VA Roseburg – Correct Electrical Deficiencies
Roseburg VAMC

U.S. Department of Veterans Affairs
Project Number 653-10-531
Contract Number VA260-12-D-0010
Task Order Number VA260-15-J-0243

10 March 2017
<table>
<thead>
<tr>
<th>DIVISION 00 - SPECIAL SECTIONS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>00 0110 Table of Contents</td>
<td></td>
</tr>
<tr>
<td>00 0115 List of Drawing Sheets</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DIVISION 01 - GENERAL REQUIREMENTS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>01 0000 General Requirements</td>
<td></td>
</tr>
<tr>
<td>01 3216 Project Schedules</td>
<td></td>
</tr>
<tr>
<td>01 3323 Shop Drawings, Product Data, and Samples</td>
<td></td>
</tr>
<tr>
<td>01 3526 Safety Requirements</td>
<td></td>
</tr>
<tr>
<td>01 4219 Reference Standards</td>
<td></td>
</tr>
<tr>
<td>01 4529 Testing Laboratory Services</td>
<td></td>
</tr>
<tr>
<td>01 5719 Temporary Environmental Controls</td>
<td></td>
</tr>
<tr>
<td>01 5816 Temporary Interior Signage</td>
<td></td>
</tr>
<tr>
<td>01 7419 Construction Waste Management</td>
<td></td>
</tr>
<tr>
<td>01 7700 Close Out Procedures</td>
<td></td>
</tr>
<tr>
<td>01 9100 General Commissioning Requirements</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DIVISION 02 - EXISTING CONDITIONS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>02 4100 Demolition</td>
<td></td>
</tr>
<tr>
<td>02 8211 Traditional Asbestos Abatement</td>
<td></td>
</tr>
<tr>
<td>02 8333 Lead-Based Paint Removal and Disposal</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DIVISION 03 - CONCRETE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>03 3053 Cast-In-Place Concrete (Short Form)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DIVISION 09 - FINISHES</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>09 0600 Schedule for Finishes</td>
<td></td>
</tr>
<tr>
<td>09 2216 Non-Structural Metal Framing</td>
<td></td>
</tr>
<tr>
<td>09 2300 Gypsum Plastering</td>
<td></td>
</tr>
<tr>
<td>09 2400 Portland Cement Plastering</td>
<td></td>
</tr>
<tr>
<td>09 2600 Veneer Plastering</td>
<td></td>
</tr>
<tr>
<td>09 2900 Gypsum Board</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DIVISION 13 – SPECIAL CONSTRUCTION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>13 0541 Seismic Restraint Requirements for Non-Structural Components</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DIVISION 23 - HVAC</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>23 0511 Common Work Results for HVAC</td>
<td></td>
</tr>
<tr>
<td>23 0512 General Motor Requirements for HVAC</td>
<td></td>
</tr>
</tbody>
</table>
SECTION 00 0110 - TABLE OF CONTENTS

23 0541 Noise and Vibration Control for HVAC Piping and Equipment
23 0711 HVAC and Boiler Plant Insulation
23 2300 Refrigerant Piping
23 8100 Decentralized Unitary HVAC Equipment

DIVISION 26 - ELECTRICAL
26 0511 Requirements for Electrical Installations
26 0513 Medium-Voltage Cables
26 0519 Low Voltage Electrical Power Conductors & Cables (600 Volts & Below)
26 0526 Grounding & Bonding for Electrical Systems
26 0533 Raceway & Boxes for Electrical Systems
26 0541 Underground Electrical Construction
26 0573 Overcurrent Protective Device Coordination Study
26 0800 Commissioning of Electrical Systems
26 1219 Pad-Mounted, Liquid-Filled, Medium Voltage Transformers
26 2300 Low-Voltage Switchgear
26 2313 Generator Paralleling Controls
26 2416 Panelboards
26 2921 Enclosed Switches and Circuit Breakers
26 3213 Generator Control Panel Replacement & Cloud Remote Monitoring & Control
26 3623 Automatic Transfer Switches

--- END ---
LIST OF DRAWING SHEETS

The drawings listed below accompanying this specification form a part of the contract.

