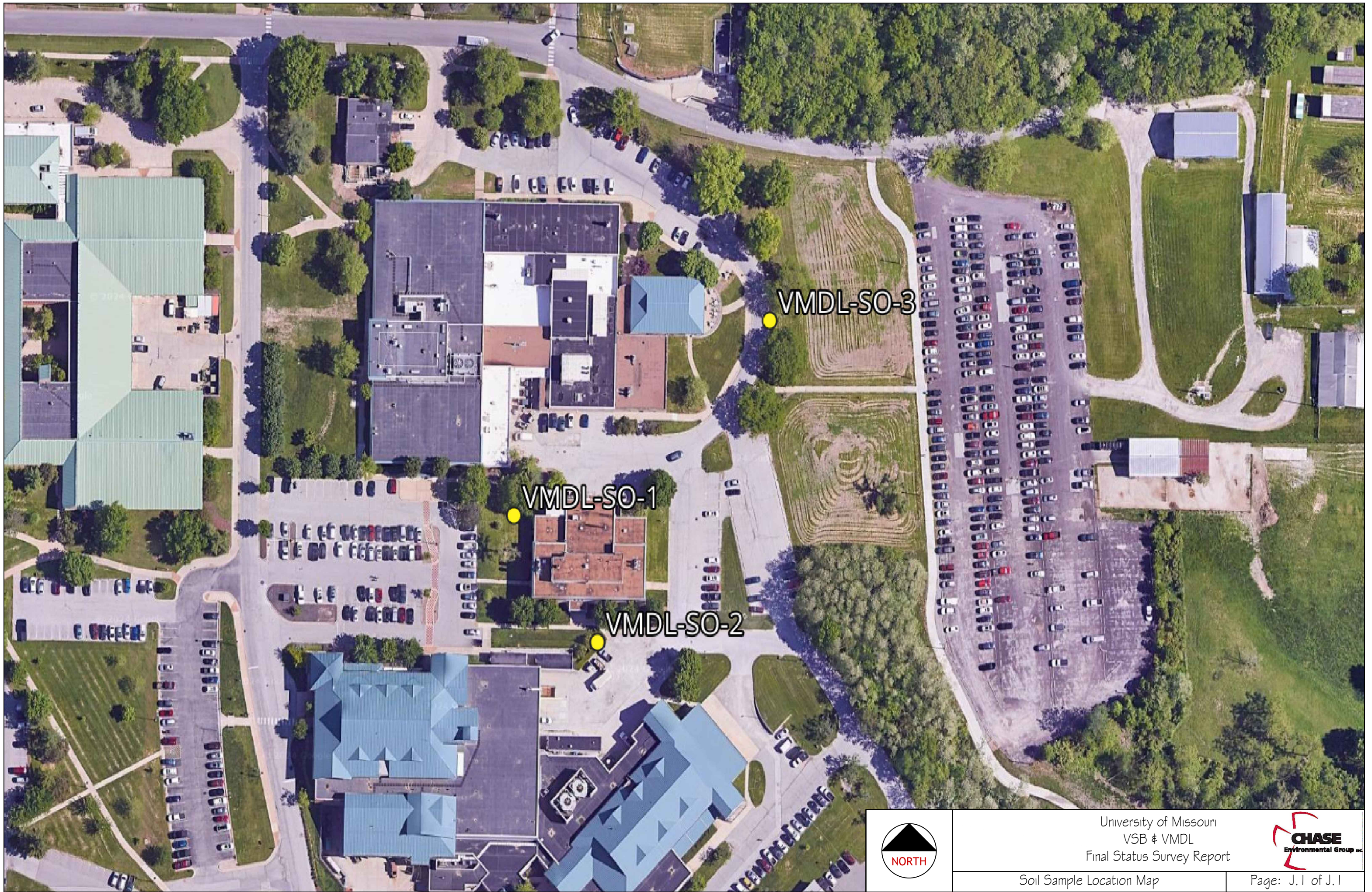
Initiated By: KNOXLAB Init Date: 01/17/24 Receive Date: 01/17/24

Notification of Variance	
Person Notified:	Contacted By:
Notify Date:	
Notify Method:	
Notify Comment:	

Client Response	
Person Responding:	
Response Date:	
Response Method:	
Response Comment:	

Criteria	Yes	No	NA	Comment
1 Shipping container custody seals present and intact.			NA	
2 Sample container custody seals present and intact.			NA	
3 Sample containers received in good condition.	Y			
4 Chain of custody received with samples.	Y			
5 All samples listed on chain of custody received.	Y			
6 Sample container labels present and legible.	Y			
7 Information on container labels correspond with chain of custody.	Y			
8 Sample(s) properly preserved.	Y			
9 Sample(s) appropriate container(s).	Y			
10 Other. (Describe)			NA	
For Hazardous Materials Only:				
11 Paperwork shows TBE and shippers name, address and phone number.			NA	
12 Paperwork shows sample quantity information.			NA	

Appendix J
Soil Sample Location Map



University of Missouri
VSB & VMDL
Final Status Survey Report



**SECTION 09 9000
PAINTING AND COATING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - 1. Mechanical and Electrical:
 - a. In finished areas, paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
 - 2. All items noted on drawings to be painted.
- D. Do not paint or finish the following:
 - 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Glass.
 - 6. Concealed pipes, ducts, and conduits.

1.02 SUBMITTALS

- A. See Division One for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
 - 3. Manufacturer's installation instructions.
 - 4. If proposal of substitutions is allowed under submittal procedures, explanation of all substitutions proposed.
- C. Samples: Submit two paper draw down samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
- D. Certification: By manufacturer that paint and finishes comply with VOC limits specified.
- E. Certification: By manufacturer that all paints and coatings do not contain any of the prohibited chemicals specified; GreenSeal GS-11 certification is not required but if provided shall constitute acceptable certification.
- F. Manufacturer's Instructions: Indicate special surface preparation procedures and substrate conditions requiring special attention
- G. Maintenance Data: Submit coating maintenance manual including product technical data sheets, safety data sheets (SDS), care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum ten years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years' experience.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, product name, product code, color designation, VOC content, batch date, environmental handling, surface preparation, application, and use instructions.
- C. Paint Materials: Store at a minimum of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.05 FIELD CONDITIONS

- A. Do not apply materials when environmental conditions are outside the ranges required by manufacturer.
- B. Follow manufacturer's recommended procedures for producing the best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer, no exceptions.
- B. Basis of Design Products: Subject to compliance with requirements, provide Sherwin-Williams Company products as indicated; www.sherwin-williams.com.
 - 1. Other Acceptable Manufacturers:
 - a. PPG Paints: www.ppgpaints.com.
 - b. Behr Process Corporation: www.behr.com.
 - 2. Substitutions: See Division One.

2.02 PAINTINGS AND COATINGS

- A. General:
 - 1. Provide factory-mixed coatings unless otherwise indicated.
 - 2. Do not reduce, thin, or dilute coatings or add materials to coatings unless specifically indicated in manufacturer's instructions.
- B. Volatile Organic Compound (VOC) Content:
 - 1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site, or other method acceptable to authorities having jurisdiction.
- C. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- D. Flammability: Comply with applicable code for surface burning characteristics.
- E. Colors:
 - 1. Extend colors to surface edges; colors may change at any edge as directed by Architect.
 - 2. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.03 PAINT SYSTEMS - EXTERIOR

- A. Exterior Ferrous Metal - Galvanized and Non-Galvanized; Conduit and other ferrous metal items shown on drawings to be painted.
 - 1. Two topcoats and one coat primer.
 - 2. Semi-Gloss Finish.
 - a. Primer: Sherwin-Williams DTM Acrylic Primer Product No. B-66-W1.
 - b. Topcoat Product: Sherwin-Williams DTM Acrylic Coating Product No. B-66-W2-11.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or repair existing coatings that exhibit surface defects.
- D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- E. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- F. Corroded Steel and Iron Surfaces to be Painted: Prepare using at least SSPC-PC 2 (hand tool cleaning) or SSPC-SP 3 (power tool cleaning) followed by SSPC-SP 1 (solvent cleaning).
- G. Uncorroded, Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
- H. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

3.03 APPLICATION

- A. Protect adjacent materials from damage as a result of this work.
- B. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- C. Apply products in accordance with manufacturer's written instructions.
- D. Apply coatings at spread rate required to achieve manufacturer's recommended dry film thickness.
- E. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- F. Apply each coat to uniform appearance.
- G. Sand metal surfaces lightly between coats to achieve required finish.
 - 1. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 PRIMING

- A. Apply primer to all surfaces unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.
- B. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. Clean surfaces immediately of overspray, splatter, and excess material.
- C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.06 PROTECTION

- A. Protect finished coatings from damage until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

**SECTION 23 0100
BASIC MECHANICAL REQUIREMENTS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Special Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 23.

1.2 SUMMARY

- A. This Section includes general administrative and procedural requirements for mechanical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
1. Submittals.
 2. Material and Equipment Selection.
 3. Record documents.
 4. Maintenance manuals.

1.3 SUBMITTALS

- A. General: Submittals are not requested for all products covered in the specifications. Submit only the data requested under the submittals portion of each specification section or where indicated in a Submittal Log, if included within Division 01. Un-requested submittals will not be processed, reviewed or returned and the contractor will be notified that the submittal will not be reviewed by the engineer of record.
1. Non-requirement of submittals, when so noted, is not to be construed as an allowance for substitutions and does not relieve the contractor from full compliance with the plans and specifications.
 2. Any deviation from specified items is considered a substitution. If the contractor desires to use other than specified items, then a formal request for substitution must be submitted prior to bid date (no exceptions), in accordance with the procedures and time limitations set forth in Division 01. Where not defined in Division 01, requests for substitutions shall be submitted no less than ten (10) working days prior to bid date. Review of substitution requests by the Engineer shall be done at the expense of the contractor. Charges for this substitution review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.
- B. It is the responsibility of the Contractor to ensure that all submittals have been reviewed for total completeness and accuracy as to the requirements of the specifications and drawings before being submitted to the Engineer for review.
1. One comprehensive submittal shall be provided for each individual specification section. All required submittal information called for in each individual specification section shall be included in the submittal.
 2. The Engineer of Record shall not be responsible for informing the contractor on items that have not been included and are necessary for a complete review of the required submittal information for a specification section.
 3. The Engineer of Record shall have the option of returning any submittal, unmarked, if all required documentation called for in the specifications has not been provided in the submittal.
 4. The Engineer of Record shall review each submittal no more than two (2) times and return to the contractor with the appropriate disposition.

5. If the Engineer of Record is required to review a submittal a second time, it shall be limited to review of the changed information, clearly highlighted by the submitter, and/or confirmation of documentation only and it shall be returned to the contractor with the appropriate disposition.
 6. If the submittal is required to be reviewed a third time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.
- C. Operation and Maintenance Manuals: All items required for insertion into each Operation and Maintenance (O&M) Manual are called out in the submittals portion of each specification section or in a Submittal Log, if included within Division 01. It is the responsibility of the Contractor to ensure that the O&M submittal has been reviewed and includes all the requirements of the specifications. The Engineer of Record shall review the submittal for the Operation and Maintenance Manual one (1) time and return to the contractor with the appropriate disposition.
1. If the submittal is required to be reviewed a second time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.
 2. Submittals for the Operation and Maintenance Manual must be original documentation.
 3. Photo copies of marked up Operations and Maintenance submittals are not acceptable.
- D. Refer to Division 01 and each individual Division 23 Section for additional submittal requirements.

1.4 REFERENCED STANDARDS

- A. American Society of Heating, Refrigerating and Air-Conditioning Engineers. Guideline 4-1993 *Preparation of Operating and Maintenance Documentation for Building Systems*. Atlanta, GA: ASHRAE, 1993.

1.5 MATERIAL AND EQUIPMENT SELECTION

- A. Product Options: The specification of each item of major mechanical equipment required for the project may include a list of manufacturers, with one "basis of design" manufacturer, type, and model identified by virtue of their listing in the equipment schedule on the Drawings. Where several manufacturers in addition to the "basis of design" manufacturer are listed in the specifications, it shall be understood that the words "or approved equal by" are implied to precede each of the other manufacturer's names. The Contractor shall note that the requirements of Division 01, Special Conditions, Substitutions and Equal governs when the requirements of this section are in conflict with the referenced Division 1 requirements.
1. The manufacturers other than the "basis of design" may be furnished at the contractor's option in lieu of the "basis of design" product, provided that the selected manufacturer's product is equal in all material and functional respects. In addition to submittal requirements that may be specified in this section, submit a line-by-line written verification of the applicable specification section(s) identifying compliance with or variations from the specified features, materials, performance, capacities, weight, size, durability, energy consumption and efficiency, warranty, and visual impact (if exposed to view by other than maintenance persons). The burden of proof of manufacturer/product equality is on the contractor.
 2. Where a product is not scheduled on the drawings and, therefore, where no "basis of design" is indicated, selection among all of the listed manufacturers and products is at the contractor's option, subject to the requirements of the Contract Documents.
 3. Products of manufacturers not listed in the Contract Documents are considered Substitutions and are not permitted, except as provided under the General and Special Conditions.
- B. Listing of a manufacturer does not imply approval of that manufacturer's standard product or products. Rather, listing of a manufacturer indicates only a general acceptance of that

manufacturer's name and reputation. Final approval is subject to full compliance with these Contract Documents.

- C. Model numbers identified on the Drawings notwithstanding, all equipment must comply with the requirements of these Contract Documents. Do not assume that a manufacturer's standard product is acceptable as is. For example, one or more custom modifications, custom colors or finishes, manufacturer's options, and/or accessories may be required to meet the specified requirements.
- D. Where drawings indicate sizes, profiles, connections, and dimensional requirements of material and equipment, these are based on the "basis of design" manufacturer, type and model indicated. In the event that equipment of power, dimensions, capacities, layout, connections, and/or ratings differing from the "basis of design" are selected by the contractor and approved by the Owner's representative, any necessary adjustments are the contractor's responsibility. All connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, pipe and duct sizes, pipe and duct layout, and the like shall be adjusted by the contractor to suit the equipment provided. No additional costs will be approved for these changes. Should revisions to the design because of contractor's selection of manufacturer, type, or model other than the "basis of design" require additional review and/or redesign by an Architect or Engineer, the contractor shall reimburse the Owner for Owner's added professional fee expenses.
- E. Where two or more materials are listed in the "Part 2 – Products" subsection of any Division 23 section, do not assume that the selection of materials is the contractor's option. Refer to "Part 3 – Execution" subsection of that same Division 23 section for an explanation of which specific material(s) shall be used for which specific application(s). For example, Part 2 may list several types and grades of piping, and Part 3 will describe which type and grade of pipe to use for a given application.

1.6 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 01. In addition to the requirements specified in Division 01, indicate the following installed conditions:
 - 1. Ductwork mains and branches, size and location; locations of dampers and other control devices requiring periodic maintenance or repair.
 - 2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Indicate actual inverts and horizontal locations of all underground piping.
 - 3. Valve location diagrams, complete with valve tag chart. Refer to Division 23 Section "Basic Mechanical Materials and Methods."
 - 4. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - 5. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
 - 6. Contract Modifications, actual equipment and materials installed.

1.7 MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 01. In addition to the requirements specified in Division 01, include the following information for equipment items:
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

B. In addition to the above, comply with ASHRAE Guideline 4-1993 *Preparation of Operating and Maintenance Documentation for Building Systems*.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 23 0100

**SECTION 23 0500
BASIC MECHANICAL MATERIALS AND METHODS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 230100 "Basic Mechanical Requirements" applies to the work of this Section as if fully repeated herein.

1.2 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other Division 23 Sections:
 - 1. Materials and installation instructions common to mechanical systems.
 - 2. Pipe joining materials and methods.
 - 3. Pipe sleeves.
 - 4. Labeling and identifying mechanical systems and equipment.
 - 5. Non-shrink grout for equipment installations.
 - 6. Painting and finishing of mechanical work.
 - 7. Concrete base construction requirements.
 - 8. Coordination with Structural work.
 - 9. Selective Demolition.
 - 10. Cutting and patching.
- B. Pipe and pipe fitting materials are specified in individual Division 23 piping system Sections.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Any space not inside chiller room or electrical room on this project.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following abbreviations are used throughout Division 23 Specification Sections:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. CR: Chlorosulfonated polyethylene synthetic rubber.

4. EPDM: Ethylene propylene diene terpolymer rubber.
5. NBR: Acrylonitrile-butadiene rubber.
6. NP: Nylon plastic.
7. PE: Polyethylene plastic.

1.4 SUBMITTALS

- A. Product Data: For transition couplings, flexible pipe connectors, mechanical sleeve seals, and identification materials and devices.
- B. Shop Drawings: Detail fabrication and installation for supports and anchorage for mechanical materials and equipment.
- C. Coordination Drawings: For access panel and door locations.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code – Steel."
- B. Welding: Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
 1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.
 3. Contactor shall retain all welding certificates on file and produce them for review upon request by the Owner and/or Owner's representative.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor or roof, if stored thereupon. Protect flanges, fittings, and piping specialties from moisture and dirt.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
- C. Protect ductwork interiors from the elements and foreign materials throughout construction. Deliver ducts with shop-applied impervious protective covering over all open ends. Maintain protective end coverings through shipping, storage, and handling to prevent entrance of dirt, debris, and moisture. Elevate stored ducts above grade. As ductwork is installed, remove protective end covering as each successive segment is connected, but with protective end covering maintained over open ends remaining exposed.
- D. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Panels."
- G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.
- H. Coordinate connection of electrical services.
- I. Dielectric fittings are not allowed. Install bronze shutoff valve where dissimilar metals are joined. Valve must be installed in an accessible area or above an access panel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Transition Couplings:
 - a. Dresser Industries, Inc.
 - b. or approved equal.
 - 2. Identifying Devices and Labels:
 - a. Brady USA, Inc., Signmark Div.
 - b. Brimar Industries, Inc.
 - c. Kolbi Industries, Inc.
 - d. Panduit Corp.
 - e. Seton Name Plate Co.

2.2 PIPE AND PIPE FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe and fitting materials and joining methods.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

- C. Pipe-Flange Joining Gaskets: Suitable for chemical and thermal conditions of piping system contents. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness, unless thickness or specific material is indicated.
 - 1. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - 2. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- D. Pipe-Flange Joining Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- E. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- F. Solder Filler Metals: ASTM B32 lead-free alloys. Include water-flushable flux according to ASTM B813.
- G. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- H. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- I. Solvent Cements: Manufacturer's standard solvent cements for the following:
 - 1. CPVC Piping: ASTM F493.
- J. Plastic Pipe Seals: ASTM F477, elastomeric gasket.
- K. Transition Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
 - 1. Sleeve: ASTM A126, Class B, gray iron.
 - 2. Followers: ASTM A47 (ASTM A47M) malleable iron or ASTM A536 ductile iron.
 - 3. Gaskets: Rubber.
 - 4. Bolts and Nuts: AWWA C111.
 - 5. Finish: Enamel paint.

2.4 PIPE SLEEVES

- A. The following sleeve materials are for wall, floor, slab, and roof penetrations.
- B. Steel Pipe: ASTM A53, Type E, Grade A, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.
- E. PE: Manufactured, reusable, tapered, cup shaped, smooth outer surface, with nailing flange for attaching to wooden forms.

- F. Contractor's Option: Pre-engineered, UL-listed fire-resistance rated and watertight cast-in-place floor sleeving systems meeting the following specifications will be acceptable in lieu of traditional floor sleeves with field-installed firestop, at contractor's option.
1. Description: Cast-in-place, factory-assembled, one-piece watertight firestop device for use in concrete floors formed with wood and/or steel decking to protect penetrating objects from expansion and contraction of concrete, thermal and seismic movement, and the passage of air, smoke, fire, and hot gasses.
 2. Manufacturer: Subject to compliance with requirements, provide Hydroflame™ sleeving system by Hubbard Enterprises / Holdrite; or approved equal.
 3. Include an outer sleeve lined with an intumescent strip; and a radial extended flange attached to one end of the sleeve for fastening to concrete formwork; or wide outside wings attached to one end of the sleeve for fastening to metal deck concrete formwork and span deck corrugations.
 4. Include a waterstop gasket and mid-body seal consisting of one to three concentric raised rings for embedment and sealing to the concrete slab. For applications involving a corrugated deck, also include a cone attached to the base for extending the device through the metal deck.
 5. Product shall provide a two-hour fire-resistance rated assembly when tested according to ASTM E814 or ANSI/UL 1479.

2.5 IDENTIFYING DEVICES AND LABELS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 23 Sections. If more than one type is specified for application, selection is installer's option, but provide one selection for each product category.
- B. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- C. Chiller Room Warning Sign: Each entrance to a refrigerating machinery room shall be provided with a legible permanent sign, securely attached and easily accessible, reading "Machinery Room – Authorized Personnel Only." A second sign shall further state "Audible and Visual Refrigerant Alarm Sounding Indicates Refrigerant Detection – Entry is Forbidden Except by Those Personnel Trained in Emergency Procedures."