<table>
<thead>
<tr>
<th>Page</th>
<th>Sheet Number</th>
<th>Sheet Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G001</td>
<td>Title Sheet</td>
</tr>
<tr>
<td>2</td>
<td>EG001</td>
<td>Electrical Legend</td>
</tr>
<tr>
<td>3</td>
<td>ES010</td>
<td>Electrical Site Plan</td>
</tr>
<tr>
<td>4</td>
<td>EP100</td>
<td>Building 1 &amp; 1AC Basement Electrical Plan</td>
</tr>
<tr>
<td>5</td>
<td>EP101</td>
<td>Building 1 &amp; 1AC First Floor Electrical Plan</td>
</tr>
<tr>
<td>6</td>
<td>EP102</td>
<td>Building 1 &amp; 1AC 2nd Floor Electrical Plan</td>
</tr>
<tr>
<td>7</td>
<td>EP103</td>
<td>Building 1 &amp; 1AC 3rd Floor Electrical Plan</td>
</tr>
<tr>
<td>8</td>
<td>EP104</td>
<td>Building 1 &amp; 1AC 4th Floor Electrical Plan</td>
</tr>
<tr>
<td>9</td>
<td>EP105</td>
<td>Building 1 &amp; 1AC 5th Floor Electrical Plan</td>
</tr>
<tr>
<td>10</td>
<td>EP106</td>
<td>Building 1 &amp; 1AC Attic Electrical Plan</td>
</tr>
<tr>
<td>11</td>
<td>EP107</td>
<td>Building 1 &amp; 1AC Enlarged Electrical Room Plans</td>
</tr>
<tr>
<td>12</td>
<td>EP201</td>
<td>Building 2 First Floor Electrical Plan</td>
</tr>
<tr>
<td>13</td>
<td>EP202</td>
<td>Building 2 2nd Floor Electrical Plan</td>
</tr>
<tr>
<td>14</td>
<td>EP203</td>
<td>Building 2 3rd Floor Electrical Plan</td>
</tr>
<tr>
<td>15</td>
<td>EP301</td>
<td>Building 3 First Floor Electrical Plan</td>
</tr>
<tr>
<td>16</td>
<td>EP302</td>
<td>Building 3 2nd Floor Electrical Plan</td>
</tr>
<tr>
<td>17</td>
<td>EP303</td>
<td>Building 3 3rd Floor Electrical Plan</td>
</tr>
<tr>
<td>18</td>
<td>EP401</td>
<td>Building 7 First Floor Electrical Plan</td>
</tr>
<tr>
<td>19</td>
<td>EP501</td>
<td>Building 13 Ground &amp; First Floor Electrical Plans</td>
</tr>
<tr>
<td>20</td>
<td>EP601</td>
<td>Building 17 Electrical Plan</td>
</tr>
<tr>
<td>21</td>
<td>EP701</td>
<td>Building 58, T-6, &amp; T-8 Electrical Plans</td>
</tr>
<tr>
<td>22</td>
<td>EP801</td>
<td>Building 61, 64, 65, &amp; 71 Electrical Plans</td>
</tr>
<tr>
<td>23</td>
<td>EP901</td>
<td>Building 81 Electrical Plan</td>
</tr>
<tr>
<td>24</td>
<td>EP1001</td>
<td>Building 82, 85, 86 Electrical Plans</td>
</tr>
<tr>
<td>25</td>
<td>EP1101</td>
<td>Building 88 Electrical Plans</td>
</tr>
<tr>
<td>26</td>
<td>EE1200</td>
<td>Electrical Transformer Details</td>
</tr>
<tr>
<td>27</td>
<td>EE1300</td>
<td>Electrical Primary One-Line Diagram and Circuit Legends</td>
</tr>
<tr>
<td>28</td>
<td>EE1301</td>
<td>Bldg 1 Electrical One-Line Diagram</td>
</tr>
<tr>
<td>29</td>
<td>EE1302</td>
<td>Bldgs 1AC, 64 &amp; 65 Electrical One-Line Diagrams</td>
</tr>
<tr>
<td>30</td>
<td>EE1303</td>
<td>Bldgs 11, 13, 16, 71, 81, 82, T6 &amp; T8 Electrical One-Line Diagrams</td>
</tr>
<tr>
<td>31</td>
<td>EE1304</td>
<td>Bldgs 2, 3, 17, 58, 85, &amp; 86 Electrical One-Line Diagrams</td>
</tr>
<tr>
<td>32</td>
<td>EE1305</td>
<td>Bldg 88 Electrical One-Line Diagrams</td>
</tr>
<tr>
<td>33</td>
<td>EE1306</td>
<td>Bldg 1 Electrical SKM Calculation Diagrams</td>
</tr>
<tr>
<td>34</td>
<td>EE1307</td>
<td>Bldg 1 &amp; 1AC Electrical SKM Calculation Diagrams</td>
</tr>
<tr>
<td>35</td>
<td>EE1308</td>
<td>Bldg 1AC, 3 &amp; 17 Electrical SKM Calculation Diagrams</td>
</tr>
<tr>
<td>36</td>
<td>EE1309</td>
<td>Bldg 2 Electrical SKM Calculation Diagrams</td>
</tr>
<tr>
<td>37</td>
<td>EE1310</td>
<td>Bldgs 4, 5, 6, 13, 16, T6, T8 &amp; 71 Electrical SKM Calculation Diagrams</td>
</tr>
<tr>
<td>38</td>
<td>EE1311</td>
<td>Time Current Curves</td>
</tr>
<tr>
<td>39</td>
<td>EE1312</td>
<td>Time Current Curves</td>
</tr>
<tr>
<td>40</td>
<td>EE1313</td>
<td>Time Current Curves</td>
</tr>
<tr>
<td>41</td>
<td>EE1314</td>
<td>Time Current Curves</td>
</tr>
<tr>
<td>42</td>
<td>EE1315</td>
<td>Time Current Curves</td>
</tr>
<tr>
<td>43</td>
<td>EE1316</td>
<td>Time Current Curves</td>
</tr>
<tr>
<td>44</td>
<td>EE1317</td>
<td>Electrical Panel Details</td>
</tr>
<tr>
<td>45</td>
<td>EE1318</td>
<td>Electrical Labeling Details</td>
</tr>
<tr>
<td>46</td>
<td>EE1319</td>
<td>Electrical Panel Schedules</td>
</tr>
</tbody>
</table>
SECTION 00 0115 - LIST OF DRAWING SHEETS

47. EE1320   Electrical Panel Schedules
48. EE1321   Electrical Panel Schedules
49. EE1322   Electrical Panel Schedules
50. EE1323   Electrical Panel Schedules
51. MH100    Building 82 Mechanical Plan

- - - END - - -
# GENERAL REQUIREMENTS

## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>SAFETY REQUIREMENTS</td>
<td>1</td>
</tr>
<tr>
<td>1.2</td>
<td>GENERAL INTENTION</td>
<td>2</td>
</tr>
<tr>
<td>1.3</td>
<td>STATEMENT OF BID ITEM(S)</td>
<td>3</td>
</tr>
<tr>
<td>1.4</td>
<td>SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR</td>
<td>4</td>
</tr>
<tr>
<td>1.5</td>
<td>CONSTRUCTION SECURITY REQUIREMENTS</td>
<td>5</td>
</tr>
<tr>
<td>1.6</td>
<td>OPERATIONS AND STORAGE AREAS</td>
<td>6</td>
</tr>
<tr>
<td>1.7</td>
<td>ALTERATIONS</td>
<td>14</td>
</tr>
<tr>
<td>1.8</td>
<td>DISPOSAL AND RETENTION</td>
<td>16</td>
</tr>
<tr>
<td>1.9</td>
<td>PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS</td>
<td>18</td>
</tr>
<tr>
<td>1.10</td>
<td>RESTORATION</td>
<td>19</td>
</tr>
<tr>
<td>1.11</td>
<td>PHYSICAL DATA</td>
<td>20</td>
</tr>
<tr>
<td>1.12</td>
<td>PROFESSIONAL SURVEYING SERVICES</td>
<td>21</td>
</tr>
<tr>
<td>1.13</td>
<td>LAYOUT OF WORK</td>
<td>21</td>
</tr>
<tr>
<td>1.14</td>
<td>AS-BUILT DRAWINGS</td>
<td>24</td>
</tr>
<tr>
<td>1.15</td>
<td>USE OF ROADWAYS</td>
<td>24</td>
</tr>
<tr>
<td>1.16</td>
<td>Not Used</td>
<td>25</td>
</tr>
<tr>
<td>1.17</td>
<td>TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT</td>
<td>30</td>
</tr>
<tr>
<td>1.18</td>
<td>TEMPORARY USE OF EXISTING ELEVATORS</td>
<td>31</td>
</tr>
<tr>
<td>1.19</td>
<td>Not Used</td>
<td>33</td>
</tr>
<tr>
<td>1.20</td>
<td>TEMPORARY TOILETS</td>
<td>34</td>
</tr>
<tr>
<td>1.21</td>
<td>AVAILABILITY AND USE OF UTILITY SERVICES</td>
<td>35</td>
</tr>
<tr>
<td>1.22</td>
<td>NEW TELEPHONE EQUIPMENT</td>
<td>36</td>
</tr>
<tr>
<td>1.23</td>
<td>TESTS</td>
<td>36</td>
</tr>
<tr>
<td>1.24</td>
<td>INSTRUCTIONS</td>
<td>38</td>
</tr>
<tr>
<td>1.25</td>
<td>GOVERNMENT FURNISHED PROPERTY</td>
<td>39</td>
</tr>
<tr>
<td>1.26</td>
<td>RELOCATED EQUIPMENT &amp; ITEMS</td>
<td>40</td>
</tr>
<tr>
<td>1.27</td>
<td>STORAGE SPACE FOR DEPARTMENT OF VETERANS AFFAIRS EQUIPMENT</td>
<td>41</td>
</tr>
<tr>
<td>1.28</td>
<td>CONSTRUCTION SIGN</td>
<td>42</td>
</tr>
<tr>
<td>1.29</td>
<td>SAFETY SIGN</td>
<td>43</td>
</tr>
<tr>
<td>1.30</td>
<td>PHOTOGRAPHIC DOCUMENTATION</td>
<td>44</td>
</tr>
<tr>
<td>1.31</td>
<td>FINAL ELEVATION DIGITAL IMAGES</td>
<td>48</td>
</tr>
<tr>
<td>1.32</td>
<td>HISTORIC PRESERVATION</td>
<td>49</td>
</tr>
<tr>
<td>1.33</td>
<td>VA TRIRIGA CPMS</td>
<td>49</td>
</tr>
</tbody>
</table>

--- END ---
GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SAFETY REQUIREMENTS

A. Refer to section 01 3526, SAFETY REQUIREMENTS for safety and infection control requirements.

1.2 GENERAL INTENTION

A. Contractor shall completely prepare site for building operations, including demolition and removal of existing structures, and furnish labor and materials and perform work for the Correct Electrical Deficiencies project, ATS Gen Set, and ATS Monitoring System as required by drawings and specifications.

B. Visits to the site by Bidders may be made only by appointment with the Medical Center Engineering Officer.

C. Offices of Enginuity-Belay / POWER LLC, as Architect Engineers, will render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not be construed as expressing or implying a contractual act of the Government without affirmations by Contracting Officer or his duly authorized representative.

D. Before placement and installation of work subject to tests by testing laboratory retained by Department of Veterans Affairs, the Contractor shall notify the COTR in sufficient time to enable testing laboratory personnel to be present at the site in time for proper taking and testing of specimens and field inspection. Such prior notice shall be not less than three work days unless otherwise designated by the COTR.

E. All employees of general contractor and subcontractors shall comply with VA security management program and obtain permission of the VA police, be identified by project and employer, and restricted from unauthorized access.

F. Prior to commencing work, general contractor shall provide proof that a OSHA certified “competent person” (CP) (29 CFR 1926.20(b)(2) will maintain a presence at the work site whenever the general or subcontractors are present.

G. Training:
   1. All employees of general contractor or subcontractors shall have the 10-hour OSHA certified Construction Safety course, and all supervisors and foremen shall have the 30-hour OSHA certified ROSEBURG VA HEALTH CARE SYSTEM NEW SARRTP BUILDING FINAL STAMPED SUBMITTAL 01 00 00 -2 Construction Safety course and/or other relevant competency training, as determined by VA CP with input from the ICRA team.
   2. Submit training records of all such employees for approval before the start of work.

1.3 STATEMENT OF BID ITEM(S)

A. ITEM I, General Construction: Work includes general construction, necessary removal of existing construction, and certain other items.

B. ITEM II, Electrical Work: Work includes all labor, material, equipment and supervision to perform the required electrical construction work on this project including replacement of electrical panel components, replacement of automatic transfer switches, installation of a genset monitoring and control system, installation of transformers, commissioning of electrical systems, and certain other items.

C. ITEM III, Mechanical Work: Work includes all labor, material, equipment and supervision to perform the required Mechanical construction work on this project including installation of HVAC equipment and related components, and certain other items.
1.4 **SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR**
   A. Drawings and contract documents may be obtained from the website where the solicitation is posted. Additional copies will be at Contractor’s expense.

1.5 **CONSTRUCTION SECURITY REQUIREMENTS**
   A. **Security Plan:**
      1. The security plan defines both physical and administrative security procedures that will remain effective for the entire duration of the project.
      2. The General Contractor is responsible for assuring that all sub-contractors working on the project and their employees also comply with these regulations.
   B. **Security Procedures:**
      1. General Contractor’s employees shall not enter the project site without appropriate badge. They may also be subject to inspection of their personal effects when entering or leaving the project site.
      2. Before starting work the General Contractor shall give one week’s notice to the Contracting Officer so that security escort arrangements can be provided for the employees. This notice is separate from any notices required for utility shutdown described later in this section.
      3. No photography of VA premises is allowed without written permission of the Contracting Officer.
      4. VA reserves the right to close down or shut down the project site and order General Contractor’s employees off the premises in the event of a national emergency. The General Contractor may return to the site only with the written approval of the Contracting Officer.
      5. The Contractor shall be responsible for job site security. At the request of the COTR, it may be necessary for the Contractor to retain the services of a private security officer to protect job site workspace.
   C. **Key Control:**
      1. The General Contractor shall provide duplicate keys and lock combinations to the Contracting officer’s technical representative (COTR) for the purpose of security inspections of every area of project including tool boxes and parked machines and take any emergency action.
   D. **Document Control:**
      1. Before starting any work, the General Contractor/Sub Contractors shall submit an electronic security memorandum describing the approach to following goals and maintaining confidentiality of “sensitive information”.
      2. The General Contractor is responsible for safekeeping of all drawings, project manual and other project information. This information shall be shared only with those with a specific need to accomplish the project.
      3. Certain documents, sketches, videos or photographs and drawings may be marked “Law Enforcement Sensitive” or “Sensitive Unclassified”. Secure such information in separate containers and limit the access to only those who will need it for the project. Return the information to the Contracting Officer upon request.
      4. These security documents shall not be removed or transmitted from the project site without the written approval of Contracting Officer.
      5. All paper waste or electronic media such as CD’s and diskettes shall be shredded and destroyed in a manner acceptable to the VA.
      6. Notify Contracting Officer and Site Security Officer immediately when there is a loss or compromise of “sensitive information”.