2.6 CONCRETE AND GROUT

- A. Concrete: For all minor concrete work required for mechanical installations, such as concrete equipment bases and supports, refer to Division 03 Sections for specification of cast-in-place concrete and reinforcing materials, whose requirements apply to the work of Division 23 as if fully reproduced herein.
- B. Non-shrink, Nonmetallic Grout: ASTM C1107, Grade B.
1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psig (34.5-MPa), 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

2.7 PAINTING AND FINISHING

- A. For all painting and finishing work required for mechanical installations, as described in Part 3 of this Section and/or on the Drawings, refer to Division 09 Sections for specification of paint

and finishing materials, whose requirements apply to the work of Division 23 as if fully reproduced herein.

PART 3 - EXECUTION

3.1 GENERAL MECHANICAL INSTALLATION REQUIREMENTS

- A. Verify all dimensions by field measurements.
- B. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
- C. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
- D. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
- E. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
- F. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.2 PIPING SYSTEM INSTALLATION REQUIREMENTS

- A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Division 23 piping Sections specify unique piping installation requirements.
- B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.
- C. Install components with pressure rating equal to or greater than system operating pressure.
- D. Install piping at indicated slope, and free of sags and bends.
- E. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal. Install piping to allow application of insulation plus 1-inch (25-mm) clearance around insulation.
- F. Locate groups of pipes parallel to each other, arranged and spaced to permit valve servicing.
- G. Install fittings for changes in direction and branch connections. Install couplings according to manufacturer's written instructions.
- H. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

- I. Electrical Equipment Spaces: Route piping to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- J. Piping Support: As specified in Division 23 Section "Hangers and Supports."

3.3 PIPING JOINING REQUIREMENTS

- A. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipefittings and valves as follows:
 - 1. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - 2. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
 - 3. Align threads at point of assembly.
 - 4. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Apply one coat of self-priming, rust-inhibitor paint around the entire circumference of each welded pipe joint; regardless of whether or not the piping is specified to be painted. Paint may be brush-applied, roller-applied, or spray-applied at contractor's option.
- H. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.

2. CPVC Piping: ASTM D2846 and ASTM F493.
- J. Piping Connections: Make connections according to the following, unless otherwise indicated.
1. Install unions, in piping 2-inch NPS (DN50) and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS (DN50) or smaller threaded pipe connection.
 2. Install flanges, in piping 2½-inch NPS (DN65) and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
 3. Dry Piping Systems: Install bronze shutoff valve to connect piping materials of dissimilar metals.
 4. Wet Piping Systems: Install bronze shutoff valve to connect piping materials of dissimilar metals.
 5. Valve Caps: Any valve that represents a termination or the end of a run (e.g., blowdown or drain valve, hose-end valve, etc.) shall be fitted with a permanent but removable cap, plug, or blind flange matching the valve construction, to minimize risk in the event the valve is accidentally opened under pressure.
 6. Install shut off valve between hydronic riser and flexible pipe connector. All shut off valves must be accessible.
 7. Connect copper branch lines to steel or iron mains as follows: Install steel branch pipe off main with black iron nipple connected to bronze ball valve. Connect bronze ball valve to copper piping with threaded copper male adaptor, which is then soldered to the copper branch line.

3.4 PIPE-PENETRATION INSTALLATION REQUIREMENTS

- A. Except as noted otherwise, install escutcheons for both insulated and bare piping in the following cases:
1. New piping of penetrations of newly-constructed walls, ceilings, and floors.
 2. New piping penetrations of existing walls, ceilings, and floors.
 3. Existing piping which penetrates newly-constructed walls, ceilings, and floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening. Use one-piece type for new piping and split-plate type for existing piping as specified in Part 2 of this section.
- C. Install floor plates for piping penetrations of unfinished floors in service spaces and equipment rooms. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening. Use one-piece floor-plate type for new piping and split-casting floor-plate type for existing piping as specified in Part 2 of this section.
- D. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.
- E. Cut sleeves to length for mounting flush with both surfaces. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
- F. Build sleeves into new walls and slabs as work progresses.
- G. Install sleeves large enough to provide ¼-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

1. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS (DN150).
 2. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Flashing and Sheet Metal" for flashing.
 3. Seal space outside of sleeve fittings with nonshrink, nonmetallic grout.
- H. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants. Refer to Division 07 Section "Joint Sealants" for materials. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.
- I. Sleeves are not required for core-drilled holes.
- J. Permanent sleeves are not required for holes formed by PE removable sleeves.

3.5 EQUIPMENT INSTALLATION REQUIREMENTS

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Division 23 and Division 26 for rough-in requirements.
- C. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.
- D. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.
- E. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- F. Positive attachment and anchorage of all equipment to the structure or floor is required. Do not rely on friction or gravity as a means of attachment.
- G. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- H. Install equipment giving right of way to piping installed at required slope.
- I. Install flexible pipe connectors at the following locations. Install on equipment side of shutoff valves.
1. Inlet and outlet of each pump.
 2. Where indicated elsewhere in these specifications.
 3. Where detailed on the Drawings.
- J. Support for Suspended Equipment: As specified in Division 23 Section "Hangers and Supports."

3.6 PAINTING AND FINISHING

- A. For all painting and finishing work required for mechanical installations.

- B. All carbon steel piping shall have an epoxy paint applied to the entire system prior to any liquid entering system and before any insulation is applied to piping system.
- C. All interior and exterior ferrous piping and appurtenances, including steel, galvanized steel, cast iron and ductile iron, exposed to view in finished or unfinished spaces shall be painted. Responsibility of mechanical piping, equipment and supports shall be assigned to Division 09 Sections for application requirements.
- D. Painting HVAC Work: Paint the following work where exposed to view in finished or unfinished spaces: Uninsulated steel piping, pipe hangers and supports, tanks that do not have factory-applied final finishes, all interior and exterior ferrous piping and appurtenances, including steel, galvanized steel, cast iron and ductile iron.
- E. Steel Substrates: Primer, alkyd, anti-corrosive, for metal, MPI #79; plus topcoat of latex, interior, semi-gloss, MPI #54.
- F. Galvanized-Metal Substrates: Primer, galvanized, water based, MPI #134; plus topcoat of latex, interior, semi-gloss, MPI #54.
- G. Aluminum (Not Anodized or Otherwise Coated) Substrates: Primer, quick dry, for aluminum, MPI #95; plus topcoat of latex, interior, semi-gloss, MPI #54.
- H. ASJ Insulation-Covering Substrates: Including pipe and duct coverings. Primer sealer, latex, interior, MPI #50; plus topcoat of latex, interior, semi-gloss, MPI #54.
- I. Primers specified above may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

3.7 COORDINATION WITH STRUCTURAL WORK

- A. Concrete: Do not embed pipes, wires, tube, boxes, ducts or other cavity-creating elements in concrete work unless shown on or permitted by the structural drawings. Openings through concrete not shown on the structural drawings are subject to approval by the structural engineer of record. See coordination drawing requirements under Submittals.
- B. Supported Slab: Do not suspend loads exceeding 500 pounds within any 100 square feet of contiguous area from concrete supported slab. Suspend such loads from structural steel only. Any "sub-framing" required is responsibility of Contractor or sub-contractor installing material requiring support.
 1. Openings in concrete floor slabs not shown on structural drawings, such as openings required for stacks, pipes, ducts, plumbing vents, etc., shall be the responsibility of the trade requiring openings. Form blockouts in the slab, reinforcing deck, and cut openings after concrete has reached specified strength.
 2. Where openings larger than 12-inches are required but not shown on structural drawings, secure written approval from Architect/Engineer prior to cutting deck.

3.8 SELECTIVE DEMOLITION

- A. Disconnect, demolish, and remove mechanical work as indicated on the Drawings, and as required for installation of new work shown. Coordinate with Division 26 for disconnection of power to electrically-powered equipment prior to demolition.
- B. Remove accessible work in its entirety. Repair cut surfaces to match adjacent surfaces. Abandon in place embedded or buried work, unless noted otherwise.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 5. Equipment to Be Removed: Disconnect, drain and cap services and remove equipment.
- C. Removal: Unless otherwise indicated, remove demolished pipe, duct and equipment from the Project site. Handle and dispose of in accordance with National, State, and Local regulations.
1. Relocation: Remove, store, clean, reinstall, reconnect, and make operational all work indicated for relocation.
 2. Salvage: Remove and deliver to Owner all work indicated for salvage.
- D. Refer to Division 01 Sections "Selective Demolition" and/or "Selective Structure Demolition" for additional requirements.
- E. For selective demolition of any appliance or piece of equipment containing a CFC, HCFC, or HFC refrigerant: Prior to demolition, refrigerant shall be evacuated and captured in full compliance with the Clean Air Act; using only technicians with the proper refrigerant license as according to law, stored in approved containers, and shipped to a licensed refrigerant recycling facility all as required by the United States Environmental Protection Agency.

3.9 CUTTING AND PATCHING

- A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay. Perform cutting and patching in accordance with the following:
- B. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
- C. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
1. Uncover Work to provide for installation of ill-timed Work.
 2. Remove and replace defective Work.
 3. Remove and replace Work not conforming to requirements of the Contract Documents.
 4. Install equipment and materials in existing structures.
- D. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, pumps, and other mechanical items made obsolete by the new Work.
- E. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.
- F. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- G. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

- H. Repair cut surfaces to match adjacent installations.
- I. Repair any building insulation or building fireproofing materials, whether new or existing, that are removed or scraped away in order to make a mechanical installation, so as to maintain an equivalent insulation or fire rating as existed without said mechanical installation.
- J. Refer to Division 01 Sections "Execution" and/or "Cutting and Patching" for additional requirements.

3.10 GROUTING

- A. Install nonmetallic, non-shrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Mix grout according to manufacturer's written instructions. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Place grout, completely filling equipment bases. Avoid air entrapment during placing of grout. Place grout on concrete bases to provide smooth bearing surface for equipment. Place grout around anchors.
- E. Cure placed grout according to manufacturer's written instructions.

END OF SECTION 23 0500

**SECTION 26 0500
COMMON WORK RESULTS FOR ELECTRICAL**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. This Section specifies the basic requirements for electrical installations and includes requirements common to all sections of Division 26 and 33. It expands and supplements the requirements specified in sections of Division 00.
- B. Drawings and general provisions of the Contract, including general and supplementary conditions and specification sections Divisions 1, 26, and 33, apply to this Section.
- C. Codes and Standards: All equipment, material and installations shall comply with applicable codes, standards, and installation practices. Comply with the requirements of the applicable local building codes, the applicable NEC, all local rules and regulations including those of the fire authorities. Comply with all applicable NFPA standards. All material and equipment shall be listed by the Underwriters Laboratories (UL) standard that is applicable for the specific purpose of the material and equipment. The National Electrical Code, National Electrical Manufacturer's Association (NEMA) Standards, and applicable ANSI and IEEE standards shall apply to the pertinent materials, equipment, and installation practices. Testing shall be in accordance with the applicable International Electrical Testing Association (NETA) standards.
 - 1. These specifications include references to the 2020 edition of the NFPA 70 "National Electrical Code." Where a different edition of the NEC has been adopted by the local Authority Having Jurisdiction, the references associated with that edition of the Code shall be applicable.

1.2 SUMMARY OF WORK

- A. The word "furnish" means supply for use, the word "install" means install in its proper location and connect up complete and ready for operation, and the word "provide" means to furnish and install.
- B. Provide all new materials as indicated on the drawings and specifications and all items required to make the electrical system complete and in working order.
- C. System descriptions included in scope of work are as follows:
 - 1. Electrical power systems, including luminaires, distribution equipment, motors, wiring devices, etc.
 - 2. Electrical power distribution service from the Campus Utility
 - 3. Selective demolition work and modification of existing systems and equipment.

1.3 WORK SEQUENCE

- A. All work that produces excessive noise or interference with normal building operations shall be coordinated and scheduled with the Owner. Such work may require scheduling of work after occupied hours or weekends. The Owner reserves the right to determine when such work is conducted.

1.4 QUALITY ASSURANCE

- A. Responsibility Prior to Submitting Pricing or Bid Data:
1. Thoroughly review the contract documents and specifications and visit the site prior to issuing bid. Resolve all reported deficiencies with the Engineer prior to awarding any subcontracts, ordering material, or starting any work.
- B. Qualifications:
1. Only products of specified manufacturers, or approved equals as determined by the Engineer, are acceptable.
 2. Employ only workmen who are skilled in their trades.
- C. Compliance with Codes, Laws, and Ordinances:
1. Conform to all requirements of the state, city and local codes, laws and ordinances and other regulations having jurisdiction over this installation.
 2. If there are any discrepancies between the codes and regulations and these specifications, the Engineer shall determine the method or equipment to be used.
 3. Inform the Engineer in writing, requesting a clarification at the time of the bidding, if any parts of the drawings or specifications are found not to comply with the codes or regulations. Submit a separate price to make the system comply if there is insufficient time for this procedure.
 4. Inform the Engineer in writing requesting a clarification if there is any discrepancy between a manufacturer's recommendation and these specifications.
 5. Follow the current issue of NFPA 70 "National Electrical Code" if there are no local codes having jurisdiction.
- D. Examination of Drawings:
1. The drawings for the indicated work are diagrammatic, intended to convey the scope of the electrical work and to indicate the general arrangements and locations of equipment, wiring devices, etc., and the approximate sizes of equipment. Field verification of dimensions on plans is required. The actual conditions, including heights, lengths and orientation shall be the basis of the work.
 2. The electrical drawings and specifications shall be considered as mutually explanatory and complementary. Any electrical work called for by one and not by the other shall be performed as though required by all. All sections and subsections of the Electrical work shall be governed by and subject to the general and supplementary conditions. Report any discrepancies in or between the drawings and specifications, or between the drawings and actual field conditions to the Engineer in sufficient time to issue an addendum for clarification.
 3. Determine the exact locations for equipment and rough-ins, and the exact routing of raceways.
 4. Do not scale drawings to determine equipment and system locations.
 5. Not all required components are shown on the documents, including junction boxes, pull boxes, conduit fittings, etc. Provide all components required for proper installation of the work.
 6. Any item either shown on the drawings or called for in the specifications shall be included in this contract.
 7. Determine quantities and quality of material and equipment required from the documents. Provide the more expensive or higher quality amount where discrepancies arise among drawings, schedules or specifications.

E. Electronic Media and Files:

1. Electronic media files of the contract drawings in AutoCAD or PDF format and copies of the specifications in PDF format may be requested.
2. Complete and return a signed "Electronic File Transmittal" form provided by Ross & Baruzzini upon request for electronic media,
3. Obtain approval from the appropriate Design Professional for use of their part of the documents if the information requested includes information prepared by other than Ross & Baruzzini.
4. The electronic contract documents may be used for preparation of shop drawings and record drawings only. The information may not be used in whole or in part for any other project.
5. The drawings prepared by Ross & Baruzzini for bidding purposes may not be used directly for raceway layout drawings or coordination drawings.
6. The use of these documents does not allow relief from the responsibility for coordination of work with other trades and verification of space available for the installation.
7. The information is provided to expedite the project with no guarantee by Ross & Baruzzini as to the accuracy or correctness of the information provided. Ross & Baruzzini accepts no responsibility or liability for the use of the provided information.

1.5 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

1.6 SUBMITTAL REVIEW RESPONSIBILITIES

- A. General: Submittals are not requested for all products covered in the specifications. Submit only the data requested under the submittals portion of each specification section or where indicated in a Submittal Log. Un-requested submittals will not be processed or reviewed and will be returned to the submitter. Refer to "Submittal Register" for all required submissions of each specification section. All required submissions of that specification section are to be submitted for review in one all-inclusive submission. Any deviation from specified items is considered a substitution.

1. Non-requirement of submittals, when so noted, is not to be construed as an allowance for substitutions and does not provide relief from full compliance with the contract documents.
2. Any deviation from specified items is considered a substitution. A formal request for substitution must be submitted prior to bid date (no exceptions), in accordance with the procedures and time limitations set forth in Division 1, if the use of other than specified items is being proposed. Where not defined in Division 1, requests for substitutions shall be submitted no less than ten (10) working days prior to bid date. The submitter must pay the engineer for review of substitution requests. Charges for this substitution review will be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.

B. Definitions:

1. Product Data: Pre-printed manufacturer's data.
2. Shop Drawings: Drawings made specifically for the manufacture of a particular piece of equipment to be used on this project.
3. Operation and Maintenance Data: Information containing instructions on the proper operation, maintenance and repair of the equipment, complete with written text, diagrams, photos, exploded views and parts lists.

Record Documents: Information indicating the actual installed conditions of the project on Mylar, electronic media, photographs or typed paper. Photographs are not allowed as a substitute for correcting the construction documents; the photographs are for the Owner's future reference. Submit type, quantities and on media specified where indicated to be submitted.

- C. Where more than one model is shown on a manufacturer's sheet, clearly indicate exactly which item and which data is relevant to the work.
- D. Where the manufacturer lists multiple part numbers or options on a single data sheet, the part number and options to be used shall be clearly set apart from other part numbers shown on that sheet.
- E. Ensure that all submittals have been reviewed for total completeness and accuracy as to the requirements of the specifications and drawings before being submitted to the Engineer for review. The Contractor's approval stamp is required on all submittals before submittal to the Engineer. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Clearly mark all deviations from the contract documents on all submittals. The item shall be required to meet all drawing and specification requirements if deviations are not clearly marked.
 - 1. One comprehensive submittal shall be provided for each individual specification section. All required submittal information called for in each individual specification section shall be included in the submittal. Partial or incomplete submissions will be rejected.
 - 2. The Engineer shall not be responsible for informing the submitter on items that have not been included and are necessary for a complete review of the required submittal information for a specification section.
 - 3. The Engineer shall have the option of returning any submittal, unmarked, if all required documentation called for in the specifications has not been provided in the submittal.
 - 4. The Engineer shall review each submittal no more than two times and return to the submitter with the appropriate disposition.
 - 5. If the Engineer is required to review a submittal a second time, it will be limited to review of the changed information, which must clearly be highlighted by the submitter. The submittal will be returned to the submitter with the appropriate disposition.
 - 6. If the submittal is required to be reviewed a third time, it shall be done at the expense of the submitter. Charges for this additional submittal review will be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.
- F. Operation and Maintenance Manuals: All items required for insertion into each Operation and Maintenance (O&M) Manual are called out in the submittals portion of each specification section or in a Submittal Log, if included within Division 1. Ensure that the O&M submittal has been reviewed and includes all the requirements of the specifications. Submit only the data requested under the submittals portion of each specification section. FAX or photo copies are not allowed as submittals for operating and maintenance manuals. The Engineer will review the submittal for the Operation and Maintenance Manual one time and return to the submitter with the appropriate disposition.
 - 1. If the submittal is required to be reviewed a second time, it shall be done at the expense of the submitter. Charges for this additional submittal review will be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.
 - 2. Submittals for the Operation and Maintenance Manual must be original documentation.
 - 3. Photo copies of marked up Operations and Maintenance submittals are not acceptable.

- G. Coordination Drawings: Prepare and submit Coordination Drawings as further described herein and as indicated in the Special Conditions. Provide the Engineer with one copy of all coordination drawings supplied to the Owner when required in this specification. Coordinate the work as outlined herein. Receipt by the Engineer of a copy of the coordination drawings is to verify conformance to the submittal requirements set forth in this specification section. It is not an admission by the Engineer as to the accuracy or completeness of the coordination proposed.
- H. Refer to Division 1 for additional submittal requirements.

1.7 BUY AMERICAN ACT

- A. Use only construction materials and components in performing under these specifications in accordance with the Buy American Act (41 USC 10a-10d), or submit waivers for same as permitted thereunder.
- B. Each material or component must be manufactured in the United States and the cost of the domestic sub-components must exceed 50% of the cost of all the components unless one or more exceptions apply under the Buy American Act.
- C. Comply by either certifying that the materials purchased for the project meet the criteria or apply for a waiver. Document compliance by one of these methods as part of each product's shop drawing submittal.

1.8 PRODUCT OPTIONS AND MATERIAL SUBSTITUTIONS

- A. Where two or more materials are listed in the "Part 2 – Products" subsection of any Division 26 and 33 section, do not assume that the selection of materials is an option. Refer to "Part 3 – Execution" subsection of that same specification section for an explanation of which specific material(s) shall be used for which specific application(s). For example, Part 2 may list several types and grades of conductors, and Part 3 will describe which type and grade of conductors to use for a given application.
- B. When two or more items of same material or equipment are required they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, wire, conduit, fittings, sheet metal, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units, and similar items used in Work except as otherwise indicated.
- C. Provide products which are compatible within systems and other connected items.
- D. Substitutions: Products other than those specified must be submitted, approved and secured in writing from the Engineer via Addendum. If requested, a sample of the proposed substitution must be submitted to the Engineer for evaluation. This sample shall be supplied at no cost to the Engineer, and will be returned to the submitter, at the submitter's expense at the end of the evaluation period.
- E. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis of design and establishes the quality required.
- F. Any material, article or equipment of other unnamed manufactures which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Engineer via Addendum. Assume all costs incurred as a result of using the offered material, article or equipment, including the part of other Divisions whose work is affected.

- G. Voluntary add or deduct prices for alternate materials may be listed on the bid form. These items will not be used in determining the low bidder. Assume all costs incurred as a result of using the offered material or equipment on his part or on the part of other Divisions whose work is affected.
- H. All material substitutions requested after the final Addendum must be listed as voluntary changes on the bid form.