---

**SECTION 01 0000 - GENERAL REQUIREMENTS**

**653-10-531 VA Roseburg Correct Electrical Deficiencies**

**100% Design Submittal 2017/03/10**

---
7. All electronic information shall be stored in specified location following VA standards and procedures using an Engineering Document Management Software (EDMS).
   a. Security, access and maintenance of all project drawings, both scanned and electronic shall be performed and tracked through the EDMS system.
   b. "Sensitive information" including drawings and other documents may be attached to e-mail provided all VA encryption procedures are followed.

E. Motor Vehicle Restrictions: Contractors and subcontractor will only be allowed to park in areas as designated by COTR. The General Contractor shall coordinate with the COTR for the use of loading and unloading areas for heavy equipment and construction supplies.

1.6 OPERATIONS AND STORAGE AREAS

A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.

B. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.

C. The General Contractor will be authorized one Laydown yard/Bull pen, location to be designated by the COTR. Laydown yard is to be fenced and secured by the General contractor at all times. If any additional security for the laydown yard is required it will be the responsibility of the General Contractor to provide.

D. The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.

(FAR 52.236-10)

E. Working space and space available for storing materials shall be as shown on the drawings. as determined by the COTR.

F. Workmen are subject to rules of Medical Center applicable to their conduct.

G. Execute work in such a manner as to interfere as little as possible with work being done by others. Keep roads clear of construction materials, debris, standing construction equipment and vehicles at all times.

H. Execute work so as to interfere as little as possible with normal functioning of Medical Center as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others. Use of equipment and tools that transmit vibrations and noises through the building structure, are not permitted in buildings that are occupied, during construction, jointly by patients or medical personnel, and Contractor's personnel, except as permitted by COTR where required by limited working space.

I. Do not store materials and equipment in other than assigned areas.

J. Schedule delivery of materials and equipment to immediate construction working areas within buildings in use by Department of Veterans Affairs in quantities sufficient for not more than two work days. Provide unobstructed access to Medical Center areas required to remain in operation.
K. Where access by Medical Center personnel to vacated portions of buildings is not required, storage of Contractor's materials and equipment will be permitted subject to fire and safety requirements.

L. Utilities Services: Where necessary to cut existing pipes, electrical wires, conduits, cables, etc., of utility services, or of fire protection systems or communications systems (except telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COTR. All such actions shall be coordinated with the COTR or Utility Company involved:

M. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.

N. Phasing:

1. The Medical Center must maintain its operation 24 hours a day 7 days a week. Therefore, any interruption in service must be scheduled and coordinated with the COTR to ensure that no lapses in operation occur. It is the CONTRACTOR'S responsibility to develop a work plan and schedule detailing, at a minimum, the procedures to be employed, the equipment and materials to be used, the interim life safety measure to be used during the work, and a schedule defining the duration of the work with milestone subtasks. The work to be outlined shall include, but not be limited to:

2. To insure such executions, Contractor shall furnish the COTR with a schedule of approximate phasing dates on which the Contractor intends to accomplish work in each specific area of site, building or portion thereof. In addition, Contractor shall notify the COTR two weeks in advance of the proposed date of starting work in each specific area of site, building or portion thereof. Arrange such phasing dates to insure accomplishment of this work in successive phases mutually agreeable to Medical Center Director, COTR and Contractor, as follows:

O. Contractor shall take all measures and provide all material necessary for protecting existing equipment and property in affected areas of construction against dust and debris, so that equipment and affected areas used in the Medical Centers operations will not be hindered. Contractor shall permit access to Department of Veterans Affairs personnel and patients through other construction areas which serve as routes of access to such affected areas and equipment. These routes whether access or egress shall be isolated from the construction area by temporary partitions and have walking surfaces, lighting etc to facilitate patient and staff access. Coordinate alteration work in areas occupied by Department of Veterans Affairs so that Medical Center operations will continue during the construction period.

P. Construction Fence: Before construction operations begin, Contractor shall provide a chain link construction fence, 2.1m (seven feet) minimum height, around the construction area indicated on the drawings. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 375mm (15 inches). Bottom of fences shall extend to 25mm (one inch) above grade. Remove the fence when directed by COTR.

Q. When a building and/or construction site is turned over to Contractor, Contractor shall accept entire responsibility including upkeep and maintenance therefore:

R. Contractor shall maintain a minimum temperature of 4 degrees C (40 degrees F) at all times, except as otherwise specified.

S. Contractor shall maintain in operating condition existing fire protection and alarm equipment. In connection with fire alarm equipment, Contractor shall make arrangements for pre-inspection of site with Fire Department or Company (Department of Veterans Affairs or municipal) whichever will be required to respond to an alarm from Contractor's employee or watchman.
T. Utilities Services: Maintain existing utility services for Medical Center at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, steam, gases, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COTR.

U. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of COTR. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without a detailed work plan, the Medical Center Director’s prior knowledge and written approval. Refer to specification Sections 26 0511, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, 27 0511 REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS and 28 0500, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY for additional requirements.

V. Contractor shall submit a request to interrupt any such services to COTR, in writing, 15 days in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.

W. Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of Medical Center. Interruption time approved by Medical Center may occur at other than Contractor's normal working hours. A typical time would be 0430 through 0700.

X. Major interruptions of any system must be requested, in writing, at least 15 calendar days prior to the desired time and shall be performed as directed by the COTR.

Y. In case of a contract construction emergency, service will be interrupted on approval of COTR. Such approval will be confirmed in writing as soon as practical.

Z. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.

AA. Abandoned Lines: All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, which are to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged at the main, branch or panel they originate from. The lines shall not be capped in finished areas, but shall be removed and sealed, capped or plugged at the main.

BB. To minimize interference of construction activities with flow of Medical Center traffic, comply with the following:

CC. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles. Wherever excavation for new utility lines cross existing roads, at least one lane must be open to traffic at all times with approval.

DD. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the COTR.

EE. Coordinate the work for this contract with other construction operations as directed COTR. This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.

FF. Coordination of Construction with Cemetery Director: The burial activities at a National Cemetery shall take precedence over construction activities. The Contractor must cooperate and coordinate with the Cemetery Director, through the COTR, in arranging construction schedule to cause the least possible interference with cemetery activities in actual burial areas. Construction noise during the interment services shall not disturb the service. Trucks and workmen shall not pass through the service area during this period:
GG. The Contractor is required to discontinue his work sufficiently in advance of Easter Sunday, Mother's Day, Father's Day, Memorial Day, Veteran's Day and/or Federal holidays, to permit him to clean up all areas of operation adjacent to existing burial plots before these dates.

HH. Cleaning up shall include the removal of all equipment, tools, materials and debris and leaving the areas in a clean, neat condition.

1.7 ALTERATIONS

A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COTR and a representative of VA Supply Service, of buildings and areas of buildings, in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by all three to the Contracting Officer. This report shall list by rooms and spaces:

1. Existing condition and types of resilient flooring, doors, windows, walls and other surfaces not required to be altered throughout affected areas of buildings.
2. Existence and conditions of items such as plumbing fixtures and accessories, electrical fixtures, equipment, venetian blinds, shades, etc., required by drawings to be either reused or relocated, or both.
3. Shall note any discrepancies between drawings and existing conditions at site.
4. Shall designate areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and COTR.

B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of COTR and/or Supply Representative, to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by Contractor with new items in accordance with specifications which will be furnished by Government. Provided the contract work is changed by reason of this subparagraph B, the contract will be modified accordingly, under provisions of clause entitled "DIFFERING SITE CONDITIONS" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).

C. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and COTR together shall make a thorough re-survey of the areas of buildings involved. They shall furnish a report on conditions then existing, of resilient flooring, doors, windows, walls and other surfaces as compared with conditions of same as noted in first condition survey report:

1. Re-survey report shall also list any damage caused by Contractor to such flooring and other surfaces, despite protection measures; and, will form basis for determining extent of repair work required of Contractor to restore damage caused by Contractor's workmen in executing work of this contract.

D. Protection: Provide the following protective measures:

1. Wherever existing roof surfaces are disturbed they shall be protected against water infiltration. In case of leaks, they shall be repaired immediately upon discovery.
2. Temporary protection against damage for portions of existing structures and grounds where work is to be done, materials handled and equipment moved and/or relocated.
3. Protection of interior of existing structures at all times, from damage, dust and weather inclemency. Wherever work is performed, floor surfaces that are to remain in place shall be adequately protected prior to starting work, and this protection shall be maintained intact until all work in the area is completed.

1.8 DISPOSAL AND RETENTION

A. Materials and equipment accruing from work removed and from demolition of buildings or structures, or parts thereof, shall be disposed of as follows:

1. Reserved items which are to remain property of the Government are identified by attached tags or noted on drawings or in specifications as items to be stored. Items that remain property of the Government shall be removed or dislodged from present locations.
in such a manner as to prevent damage which would be detrimental to reinstallation and reuse. Store such items where directed by COTR.

2. Items not reserved shall become property of the Contractor and be removed by Contractor from Medical Center.

3. Items of portable equipment and furnishings located in rooms and spaces in which work is to be done under this contract shall remain the property of the Government. When rooms and spaces are vacated by the Department of Veterans Affairs during the alteration period, such items which are NOT required by drawings and specifications to be either relocated or reused will be removed by the Government in advance of work to avoid interfering with Contractor's operation.

4. PCB Transformers and Capacitors: The Contractor shall be responsible for disposal of the Polychlorinated Biphenyl (PCB) transformers and capacitors. The transformers and capacitors shall be taken out of service and handled in accordance with the procedures of the Environmental Protection Agency (EPA) and the Department of Transportation (DOT) as outlined in Code of Federal Regulation (CFR), Titled 40 and 49 respectively. The EPA's Toxic Substance Control Act (TSCA) Compliance Program Policy Nos. 6-PCB-6 and 6-PCB-7 also apply. Upon removal of PCB transformers and capacitors for disposal, the "originator" copy of the Uniform Hazardous Waste Manifest (EPA Form 8700-22), along with the Uniform Hazardous Waste Manifest Continuation Sheet (EPA Form 8700-22A) shall be returned to the Contracting Officer who will annotate the contract file and transmit the Manifest to the Medical Center's Chief.

a. Copies of the following listed CFR titles may be obtained from the Government Printing Office:
   1) 40 CFR 261 Identification and Listing of Hazardous Waste
   2) 40 CFR 262 Standards Applicable to Generators of Hazardous Waste
   3) 40 CFR 263 Standards Applicable to Transporters of Hazardous Waste
   4) 40 CFR 761 PCB Manufacturing, Processing, Distribution in Commerce, and use Prohibitions
   5) 49 CFR 172 Hazardous Material tables and Hazardous Material Communications Regulations
   6) 49 CFR 173 Shippers General Requirements for Shipments and Packaging
   7) 49 CRR 173 Subpart A General
   8) 49 CFR 173 Subpart B Preparation of Hazardous Material for Transportation
   9) 49 CFR 173 Subpart J Other Regulated Material; Definitions and Preparation
   10) Compliance Program Policy Nos. 6-PCB-6 and 6-PCB-7

1.9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS

A. The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer.

B. The Contractor shall protect from damage all existing improvements and utilities at or near the work site and on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

(FAR 52.236-9)
C. Refer to Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, for additional requirements on protecting vegetation, soils and the environment. Refer to Articles, "Alterations", "Restoration", and "Operations and Storage Areas" for additional instructions concerning repair of damage to structures and site improvements.

D. Refer to FAR clause 52.236-7, "Permits and Responsibilities," which is included in General Conditions. A National Pollutant Discharge Elimination System (NPDES) permit is required for this project. The Contractor is considered an "operator" under the permit and has extensive responsibility for compliance with permit requirements. VA will make the permit application available at the (appropriate medical center) office. The apparent low bidder, contractor and affected subcontractors shall furnish all information and certifications that are required to comply with the permit process and permit requirements. Many of the permit requirements will be satisfied by completing construction as shown and specified. Some requirements involve the Contractor's method of operations and operations planning and the Contractor is responsible for employing best management practices. The affected activities often include, but are not limited to the following:

1. Designating areas for equipment maintenance and repair;
2. Providing waste receptacles at convenient locations and provide regular collection of wastes;
3. Locating equipment wash down areas on site, and provide appropriate control of wash-waters;
4. Providing protected storage areas for chemicals, paints, solvents, fertilizers, and other potentially toxic materials; and
5. Providing adequately maintained sanitary facilities.