1.9 PRODUCT, DELIVERY, STORAGE, HANDLING AND MAINTENANCE

- A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage and handling. Protect stored equipment and materials from damage.
- B. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations. Review the site prior to bid for path locations and any required building modifications to allow movement of equipment.
- C. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage.
- D. Keep all materials clean, dry and free from damaging environments.

1.10 MISCELLANEOUS MATERIALS

- A. Miscellaneous Materials Include:
 - 1. Miscellaneous metals for support of electrical materials and equipment.
 - 2. Wood grounds, nailers, blocking, fasteners and anchorage for support of electrical materials and equipment.
 - 3. Sealers for sealing around electrical materials and equipment; and for sealing penetrations in floors and walls.

1.11 WARRANTIES

- A. Refer to the Division 1 "Closeout Procedures" for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.
- B. Compile and assemble the warranties specified in Divisions 26 and 33 into a separated set of vinyl covered, three-ring binders, tabulated and indexed for easy reference.
- C. Provide complete warranty information for each item to include product or equipment, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.
- D. Warranty requires correction of all work found to be defective or nonconforming to the Contract Documents, without cost to the Owner. Bear all costs associated with corrective measures and damage due to defects or nonconformance with the Contract Documents, excluding repairs required as a result of improper maintenance or operation, or normal wear and tear as determined by the Engineer.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS LUMBER

- A. All lumber shall be fire-treated.
- B. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative-treated in accordance with AWPB LP-2, and kiln-dried to a moisture content of not more than 19 percent.

2.2 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time and recommended for interior and exterior applications.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Equipment: Install to facilitate service, maintenance and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- C. Right-of-Way: Give to piping systems installed at a required slope.
- D. Jobsite Safety: The Contractor is the sole entity responsible for jobsite safety.

3.2 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances and other conditions affecting installation and application of sealants and access panels. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Coordinate equipment rough-in requirements with Divisions 1, 26, and 33.

3.4 ELECTRICAL INSTALLATIONS

- A. Coordinate electrical equipment and materials installation with other building components.
- B. Verify all dimensions by field measurements.
- C. Coordinate the installation of required supporting devices and other structural components as they are constructed.

- D. Sequence, coordinate and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning outside the building.
- E. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
- F. Install systems, materials and equipment to conform to project requirements and approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
- G. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. Maintain code clearances in front of and about all electrical equipment. As much as practical, connect equipment for ease of disconnecting with minimum of interference with other installations.
- H. Include in the Work all labor, materials, equipment, services, apparatus and drawings (in addition to the Contract Documents) as required to complete the intended Work.
- I. Only new, clean and perfect equipment, apparatus, materials and supplies of latest design and manufacture shall be incorporated in the Work in order to assure an electrical system of high quality.
- J. The Work required in order to obtain utility services such as telephone and electric, is delineated in these specifications and on the drawings. Unless otherwise noted, construction or connection charges (except for temporary power) by those companies shall be paid by the Owner.
- K. Determine electrical utility elevations prior to installation and coordinate with other existing utilities/trades. Installation priorities at a minimum shall be as follows:
 - 1. Luminaires.
 - 2. Gravity flow piping, including steam and condensate.
 - 3. Other piping.
 - 4. Conduits.

3.5 CONNECTIONS TO EQUIPMENT AND APPLIANCES

- A. In many instances the drawings show an outlet box and power supply for specific equipment, be it Owner- or Contractor-furnished. It is to be understood, unless otherwise noted, that the Work includes a connection from the box to the equipment or appliance. Verify circuit conductor quantities and sizes and overcurrent device number of poles and rating as well as any special grounding requirements, for all Owner-furnished equipment and adjust the required work accordingly.

3.6 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 1 Section "Execution." In addition to the requirements specified in Division 1, the following requirements apply:
 - 1. Perform cutting, fitting and patching of electrical equipment and materials required to:

- a. Uncover Work to provide for installation of ill-timed Work.
 - b. Remove and replace defective Work.
 - c. Remove and replace Work not conforming to requirements of the Contract Documents.
 - d. Remove samples of installed Work as specified for testing.
 - e. Install equipment and materials in existing structures.
 - f. Cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including but not limited to, removal of electrical items indicated to be removed and items made obsolete by the new Work.
2. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.
- a. Protect the structure, furnishings, finishes and adjacent materials not indicated or scheduled to be removed.
 - b. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.7 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used.
- C. Contract shall X-ray concrete slabs and walls prior to core drilling to avoid damage to utilities or reinforced steel.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.8 SLEEVE-SEAL INSTALLATION

- A. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve.
- B. Install to seal exterior wall penetrations.
- C. Install in concrete slabs and walls and all other fire-rated floors and walls for raceways and cable installations. Provide insulated bushings at each end of sleeve. For sleeves through fire rated-wall or floor construction, apply UL-listed firestopping sealant in gaps between sleeves and enclosed conduits and cables.
 - 1. Conduit Seals: Install seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

3.9 APPLICATION OF SEALERS

- A. General: Comply with sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
 - 1. Comply with recommendations of ASTM C 962 for use of elastomeric sealants.
- B. Tooling: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.10 FIRESTOPPING

- A. Apply rated firestopping sealants at all penetrations of fire and smoke walls; at all penetrations of floors and at other locations as noted on the drawings or where required by Code. Consider walls that are common to different abutting buildings, to different additions to buildings, and to fire and smoke separations within buildings as requiring firestopping sealant. For existing buildings where fire separations are not noted on any drawings, use reasonable logic as to which separations are fire-rated. When in doubt, consult with Engineer.
- B. Provide firestopping materials and installation in accordance UL listings and methods.

3.11 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.

- B. Clean all foreign paint, grease, oil, dirt, labels, stickers, etc., from all equipment.
- C. Remove all rubbish, debris, etc., accumulated during construction from the premises.
- D. Refer to the Division 1 Section "Closeout Procedures" for general requirements for final cleaning.

3.12 SPECIAL REQUIREMENTS

- A. Coordinate the installation of all equipment, controls, devices, etc., with other trades to maintain clear access area for servicing.
- B. Install all equipment to maximize access to parts needing service or maintenance. Review the final location, placement and orientation of equipment with the Owner's representative prior to setting equipment.
- C. Include removal and reinstallation of equipment and devices if they were installed without regard to coordination of access requirements and without previous confirmation with the Owner's representative.

3.13 SYSTEM COMMISSIONING

- A. The electrical systems shall be complete and operating. Include system start-up, testing, balancing and satisfactory system performance. This includes all calibration and adjustment of electrical controls, balancing of loads, troubleshooting and verification of software, and final adjustments that may be needed.
- B. All operating conditions and control sequences shall be tested during the start-up period. Testing all interlocks, safety shut-downs, controls and alarms.
 - 1. Utilize only skilled technicians to ensure that all systems perform properly. Reimburse the Owner on a time and materials basis for services rendered at the Engineer's standard hourly rates in effect when the services are requested if the Engineer is requested to visit the job site for troubleshooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation, workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design. Pay the Owner for services required that are project-, installation- or workmanship-related. Payment is due within 30 days after services are rendered.

3.14 FIELD QUALITY CONTROL

- A. General:
 - 1. All required equipment and systems tests shall be made during and post-Construction as required.
 - 2. All required testing instruments, meters, etc., shall be provided.
 - 3. Technicians operating testing equipment shall be trained in testing procedures.
 - 4. Testing shall confirm that equipment and systems provided by the Contractor have been installed properly.
 - 5. Unsatisfactory test results shall result in revisions or replacement of equipment or settings as required to provide a system capable of meeting test requirements. Tests shall be repeated or additional tests made as necessary to confirm system capability as required by the Owner, Engineer or Authority Having Jurisdiction.

3.15 EXCAVATION, FILL, BACKFILL, COMPACTION, AND RESTORATION

A. General:

1. Prior to any excavation or digging, verify all underground utility locations. Contact all location services with sufficient time allowance for completion of utility location documentation.
2. Unless noted otherwise provide all excavation, fill, backfill, compaction and restoration required for the scope of work.

B. Excavation:

1. Excavations shall be made to proper dimensions and to accurate, solidate and undisturbed earth.
2. Provide all excavations that exceed the depth requirements with concrete of the same characteristics for foundations or compacted sand gravel fill. The type of fill shall be determined by the Engineer.
3. Do not damage surrounding structures, equipment or buried pipe. Do not undermine footing or foundation.
4. Protect all excavations to prevent cave-ins and risk to workmen.
5. Saw-cut pavement or concrete surfaces where required for excavation with clean edges.
6. Notify Engineer if bearing soil is not found to be adequate and halt excavation operation until given direction from the Engineer.
7. Confirm the soil conditions at their own cost. Excavations shall be conducted as required in the documents.
8. A compacted bed of sand and gravel (minimum of 3 inches deep) shall be provided where trench is excavated in rock.

C. Dewatering:

1. All trenches and pits shall be kept free of accumulation of water. Provide all required equipment.

D. Underground Obstructions:

1. The electrical drawings do not necessarily show all underground piping, conduit, feeders, foundations, and other obstructions in the vicinity of the construction. Review the documents of all Divisions to determine other obstructions. Take applicable precautions in making installations near underground obstructions.
2. If objects not indicated on the drawings are encountered, remove, relocate or perform extra work as indicated by the Engineer.

E. Fill and Backfilling:

1. Furnish all necessary sand and material for backfilling. Waste material and garbage are not acceptable materials.
2. Remove excess excavated earth as directed.
3. Backfill materials shall be suitable for required compaction, clean and free of perishable materials, frozen earth, debris, earth with a high void content, and stones greater than 4 inches in diameter. Water is not permitted to remain in un-backfilled trenches.
4. All trenches and excavations shall be backfilled immediately after completion of conduit installation or forms removal unless otherwise noted.
5. Areas around piers, independent foundations or structures shall have backfilled on all sides to prevent displacement. Fill and backfill shall be spread uniformly.

6. All conduits that are not concrete encased shall be provided with a bed of a minimum of 3 inches depth of compacted sand. Backfill shall be provided with compacted layers above the conduits.
7. Provide sand backfill to grade for all conduits under slabs or paved areas. All other conduits shall have sand backfill to 6 inches above the top of the conduit.
8. Backfill shall be made in layers of sand not exceeding 6 inches in depth.
9. Protect surface to prevent loads from the top of the surface for a minimum of 48 hours after backfilling operation.

F. Surface Restoration:

1. Areas shall be restored to the original condition, including areas that are landscaped. Replace all planting and landscaping features removed or damaged to its original condition. At least 6 inches of topsoil shall be applied where disturbed areas are to be seeded or sodded. All lawn areas shall be sodded unless seeding is called out in the drawings or specifications.
2. Concrete or asphalt type pavement and other surfaces removed or damaged shall be replaced to original condition. Broken edges shall be saw cut and repaired as directed by Engineer.

3.16 OPERATION AND MAINTENANCE DATA

- A. Refer to the Division 1 Section: "Closeout Procedures" for procedures and requirements for preparation and submittal of maintenance manuals.
- B. In addition to the information required by Division 1 for Maintenance Data, include the following information:
 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
 2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions, regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.
 3. Maintenance procedures for routine preventive maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 4. Servicing instructions and lubrication charts and schedules.
- C. Submit three (3) properly indexed and bound copies in "D" ring style notebooks, of the Operations and Maintenance Instructions to the Engineer. Make all corrections or additions required.
- D. Operation and Maintenance Instructions shall include:
 1. Notebooks shall be heavy duty locking three-ring binders, black in color, and incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. "Peel and stick" labels are not acceptable. Sheet lifters shall be supplied at the front of each notebook. Size notebooks a minimum of 1/2 inch thicker than the material for future inserts. Label the spine and front cover of each notebook. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other forms of binding will be acceptable.
 2. Prepare binder covers (front and spine) with printed title "Operation and Maintenance Instructions," title of project, and subject matter of binder when multiple binders are required.

3. Title page with project title, Engineer, Contractor, and Subcontractor with addresses, telephone numbers, and contacts.
 4. Table of Contents describing all index tabs.
 5. Listing of all Subcontractors and major equipment suppliers with addresses, telephone numbers and contacts.
 6. Index tabs dividing information by specification section, major equipment, or systems. All tab titles shall be clearly printed under reinforced plastic tabs. Label all equipment to match the identification in the construction documents.
 7. Copies of warranties.
 8. Copies of all final approved shop drawings and submittals. Copy of power system study and overcurrent protective device settings.
 9. Copies of all factory inspections and or equipment start-up reports.
 10. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
 11. Dimensional drawings of equipment.
 12. Detailed parts lists, each with a list of suppliers.
 13. Operating procedures for each system.
 14. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
 15. Repair procedures for major components.
 16. Replacement parts and service material requirements for each system and the frequency of service required.
 17. Instruction books, cards, and manuals furnished with the equipment.
- E. Operation and maintenance data shall consist of written instructions for the care, maintenance, and operation of the equipment and systems. Instruction books, cards, manuals furnished with the equipment shall be included.
- F. In addition to the information required by Division 1 for Maintenance Data, include the following information:
1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
 2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions, regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.
 3. Maintenance procedures for routine preventive maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 4. Servicing instructions and lubrication charts and schedules.
- G. Adequately instruct the Owner's designated representative in the maintenance, care, and operation of the complete systems installed under this contract.
- H. Provide verbal and written instructions to the Owner's representatives by factory personnel in the care, maintenance and operation of the equipment and systems.
- I. Make DVD format compact disc of the instructions to the Owner while explaining the system so additional personnel may view the instructions at a later date. The video shall become the property of the Owner.
- J. The instructions shall include:
1. Maintenance of equipment.

2. Start-up procedures for all major equipment.
- K. Notify the Engineer of the time and place for the verbal instructions to the Owner's representative so his representative can be present if desired.
 - L. Minimum hours of instruction time for each item and/or system shall be as indicted in each individual specification section.
 - M. Operating Instructions:
 1. Include instructions to the Owner's representatives for the electrical and specialized systems, using factory-authorized technical representatives.

3.17 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 1 Section "Closeout Procedures." In addition to the requirements specified in Division 1, indicate installed conditions for:
 1. Raceways of 2-inches and larger, indicating size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
 2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 3. Location of every home run point, such as receptacle, lighting fixture, or switch.
 4. Approved substitutions, Contract modifications, and actual equipment and materials installed.
 5. Mark Drawings to indicate revisions to conduit size and location both exterior and interior; actual equipment locations, dimensioned from column lines; concealed equipment, dimensioned to column lines; distribution and branch electrical circuitry; fuse and circuit breaker size and arrangements; support and hanger details; change orders; concealed control system devices.
 6. Mark Specifications to indicate approved substitutions, change orders, actual equipment and materials used.
- B. Maintain at the job site a separate and complete set of electrical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.
- C. Mark Drawings to indicate revisions to conduit size and location both exterior and interior; actual equipment locations, dimensioned from column lines; concealed equipment, dimensioned to column lines; distribution and branch electrical circuitry; fuse and circuit breaker size and arrangements; support and hanger details; Change Orders; concealed control system devices.
- D. Mark drawings and specifications to indicate approved substitutions; Change Orders, and actual equipment and materials used. Mark all Change Orders, RFI responses, clarifications, and other supplemental instructions on the documents. Record documents that merely reference the existence of the above items are not acceptable. Reimburse the Engineer for all costs for the Engineer to develop record documents which comply with this requirement if unable to comply with said above requirements. Reimbursement shall be made at the Engineer's hourly rates in effect at the time of the work.
- E. Record changes daily and keep the marked drawings available for the Engineer's examination at any normal work time.

- F. Upon completing the job, and before final payment is made, give the marked-up drawings to the Engineer.

3.18 PROJECT CLOSEOUT

- A. The following paragraphs supplement the requirements of Division 1:
- B. Final Jobsite Observation:
 - 1. Certify that the project jobsite is ready for the final jobsite observation.
 - 2. Reimburse the Engineer, based on the Engineer's standard hourly rates as defined in their contract with the Owner, for additional time and expenses when additional trips are required because the project jobsite was not ready for final observation and additional trips are required by the Engineer for review of final conditions.
 - 3. Notify the Engineer a minimum of two working days prior to installation of ceiling tiles or lay-in ceilings to allow the Engineer to visit the project site.
- C. Submit the following documents to the Engineer prior to requesting final payment:
 - 1. Operation and maintenance manuals with copies of approved shop drawings.
 - 2. Record documents including electronic AutoCAD or REVIT drawings and specifications.
 - 3. Documentation of completion of all required training of Owner's personnel.
 - 4. Provide spare parts, maintenance and extra materials in quantities specified in individual specification sections.
 - 5. Inspection and testing reports.
 - 6. Start-up reports on all equipment requiring a factory installation or start-up.

END OF SECTION 26 0500

**SECTION 26 0519
CONDUCTORS AND CABLES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

- 1. Conductors and Cables.

1.3 SUBMITTALS

- A. Submittals for approval by the Engineer are not required for this section. Unrequested submittals will not be processed or reviewed. Non-requirement of submittals is not to be construed as an allowance for substitutions and does not allow relief from full compliance with the contract documents.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70 "National Electrical Code."
 - 1. Conform to applicable codes and regulations regarding toxicity of combustion products of insulating materials.
- C. UL Compliance: Provide components which are listed and labeled by Underwriters Laboratories under the following standards.
 - 1. UL Std. 83 Thermoplastic-Insulated Wires and Cables.
 - 2. UL Std. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- D. NEMA and ICEA Compliance: Provide components which comply with the following standards:
 - 1. WC-70: Power Cables Rated 2,000V or Less for the Distribution of Electrical Energy.
- E. IEEE Compliance: Provide components which comply with the following standard.
 - 1. Std. 82: Test procedures for Impulse Voltage Tests on Insulated Conductors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. American Insulated Wire Corp.; a Leviton Company.

2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.
5. Cerro Wire.
6. Superior Essex.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.

2.2 CONDUCTORS AND CABLES

A. General: Provide wire and cable suitable for the temperature, conditions and location where installed.

B. Feeders: Copper, 600 volt insulation. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Branch Circuits: Copper, 600 volt insulation. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

D. Control Circuits: Copper, stranded conductor, 600 volt insulation.

E. Single Conductors for Feeders and Branch Circuits:

1. Stranding: Provide solid conductors for branch circuits and non-vibrating power utilization equipment utilizing Number 10 AWG and smaller. Provide stranded conductors for Number 8 AWG and larger. Provide stranded conductors, regardless of size, for connections to vibrating equipment such as motors and transformers.

2.3 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type and class for application and service required.

PART 3 - EXECUTION

3.1 CONDUCTOR INSULATION, APPLICATIONS AND WIRING METHODS

A. Concealed below Underground: Type THWN, single conductors in raceway.

B. Exposed, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.

3.2 DEVIATION FROM CONTRACT DRAWINGS

A. Basis of Design is copper conductors installed in raceway, based on 30 degrees C ambient temperature (NEC Table 310.15(B)(16)). If materials or methods selected for installation differ

from the basis of design, this contractor shall be responsible for sizing conductors and conduits to meet or exceed the ampacity of circuits selected for the basis of design.

- B. Routing multiple conductors within a single conduit requires the conductor ampacity to be derated per National Electrical Code Article 310. Do not provide more than 4 conductors within a single conduit.
- C. Underground duct conductor ampacity is based on table B.310.15(B)(2)(7) of the National Electrical code, or has been calculated in accordance with Informative Annex B: Application Information for Ampacity Calculation. Deviation from the contract documents in regard to conductor and conduit quantities or orientation as suggested by the Contractor shall require supporting calculations and a sketch for Engineer approval.
- D. Where ungrounded conductors are increased in size for any reason, equipment grounding conductors shall be increased in size proportionally according to the circular mil area of the ungrounded conductors.

3.3 INSTALLTION OF CONDUCTORS AND CABLES

- A. Install products in accordance with manufacturer's instructions.
- B. Completely and thoroughly swab raceway before installing wire.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means including fish tape, cable, rope, and basket weave wire and cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable. Do not exceed maximum tensile strength of conductor or grip. Do not exceed maximum sidewall pressure limitations of cables.
- E. Pull conductors simultaneously where more than one is being installed in the same raceway.
- F. Feeder conductors shall be continuous and shall not contain splices.
- G. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than Number 10 AWG cabled in individual circuits. Make terminations so there is no more than 1/8 inch of exposed bare conductor at the terminal. Observe NEC 310.15 (B)(2)(a) adjustment factors.
- H. Use conductor not smaller than Number 12 AWG for power and lighting circuits.
- I. Use Number 10 AWG conductors (phase, neutral and ground) for 20 ampere, 120 volt branch circuits longer than 75 feet, unless drawings requirements are more stringent.
- J. Use Number 10 AWG conductors (phase, neutral and ground) for 20 ampere, 277 volt branch circuits longer than 200 feet, unless drawings requirements are more stringent.
- K. Place an equal number of conductors for each phase, neutral and ground of a circuit within the same raceway or cable when routing parallel conductors. Conductor lengths must be equal.
- L. Support cables according to Division 26 Section "Hangers and Supports."