1.10 RESTORATION

A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any ducts, plumbing, steam, gas, or electric work without approval of the COTR. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the COTR before it is disturbed. Materials and workmanship used in restoring work, shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.

B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, ceilings, partitions, floors, mechanical and electrical work, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.

C. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone) which are not scheduled for discontinuance or abandonment.

D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by adjustment to contract time and price in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2).

1.11 PHYSICAL DATA

A. Data and information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.

B. The indications of physical conditions on the drawings and in the specifications are the result of site investigations by the A/E team.

(FAR 52.2364)
C. Government does not guarantee that other materials will not be encountered nor that proportions, conditions or character of several materials will not vary from those indicated by explorations. Bidders are expected to examine site of work and logs of borings; and, after investigation, decide for themselves character of materials and make their bids accordingly. Upon proper application to Department of Veterans Affairs, bidders will be permitted to make subsurface explorations of their own at site.

1.13 LAYOUT OF WORK

A. The Contractor shall lay out the work from Government established base lines and bench marks, indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at Contractor's own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the Contracting Officer. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the Contracting Officer until authorized to remove them. If such marks are destroyed by the Contractor or through Contractor's negligence before their removal is authorized, the Contracting Officer may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

(BAR 52.236-17)

B. Establish and plainly mark center lines for each building and corner of column lines and/or addition to each existing building, and such other lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for each such structure and/or addition, are in accordance with lines and elevations shown on contract drawings.

C. Following completion of general mass excavation and before any other permanent work is performed, establish and plainly mark (through use of appropriate batter boards or other means) sufficient additional survey control points or system of points as may be necessary to assure proper alignment, orientation, and grade of all major features of work. Survey shall include, but not be limited to, major utilities:

1. Such additional survey control points or system of points thus established shall be checked and certified by a registered land surveyor or registered civil engineer. Furnish such certification to the COTR before any work (such as utilities and other major controlling features) is placed.

D. During progress of work, and particularly as work progresses from floor to floor, Contractor shall have line grades and plumb of all major form work checked and certified by a registered land surveyor or registered civil engineer as meeting requirements of contract drawings. Furnish such certification to the COTR before any major items of concrete work are placed. In addition, Contractor shall furnish to the COTR certificates from a registered land surveyor or registered civil engineer that the following work is complete in every respect as required by contract drawings.

E. Lines of each building and/or addition.

F. Lines and elevations of all outside distribution systems.

G. Whenever changes from contract drawings are made in line or grading requiring certificates, record such changes on a reproducible drawing bearing the registered land surveyor or registered civil engineer seal, and forward these drawings upon completion of work to COTR.

H. Upon completion of the work, the Contractor shall furnish the COTR one electronic copy and reproducible drawings at the scale of the contract drawings, showing the finished grade on the grid developed for constructing the work, including burial monuments and fifty foot stationing along new road centerlines. These drawings shall bear the seal of the registered land surveyor or registered civil engineer.
I. The Contractor shall perform the surveying and layout work of this and other articles and specifications in accordance with the provisions of Article "Professional Surveying Services".

1.14 AS-BUILT DRAWINGS

A. The contractor shall maintain two full size sets of as-built drawings which will be kept current during construction of the project, to include all contract changes, modifications and clarifications.

B. All variations shall be shown in the same general detail as used in the contract drawings. To insure compliance, as-built drawings shall be made available for the COTR review, as often as requested.

C. Contractor shall deliver two approved completed sets of as-built drawings in the electronic version (scanned PDF) to the COTR, Chief Engineer and Chief of Facilities Management within 15 calendar days after each completed phase and after the acceptance of the project by the COTR.

D. Paragraphs A, B, & C shall also apply to all shop drawings.

1.15 USE OF ROADWAYS

A. For hauling, use only established public roads and roads on Medical Center property and, when authorized by the COTR such temporary roads which are necessary in the performance of contract work. Temporary roads shall be constructed and restoration performed by the Contractor at Contractor's expense. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.

B. When certain buildings (or parts of certain buildings) are required to be completed in advance of general date of completion, all roads leading thereto must be completed and available for use at time set for completion of such buildings or parts thereof.

1.16 – NOT USED

1.17 TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT

A. Use of new installed mechanical and electrical equipment to provide heat, ventilation, plumbing, light and power will be permitted subject to written approval and compliance with the following provisions:

1. Permission to use each unit or system must be given by COTR in writing. If the equipment is not installed and maintained in accordance with the written agreement and following provisions, the COTR will withdraw permission for use of the equipment.

2. Electrical installations used by the equipment shall be completed in accordance with the drawings and specifications to prevent damage to the equipment and the electrical systems, i.e. transformers, relays, circuit breakers, fuses, conductors, motor controllers and their overload elements shall be properly sized, coordinated and adjusted. Installation of temporary electrical equipment or devices shall be in accordance with NFPA 70, National Electrical Code, (2014 Edition), Article 590, Temporary Installations. Voltage supplied to each item of equipment shall be verified to be correct and it shall be determined that motors are not overloaded. The electrical equipment shall be thoroughly cleaned before using it and again immediately before final inspection including vacuum cleaning and wiping clean interior and exterior surfaces.

3. Units shall be properly lubricated, balanced, and aligned. Vibrations must be eliminated.

4. Automatic temperature control systems for preheat coils shall function properly and all safety controls shall function to prevent coil freeze up damage.

5. The air filtering system utilized shall be that which is designed for the system when complete, and all filter elements shall be replaced at completion of construction and prior to testing and balancing of system.

6. All components of heat production and distribution system, metering equipment, condensate returns, and other auxiliary facilities used in temporary service shall be
cleaned prior to use; maintained to prevent corrosion internally and externally during use; and cleaned, maintained and inspected prior to acceptance by the Government.

B. Prior to final inspection, the equipment or parts used which show wear and tear beyond normal, shall be replaced with identical replacements, at no additional cost to the Government.

C. This paragraph shall not reduce the requirements of the mechanical and electrical specifications sections.

D. Any damage to the equipment or excessive wear due to prolonged use will be repaired replaced by the contractor at the contractor’s expense.

1.18 TEMPORARY USE OF EXISTING ELEVATORS

A. Use of existing elevators for handling building materials and Contractor's personnel will be permitted subject to following provisions:

1. Contractor makes all arrangements with the COTR for use of elevators. The COTR will ascertain that elevators are in proper condition. Contractor shall coordinate with the COTR to identify elevators that may be used by the Contractor, allowable times of use, and any time(s) that the Contractor may have exclusive use of specific elevator(s). Personnel for operating elevators will not be provided by the Department of Veterans Affairs.

2. Contractor covers and provides maximum protection of following elevator components:
   a. Entrance jambs, heads soffits and threshold plates.
   b. Entrance columns, canopy, return panels and inside surfaces of car enclosure walls.
   c. Finish flooring.

3. Government will accept hoisting ropes of elevator and rope of each speed governor if they are worn under normal operation. However, if these ropes are damaged by action of foreign matter such as sand, lime, grit, stones, etc., during temporary use, they shall be removed and replaced by new hoisting ropes at the contractors expense.

4. If brake lining of elevators are excessively worn or damaged during temporary use, they shall be removed and replaced by new brake lining at the contractors expense.

5. All parts of main controller, starter, relay panel, selector, etc., worn or damaged during temporary use shall be removed and replaced with new parts at the contractors expense, if recommended by elevator inspector after elevator is released by Contractor.

6. Place elevator in condition equal, less normal wear, to that existing at time it was placed in service of Contractor as approved by Contracting Officer.

1.19 – NOT USED

1.20 TEMPORARY TOILETS

A. Provide where directed, (for use of all Contractor's workmen) ample temporary sanitary toilet accommodations with suitable sewer and water connections; or, when approved by COTR, provide suitable dry closets where directed. Keep such places clean and free from flies, and all connections and appliances connected therewith are to be removed prior to completion of contract, and premises left perfectly clean.

1.21 AVAILABILITY AND USE OF UTILITY SERVICES

A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The amount to be paid by the Contractor for chargeable electrical services shall be the prevailing rates charged to the Government. The Contractor shall carefully conserve any utilities furnished without charge.

B. The Contractor, at Contractor’s expense and in a workmanlike manner, in compliance with code and as satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of electricity used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia and repair restore the infrastructure as required.
C. Contractor shall install meters at Contractor's expense and furnish the Medical Center a monthly record of the Contractor's usage of electricity as hereinafter specified.

D. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials:
   1. Obtain heat by connecting to Medical Center heating distribution system.

E. Electricity (for Construction and Testing): Furnish all temporary electric services.
   1. Obtain electricity by connecting to the Medical Center electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices providing temporary heat. Electricity for all other uses is available at no cost to the Contractor.

   1. Obtain water by connecting to the Medical Center water distribution system. Provide reduced pressure backflow preventer at each connection as per code. Water is available at no cost to the Contractor.
   2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at COTR discretion) of use of water from Medical Center's system.

1.22 NEW TELEPHONE EQUIPMENT
A. The contractor shall coordinate with the work of installation of telephone equipment by others. This work shall be completed before the building is turned over to VA.

1.23 TESTS
A. As per specification section 23 05 93 the contractor shall provide a written testing and commissioning plan complete with component level, equipment level, sub-system level and system level breakdowns. The plan will provide a schedule and a written sequence of what will be tested, how and what the expected outcome will be. This document will be submitted for approval prior to commencing work. The contractor shall document the results of the approved plan and submit for approval with the as built documentation.

B. Pre-test mechanical and electrical equipment and systems and make corrections required for proper operation of such systems before requesting final tests. Final test will not be conducted unless pretested.

C. Conduct final tests required in various sections of specifications in presence of an authorized representative of the Contracting Officer. Contractor shall furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests.

D. Mechanical and electrical systems shall be balanced, controlled and coordinated. A system is defined as the entire system which must be coordinated to work together during normal operation to produce results for which the system is designed. For example, air conditioning supply air is only one part of entire system which provides comfort conditions for a building. Other related components are return air, exhaust air, steam, chilled water, refrigerant, hot water, controls and electricity, etc. Another example of a system which involves several components of different disciplines is a boiler installation. Efficient and acceptable boiler operation depends upon the coordination and proper operation of fuel, combustion air, controls, steam, feed water, condensate and other related components.

E. All related components as defined above shall be functioning when any system component is tested. Tests shall be completed within a reasonably period of time during which operating and environmental conditions remain reasonably constant and are typical of the design conditions.

F. Individual test result of any component, where required, will only be accepted when submitted with the test results of related components and of the entire system.
1.24 INSTRUCTIONS

A. Contractor shall furnish Maintenance and Operating manuals (hard copies and electronic) and verbal instructions when required by the various sections of the specifications and as hereinafter specified.

B. Manuals: Maintenance and operating manuals and one compact disc (four hard copies and one electronic copy each) for each separate piece of equipment shall be delivered to the COTR coincidental with the delivery of the equipment to the job site. Manuals shall be complete, detailed guides for the maintenance and operation of equipment. They shall include complete information necessary for starting, adjusting, maintaining in continuous operation for long periods of time and dismantling and reassembling of the complete units and subassembly components. Manuals shall include an index covering all component parts clearly cross-referenced to diagrams and illustrations. Illustrations shall include "exploded" views showing and identifying each separate item. Emphasis shall be placed on the use of special tools and instruments. The function of each piece of equipment, component, accessory and control shall be clearly and thoroughly explained. All necessary precautions for the operation of the equipment and the reason for each precaution shall be clearly set forth. Manuals must reference the exact model, style and size of the piece of equipment and system being furnished. Manuals referencing equipment similar to but of a different model, style, and size than that furnished will not be accepted.

C. Instructions: Contractor shall provide qualified, factory trained manufacturers' representatives to give detailed training to assigned Department of Veterans Affairs personnel in the operation and complete maintenance for each piece of equipment. All such training will be at the job site. These requirements are more specifically detailed in the various technical sections. Instructions for different items of equipment that are component parts of a complete system, shall be given in an integrated, progressive manner. All instructors for every piece of component equipment in a system shall be available until instructions for all items included in the system have been completed. This is to assure proper instruction in the operation of inter-related systems. All instruction periods shall be at such times as scheduled by the COTR and shall be considered concluded only when the COTR is satisfied in regard to complete and thorough coverage. The contractor shall submit a course outline with associated material to the COTR for review and approval prior to scheduling training to ensure the subject matter covers the expectations of the VA and the contractual requirements. The Department of Veterans Affairs reserves the right to request the removal of, and substitution for, any instructor who, in the opinion of the COTR, does not demonstrate sufficient qualifications in accordance with requirements for instructors above.