- M. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS AND TERMINATIONS

- A. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.
- B. Clean conductor surfaces before installing lugs and connectors.
- C. Utilize solderless compression terminals applied with circumferential compression for conductor sizes 8 AWG and larger and crimp in accordance with manufacturer instructions. Indenter compression method may be used for conductor sizes 10 AWG and smaller.
- D. Phase Sequence: Connections to phase conductors at electrical equipment shall be made such that the A-B-C conductors, when facing the equipment, are oriented top to bottom, or left to right.

3.5 SPLICES AND TAPS

- A. Conductor splices shall be kept to a minimum.
- B. Only splice within accessible junction boxes or enclosures.
- C. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors. Splices and taps shall be capable of carrying the full ampacity of the conductors without perceptible temperature rise.
- D. Below Grade:
 - 1. Use specified insulated connectors suitable and approved for below grade wiring connectors. Ensure that conductors do not apply tension to splice.

3.6 FIELD QUALITY CONTROL

- A. Inspect wire for physical damage and proper connection.
- B. Measure tightness of bolted connections with properly scaled and calibrated torque tool and compare torque measurements with manufacturer's recommended values.
- C. Before energizing, test wires and cables for electrical continuity and for short circuits.
- D. Remove and replace malfunctioning conductors and retest as specified above.

END OF SECTION 26 0519

**SECTION 26 0526
GROUNDING AND BONDING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Listing and Labeling: Provide products specified in this Section that are listed and labeled for the specific purposes by Underwriters Laboratories.
- D. Testing Agency Qualifications: Member Company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING PRODUCTS

- A. Products: Of types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

2.2 CONDUCTORS

- A. General: Comply with Division 26 Section "Conductors and Cables" for insulated grounding conductors. Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.
- B. Equipment Grounding Conductor: Green insulated; conductor metal shall match branch circuit conductor metal.

2.3 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

3.2 EQUIPMENT GROUNDING

- A. Equipment Grounding Conductor Application: Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.
- B. Install separate insulated equipment grounding conductors with all feeders and branch circuit conductors. Terminate each end on a grounding lug or bus.

3.3 CONNECTIONS

- A. General: Select connectors, hardware and conductors and make connections in such a manner as to minimize possibility of galvanic action or electrolysis.
 - 1. Make connections with clean bare metal at points of contact.
- B. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Exothermic-welded or compression-type connectors.
- C. Equipment Grounding Conductors: Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs.
- D. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A
- E. Compression-Type Connections: Use hydraulic compression tools of at least 14-ton size to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections: After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements:
 - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

END OF SECTION 26 0526

**SECTION 26 0529
HANGERS AND SUPPORTS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals and associated fastenings.
 - 2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.
- D. RNC: Rigid non-metallic conduit.
- E. Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of four times the applied force.

1.4 SUBMITTALS

- A. Submittals for approval by the Engineer are not required for this section. Unrequested submittals will not be processed or reviewed. Non-requirement of submittals is not to be construed as an allowance for substitutions and does not allow relief from full compliance with the contract documents.

1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Electrical components shall be listed and labeled for the specific intended purpose by Underwriters Laboratories, Inc.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 COORDINATION

- A. Coordinate size, shape and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Slotted Metal Angle and U-Channel Systems:

- a. Allied Tube & Conduit.
- b. American Electric.
- c. B-Line Systems, Inc.
- d. GS Metals Corp.
- e. Unistrut Diversified Products.

2. Conduit Sealing Bushings:

- a. Bridgeport Fittings, Inc.
- b. Killark Electric Mfg. Co.
- c. O-Z/Gedney.
- d. Raco, Inc.
- e. Red Seal Electric Corp.

2.2 COATINGS

A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish or inherent material characteristic.

2.3 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets and spring steel clamps.

B. Fasteners: Types, materials and construction features as follows:

1. Expansion Anchors: Carbon steel wedge or sleeve type.
2. Toggle Bolts: All steel springhead type.
3. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.

C. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps and cap screws.

D. U-Channel Systems: 16-gauge steel channels, with 9/16-inch-diameter holes, between one and one half and two and one half inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.

2.4 FABRICATED SUPPORTING DEVICES

A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.

B. Steel Brackets: Fabricated of angles, channels and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.
- B. Coordinate with the building structural system and with other disciplines' installations.
- C. Raceway Supports: Comply with the NEC and the following requirements:
 - 1. Conform to manufacturer's recommendations for selection and installation of supports.
 - 2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs, provide additional strength until there is a minimum of 200 pounds safety allowance in the strength of each support.
 - 3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
 - 4. Support parallel runs of horizontal raceways together on trapeze-type hangers.
 - 5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-inch and smaller raceways serving branch circuits, telephone and data above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
 - 6. Space supports for raceways in accordance with Table I of this section. Space supports for raceway types not covered by the above in accordance with NEC.
 - 7. Support exposed and concealed raceway within 3 feet of boxes, access fittings, device boxes or cabinets.
 - 8. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers and other devices.
- D. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, motor control centers, disconnect switches and control components in accordance with the following:
 - 1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
 - 2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4-inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
 - 3. Do not fasten supports to ceiling systems, piping, ductwork, mechanical equipment or conduit unless otherwise noted.
 - 4. Do not use powder-actuated anchors without specific permission.
 - 5. Do not drill structural steel members.
 - 6. Install surface-mounted cabinets and panelboards with minimum of four anchors.
 - 7. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

- E. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.
1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.2 PAINTING

- A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

TABLE I: SPACING FOR RACEWAY SUPPORTS

Raceway Size (Inches)	No. of Conduits in Run	Location	Maximum Spacing of Supports (Feet)		
			RMC & IMC*	EMT	RNC
HORIZONTAL RUNS					
1/2, 3/4	1 or 2	Flat ceiling or wall.	5	5	3
1/2, 3/4	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	7	7	--
1/2, 3/4, 1	3 or more	Any location.	7	7	--
1 & larger	1 or 2	Flat ceiling or wall.	6	6	--
1 & larger	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	10	10	--
1 & larger	3 or more	Any location.	10	10	--
Any	--	Concealed.	10	10	--
VERTICAL RUNS					
1/2, 3/4	--	Exposed.	7	7	--
1, 1-1/4	--	Exposed.	8	8	--
1-1/2 and larger	--	Exposed.	10	10	--
Up to 2	--	Shaftway.	14	10	--
2-1/2	--	Shaftway.	16	10	--
3 & larger	--	Shaftway.	20	10	--
Any	--	Concealed.	10	10	--

*Maximum spacings for IMC above apply to straight runs only. Otherwise the maximums for EMT apply.

END OF SECTION 26 0529

**SECTION 26 0533
RACEWAYS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following raceways electrical wiring:
 - 1. Metallic Conduit and Tubing.
 - 2. Non-Metallic Conduit and Tubing.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. NBR: Acrylonitrile-butadiene rubber.
- H. RMC: Rigid metallic conduit
- I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Submittals for approval by the Engineer are not required for this section. Unrequested submittals will not be processed or reviewed. Non-requirement of submittals is not to be construed as an allowance for substitutions and does not allow relief from full compliance with the contract documents.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70 "National Electrical Code" for components and installation.
- C. Comply with NECA "Standard of Installation."
- D. Listing and Labeling: Provide products specified in this Section that are listed and labeled by Underwriters Laboratories for the specific purpose and comply with the following standards:

1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
3. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
4. ANSI C80.5 – Aluminum Rigid Conduit.
5. ANSI/NFPA 70 - National Electrical Code.
6. ANSI/NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable.
7. NECA "Standard of Installation."
8. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
9. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
10. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
11. NEMA TC 6 - PVC and ABS Plastic Utilities Duct for Underground Installation.
12. NEMA TC 9 – Fittings for PVC Plastic Utilities Duct for Underground Installation.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Provide conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) for each service indicated. Where types and grades are not indicated, provide proper selection determined by installer to fulfill wiring requirements, and comply with applicable portions of NFPA 70 for raceways.
- B. Bushings: Bushings for terminating conduits smaller than 1-1/4 inches are to have flared bottom and ribbed sides, with smooth upper edges to prevent injury to cable insulation. Install insulated type bushings for terminating conduits 1-1/4 inches and larger. Upper edge to have phenolic insulating ring molded into bushing. Bushings to have screw type grounding terminal.
- C. Raintight Sealing Hubs: Two piece type with outer internally-threaded hub to receive conduit, inner locking ring with bonding screw, insulated throat, and V-shaped ring or O-ring.
- D. Conduit sealing bushings for service entrances: OZ Gedney conduit sealing bushings.

2.2 METAL CONDUIT AND TUBING

- A. Rigid Steel (Metallic) Conduit:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. LTV Steel Tubular Products Company.
 - c. O-Z Gedney.
 - d. Wheatland Tube Company.
 2. Description: Conduit to be seamless, hot dipped galvanized rigid steel. Threads to be cut and ends chamfered prior to galvanizing. Galvanizing to provide zinc coating fused to inside and outside walls of conduit. Provide an enamel lubricating coating on the inside of the conduit. Conduit to conform to ANSI C80.1 and listed and labeled under UL 6.
 3. Fittings and Conduit Bodies: NEMA FB 1, single piece threaded, cadmium plated malleable iron.
 4. Joint Compound: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

B. Aluminum Rigid Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. LTV Steel Tubular Products Company.
 - c. O-Z Gedney.
 - d. Wheatland Tube Company.
2. Description: Conduit to be seamless, 6063 alloy, T-1 temper. Conduit to conform to ANSI C80.5 and listed and labeled under UL 6a.
3. Fittings and Conduit Bodies: Comprised of same alloy. Provide listed antioxidant joint compound per manufacturer's written recommendations.

C. Flexible Metal Conduit: Zinc-coated steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFC Cable Systems.
 - b. Alflex Inc.
 - c. Electri-Flex Co.
2. Description: Interlocked steel construction, consisting of spirally wrapped, convoluted hot dip galvanized steel strip. Zinc coating to cover both sides and all edges of steel strip. Convolutions to be interlocked to prevent separation when conduit is bent at radius equal to 4-1/2 times conduit O.D. Conduit to be listed and labeled under UL 1.
3. Fittings: ANSI/NEMA FB 1 -1988. Threadless hinged clamp type, galvanized zinc coated cadmium plated malleable cast iron.

D. Liquidtight Flexible Metal Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFC Cable Systems.
 - b. Alflex Inc.
 - c. Electri-Flex Co.
2. Description: Flexible steel conduit with PVC jacket, listed and labeled under UL 360
3. Fittings: and Conduit Bodies: Watertight, compression type, galvanized zinc coated cadmium plated malleable cast iron. Conduit to be listed and labeled under UL 360.

E. Electrical Metallic Tubing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Republic Conduit.
 - c. Wheatland Tube Company.

2. Description: Conduit to be seamless, hot dipped or electro-galvanized steel tubing. Galvanizing to provide zinc coating fused to outside walls of conduit. Provide an enamel lubricating coating on the inside of the conduit. Conduit to conform to ANSI C80.3 - 1983 and listed and labeled under UL 797.

2.3 NONMETALLIC CONDUIT AND TUBING

A. Rigid Non-Metallic Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cantex.
 - b. J.M. Manufacturing.
 - c. Allied Tube & Conduit.
 - d. Lamson & Sessions; Carlon Electrical Products.
2. Description: Conduit to be PVC, Schedule 40, rated for use with 90 degrees C conductors and suited for direct burial and above ground use in direct sunlight, whether encased in concrete or not. Conduit to conform to latest edition of ASTM F512, NEMA TC-2, and be listed and labeled under UL 651.
3. Fittings and Conduit Bodies: Manufactured per NEMA TC-3 and UL 651 listed to match conduit, type and material. Expansion fittings shall allow for six inch movement, and shall be similar to Carlon E945 series. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

PART 3 - EXECUTION

3.1 METALLIC AND NON-METALLIC CONDUIT APPLICATION

- A. Outdoor Locations Above Grade (Including Roofs): Aluminum Rigid Conduit unless otherwise noted on plans.
- B. Indoor Locations:
 1. Finished spaces, concealed above suspended ceilings and interior walls and partitions: EMT.
 2. Exposed: RMC.
 3. Exposed, subject to physical damage (this includes all conduit in tunnel): RMC.
 4. Wet or Damp Locations: RMC
 5. Connections to vibrating equipment: FMC, except use LFMC in wet or damp locations.
- C. Underground:
 1. Within 5 feet-0 inches of the building perimeter: RNC.
 2. Greater than 5 feet-0 inches of the building perimeter: RNC.
- D. Conduit Size: Conduits shall be sized as shown on drawings. Where conduit sizes are not indicated, conduits shall be sized in accordance with the latest version of the National Electrical Code (NFPA 70) and shall be limited to a 40 percent conductor fill percentage. Conductor ampacities must be maintained; therefore adjustment factors for temperature and quantity derating values must be observed.
 1. Minimum Conduit Size: Unless otherwise noted, **1 inch**.

3.2 METALLIC AND NON-METALLIC CONDUIT INSTALLATION

A. General Installation Requirements

1. Conduits shall be mechanically and electrically continuous from source of current to all outlets unless a properly sized grounding conductor is routed within the conduit. All metallic conduits shall be bonded per NFPA 70.
2. Do not reduce the indicated sizes of raceways. Conduit sizes may only change at junction and pull boxes.
3. Complete raceway installation before starting conductor installation.
4. Use temporary closures to prevent foreign matter from entering raceway.
5. Avoid moisture traps; provide junction box with drain fitting at low points in raceway system.
6. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Empty raceways shall be labeled at each end indicating origin of the raceway. Labels shall be self-adhesive vinyl labels.
7. This contractor shall be responsible for all openings required in masonry or exterior walls for conduit routing. A qualified contractor capable of repairing all openings in a manner that matches existing conditions shall be hired by the electrical contractor.
8. Install aluminum conduit in the exterior cooling tower pit area. Where aluminum raceways are installed and pass through concrete, install in nonmetallic sleeve.

B. Conduit Routing:

1. In general, conduit shall be exposed within unfinished spaces (such as mechanical and utility areas).
2. Raceway routing proposed on Drawings is diagrammatic in nature and shown in approximate locations unless dimensioned. Coordinate conduit routing with beams, joists, columns, windows, etc., as required to complete wiring system. Verify field measurements, routing and termination locations of raceway with obstructions and other trades prior to rough-in. The electrical contractor shall be responsible for any expense due to the failure of coordination between other trades to ensure fit and avoid conflict.
3. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions, except as otherwise indicated.
4. Route exposed conduit and conduits parallel and perpendicular to building structural lines, and as close to building structure as possible.
5. Raceways are not to cross pipe shafts or ventilating duct openings, nor are they to pass through HVAC ducts. Maintain adequate clearance between raceway and piping.
6. Coordinate layout and installation of conduit with other construction elements to ensure adequate headroom, working clearance and access.
7. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
8. Do not install aluminum conduits in contact with concrete.

C. Conduit Supports:

1. Install raceways level and square and at proper elevations. Provide adequate headroom. Group related conduits; support using conduit rack. Construct rack using steel channel. All conduit supports shall be secured to walls, structural members, slabs and bar joists. Do not support conduits from non-structural members, such as ductwork, water or fire suppression piping.
2. Run parallel or banked raceways together, on common support racks where practical and make bends from same center line to make bends parallel. Use factory elbows only where

they can be installed parallel; otherwise, provide field bends for parallel raceways. Provide space within each rack for 20 percent additional conduits.

3. Support raceways as specified in Division 26 Section "Hangers and Supports."

D. Conduit Fittings and Terminations:

1. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
2. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
3. Install raceway sealing fittings according to the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound..

Raceway Material	Indoor, conditioned areas	Outdoors and non-conditioned areas
Steel	One expansion fitting in runs longer than 80 feet, additional expansion fittings every 400 feet	One expansion fitting in runs longer than 40 feet, additional expansion fittings every 200 feet
Aluminum	One expansion fitting in runs longer than 40 feet, additional expansion fittings every 200 feet	One expansion fitting in runs longer than 20 feet, additional expansion fittings every 100 feet
PVC	One expansion fitting in runs longer than 20 feet, additional expansion fittings every 100 feet	One expansion fitting in runs longer than 10 feet, additional expansion fittings every 50 feet

4. Flexible Connections: Use maximum of 6 feet of flexible metal conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement and for all motors. Use Liquidtight flexible metal conduit in wet or damp locations. Install ground conductor across flexible connections.
5. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.

E. Conduit Bends:

1. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
2. Make bends and offsets so the inside diameter is not reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
3. Use conduit benders to make sharp changes in direction, as around beams. Use hydraulic one-shot bender when field-fabricated elbows are required for bends in metal conduit larger than 2 inch size.
4. Stub-Up Connections: Use type of conduit described for stub-ups from slab. Extend conduit through concrete floor for connection to freestanding equipment to a distance 6-inches above the floor. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

3.3 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.4 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.5 CLEANING

- A. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches and abrasions.

3.6 MARKING AND IDENTIFICATION

- A. Mark and identify conduits in accordance with Section 26 0553 "Identification for Electrical Systems."

3.7 RECORD DOCUMENTS

- A. Accurately record actual routing of all feeder and sub-feeder conduits regardless of size and branch circuits conduits larger than 2-inches.

END OF SECTION 26 0533

SECTION 26 0534
BOXES, CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes boxes, cabinets, enclosures, and handholes for electrical wiring.

1.3 SUBMITTALS

- A. Submittals for approval by the Engineer are not required for this section. Unrequested submittals will not be processed or reviewed. Non-requirement of submittals is not to be construed as an allowance for substitutions and does not allow relief from full compliance with the contract documents.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.
- B. Comply with the following standards:
 - 1. NECA "Standard of Installation."
 - 2. NEMA OS 1: Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
 - 3. NEMA OS 2: Non-Metallic Outlet Boxes, Device Boxes, Covers and Box Supports.
 - 4. NEMA FB 1: Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable.
 - 5. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

PART 2 - PRODUCTS

2.1 OUTLET BOXES

- A. General: Outlet boxes shall be constructed in accordance with National Electrical Code Article 314. Outlet boxes shall be sized for the volume required by the National Electrical Code, but in no case shall they be less than 1-1/2 inches deep.
- B. Sheet Metal Boxes: Comply with NEMA OS 1, galvanized steel.
- C. Cast Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy or aluminum, type FD with gasketed cover and threaded hubs.
- D. Boxes for receptacle, telephone and data outlets shall be 4-11/16 inches square by 2-1/8 inches deep and shall be provided with extension rings. Furnish outlet boxes with fixture studs where required.

- E. Boxes for switches or local light control shall be 4 inches square by 1-1/2 inches deep and shall be provided with raised cover to fit flush with finished wall line. Provide single box for multiple-ganged devices with single coverplate, sized for the quantity of devices to be installed.
- F. Provide 4-inch octagonal and square outlet boxes for all exposed conduit work with fixture extension pan or deep fixture canopy to enclose the outlet box.
- G. Boxes for recessed light fixtures shall be 4-inch octagonal or square according to fixture hardware requirements, minimum 1-1/2 inches deep complete with blank cover.
- H. Provide corrosion-resistant steel knockout closures for unused openings.

2.2 JUNCTION AND PULL BOXES

- A. Small Sheet Metal Pull and Junction Boxes: Comply with NEMA OS 1, galvanized steel. Flush-mounted boxes shall have an overlapping cover.
- B. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1, galvanized with gasketed cover.
- C. Stainless Steel Pull and Junction Boxes: Stainless steel NEMA 4X with gasketed cover.
- D. Covers: Covers shall be the same material as the box. Covers shall be on the largest access side of the box, unless otherwise indicated.
 - 1. Less than 12 inches in any dimension: Screw-on cover.
 - 2. Greater than 12 inches in any dimension: Hinged cover.

PART 3 - EXECUTION

3.1 BOX AND CABINET INSTALLATION

- A. General Installation Requirements:
 - 1. Electrical boxes are shown on drawings in approximate locations unless dimensioned. The Engineer shall be allowed to adjust the location of boxes up to 10 feet in any direction without additional cost to the project. This is intended for boxes for receptacles and switches and other wiring devices.
 - 2. Provide boxes as shown and for splices, taps, wire pulling, equipment and fixture connections and where required by applicable codes and installation practices.
 - 3. Locate boxes to maintain headroom and present a neat appearance. Locate to allow proper access. Provide access doors for boxes located above inaccessible ceilings.
 - 4. Provide knockout closures to cap unused knockout holes where blanks have been removed.
 - 5. Support all boxes, cabinets and enclosures rigidly and independently of conduit except where specifically allowed by the National Electrical Code. Use supports suitable for the purpose.
 - 6. Boxes located outdoors above ground shall be raintight and gasketed cast aluminum.
 - 7. Provide covers for all boxes.
 - 8. Do not install boxes back-to-back in same wall. Provide at least 6 inch separation or greater where required by the building code. In hollow fire walls, maintain minimum 24 inch horizontal separation between outlets on opposite sides. As an alternate to the 24 inch separation, the use of listed putty pads or other listed materials and methods approved by the Authority Having Jurisdiction are acceptable.

3.2 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.3 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

3.4 CLEANING

- A. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

3.5 MARKING AND IDENTIFICATION

- A. Mark and identify boxes, cabinets and enclosures in accordance with Section 260553 "Identification for Electrical Systems."

END OF SECTION 26 0534

SECTION 26 0543
UNDERGROUND DUCTS, RACEWAYS AND UTILITY STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks
 - 2. Handholes.

1.3 DEFINITION

- A. RNC: Rigid nonmetallic conduit.
- B. RMC: Rigid metallic conduit

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Duct-bank materials, including separators and miscellaneous components.
 - 2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings and solvent cement.
 - 3. Warning tape.
- B. Record Documents: Show dimensioned locations of underground ducts and handholes.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firm experienced in manufacturing underground precast concrete utility structures of types and sizes required and similar to those indicated for this Project. Firm must have a record of successful in-service performance.
- B. Comply with NFPA 70 "National Electrical Code" and ANSI C2 "National Electrical Safety Code" for components and installation.
- C. Coordinate layout and installation of ducts and handholes with final arrangement of other utilities as determined in the field.
- D. Coordinate elevations of duct and duct bank entrances into manholes and handholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and ensure duct runs drain to manholes and handholes, and as approved by the Engineer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

- B. Store all underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support precast concrete units only at designated lifting or supporting points.

PART 2 - PRODUCTS

2.1 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide specified products by one of the following:
 - 1. Underground Precast Concrete Utility Structures (handholes):
 - a. Precision Precast
 - 2. Nonmetallic Ducts:
 - a. CANTEX, Inc.
 - b. Certainteed Corp, Pipe & Plastics Group.
 - c. Allied Tube & Conduit.
 - d. Carlon.
- B. Conduit and Duct:
 - a. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
 - b. PVC Conduit and Tubing Fittings: NEMA TC 3.
- C. Manufactured Bends: Not less than 36-inch radius.

2.2 METAL CONDUIT AND TUBING

- A. Rigid Steel (Metallic) Conduit:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. LTV Steel Tubular Products Company.
 - c. O-Z Gedney.
 - d. Wheatland Tube Company.
 - 2. Description: Conduit to be seamless, hot dipped galvanized rigid steel. Threads to be cut and ends chamfered prior to galvanizing. Galvanizing to provide zinc coating fused to inside and outside walls of conduit. Provide an enamel lubricating coating on the inside of the conduit. Conduit to conform to ANSI C80.1 and listed and labeled under UL 6.
 - 3. Fittings and Conduit Bodies: NEMA FB 1, single piece threaded, cadmium plated malleable iron.
 - 4. Joint Compound: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.3 PRECAST CONCRETE HANDHOLES

- A. Comply with ASTM C 858 for design and manufacturing processes.

- B. Hardware shall be stainless steel.
- C. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or pullbox.
 - 1. Frame and Cover: Weatherproof cast-iron frame with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing stainless steel bolts.
 - 2. Frame and Cover: Weatherproof steel frame with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing stainless steel bolts.
 - 3. Frame and Cover: Weatherproof galvanized steel, with hinged steel access door assembly with tamper-resistant, captive, cover-securing stainless steel bolts.
 - a. Cover Handle: Recessed.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, "ELECTRIC."
 - 6. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.

2.4 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.

PART 3 - EXECUTION

3.1 CORROSION PROTECTION

- A. Aluminum shall not be installed in contact with earth or concrete.

3.2 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Branch Circuits: RNC, NEMA TC 2 Schedule 40-PVC, in direct-buried duct bank unless otherwise indicated.
- B. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: Underground plastic utilities duct, installed in concrete-encased duct bank unless otherwise indicated.

3.3 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Pull Boxes for 600 V and Less
 - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete.
 - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20
 - 3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-20

3.4 EXAMINATION

- A. Examine site to receive ducts and manholes for compliance with installation tolerances and other conditions affecting performance of the underground ducts and manholes. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.5 EARTHWORK

- A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated compaction equipment.

- B. Restore surface features at areas disturbed by excavation and reestablish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoil, fertilizer, lime, seed, sod, sprig and mulch. Comply with Division 32 Sections "Turf and Grasses" and "Plants."
- D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 02 Section "Cutting and Patching."

3.6 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured elbows for stub-ups at equipment and at building entrances. Use manufactured long sweep bends with a minimum radius of three feet both horizontally and vertically at other locations. Use larger sweeps when called out on documents, or otherwise required. RTRC (fiberglass) long sweep elbows may be used to reduce the coefficient of friction and elbow burn-through.
- C. Joints: Make joints in ducts and fittings watertight according to manufacturer's instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.
- D. Duct Entrances to Manholes: Use end bells, spaced approximately 10 inches on-center for 5-inch ducts, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 ft. from the end bell without reducing duct line slope and without forming a trap in the line.
 - 2. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 5 ft. outside the building wall without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified below:
 - 1. Waterproofed Wall and Floor Entrances: Install a watertight entrance-sealing device with the sealing gland assembly on the inside. Anchor device into masonry construction with one or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight.
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf test nylon cord in ducts, including spares.
- H. Concrete-Encased Ducts: Support ducts on duct separators coordinated with duct size and required duct spacing, and install according to the following:
 - 1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together

- using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.
 3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
 4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
 5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
 6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
 7. Depth: Except as otherwise indicated on drawings, install top of duct bank at least 36 inches below finished grade.
 8. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12 inch increment of ductbank width

3.7 INSTALLATION OF HANDHOLES

A. Precast Concrete Handhole Installation:

1. Comply with ASTM C 891 unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:

1. Install handholes with bottom below the frost line unless otherwise noted.
2. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
3. Where indicated, cast handhole cover frame integrally with handhole structure.

END OF SECTION 26 0543

**SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 1. Identification for underground systems.
 2. Identification for raceways.
 3. Identification for wires, cables and conductors.
 4. Identification for electrical equipment.
 5. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Submittals for approval by the Engineer are not required for this section. Unrequested submittals will not be processed or reviewed. Non-requirement of submittals is not to be construed as an allowance for substitutions and does not allow relief from full compliance with the contract documents.

1.4 QUALITY ASSURANCE

- A. Comply with the following standards:
 1. ANSI A13.1 and IEEE C2.
 2. NFPA 70.
 3. 29 CFR 1910.144 and 29 CFR 1910.145.
 4. ANSI Z535.4 for safety signs and labels.
- B. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Electromark - Wolcott, New York.
2. Ideal Industries, Inc.
3. 3M.
4. Panduit Corp.
5. Seton Name Plate Co.
6. Thomas & Betts.
7. W. H. Brady, Co. - Signmark Division - Milwaukee, Wisconsin.

2.2 ELECTRICAL IDENTIFICATION PRODUCTS

- A. Self-Adhesive Vinyl Labels (Raceways and Boxes): Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- B. Self-Adhesive Vinyl Tape for Banding (Raceway, Wire and Cable): Colored, heavy duty, waterproof, fade resistant; 2 inches wide.
- C. Self-Adhesive Tape Markers (Wire and Cable): Vinyl or vinyl-cloth, self-adhesive, wraparound, cable and conductor markers with preprinted numbers and letters.
- D. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.
- E. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.
- F. Snap-Around, Color-Coding Bands (Raceways and Cables): Slit, pre-tensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- G. Colored Adhesive Marking Tape (Raceways, Wires, and Cables): Self-adhesive plastic coated cloth tape similar to Brady 441XX or 442XX series.
- H. Conductor Identification Products:
 1. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
 2. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- I. Underground Line Warning Tape:
 1. Underground Line Marking Tape: Permanent, bright-colored, corrosion-resistant, continuous-printed, plastic tape compounded for direct-burial service not less than 6 inches wide by 4 mils thick. Printed legend shall be indicative of general type of underground line below. Tape shall be 100% plastic to allow locating buried tape with electronic detection equipment. Provide marking tape similar to Thomas & Betts NAF series.

2.3 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Overlay shall provide a weatherproof and UV-resistant seal for label. Labels shall be at least 2-1/4 inches high. Where space does not permit this label size, smaller stock and lettering is permitted.
- B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with lettering and background colors as indicated. Labels shall be at least 2-1/4 inches high. Where space does not permit this label size, smaller stock and lettering is permitted.
- C. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Labels shall be at least 2-1/4 inches high. Where space does not permit this label size, smaller stock and lettering is permitted.

2.4 CABLE TIES

- A. Cable Ties: Fungus-inert, self-extinguishing, nylon one-piece, self-locking cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a minimum temperature range from minus 50 degrees F to 350 degrees F. Provide ties in specified colors when used for color-coding.
- B. Identification Cable Ties: Same as "Cable Ties" above, except with integral tab of suitable size for marking requirements.

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior). Comply with maximum volatile organic compound levels imposed within Division 09.
- B. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Increase size of labels and letters to those appropriate for viewing from the floor for elevated components.
- C. Lettering and Graphics: Coordinate names, abbreviations, colors and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering and colors as required by code.
- D. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.
- E. Clean and degrease surfaces prior to applying identification products. Apply identification to surfaces that require finish after finish work is completed. Utilize primer for metal surfaces, heavy-duty acrylic resin block filler for concrete masonry, and clear alkali-resistant alkyd binder-type sealer for concrete surfaces.

- F. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

3.2 LABEL COLOR CODE LEGEND

- A. Provide the following color coding scheme for each label based on the power system it is identifying:
 - 1. Normal Power: Black letters on white background.

3.3 RACEWAY IDENTIFICATION

- A. Identify Raceways of Certain Systems with Color Banding: Band exposed and accessible raceways of the following systems for identification. Bands shall be pre-tensioned, snap-around colored plastic sleeves, colored adhesive marking tape, or a combination of the two. Make each color band 2 inches wide, completely encircling conduit and place adjacent bands of two-color markings in contact, side by side. Install bands at changes in direction, at penetrations of walls and floors and at 20-foot maximum intervals in straight runs. Apply the following colors:
 - 1. Normal Distribution System (208/120V): White.
 - 2. Ground: Green.
 - 3. At contractor option, manufacturer painted EMT conduit (when EMT conduit is allowed or required to be used for the above systems), may be utilized in lieu of the banding noted above. Fittings would not have to be painted. All painting shall comply with Division 09 requirements.
- B. Where conduits leave a switchboard, panelboard, motor control center, etc., identification shall be provided on each conduit indicating the load being served.
- C. Contractor shall be responsible for providing the Owner with laminated, colored, typewritten legends indicating the identification color scheme. At a minimum, these legends should be installed in the main electrical room and branch electrical closets. Provide two additional legends to the Owner to use at their discretion.
- D. Identification of Raceways with Labeling:

1. Raceway Labeling: Provide labeling on conduits indicating electrical distribution system contained within (e.g. Normal, Life Safety, etc.) and operating voltage level. Label size shall be as follows:

Nominal EMT conduit size	Nominal RGS conduit size	Length of color background on label	Height of letters
up to 1 inch	up to 3/4 inch	8 inches	1/2 inch
1.25 to 1.5 inches	1 to 1.5 inches	8 inches	3/4 inch
2 to 5 inches	2 to 5 inches	12 inches	1.25 inches
6 inches	6 inches	24 inches	2.5 inches

3.4 BOX IDENTIFICATION

- A. Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage:
 1. Normal Power.
- B. At each junction, pull and connection box, identify the following: with self-adhesive vinyl labels or permanent marker (color coded) neatly hand-printed. Identification of these boxes shall be located on the inside of cover if located in finished spaces:
 1. Power and lighting circuits: Indicate system voltage and identify contained circuits and panelboard serving load (e.g., "120V, PP1-1, 3, 5").
 2. Other wiring: Indicate system type and wiring description (e.g., "FIRE ALARM NAC #2").

3.5 CIRCUIT IDENTIFICATION

- A. Label conductors as follows:
 1. Multiple Power or Lighting Circuits in the Same Enclosure: Where multiple branch circuits are terminated or spliced in a box or enclosure, label each conductor with source and circuit number.

3.6 CONDUCTOR COLOR CODING

- A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, panelboards, manholes, handholes, switches, etc., use color-coding conductor tape to identify the phase.
 1. Color-Coding for Conductors rated 600 V or Less: Use colors listed below for all conductors.
 - a. Color shall be factory-applied, or field-applied for sizes larger than No. 6 AWG, if Authorities Having Jurisdiction permit
 - 1) Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
 - b. Colors for 208/120V Circuits:

- 1) Phase A: Black.
- 2) Phase B: Red.
- 3) Phase C: Blue.
- 4) Neutral: White.
- 5) Ground Bond: Green.

3.7 ELECTRICAL EQUIPMENT IDENTIFICATION

- A. On each unit of equipment, install unique designation label that is consistent with wiring diagrams, one-line diagram, schedules and the Operation and Maintenance Manual. Each section of a multiple-section equipment lineup shall be provided with its own identification label. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets and racks of each system. Systems include power, lighting, control, communication, signal, monitoring and alarm systems unless equipment is provided with its own identification.
- B. Labeling Instructions:
1. Indoor Equipment: Provide self-adhesive, engraved, laminated acrylic or melamine label
 2. Outdoor Equipment: Provide engraved, laminated acrylic or melamine label.
 3. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 4. Nameplate Data: Provide permanent operational data nameplate on each item of power operated equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances and similar essential data. Locate nameplates in an accessible location.
 5. Automatically Started Equipment: Provide adhesive label reading "DANGER - WARNING THIS MACHINE IS AUTOMATICALLY CONTROLLED. IT MAY START AT ANY TIME" on all motors, generators and other moving or hazardous equipment which is remotely or automatically operated. Sign to be similar to Brady Number 88191.
- C. Specific Equipment Requirements:
1. Control Equipment: Including but not limited to disconnect switches, starters, variable-speed controllers, contactors, motor control centers, pushbutton stations, etc.
 - a. Identification label shall include the following:
 - 1) Equipment type and tag designation shown on the contract documents of the actual equipment served in 1/2 inch high bold lettering.
 - 2) Location of equipment being served in 1/4 inch high bold lettering. If the equipment being served by the control equipment is located in the same room, identify location as "THIS ROOM."
 - 3) Voltage and phase rating of equipment in 1/4 inch high bold lettering.
 - 4) The name of the upstream equipment and location/room number it is located in using 1/4 inch high bold lettering.
 - b. Example Identification Label:

AHU-6 Supply Fan 'AHU-6S'
Located in Mechanical Room 001
480V 3-Phase, 3 Wire
Fed from Distribution Panel MHEQ; Room 200

END OF SECTION 26 0553

**SECTION 26 0600
ELECTRICAL DEMOLITION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Electrical coordination, materials and methods for electrical demolition associated with remodeling of an existing area or facility for re-use.

1.3 SELECTIVE DEMOLITION

- A. This Section includes limited scope general construction materials and methods for application with electrical installations as follows:
- B. Selective demolition including:
 - 1. Nondestructive removal of materials and equipment for reuse or salvage as indicated.
 - 2. Dismantling electrical materials and equipment made obsolete by these installations.
 - 3. Miscellaneous metals for support of electrical materials and equipment required to remain.
 - 4. Firestopping as required to maintain existing partition ratings.

1.4 PROJECT CONDITIONS

- A. Conditions Affecting Selective Demolition: The following project conditions apply:
 - 1. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
 - 2. Locate, identify and protect electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.
 - 3. Maintain and protect existing building services that transit the area affected by selective demolition.

1.5 SEQUENCE AND SCHEDULING

- A. Coordinate the shut-off and disconnection of electrical services with the Owner and Campus utility. Coordinate any electrical outages required for service switchovers or connections with the Owner a minimum of five working days prior to the interruption. Comply with Owner's specific requirements for partial or complete outage requests.
- B. All work that produces excessive noise and/or interference with normal building operations, as indicated on the drawings, shall be coordinated and scheduled with the Owner.
- C. Assume that all required re-connection of existing systems or equipment not indicated for demolition must remain operational unless otherwise noted. Provide temporary connections to maintain electrical services and systems serving adjacent areas during required outages.

- D. Maintain existing electrical service and electrical distribution equipment in operation until the new electrical service or distribution equipment is energized, tested and accepted.

1.6 DRAWINGS AND SPECIFICATIONS

- A. The architectural, structural, mechanical and electrical drawings and specifications shall be considered as mutually explanatory and complementary. Any electrical demolition work called for by one and not by the other shall be performed as though required by all. All sections and subsections of the Electrical work shall be governed by and subject to the general and supplementary conditions. Any discrepancies in or between the drawings and specifications, or between the drawings and actual field conditions shall be reported to the Engineer/Architect in sufficient time to issue an addendum for clarification.
- B. The electrical drawings are diagrammatic and the drawings indicate the general layout of the electrical systems. Field verification of scale dimensions on plans is directed since actual locations, distance and levels will be governed by actual field conditions.

PART 2 - PRODUCTS

2.1 MATERIALS AND METHODS

- A. Materials and methods required for removing, patching, connections, etc., shall be as specified in the associated specification sections.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL DEMOLITION

- A. Comply with NECA 1.

3.2 EXAMINATION AND COORDINATION

- A. Examine substrates, areas and conditions with Installer present for compliance with requirements for conditions affecting demolition.
- B. Coordinate the demolition scope of work with the Owner and other Contractors to confirm that all required electrical demolition is addressed and scheduled to avoid disputes.

3.3 SELECTIVE DEMOLITION

- A. The intention of the electrical demolition drawings is to disconnect and remove all electrical work made void by the scope of the construction and alteration.
- B. All existing electrical work and associated raceway and wiring, which has been made obsolete by the work and/or is shown dashed on the electrical demolition drawings shall be disconnected and removed back to the source of power unless otherwise noted. Although an attempt has been made to indicate all of this work, total accuracy is not guaranteed. Contractor shall visibly examine all areas and walls and ceilings scheduled for removal to determine existing electrical items to remain.
- C. Where electrical equipment, conduit, boxes and supporting hardware are removed, patch and finish the surface as required to match the existing unless otherwise noted.
- D. All removed materials, other than removed materials to be relocated, or stored or turned over to the Owner shall become the property of the Contractor and shall be removed from the project site.
- E. Acceptance of contract means installer accepts existing conditions.

- F. Provide manifests and travel and disposal forms and documents to Owner when required by Owner or regulatory agencies.

3.4 CLEANING

- A. Clean existing electrical distribution equipment affected by the project, including switchboards, motor controllers, panelboards, etc. Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide coverplates for openings. Modify existing panelboard directories (or replace) for panelboards which have had alterations to the circuits originating therein. Describe the load and location.
- B. Where luminaires are indicated to be retained and re-used, the Electrical Contractor shall clean all exterior and interior surfaces. Broken electrical parts, including guards and lens shall be replaced to match existing construction unless otherwise noted.

3.5 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical demolition to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are to be provided using UL listed materials and methods.

END OF SECTION 26 0600

**SECTION 26 0923
LIGHTING CONTROL DEVICES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior photocells.

1.3 SUBMITTALS

- A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

- A. Products supplied shall be from a single manufacturer that has been continuously involved in manufacturing of lighting controls for a minimum of five (5) years. Mixing of manufacturers shall not be allowed.
- B. All components shall be U.L. listed, offer a five (5) year warranty and meet all state and local applicable code requirements.
- C. All occupancy sensors shall be tested to NEMA WD 7-2011 Occupancy Motion Sensors Standard.

PART 2 - PRODUCTS

2.1 EXTERIOR PHOTOCELLS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
 - 1. Cooper Industries, Inc
 - 2. Hubbell Building Automation
 - 3. Intermatic, Inc.
- B. Description: Solid state, with SPST or DPST dry contacts rated for 1800 VA, to operate connected load, complying with UL 773.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range.
 - 3. Time Delay: Thirty-second minimum, to prevent false operation.
 - 4. Lightning Arrester: Air-gap type.
 - 5. Mounting: Twist lock complying with NEMA C136.10, with base.

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

- A. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- B. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- C. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.2 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 26 0553 "Identification for Electrical Systems."
 - 1. Identify circuits or luminaires controlled by photoelectric sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.

END OF SECTION 26 0923

**SECTION 26 2416
PANELBOARDS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Lighting and appliance branch-circuit panelboards.

1.3 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections and details. Show tabulations of installed devices, equipment features and ratings such as voltage, main bus ampacity, integrated short circuit ampere rating, overcurrent protective device arrangement and sizes.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 by a qualified testing agency and marked for intended location and application.
- D. Comply with NEMA PB 1 "Panelboards."
- E. Comply with NFPA 70 "National Electrical Code."

1.5 WARRANTY

- A. Warranty: Panelboard and components shall be warranted to be free from manufacturing defects for a period of one year after project acceptance by Owner.

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344
- B. Enclosures: NEMA PB 1, Type 1, flush or surface mounted as shown on drawings.
 1. Rated for environmental conditions at installed location, unless otherwise noted on drawings, the following types shall be used in the listed locations:

Location	NEMA Type
Interior Dry Location	NEMA 1

2. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Same finish as panels and trim.
 3. Directory Card: Inside panelboard door, mounted in transparent card holder.
- C. Phase, Neutral, and Ground Buses:
1. Material: Copper
 2. Main bussing shall be fully rated, non-tapered, ready to receive those overcurrent devices indicated as spaces without modifying the bus. Neutral bus to be rated at 100 percent of the main bus rating, capable of accepting terminations based on the maximum number of branch circuit protective devices allowed in the panelboard plus 6 additional conductors.
 3. Equipment Ground Bus: Adequate for panelboard feeder and branch-circuit equipment ground conductors. Equipment ground bus shall be large enough and have sufficient quantity and sizes of terminations to allow for termination of panelboard feeder plus one equipment-grounding conductor per circuit, based on the maximum number of branch circuit protective devices allowed in the panelboard plus 6 additional conductors. Increase terminations to accommodate additional feeder conductors where double-lugged panelboards are indicated. When panelboards are multiple sections, provide equipment ground busses in each section of sufficient size for all grounding conductors in that section. Ground busses to be insulated from the panelboard enclosure where isolated ground busses are called for. Ground busses shall be bonded to enclosure when isolated ground busses are not called for.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Main, Neutral, and Ground Lugs and Buses: Provide mechanical connectors for conductors. Provide necessary additional wire bending and terminating space when sub-feed and feed-through lugs are called for.

- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- F. Future Devices: Mounting brackets, bus connections, filler plates and necessary appurtenances required for future installation of devices.
- G. Overcurrent Protection Devices: Multiple pole overcurrent protection devices shall be provided with a common trip handle for all poles. Tandem circuit breakers are not allowed.
- H. Panelboard Short-Circuit Current Rating: All distribution and branch circuit panelboards shall be fully rated to interrupt symmetrical short circuit current available at terminals. Series rated equipment is not allowed.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. ABB
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Doors: Hinged front cover, entire front trim hinged to box and with standard door within concealed hinged trim cover (door-in-door). Provide flush locks, keyed alike.
- D. Interiors: Provide physical means to prevent installation of more overcurrent protection devices than the quantity for which the enclosure was listed. Interiors shall be field convertible for top or bottom feed.
- E. Box: Box shall be nominally 5-3/4 inches deep by 20 inches wide.
- F. Circuit Numbering: Provide factory fabricated circuit numbers adjacent to each circuit breaker pole position. Numbering shall be continuous from topmost pole position to last possible pole position. Number sequence on left shall be 1-3-5-7, etc., and number sequence on right shall be 2-4-6-8, etc. Numbering material shall be insertable or strip type, as manufactured by the panelboard manufacturer for the specific panelboard. Adhesive markers and pen type markers are not acceptable.
- G. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 1. Circuit Breakers: Provide molded-case, thermal-magnetic, trip-free, bolt-on circuit breakers (unless otherwise noted) replaceable without disturbing adjacent units. Circuit breaker escutcheon shall have ON and OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the "ON" or "OFF" position. Circuit breaker faceplate and handle shall indicate rated ampacity. Circuit breaker faceplate shall indicate UL certification standards with applicable voltage systems and corresponding AIC ratings. Circuit breakers 30 amperes and less shall be UL listed to accept copper conductors with insulation rated at 60, 75 and 90 degrees Celsius, with conductors sized from the 60

degree Celsius column of Table 310.15(B)(16) of the NEC. Circuit breakers larger than 30 amperes shall be UL listed to accept copper conductors with insulation rated at 75 or 90 degrees Celsius with conductors sized from the 75 degree Celsius column of Table 310.16 of the NEC.

- H. Short Circuit Rating: Provide short circuit rating for each panelboard as indicated on drawings. Ratings indicated are minimum values. Manufacturer shall provide the next larger rating if the value indicated is unavailable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- B. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mounting height: Mount panelboards such that the center grip of any operating handle, when in its highest position, is not more than 79 inches above the floor. Align top edges of panelboard covers where multiple panelboards are installed in the same general area.
- C. Install overcurrent protective devices and controllers not already factory installed.
- D. Install filler plates in unused spaces.

3.3 IDENTIFICATION

- A. Comply with requirements within Division 26 Section "Identification for Electrical Systems."
- B. Circuit Directory: Provide typed circuit directory reflective of final circuit changes. Identify all circuits including spares. Spaces shall be left blank. Circuit designations shall describe the load type and location. For example, "Lighting - North Corridor" or "Receptacles - Rooms A, B, C and X, Y, Z." Use Owner's room designations, not designations shown on the plans, if different. Type on cardboard stock installed behind clear acrylic holder enabling removal of the directory.

3.4 FIELD QUALITY CONTROL

- A. Visual and Mechanical Inspection: Include the following inspections and related work:
 - 1. Inspect for defects and physical damage, labeling and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
 - 2. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
 - 3. Check panelboard mounting, area clearances, alignment and fit of components.

4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

END OF SECTION 26 2416

SECTION 311000

SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and removing site utilities.
7. Temporary erosion and sedimentation-control measures.

1.3 DEFINITIONS

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, or gray than underlying subsoil; contains organics; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain on Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs or videotape.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
- B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Notify Missouri One Call for area where Project is located before site clearing.
- C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises as directed by Owner.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 Section "Earth Moving."
 - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.

- B. Locate and clearly identify trees, shrubs, and other vegetation to remain as shown on the Plans. Contractor shall verify all Superintendents, Managers, Subcontractors, etc. are aware of and understand where vegetation is to be protected.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to the Civil Construction Plans and requirements of authorities having jurisdiction.
- B. Verify that flows of untreated water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

- A. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Owner.

3.4 EXISTING UTILITIES

- A. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than 5 days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.
- B. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Remove all stumps by excavating to include removal of associated root system.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm), and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

- A. See Landscape specifications for topsoil testing requirements.
- B. Remove sod and grass before stripping topsoil.
- C. Strip topsoil to a depth of 6 to 18 inches, as encountered onsite, in a manner to prevent intermingling with underlying subsoil or other waste materials.
 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; trash, debris, weeds, roots, and other waste materials.
- D. Stockpile topsoil away from edge of excavations without intermixing with subsoil in onsite area shown on Civil Plans. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 1. Do not stockpile topsoil within protection zones.
 2. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 311000

SECTION 312000

EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses, and plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Base course for concrete walks and pavements.
5. Subbase course for asphalt paving.
6. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Sections:

1. Division 31 Section "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

D. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Owner. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Owner. Unauthorized excavation, as well as remedial work directed by Owner, shall be without additional compensation.

F. Fill: Soil materials used to raise existing grades.

G. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. (0.57 cu. m) or more in volume.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Aggregate layer placed between the subgrade and hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

1. Warning Tape: 12 inches (300 mm) long; of each color.

C. Material Test Reports: For each on-site soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.

2. Laboratory compaction curve according to ASTM D 698.

D. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.5 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

- B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
 - 1. Do not proceed with work on adjoining property until directed by Owner.
- C. Utility Locator Service: Notify "Missouri One Call" for area where Project is located before beginning earth moving operations.
- D. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 31 Section "Site Clearing," and as indicated in the Civil Plans are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GM, GC, SM, SW, SP, SC, and CL according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 8 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Soils that classify as CH should be analyzed and approved by a qualified geotechnical engineer prior to use.
- C. Unsatisfactory Soils: Soil Classification Groups OL, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within -2 to +4 percent of optimum moisture content at time of compaction.
 - 2. Unsatisfactory soils also include frozen soil, organics, rubbish, large rocks, construction materials like bricks or large pieces of concrete, wood, or other deleterious material.
- D. Subbase Material: Subbase material shall meet the crushed stone base MoDOT requirements of Section 1007 of the current Missouri Standards for Highway Construction, Type 1.
- E. Engineered Fill: Soil or granular fill containing sufficient fines to establish a moisture density relationship.
- F. Bedding Course: Material that meets the current specifications of MoDOT Type 1 or 5 granular material, or approved equal.
- G. Drainage Course: Rock course meeting the gradation requirements for a #67 rock as defined by ASTM C33.

2.2 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications. Conduit to remain empty for this Project.
4. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. All activities will be contained within construction boundaries indicated on site plan. Specified excavation requirements, precautions, and protective systems will be observed at all times.
- B. Movement of trucks and equipment on Owner's property will be in accordance with Owner's instructions.
- C. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- D. Protect and maintain erosion and sedimentation controls during earth moving operations.
- E. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials..

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Owner. The Contract Sum will be adjusted for rock excavation according to changes in work.
 1. Earth excavation includes foundations, footings, concrete piers, excavating pavements and obstructions visible on surface; underground structures, utilities, and other items

indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.

- a. Ram hammering; or ripping of material not classified as rock excavation is earth excavation.
2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 6 inches (150 mm) beneath pipe in trenches, and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.6 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe with a minimum cover of 48 inches (30" minimum cover for gas line trench, see detail in civil construction plans).
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.
 1. Clearance: 6 inches (150 mm) each side of pipe or conduit.
- C. Trench Bottoms: Excavate trenches 4 inches (100 mm) deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe. Remove projecting stones and sharp objects along trench subgrade.
 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.7 SUBGRADE INSPECTION

- A. Notify Owner when excavations have reached required subgrade.
- B. If Owner determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 20 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph (5 km/h).

2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Owner, and replace with compacted backfill or fill as directed.
3. All proof-rolls shall be observed by a representative of Engineering Surveys and Services and the Owner.

- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Owner, without additional compensation.

3.8 NARROW DEEP EXCAVATIONS AND UNAUTHORIZED EXCAVATION

- A. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Owner.
1. Fill unauthorized excavations under pipe, or conduit as directed by Owner.

3.9 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 2. Surveying locations of underground utilities for Record Documents.
 3. Testing and inspecting underground utilities.
 4. Removing concrete formwork.
 5. Removing trash and debris.
 6. Removing temporary shoring and bracing, and sheeting.
 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.11 UTILITY TRENCH BACKFILL

- A. Trenches will not be backfilled until all required tests are completed and the utility systems, as installed, conform to requirements specified by the contract documents.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.
- C. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

- D. Trenches under Pavement: Place and compact backfill of Engineered Fill to the bottom of the pavement rock base and a minimum 1 foot beyond edge of pavement in all directions. Place and compact in 8" max lifts.
- E. Backfill voids with satisfactory soil while removing shoring and bracing.
- F. Trenches outside of pavement, buildings, or structural areas: Place and compact initial backfill of Bedding Course, to a height of 12 inches (300 mm) over the pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
 - 2. Backfill remaining trench of Satisfactory Soil material, free of particles larger than 1 inch (25 mm) in any dimension, in 8" maximum lifts to the bottom of top soil layer.
- G. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.12 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use satisfactory soil material.
 - 4. Under building slabs, use satisfactory soil material.
 - 5. Under footings and foundations, use satisfactory soil material.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within -2 to +4 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by +4 percent and is too wet to compact to specified dry unit weight.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. Under building slabs compact each layer of backfill or fill soil material at least 95 percent.
 - 2. Under walkways, structures, steps, and pavements, compact each layer of backfill or fill soil material at least 95 percent.
 - 3. Under turf or unpaved areas, compact each layer of backfill or fill soil material at least 95 percent to achieve bottom of topsoil layer elevation,
 - 4. For utility trenches, compact each layer to at least 95 percent.

3.15 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Turf or Unpaved Areas: 6" below finish grade, plus or minus 1 inch (25 mm).
 - 2. Walks: Plus or minus 1/2 inch (13 mm).
 - 3. Pavements: Plus or minus 1/2 inch (13 mm).
- C. Owner will place topsoil. Contractor to grade finish grade 6 inches lower than finish grades shown on plans to within plus or minus 1" of finish grade in all disturbed green space areas.

3.16 SUBBASE COURSE UNDER PAVEMENTS AND WALKS

- A. Place subbase course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course under pavements and walks as follows:
 - 1. Shape subbase course to required crown elevations and cross-slope grades.
 - 2. Place subbase course 6 inches (150 mm) or less in compacted thickness in a single layer.
 - 3. Place subbase course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
 - 4. Place and compact subbase course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.17 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared structural fill, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Place drainage course 6 inches (150 mm) or less in compacted thickness in a single layer.
2. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
3. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.
4. Install vapor retarder on prepared drainage course according to manufacturer's written instructions, overlapping sides and ends.

3.18 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- C. Testing agency will test compaction of soils in place according to ASTM D 1556 and ASTM D 6938 as applicable. Tests will be performed at the following locations and frequencies:
 1. Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2,500 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 150 feet (45 m) or less of wall length, but no fewer than two tests.
 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet (46 m) or less of trench length, but no fewer than two tests.
 4. Paved areas, sidewalks, and other potential structural areas: At each compacted backfill layer, at least one test for every 10,000 square feet, but in no case fewer than 3 tests per lift.
- D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.
- E. Prior to the Contractor demobilizing from the site, the testing agency shall perform an as-built survey of all improvements constructed for the project to determine if they match the approved plans. Any and all deficiencies shall be corrected to match the plans by the Contractor with no additional compensation.

3.19 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 1. Scarify or remove and replace soil material to depth as directed by Owner; reshape and recompact.

- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.20 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil, topsoil, and waste materials including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 312333

TRENCHING AND BACKFILLING

PART 1 -GENERAL

1.1 SECTION INCLUDES

- A. This section encompasses the work required for excavation of trenches, structures, appurtenances, bedding, over-excavation of unsuitable material, and backfilling for the installation of utilities.
- B. Drawings and General Provisions of Contract, including General and Special Conditions, apply to this section.

1.2 DEFINITIONS

- A. Maximum Density: Maximum dry weight in pounds per cubic foot of a specific material, as determined by ASTM D698, Standard Proctor Density
- B. Optimum Moisture: Percentage of water at maximum density
- C. Rock Excavation: Material that requires blasting or jack hammering for its practical and effective removal
 - 1. Materials include sandstone, limestone, flint, granite, quartzite, or similar material, in masses measuring more than one (1) cubic yard in volume or in ledges 4" or more in thickness.
 - 2. Rock encountered in two or more ledges, being 3" or thicker, with interlaying earth strata 12" thick, the entire volume from the top of the top ledge to the bottom of the bottom ledge will be classified as rock.
- D. Rubble: Buried concrete foundations, beams, walls, and other material which requires blasting or jack hammering for its practical and effective removal.
- E. Earth Excavation: Earth excavation will include all material not otherwise classified. Decomposed or disintegrated shale, which can be effectively plowed, spaded, or removed with power drive excavation equipment, and gravel base will be classified as earth excavation.
- F. Unstable Subgrade is subgrade softened, eroded by flooding or placement during unfavorable weather, or other Contractor controlled actions.
- G. Unsuitable Subgrade is natural material that cannot be compacted to the requirements of this section.
- H. Over excavation of Unsuitable Material: Removal of material that is too soft to provide adequate support as determined by the Owner's Representative for pipe being placed in the bottom of the trench.
- I. Granular Material Backfill and Bedding: Coarse sand, crushed rock or gravel, free from dust, clay, organic, and other undesirable materials.
- J. Payment Line: Used for over excavation of unsuitable material. The payment line shall be considered the lower of the bottom of the bedding material or a line 6" below and parallel to the pipe flow line. Width of over excavation shall be 2-feet

greater than the outside diameter of the pipe.

1.3 JOB CONDITIONS

A. Blasting: Blasting is not permitted on this project.

B. Length of open trench.

1. The maximum length of open trench shall be 200 feet.

2. The Contractor shall not leave an unattended open trench without fencing.

C. Protection of existing underground utilities.

1. The location of existing utilities shown on the drawings is based upon information and data supplied to the Owner or Engineer by the owner of the utility. The utilities are shown for information only. The information is not guaranteed to be either complete or accurate. It is the Contractor's responsibility to contact all utilities and obtain utility staking prior to construction.

2. Any damage to existing utilities shall be reported to the utility and repaired in accordance with the utility's standards.

3. The cost of repairs to damaged utilities shall be borne by the Contractor.

4. If utility service must be interrupted to complete a construction operation, the Contractor shall obtain permission from the Owner's Representative.

a. The Contractor shall notify the Owner's Representative at least 72 hours in advance of the time of the interruption and the expected duration of the interruption.

b. If the utility requires standby service, it shall be provided at the Contractor's expense.

5. If a non-scheduled interruption of utility service results from accidental damage, the Contractor shall take immediate steps as necessary to notify the Owner's Representative and restore service. The Contractor's personnel shall not leave the site until the interruption has been restored.

D. Scheduling

1. Clean up shall be performed promptly following utility installation backfill.

2. Repair of trench settlement shall be performed promptly.

E. Erosion Control

1. The Contractor shall comply with the Drawings, Specifications, and all applicable Federal, State, or Local erosion control regulations.

2. The Contractor shall perform regular maintenance of all erosion control devices until time of final acceptance.

F. Maintenance

1. The Contractor is responsible for repair of trench settlement up to the level of the adjacent' grade that occurs during construction, as well as the warranty

period. This shall include restoration of the finish surface as appropriate.

1.4 SITE COMPACTION TESTING

- A. The Owner's Representative will perform testing of compacted fill materials.
- B. Notify the Owner's Representative when work or portions of work under this Section are completed.
- C. If, during progress of work, tests indicate that compacted materials do not meet specified requirements, remove defective work. Replace at no cost to Owner.
- D. Allow the Owner's Representative the opportunity to test compacted fills before proceeding with placement of surface materials.
- E. Absence of compaction testing shall not relieve the Contractor of his obligation to satisfy the compaction requirements of this section.

1.5 PROTECTION

- A. Protect trees, shrubs and lawns, and other features remaining as part of final landscaping.
- B. Protect benchmarks and existing structures, roads, sidewalks, paving, and curbs against damage from equipment and vehicular or foot traffic.
- C. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods, as required to prevent cave-ins or loose dirt from falling into excavations.
- D. Underpin adjacent structure(s), which may be damaged by excavation work, including service lines and pipe chases.
- E. Notify the Owner's Representative of unexpected subsurface conditions and discontinue work in area until the Owner's Representative provides notification to resume work.
- F. Grade around excavations to prevent surface water runoff into excavated areas.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill

- 1. Suitable Excavated Material or Borrow shall be free of cinders, ashes, refuse, sod, vegetative, or organic matter, boulders, rocks, or pavement fragments. Material shall meet ASTM D2487, soil classification groups, GW, GP, SW, SP, SM, CL, or CH.
- 2. Do not use sand backfill.
- 3. Granular backfill: Crushed limestone or gravel with 100% passing a 1" sieve, 20-75% passing a No.4 sieve, 20-40% passing a No.8 sieve, and 6-16% passing a No. 200 sieve

B. Topsoil: Provided and installed by

Owner. C. Trench Stabilization

1. Trench stabilizing material shall consist of crushed rock or other approved material

with 100% passing the 3" sieve and 25-95% passing the 1"

sieve.

D. Concrete

1. Concrete shall be a commercial grade with a minimum 28-day compressive strength

of 4,000 psi.

E. Bedding

1. Graded, crushed stone with %" minus material.

PART 3 - EXECUTION

3.1 GENERAL

A. Replace or reinstall obstructions removed to accommodate construction equipment or to facilitate excavation after construction.

B. Do not remove trees unless noted on the drawings. Exercise care in operating equipment beneath the drip line or adjacent to trees to prevent damage. If damage occurs, the Owner will evaluate, determine the extent, and repair the damage. The Contractor is responsible for all costs related to the damage.

C. Pile excavated material suitable for backfill in an orderly manner a sufficient distance from the edge of excavation to avoid rollbacks, slides, or cave-ins.

D. Excavate by open-cut method for utilities and structures except as noted on Drawings.

E. The Contractor shall be responsible for providing barricades and protection around excavation and work areas.

3.2 SAFETY

A. The means of the work and the safety of the Contractor's employees are solely the responsibility of the Contractor. The Contractor has a contractual obligation to comply with all applicable laws and regulations including those of OSHA. At no time will either the Owner or Owner's Representative take responsibility for either the means of the work or the safety of the Contractor's employees.

3.3 SHEETING, SHORING, AND BRACING

A. Construct sheeting, shoring, and bracing required to hold walls of excavation, provide a safe area for workmen, protect existing utilities and structures, and to permit construction in the dry.

- B. Sheeting may be wood or steel.
- C. Wood Sheeting Driven below Level of Utility: Leave in place to a level of 5' below finished grade.
- D. Pull steel sheeting.
- E. When using a moveable trench box, below the spring line of pipe, it shall be lifted prior to any forward movement to avoid pipe displacement.
- F. Sheeting, shoring, and bracing shall not be paid for separately, but is considered incidental to the project.
- G. Sheeting and shoring shall be in accordance with OSHA and other applicable governmental regulations. The Contractor shall be solely responsible for complying with the regulations.
- H. Provide the Owner's Representative with shop drawings of proposed sheeting or shoring, signed and sealed by a registered Professional Engineer, licensed to practice in the state that the project is in.

3.4 PREPARATION

- A. Clearing
- B. Remove vegetative material and obstructions as necessary for construction.
- C. The Contractor shall properly dispose of removed material off the project site.
- D. The greater of the existing topsoil layer or the top 6" of native material shall be removed and disposed of offsite.

3.5 PERFORMANCE

A. General

1. General: Surplus and rejected unsuitable excavated material becomes property of the Contractor for

disposal. B. Trench Excavation

1. Excavated material shall be stored in such a manner as to avoid property damage.
Repair any damage at the Contractor's expense.
2. Excavate the base of the trench to provide a uniform and continuous bearing and support on solid and undisturbed material.
3. The minimum trench width shall be sufficient to allow space for jointing and bedding.
The maximum allowable trench width at a point 12" above the top of the pipe (pipe envelope) shall be the outside diameter plus 24 inches.
4. If rubble or rock is encountered, the trench shall be excavated to provide clearance of at least 6" below and 12" on each side of the utility line and fittings.
5. Remove and repair Unstable Subgrade at the Contractor's expense.
6. Over excavation of Unsuitable Material: When the Contractor encounters

material that is not suitable for supporting the pipe line or structure being constructed, the Contractor shall notify the Owner's Representative to obtain written instructions on how to proceed. Material removed prior to authorization of the Owner's Representative will not be eligible for payment. The over excavation will be backfilled to the payment line with granular material.

C. Bedding

1. Provide pipe with compacted granular bedding having a minimum thickness of 4" or
1/8th of the outside pipe diameter, whichever is

greater. D. Dewatering

1. Excavation, installation of bedding, pipes, structures, and backfilling shall be done in dry conditions. If the subgrade is saturated or standing water exists, the work area shall be dewatered prior to installation or backfilling operations.
2. The Contractor shall make provisions to handle water encountered during construction. The Contractor shall obtain approval from the Owner's Representative of the proposed method of dewatering.
3. The Contractor shall prevent surface water from flowing into the excavated area. Divert or pump stream flow past the area of construction. Remove water accumulating in the area of construction.
4. Do not pump water onto adjacent property without approval of the Owner's Representative and adjacent property owner.

E. Trench Backfill

1. Trenches shall be backfilled only after the locations of connections and appurtenances have been recorded by the Contractor on the drawing set. This information is to be submitted to the Owner's Representative with other construction record information.
2. Place backfill in lifts of 8" or less prior to compaction.
3. Carefully place backfill in the pipe envelope (top of bedding to a point 12" above the pipe). Material shall be of even consistency and free of clumps and boulders, finely divided. Compact material to 95% maximum Standard Proctor Density. Material within the pipe envelope shall be the same as specified for trench backfill, unless noted otherwise on the Drawings.
4. Place backfill simultaneously on both sides of pipe to prevent displacement.
5. Place backfill into the trench at an angle so that impact on installed pipe is minimized.
6. Install a 3' minimum cushion of backfill above pipe envelope before using heavy compacting equipment. If pipe is damaged, replace the section of damaged pipe and provide additional depth of cushion.

F. Backfill Above the Pipe Envelope

1. Under and within 5' of pavement and undercut structures or right of way, compact suitable excavated material to 95% of maximum Standard Proctor

Density. The Contractor may substitute granular backfill with no additional cost to the Owner.

2. Under landscaped and lawn areas, compact suitable excavated material to 95% of maximum Standard Proctor Density. The top 6" of the backfill shall be installed by the Owner.
3. Place sidewalk and pavement base and/or surface above compacted backfill as noted on the Plans.

3.6 FIELD QUALITY CONTROL

- A. The Contractor shall furnish and provide equipment and personnel to provide access for the Owner's Representative to any test location and test depth necessary, in the Owner's Representative's opinion, to properly evaluate compaction effort.
- B. If specified compaction rates are not attained, the Owner's Representative may require the Contractor to utilize different compaction methods or lift thickness.
- C. Compaction Testing
 1. The Owner's Representative will perform compaction testing, unless noted otherwise.
 2. The moisture density relation to be used in establishing compaction will be ASTM D698 (Standard Proctor) or ASTM D4253 (Relative Density).
 3. Compaction effort may be evaluated by the use of any of the following standard test methods:
 - a. ASTM D-1 556 (sand cone)
 - b. ASTM D-2922 (nuclear)
 - c. The Owner's Representative will determine the Compaction Testing Frequency.

END OF SECTION 312333

SECTION 321216

ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Hot-mix asphalt paving.
2. Asphalt surface treatments.
3. Pavement-marking paint.
4. Imprinted asphalt.

B. Related Sections:

1. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
2. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants and fillers at paving terminations.

1.3 DEFINITION

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
 1. Job-Mix Designs: For each job mix proposed for the Work.
- B. Qualification Data: For qualified manufacturer and Installer.
- C. Material Certificates: For each paving material, from manufacturer.
- D. Material Test Reports: For each paving material.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the current MoDOT Standard Specifications for Highway Construction for asphalt paving work.

- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
 - 1. Prime Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
 - 2. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
 - 3. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
 - 4. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.
- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F (12.8 deg C), and not exceeding 95 deg F (35 deg C).

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Asphalt aggregate: Per the current MoDOT Standard Specifications for Highway Construction for Type C surface course and MoDOT plant mix bituminous course.
- C. Type 1 Aggregate: Per the current MoDOT Standard Specifications for Highway Construction.

2.2 ASPHALT MATERIALS

- A. All asphalt material shall conform to the current MoDOT Standard Specifications for Highway Construction for Type C surface course and MoDOT plant mix bituminous course.
- B. Water: Potable.

2.3 AUXILIARY MATERIALS

- A. Sand: ASTM D 1073 or AASHTO M 29, Grade Nos. 2 or 3.
- B. Pavement-Marking Paint: Acrylic Waterborne Pavement Marking Paint per current MoDOT standards, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than 45 minutes.
 - 1. Color: As indicated in civil plans.

2.4 MIXES

- A. Hot-Mix Asphalt: Per the current MoDOT Standard Specifications for Highway Construction for Type C surface course and MoDOT plant mix bituminous course.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph (5 km/h).
 - 2. Proof roll with a pneumatic tired loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
 - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Owner, and replace with compacted backfill or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.
- D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

3.2 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.20 gal./sq. yd. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.
 - 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 - 2. Protect primed substrate from damage until ready to receive paving.

- C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.3 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 - 1. Place hot-mix asphalt base course per current MoDOT Standard Specifications for Highway Construction.
- B. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.4 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
 - 1. Clean contact surfaces and apply tack coat to joints.
 - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
 - 3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
 - 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
 - 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
 - 6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.5 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
 - 1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Minimum Asphaltic Course Density: At least 98 percent of reference laboratory density according to ASTM D 6927.
 2. Minimum Bituminous Course Density: At least 95 percent of reference lab density according to ASTM D 6927.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
1. Base Course: Plus or minus 1/2 inch (13 mm).
 2. Surface Course: Plus 1/4 inch (6 mm), no minus.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
1. Base Course: 1/4 inch (6 mm).
 2. Surface Course: 1/8 inch (3 mm).
 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

3.7 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Owner.
- B. Allow paving to age for 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field testing, frequency, and methods may vary as determined by and between the Owner and the Owner's Testing Agency.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. Asphaltic surface and base courses shall be randomly cored at a minimum rate of 1 core per 20,000 square feet of paving, but not less than 3 cores in light duty areas and 3 cores in heavy-duty areas shall be obtained. Asphaltic concrete pavement samples shall be tested for conformance with mix design.
- E. Immediately replace and compact hot-mix asphalt where core tests were taken.
- F. Thickness Test: Measure thickness of each core sample taken. The thickness of the course or the combined courses shall meet or exceed the indicated thickness. Where the deficiency exists, remove the affected pavement area and replace it with new pavement or, at discretion of Owner, correct deficient paving thickness with tack coat and minimum 1-in overlay.
- G. Field density test for in-place materials:
 - 1. Density test shall be conducted on each core sample taken in accordance with ASTM D1188 or D2726 as applicable.
 - 2. In-place density tests by nuclear method in accordance with ASTM D2950 shall also be taken per 20,000 square feet of paving, but not less than 3 cores in light duty areas and 3 cores in heavy-duty areas, to assure the specified density is obtained. Nuclear density shall be correlated with ASTM D1188 or D2726.
- H. Check all pavement for ponding areas. Correct all ponding areas in a way acceptable to the Owner. All corrections shall be done at no cost to the Owner.
- I. Remove and replace unacceptable areas as directed by Owner.
- J. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.9 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow milled materials to accumulate on-site.

END OF SECTION 321216

SECTION 32 1313

CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes concrete paving, including the following:

1. Driveways.
2. Roadways.
3. Parking lots.
4. Curbs and gutters.
5. Walks.

B. Related Requirements:

1. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

- a. Concrete mixture design.
- b. Quality control of concrete materials and concrete paving construction practices.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

- a. Contractor's superintendent.
- b. Concrete paving Subcontractor.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

- B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified ready-mix concrete manufacturer.
- B. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Fiber reinforcement.
 - 4. Admixtures.
 - 5. Curing compounds.
 - 6. Applied finish materials.
 - 7. Bonding agent or epoxy adhesive.
 - 8. Joint fillers.
- C. Material Test Reports: For each of the following:
 - 1. Aggregates: Flint and chert will be limited to 1% maximum, by weight of the course aggregate, in all exposed concrete (cast-in-place or precast). Lignite will be limited to 0.07%, by weight of the fine aggregate in all exposed concrete.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1.7 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

- A. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from as-drawn steel wire into flat sheets.
- B. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.
- C. Reinforcing Bars: ASTM A615/A615M, Grade 60; deformed.
- D. Steel Bar Mats: ASTM A184/A184M; with ASTM A615/A615M, Grade 60 deformed bars; assembled with clips.
- E. Plain-Steel Wire: ASTM A1064/A1064M, as drawn.
- F. Deformed-Steel Wire: ASTM A1064/A1064M.

- G. Joint Dowel Bars: ASTM A615/A615M, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.
- H. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

2.4 CONCRETE MATERIALS

- A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - 1. Portland Cement: ASTM C150/C150M, gray portland cement Type I/II [
 - 2. Fly Ash: ASTM C618, Class C.
- B. Normal-Weight Aggregates: ASTM C33/C33M, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 1 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: Potable and complying with ASTM C94/C94M.

2.5 CURING MATERIALS

- A. Water: Potable.
- B. White pigmented, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.

2.6 RELATED MATERIALS

- A. Joint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber in preformed strips.

2.7 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
 - 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.

- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Pozzolan: 15 percent.

- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 - 1. Air Content, 1-inch Nominal Maximum Aggregate Size: 6 percent minus 1 percent to plus 2 percent.
 - 2. Air Content, 3/4-inch Nominal Maximum Aggregate Size: 6 percent minus 1 percent to plus 2 percent.

- D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture in concrete as required for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

- E. Concrete Mixtures: Normal-weight concrete.
 - 1. Compressive Strength (28 Days): 4000 psi.
 - 2. Maximum W/C Ratio at Point of Placement: 0.45
 - 3. Slump Limit: 4 inches plus or minus 1 inch.

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Furnish batch certificates for each batch discharged and used in the Work.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
 - 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.

3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1 inch according to requirements in Section 312000 "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 INSTALLATION OF STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 2. Provide tie bars at sides of paving strips where indicated.
 3. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
 2. Extend joint fillers full width and depth of joint.
 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 - a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
 2. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 3/8-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- F. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels and joint devices.
- G. Screed paving surface with a straightedge and strike off.
- H. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- I. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- J. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 - 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.

2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by curing compound as follows:
 1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.9 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 1. Elevation: 3/4 inch.
 2. Thickness: Plus 3/8-inch, minus 1/4 inch.
 3. Surface: Gap below 10-foot-long; unlevelled straightedge not to exceed 1/2 inch.
 4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
 5. Lateral Alignment and Spacing of Dowels: 1 inch.
 6. Vertical Alignment of Dowels: 1/4 inch.
 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
 8. Joint Spacing: 3 inches.
 9. Contraction Joint Depth: Plus 1/4 inch, no minus.
 10. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M will be performed according to the following requirements:
 - 1. Testing Frequency: Obtain at least one composite sample for each 25 cu. yd. or fraction thereof of each concrete mixture placed each day and one test for each additional 50 cu. yd. placed.
 - 2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
 - 5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
 - 6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test to be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Test data from concrete cylinder breaks will be evaluated using procedures of the American Concrete Institute (latest edition of ACI 214) to determine if the compressive strength of the concrete tested is acceptable.
- D. Test results to be reported in writing to Owner's Representative, Engineer, and Contractor within 48 hours of testing. Reports of compressive-strength tests to contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency will make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.

- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

3.11 REPAIR AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Engineer.
- B. Drill test cores, where directed by Engineer, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321373

CONCRETE PAVING JOINT SEALANTS

SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.
2. Joint-sealant backer materials.

B. Related Requirements:

1.2 PREINSTALLATION MEETINGS

- ###### A. Preinstallation Conference: Conduct conference at Project Site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Concrete pavement joint sealants.
2. Joint-sealant backer materials.

- ###### B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of joint sealant.

C. Paving-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Entity that employs installers and supervisors who are trained and approved by manufacturer.

1.5 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backer materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS

- A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D5893/D5893M, Type NS.

2.3 JOINT-SEALANT BACKER MATERIALS

- A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
- D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

3.3 INSTALLATION OF JOINT SEALANTS

- A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.
- C. Install joint-sealant backers to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of joint-sealant backer materials.
 - 2. Do not stretch, twist, puncture, or tear joint-sealant backer materials.
 - 3. Remove absorbent joint-sealant backer materials that have become wet before sealant application and replace them with dry materials.
- D. Install joint sealants immediately following backer material installation, using proven techniques that comply with the following:
 - 1. Place joint sealants so they fully contact joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants in accordance with the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:

1. Remove excess joint sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

- A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.
- B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.5 PAVING-JOINT-SEALANT SCHEDULE

- A. Joints within concrete paving:
1. Joint Location:
 - a. Expansion and isolation joints in concrete paving.
 - b. Contraction joints in concrete paving.
 - c. Other joints as indicated.
 2. Joint Sealant: Single-component, nonsag, silicone joint sealant.
 3. Joint-Sealant Color: concrete gray.

END OF SECTION 321373

SECTION 33 1415

SITE WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water-distribution piping and related components outside the building. Terminate water-piping with appropriate caps or plugs.

1.2 DEFINITIONS

- A. CDA: Copper Development Association.
- B. DI: Ductile Iron
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. PA: Polyamide (nylon) plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PVC: Polyvinyl Chloride plastic

1.3 ACTION SUBMITTALS

- A. Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Field Quality-Control Submittals:
 1. Field quality-control reports.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare piping, valves, meters, backflow prevention devices, and fire hydrants according to the following:
 1. Ensure that piping, valves, meters, backflow prevention devices, and fire hydrants are dry and internally protected against rust and corrosion.

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2. Protect threaded ends and flange faces against damage.
 3. Set piping, valves, meters, backflow prevention devices, and fire hydrants in best position for handling and to prevent rattling.
- B. During Storage: Use precautions for piping, valves, meters, backflow prevention devices, and fire hydrants according to the following:
1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle products if size requires handling by crane or lift. Rig products to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service in accordance with requirements indicated:
1. Notify Owner no fewer than two weeks in advance of proposed interruption of service.
 2. Do not proceed with interruption of water-distribution service without Owner's written permission.

1.7 COORDINATION

- A. Coordinate with Owner.

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SITE WATER DISTRIBUTION PIPING

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with requirements of Owner (Owner is the utility supplying water).
- B. Comply with standards of authorities having jurisdiction for domestic water-service piping, including materials, installation, testing, and disinfection.
- C. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- D. Piping materials to bear label, stamp, or other markings of specified testing agency.

2.2 PIPING MATERIALS

- A. Comply with Owner requirements.
- B. DUCTILE-IRON PIPE AND FITTINGS
- C. Mechanical-Joint, Ductile-Iron Fittings:
 - 1. AWWA C110, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern, 350-psi pressure rating.
 - 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
 - 3. AWWA C104/A21.4 cement mortar-lined.
 - 4. All pipe fittings shall be installed wrapped with AWWA C105, V-Bio polyethylene film.
- D. Push-on-Joint, Ductile-Iron Pipe:
 - 1. AWWA C151/A21.51, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 2. AWWA C104/A21.4 cement mortar-lined.

2.3 PVC PIPE AND FITTINGS

- A. PVC Pipe: AWWA C900 with bell end with gasket, and with spigot end.

2.4 PIPING JOINING MATERIALS

- A. Gaskets for Ferrous Piping and Copper-Alloy Tubing: ASME B16.21, asbestos free.

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SITE WATER DISTRIBUTION PIPING

- B. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5 GATE VALVES

- A. Gate Valves - AWWA, Cast Iron:

1. From approved Columbia Water & Light manufacturers.
2. Gate Valves - Nonrising Stem, Resilient Seated: Cast- or ductile-iron body and bonnet, with bronze or cast- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - a. Standards: AWWA C509 or AWWA C515.
 - b. Minimum Pressure Rating: 200 psig
 - c. End Connections: Mechanical joint.
 - d. Interior Coating: Complying with AWWA C550.

2.6 INSTALLATION OF PIPING

- A. Water-Main Connection:

1. Arrange with utility company for tap of size and location.
2. Tap water main in accordance with requirements of water utility company and of size and in location indicated.
3. Install PE corrosion-protection encasement in accordance with ASTM A674 or AWWA C105/A21.5.
4. Install copper tube and fittings in accordance with CDA's "Copper Tube Handbook."

- B. Install ductile-iron, water-service piping in accordance with AWWA C600 and AWWA M41.

1. Install PE corrosion-protection encasement in accordance with ASTM A674 or AWWA C105/A21.5.

- C. Install PE pipe in accordance with ASTM D2774 and ASTM F645.

- D. Install PVC, AWWA pipe in accordance with ASTM F645 and AWWA M23.

- E. Bury piping with depth of cover over top at least 42 inches.

- F. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

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- G. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- H. Only Campus Facilities - Energy Management Steam and Water personnel will be allowed to operate valves on water systems.

2.7 JOINT CONSTRUCTION

- A. Make pipe joints according to the following:
 - 1. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools and procedures recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
 - 2. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
 - 3. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
 - 4. PVC Piping Gasketed Joints: Use joining materials in accordance with AWWA C900. Construct joints with elastomeric seals and lubricant in accordance with ASTM D2774 or ASTM D3139 and pipe manufacturer's written instructions.
- B. Restraints
 - 1. Mechanical joint: AWWA C111. Provide retainer type packing glands with rubber gasket, for use with PVC pipe and conforming to Uni-B-13 Pipe sizes 4" to 12" must also be FM approved. Mechanical joint restraints shall be Megalug 2000 PV, as manufactured by EBAA Iron Inc., Eastland TX, or approved equal.
 - 2. Joint Retainers: Provide ductile iron split serrated ring harnesses and rod type joint retainers for PVC bell and spigot joints. Clamps shall be designed for use with PVC pipe and shall meet Uni-B-13 Standards and be FM approved on sizes 4" to 12". Restraint harnesses shall be Series 1500 for pipe 4 inches to 12 inches, and Series 2800 for pipe 14 inches and larger, all as manufactured by EBAA Iron Inc., Eastland TX or approved equal.
 - 3. Rods, nuts and washers: 3/4" SS304 all thread rods, nuts and washers.
 - 4. All pipe joint restraints, retainers and ductile iron fittings shall be installed wrapped with AWWA C105, V-Bio polyethylene film.
 - 5. Link Assembly: Seal annular space for piping passing through walls with interlocking synthetic rubber link assembly, Link-Seal® as manufactured by PSI-Thunderline Corporation, Houston TX, or approved equal.

2.8 PIPE SEPARATION

- A. Finished pipe installation shall have minimum 12" separation to all other utilities.
- B. Maintain at least a ten foot (10') horizontal separation of water mains from any existing or proposed sanitary sewer. The distance must be measured edge to edge. Installation of the water main closer to a sanitary sewer is acceptable where the water main is laid

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in a separate trench or on an undisturbed earth shelf located on one (1) side of the sanitary sewer at an elevation so the bottom of the water main is at least eighteen inches (18") above the top of the sanitary sewer.

- C. Provide a minimum vertical distance of eighteen inches (18") between the outside of the water main and the outside of the sanitary sewer where water mains cross the sanitary sewer mains. This shall be the case where the water main is either above or below the sanitary sewer. At crossings, one (1) full length of water pipe must be located so both joints will be as far from the sanitary sewer line as possible. Special structural support for the water and sanitary sewer pipes may be required.
- D. Provide at least a ten-foot (10') horizontal separation between water mains and sanitary sewer force mains. There shall be an eighteen-inch (18") vertical separation at crossings.
- E. Locate water mains so that they do not pass through or come in contact with any sanitary sewer manhole.
- F. Consult the system Owner where above conditions cannot be met.

2.9 INSTALLATION OF PIPE AND PIPE FITTINGS

- A. Piping 2" and less:
 - 1. All domestic water service piping from the water main to the building with a nominal diameter of two inches and less shall be Type K copper or HDPE piping.
 - 2. In all installations, Type K copper shall be used where the water line enters the building. If the water meter is located in a meter pit, the piping within the meter pit, and stubbed out on either side shall also be Type K copper.
 - 3. All buried copper piping shall be wrapped with V-Bio poly wrap.
 - 4. For pulled pipe installations, tracer wire shall be pulled with pipe, without splices. Upon completion of installation, a continuity test on the wire shall be performed and all breaks shall be repaired.
 - 5. For trenched pipe installation, tracer wire shall be taped to the pipe at the three o'clock position every 5 feet. Upon completion of installation, a continuity test on the wire shall be performed and all breaks shall be repaired.
- B. PVC (Polyvinyl Chloride) Pipe: Install in accordance with AWWA C605.
- C. All joints shall be restrained with joint retainers. All fittings shall be restrained with retainer type packing glands.
- D. Install stainless steel rods between fittings on all offsets and between fittings, valves, and blind flanges, in addition to the Megalugs. On isolated fittings, valves, etc., attach restraint rings to PVC pipe and install stainless steel rods between fitting and restraint rings. Rods shall be positioned through the bolt holes in fitting and Megalug. Each rod will require four nuts and washers. Duct lugs are acceptable. The number of stainless steel rods required per fitting flange shall be as follows:

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<u>Pipe Diameter</u>	<u>No. of Rods</u>
10" and Less	2
12"	3
14"	4
16"	5
18"	6

- E. All ductile iron pipe, fittings, valves, bell end restraints, etc. shall be wrapped with a V-Bio polyethylene cover conforming to AWWA C105, and installed per AWWA C600.
- F. All dead end mains shall have a dry barrel fire hydrant at the end to facilitate flushing of the main.
- G. Pipe shall be installed in clean condition, and shall never be laid in trenches with standing water. The trench shall be dewatered during installation of the water line. Open pipe ends shall be protected with a hard cap or inflatable plug at the end of the work day. NO PLYWOOD OR DUCTTAPE COVERINGS WILL BE ALLOWED.

INSTALLATION OF ANCHORAGE

- H. Anchorage: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 - 1. Concrete thrust blocks.
 - 2. Locking mechanical joints.
- I. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: In accordance with AWWA C600.
 - 2. Gasketed-Joint, PVC Water-Service Piping: In accordance with AWWA M23.
- J. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

2.10 INSTALLATION OF VALVES

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

2.11 CONNECTIONS

- A. Connect water-distribution piping to existing water main.

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2.12 TRACER WIRE

- A. Tracer Wire shall be #14 AWG Solid, steel core soft drawn high strength tracer wire, 250# average tensile break load, 30 mil high molecular weight-high density blue polyethylene jacket complying with ASTM-D-1248, 30 volt rating. No THHN insulated wire shall be allowed. Tracer wire shall be Copperhead Industries HS-CCS or approved equal.
- B. Tracer wire shall have moisture resistant splices for direct bury applications. Splices shall be Copperhead Industries Snakebite or 3M DBR or approved equal.
- C. Tracer wire test stations shall be designed to be easily detected by magnetic and electronic locators. A magnet shall be securely attached at the top of the upper tube of the box for locating purposes. Lid shall be blue and have a brass terminal for attaching locating equipment and a brass 5 sided nut for removing cap. Tracer wire test station shall be Copperhead Industries Snake Pit or approved equal.
- D. Install continuous plastic underground warning tape during back-filling of trench for underground water piping. Tape shall be located twenty-four (24) inches above pipe, directly over each water line.
- E. Tape trace wire to the top of each water line with duct tape every five (5) feet. Wire splices shall be minimized. Terminate trace wires inside building and inside valve boxes. Drill ¼" hole in PVC valve box one inch below cast iron cover. Route wire up outside of valve box, through ¼" hole and knot. A tracer wire test station shall be installed at all fire hydrants and at all runs of piping without valves every 400 feet. Upon completion of installation and final grading, a continuity test on the wire shall be performed and all breaks shall be repaired

2.13 BACKFILL

- A. Under Pipe: All backfill under the barrel of the pipe shall be free from debris, organic matter, and stones larger than one inch, and shall be tamped into place. Sand or crushed stone aggregate (95% passing a ½" screen but not more than 10% passing a #200 sieve) are acceptable substitutes for soil.
- B. Adjacent To and Top of Pipe: The first one foot of backfill over the top of pipe shall be "¾ inch minus waste rock with fines" uncleaned crushed stone aggregate or suitable soil. Backfill shall be free of debris, brush, roots and stones or rubble more than one inch.
- C. Rough final grading of subgrade and the placement of final topsoil shall be detailed on the drawings.
- D. All sidewalks, paving, etc. which are removed or damaged during construction shall be replaced and shall match existing.

SECTION 33 1415

SITE WATER DISTRIBUTION PIPING

2.14 CLEANING

A. Clean and disinfect caps and plugs as follows:

1. Clean and disinfect caps and plugs with water containing 50 parts per million of chlorine,
2. Flush pipes to remove any air trapped in the lines during capping

B. Prepare reports of flushing and disinfecting activities.

END OF SECTION 331415

SECTION 334200

STORMWATER CONVEYANCE

SECTION 334200 - STORMWATER CONVEYANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Catch Basins

1.3 ACTION SUBMITTALS

- A. Shop Drawings:
 - 1. Manholes: Include plans, elevations, sections, details, frames, and covers.
 - 2. Catch Basins: Include plans, elevations, sections, details, frames, covers, and grates.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Handle catch basins in accordance with manufacturer's written rigging instructions.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:
 - 1. Notify Owner no fewer than two weeks in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.1 CONCRETE

- A. General: Cast-in-place concrete in accordance with ACI 318, ACI 350 and the following:
1. Cement: ASTM C150/C150M, Type II.
 2. Fine Aggregate: ASTM C33/C33M, sand.
 3. Coarse Aggregate: ASTM C33/C33M, crushed gravel.
 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
 2. Reinforcing Bars: ASTM A615/A615M, Grade 60 (420 MPa) deformed steel.
- C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - a. Invert Slope: **2** percent through manhole.
 2. Benches: Concrete, sloped to drain into channel.
 - a. Slope: **4** percent.

2.2 CATCH BASINS

- A. Standard Precast Concrete Catch Basins:
1. Description: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 2. Base Section: 6-inch minimum thickness for floor slab and 6-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
 3. Top Section: flat-slab-top type is indicated.
 4. Joint Sealant: ASTM C990 bitumen or butyl rubber.
 5. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
 6. Steps: ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP, or approved equal, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor

steps into sidewalls at 12- to 16-inch) intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 36 inches.

7. Pipe Connectors: ASTM C923, resilient, of size required, for each pipe connecting to base section.

B. Frames and Grates: ASTM A536, Grade 60-40-18, ductile iron designed for A-16 (AASHTO HS20-44), structural loading. Retain "Frames and Grates" Paragraph below for round, manhole-type structures.

2.3 PIPING MATERIALS

A. Comply with requirements in Consultant Procedures & Design Guidelines for Storm Drainage Systems, University of Missouri, most recent edition.

2.4 HPP PIPE AND FITTINGS

A. High Performance Polypropylene Pipe (HPP) having a smooth interior and an annular corrugated exterior.

1. Where up to 30 inches in diameter HPP pipe shall meet or exceed ASTM F2736.
2. Where 36 to 60 inches diameter HPP pipe shall meet or exceed ASTM F2881.
3. AASHTO loading requirements shall be met.
4. Minimum gage of piping shall be per manufacturers recommendations.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.3 CONCRETE PLACEMENT

A. Place cast-in-place concrete in accordance with ACI 318.

3.4 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth

pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 24-inch-thick, concrete masonry bulkheads.
 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and:
1. Remove manhole or structure and close open ends of remaining piping indicated to be abandoned in place.
- C. Backfill to grade in accordance with Section 312000 "Earth Moving."

3.5 FIELD QUALITY CONTROL

3.6 CLEANING

- A. Clean interior of piping of dirt and superfluous materials.

END OF SECTION 334200

**SECTION 33 6313
STEAM ENERGY DISTRIBUTION AND PIPING SPECIALTIES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 23 0100 "Basic Mechanical Requirements" and Section 23 0500 "Basic Mechanical Materials and Methods" apply to the work of this Section as if fully repeated herein.

1.2 SUMMARY

- A. This specification section shall be applied to steam and condensate service lines within all tunnels, chases, and manholes. This specification applies to temporary piping installation associated with construction phasing.
- B. This Section applies to all Division 33 sections.

1.3 DEFINITIONS

- A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).
- B. Definitions include the following:
 - 1. Medium Pressure Steam (MPS)
 - 2. Medium Pressure Condensate (MPC)
 - 3. Pumped Condensate (PC)
 - 4. Manhole Drain (D)

C. SUBMITTALS

- D. General: Follow the procedures specified in Division 1 Section "Special Conditions".
- E. Test reports specified in Part 3 of this Section.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: comply with the provisions of the following:
 - 1. ASME B 31.1 "Power Piping" for materials, fabrication, installation, and testing. Safety valves and pressure vessels shall bear the appropriate ASME label.
 - 2. ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualification" for qualifications for welding processes and operators.
 - 3. International Mechanical Code, 2018.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS - GENERAL

- A. Steel Pipe: Seamless Carbon Steel, ASTM A53 Grade B
 - 1. Steam (MPS): Schedule 40 to 10 inch, 0.375 inch wall for 12 inches and above.
 - 2. Condensate (MPC, PC): Schedule 80.

3. 2 inch and Under in Tunnels, Manholes and Chases: Socket welded.
4. 2.5 inches and Above: Welded.

B. Fittings (MPS, MPC, PC):

1. 2 inch and Under in Tunnels, Manholes and Chases: Class 3000 Socket weld forged steel fittings. ASTM A105, ANSI B16.11.
2. 2.5 inches and Above: Butt welding carbon steel, ASTM A234, ANSI B16.9, elbows to be long radius unless otherwise called for. Use Standard Weight with Schedule 40 and 0.0375 inch wall pipe, Extra Heavy with Schedule 80 pipe.

C. Unions and Flanges (MPS, MPC, PC):

1. Unions: Class 2000 forged steel, threaded, ASTM A105.
2. Flanges: 150 lb. forged steel welding neck, ASTM A105, ANSI B16.5.
3. Gaskets: Spiral wound, Class 150, Style CG or CGI, 304 SS/Industrial Grade "Flexicarb" as manufactured by Flexitallic Group, Houston, Texas or approved equal.
4. Bolting: ASTM A193, Grade B7 alloy steel stud bolts with heavy hex nuts, ASTM A194, Grade 2H.

2.2 JOINING MATERIALS (MPS, MPC, PC):

- A. Pipe-Flange Gaskets - Steam and Condensate: Spiral wound, Class 150, Style CG or CGI, 304 SS/ Industrial Grade "Flexicarb" as manufactured by Flexitallic Group, Houston, Texas, or approved equal.
- B. Bolting: ASTM A193, Grade B7 alloy steel stud bolts with heavy hex nuts, ASTM A194, Grade 2H.
- C. Welding Filler Metals: Comply with AWS D10.12 (AWS D10.12M) for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- D. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

PART 3 - EXECUTION

3.1 PIPE APPLICATIONS

General: As indicated in Section 2.1 of this specification section.

3.2 SCHEDULING

- A. All systems shall be completely assembled, tested, adjusted and demonstrated to be ready for operation to the satisfaction of the Owner before steam will be turned on.
- B. Site utility tie-ins shall be coordinated with the Owner's Representative. Contractor shall notify Owner's Representative two (2) weeks in advance of desired tie-in time. Owner's Representative will give Contractor 72 hours advance notice of actual time for tie-ins. Outages shall be kept to a minimum.
- C. Steam and condensate shall be turned on and off only by Energy Management Utility Distribution personnel.

3.3 PIPING INSTALLATIONS

- A. General Locations and Arrangements: Drawings indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
- B. Change in direction of pipelines shall be made with approved fittings or pipe bends only. Miter joints in welded pipe assemblies shall not be used except where approved by Project Manager.
- C. Backing rings shall not be used on butt welded joints.
- D. Provide flanges or unions at all final connections to equipment, traps, and valves to facilitate dismantling. Arrange piping and piping connections so that equipment being served may be serviced or totally removed without disturbing piping beyond final connections and associated shut-off valves.
- E. Pipe shall be cut to exact measurement and installed without springing or forcing. Particular care shall be taken to avoid creating, even temporarily, undue loads, forces or strains on valves, equipment or structural elements with piping connections or piping supports.
- F. All pipe shall be erected and supported in such a manner as to provide for expansion and contraction without harmful strain to structural members, pipe and pipe supports.
- G. Consideration shall be given to insulation thickness when routing piping such that adequate clearance is provided to avoid interfering with insulation.
- H. All piping in pipe chases shall be welded regardless of size.
- I. Branch connections shall be made with standard tees and 45 degree laterals of the type required for the service. In place of standard tees and 45 degree laterals in black steel piping systems, integrally reinforced weld-on fittings may be used providing branch the line is at least two pipe sizes under run pipe size.
- J. Use fittings for all changes in direction and all branch connections.
- K. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

3.4 PIPE JOINT CONSTRUCTION

- A. Welded Joints: Comply with the requirements in ASME Code B31.1 -"Power Piping."

3.5 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Attach guides to pipe and secure guides to manhole/building structure.
- C. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

3.6 FIELD QUALITY CONTROL

- A. Preparation for testing: Prepare steam and condensate piping in accordance with ASME B 31.1 and as follows:

1. Prior to assembly of pipe and piping components, all loose dirt, scale, oil and other foreign matter on internal or external surfaces shall be removed by means consistent with good piping practice. Chips and burrs from thread cutting operations shall be blown out of pipe before assembly. Cutting oil shall be removed from internal and external surfaces.
2. Leave joints including welds uninsulated and exposed for examination during the test.
3. Provide temporary restraints for expansion joints that cannot sustain the reactions due to test pressure. If temporary restraints are not practical, isolate expansion joints from testing.
4. Flush system with clean water. Clean strainers.
5. Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing against the test pressure without damage to the valve. Flanged joints at which blinds are inserted to isolate equipment need not be tested.
6. Install relief valve set at a pressure no more than 1/3 higher than the test pressure, to protect against damage by expansion of liquid or other source of overpressure during the test.

B. Leakage Testing

1. Tests shall be performed prior to cleaning, insulating, or concealing pipe. Notify Owner (Energy Management - Steam & Water Distribution) 48 hours in advance of testing.
2. Prepare and keep records of each system or section of system tested. Test reports shall include, but not necessarily be limited to, the following:
 - a. Identification of piping system or section tested.
 - b. Date of test and date of Energy Management's approval signature.
 - c. Testing medium and method or description of test procedure.
 - d. Test pressure, duration of test and recorded pressure drop.
3. Pressure tests shall apply to piping only with all equipment, traps, relief valves and instruments blocked off or disconnected. In no case shall piping or any component be subjected to pressures exceeding 90% of their published rating. All system valves within section being tested shall be open. Provide temporary restraints on expansion joints and flexible connections during pressure testing.
4. Blanks shall be furnished and installed wherever necessary to prevent cold test water from coming in contact with hot valves. Remove blanks after testing.
5. Pressure tests shall apply to piping as indicted in the following schedule. The pressure shall be gradually raised to the value given and the source then blocked off. Pressures shall be observed after the pipe and contents have stabilized at the ambient temperature and the source of test pressure shut-off. All joints shall be visually examined during test. Leaks shall be repaired and complete testing procedure repeated. Upon successful completion and approval of the tests, the piping shall be relieved of pressure, drained, and cleaned.

Leakage Test Schedule

<u>Service</u>	<u>Operating Pressure Psig</u>	<u>Hydrostatic Test Pressure Psig</u>	<u>Minimum Time (hours)</u>
Steam (MPS)	to 100	150	1
Medium Pressure Condensate (MPC)	to 100	150	1
Pumped Condensate (PC)	to 100	150	1

6. All new piping not specifically listed above shall receive an initial service leak test by gradually bringing the system up to normal operating pressure and examining for leaks.

7. On any given construction project, Owner (Energy Management) reserves the right to contract with an independent testing firm to complete ultrasonic shearwave weld inspections on randomly selected field welds. If the results of these tests indicate poor quality welds, those "failed" welds shall be replaced at no additional cost to the project. If further ultrasonic inspection is required to assure quality weld workmanship, these tests shall be at the expense of the contractor, and any and all defective welds shall be replaced at no additional cost to the project.

C. Final Inspection and Adjusting

1. After each installation is completed, tested for leaks, cleaned, by the Contractor, and approved by Energy Management - Steam and Water Distribution, it shall be filled with the fluid it is to carry. Each system shall be tested in actual operation. All valves, safety devices and equipment shall be operated and final adjustments made to place the system in operation. Such operation shall be demonstrated to the satisfaction of Energy Management – Steam and Water Distribution. The Owner shall be notified 72 hours in advance of all testing.

3.7 CLEANING

- A. Prior to assembly of pipe and piping components, all loose dirt, scale, oil, and other foreign matter on internal or external surfaces shall be removed by means consistent with good piping practice. Chips or burrs from thread cutting operations shall be blown out of pipe before assembly. Cutting oil shall be removed from internal and external surfaces.
- B. During fabrication and assembly, slag and weld spatter shall be removed from pipe joints by peening, chipping, and wire brushing.
- C. Flush the system with clean water. Remove, clean, and replace strainer screens.

3.8 COMMISSIONING

- A. Steam and condensate shall be turned on and off by Energy Management Utility Distribution personal only. Project Manager shall coordinate.

END OF SECTION 336313

**SECTION 33 6321
MECHANICAL INSULATION (CONCRETE CHASES AND MANHOLES)**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This specification section shall be applied to steam and condensate service lines within all tunnels, chases, and manholes.
- B. This Section applies to Division 33 Sections.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in other Division 33 sections.
- B. Coordinate clearance requirements with piping installer for piping insulation application.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Insulation for steam and condensate piping in trenches, and manholes shall be cellular glass insulation as manufactured in accordance with ASTM C552, Foamglas Super K as

manufactured by Pittsburgh Corning, Pittsburgh, PA, or approved equal. (Insulation and coverings for all temporary steam and condensate piping shall be the same as piping installed in trenches, manholes and tunnels as described in this specification section.)

- B. Fabrication adhesive shall be Hydrocal B-11 as manufactured by USG Corporation, Chicago IL, or approved equal.
- C. Insulation shall have bore coat of Hydrocal B-11 as manufactured by USG Corporation, Chicago IL, or approved equal.
- D. All piping insulation in manholes, trench and tunnel shall be covered with 0.024 inch thick, stucco embossed, perforated aluminum jacket, aluminum alloy. ASTM B209 with H-14 temper, 1/8 inch diameter holes on 21/64 inch staggered centers. Covering shall be Insul-Mate as manufactured by RPR Products, Inc., Houston TX, or approved equal. Fittings shall be covered with 0.016 inch perforated aluminum jackets.
- E. Flanged valves, expansion joints and steam meters shall be insulated with tight fitting, reusable insulation blankets consisting of high density insulation (fiberglass, mineral wool, ceramic fiber) covered on outside with coated glass fabric having heavy adjustable straps with buckles. Inside of blanket shall be covered with fabric suitable to specified temperature or stainless steel square mesh woven wire cloth. Insulation shall be minimum 1-1/2 inches thick. Blankets shall be suitable for temperatures up to 500 degrees F.
- F. Insulation and insulating materials containing asbestos shall not be used.
- G. Insulation thickness shall be in accordance with the schedule below (In walk tunnels and steam manholes, piping insulation may need to be thicker than listed below. Surface temperatures of the aluminum jacket shall be no more than 132 degrees F. assuming steam temperatures of 400 degrees F., an airflow of 1 mph, and an ambient temperature of 80 degrees F. Insulation manufacturer shall adjust insulation thickness accordingly if necessary to satisfy the surface temperature requirement given):

PIPE INSULATION SCHEDULE

Insulation Service	Design Symbol	Pipe Temp, Deg. F	Pipe Size	Thickness
Steam	MPS	450	2" and under	1.5"
			2-1/2" to 3"	2.0"
			4"	2.5"
			6" to 12"	3.0"
			14" and above	3.5"
Condensate	MPC	200	1-1/2" and under	1.0"
	PC		2" and above	1.5"

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL

- A. All required tests on piping must be completed and satisfactory test reports must be completed prior to application of insulation covering joints.
- B. All surfaces to be insulated shall be cleaned of all scale, rust, oil, and foreign matter and shall be dry and free of frost prior to and during application of insulation.
- C. All insulation and accessory materials shall be stored in an area that is dry and protected from the weather before and during insulation application.
- D. Insulation shall be installed to accept cyclic thermal growth and contraction of piping without damage and loss of insulating value.
- E. Insulation systems shall be installed in strict accordance with manufacturer's recommendations.
- F. Insulation shall be applied to pipe, fittings, flanges, and valves. Unions shall not be insulated. Trap installations to include traps, stop valves, check valve, and hand-blow valve, as well as piping between the stop valves shall not be insulated. Drip leg and piping up to first stop valve shall be insulated.
- G. Insulation shall be installed in a smooth, clean, workmanlike manner. Joints shall be tight and finished smooth. Stagger longitudinal joints and tightly butt sections.
- H. Insulation shall fit tightly against surface to which it is applied.
- I. Apply insulation so as to permit expansion or contraction of pipelines without causing damage to insulation.
- J. Preformed pipe covering shall be terminated at a sufficient distance from flanges to permit removal of bolts.
- K. Insulation on flanges and flanged fittings shall overlap adjacent pipe covering at least 2 inches.
- L. Pipe insulation at expansion joints shall be held back a sufficient distance to permit the specified travel into the joint.
- M. Valves shall be insulated up to the gland only so as to permit replacement of packing without disturbing insulation.
- N. Insulation shall be continuous through pipe covering protection saddles, guides and sleeves or openings in walls and floors. Aluminum jacket shall not be run through pipe saddles and guides.
- O. Lap jacket 2 inches and fasten with ½ inch stainless steel bands on 12 inch centers.
- P. Provide band 1-1/2 inches back from all discontinuous ends of jacket.

END OF SECTION 336321