1.25 GOVERNMENT-FURNISHED PROPERTY

A. The Government shall deliver to the Contractor, the Government furnished property shown on the Schedule and drawings.

B. Equipment furnished by Government to be installed by Contractor will be furnished to Contractor at the Medical Center.

C. Contractor shall be prepared to receive this equipment from Government and store or place such equipment not less than 90 days before Completion Date of project.

D. Notify Contracting Officer in writing, 60 days in advance, of date on which Contractor will be prepared to receive equipment furnished by Government. Arrangements will then be made by the Government for delivery of equipment.

1. Immediately upon delivery of equipment, Contractor shall arrange for a joint inspection thereof with a representative of the Government. At such time the Contractor shall acknowledge receipt of equipment described, make notations, and immediately furnish the Government representative with a written statement as to its condition or shortages.

2. Contractor thereafter is responsible for such equipment until such time as acceptance of contract work is made by the Government.
E. Equipment furnished by the Government will be delivered in a partially assembled (knock down) condition in accordance with existing standard commercial practices, complete with all fittings, fastenings, and appliances necessary for connections to respective services installed under contract. All fittings and appliances (i.e., couplings, ells, tees, nipples, piping, conduits, cables, and the like) necessary to make the connection between the Government furnished equipment item and the utility stub-up shall be furnished and installed by the contractor at no additional cost to the Government.

F. Completely assemble and install the Government furnished equipment in place ready for proper operation in accordance with specifications and drawings.

G. Furnish supervision of installation of equipment at construction site by qualified factory trained technicians regularly employed by the equipment manufacturer.

1.26 RELOCATED EQUIPMENT & ITEMS

A. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing equipment and items indicated by symbol "R" or otherwise shown to be relocated by the Contractor.

B. Perform relocation of such equipment or items at such times and in such a manner as directed by the COTR.

C. Suitably cap existing service lines, such as electrical, at the main whenever such lines are disconnected from equipment to be relocated. Remove abandoned lines in finished areas and cap as specified herein before under paragraph "Abandoned Lines".

D. Provide all mechanical and electrical service connections, fittings, fastenings and any other materials necessary for assembly and installation of relocated equipment; and leave such equipment in proper operating condition.

E. Contractor shall employ services of an installation engineer, who is an authorized representative of the manufacturer of this equipment to supervise assembly and installation of existing equipment, required to be relocated.

F. All service lines such as noted above for relocated equipment shall be in place at point of relocation ready for use before any existing equipment is disconnected. Make relocated existing equipment ready for operation or use immediately after reinstallation.

1.27 STORAGE SPACE FOR DEPARTMENT OF VETERANS AFFAIRS EQUIPMENT

A. Contractor shall complete approximately ______ square meters ________ (square feet) of space in building accessible from ground level without use of elevators for storage of certain materials and equipment by Department of Veterans Affairs.

   1. Provide such space with adequate light, ventilation and heat in season and lock for adequate security. Contractor shall also install and connect portion of nearest specified fire protection system including all apparatus for instant use to provide water for adequate fire protection of storage space.

   2. Storage space shall be turned over to Contracting Officer ninety days prior to Completion Date of the buildings involved.

   3. Forward two sets of drawings to Contracting Officer through the COTR 120 days prior to Completion Date of building; drawings shall indicate those areas which will be made available to Department of Veterans Affairs for temporary storage.

   4. All cost for utility services for such storage space shall be borne by Contractor until entire building is turned over for occupancy.

B. "Completion Date" shall mean that date as established by Contracting Officer upon which Contractor will turn over entire project or portions thereof to the Government.

1.28 CONSTRUCTION SIGN

A. Provide a Construction Sign where directed by the COTR. All wood members shall be of framing lumber. Cover sign frame with 0.7 mm (24 gage) galvanized sheet steel nailed securely around edges and on all bearings. Provide three 100 by 100 mm (4 inch by 4 inch) posts (or
equivalent round posts) set 1200 mm (four feet) into ground. Set bottom of sign level at 900 mm (three feet) above ground and secure to posts with through bolts. Make posts full height of sign. Brace posts with 50 x 100 mm (two by four inch) material as directed.

B. Paint all surfaces of sign and posts two coats of white gloss paint. Border and letters shall be of black gloss paint, except project title which shall be blue gloss paint.

C. Maintain sign and remove it when directed by the COTR.

D. Contractor shall coordinate with COTR for details of construction sign including required legend and other characteristics.

1.29 SAFETY SIGN

A. Provide a Safety Sign where directed by COTR. Face of sign shall be 19 mm (3/4 inch) thick exterior grade plywood. Provide two 100 mm by 100 mm (four by four inch) posts extending full height of sign and 900 mm (three feet) into ground. Set bottom of sign level at 1200 mm (four feet) above ground.

B. Paint all surfaces of Safety Sign and posts with one prime coat and two coats of white gloss paint. Letters and design shall be painted with gloss paint of colors noted.

C. Maintain sign and remove it when directed by COTR.

D. Standard Detail Drawing Number SD10000-02 of safety sign showing required legend and other characteristics of sign available on VA TIL.

E. Post the number of accident free days on a daily basis.

1.30 PHOTOGRAPHIC DOCUMENTATION

A. During the construction period through completion, provide photographic documentation of construction progress and at selected milestones including electronic indexing, navigation, storage and remote access to the documentation, as per these specifications. The commercial photographer or the subcontractor used for this work shall meet the following qualifications:

B. Demonstrable minimum experience of three (3) years in operation providing documentation and advanced indexing/navigation systems including a representative portfolio of construction projects of similar type, size, duration and complexity as the Project.

C. Demonstrable ability to service projects throughout North America, which shall be demonstrated by a representative portfolio of active projects of similar type, size, duration and complexity as the Project.

D. Photographic documentation elements:

1. Each digital image shall be taken with a professional grade camera with minimum size of 6 megapixels (MP) capable of producing 200x250mm (8 x 10 inch) prints with a minimum of 2272 x 1704 pixels and 400x500mm (16 x 20 inch) prints with a minimum 2592 x 1944 pixels.

2. Indexing and navigation system shall utilize actual AUTOCAD construction drawings, making such drawings interactive on an on-line interface. For all documentation referenced herein, indexing and navigation must be organized by both time (date-stamped) and location throughout the project.

3. Documentation shall combine indexing and navigation system with inspection-grade digital photography designed to capture actual conditions throughout construction and at critical milestones. Documentation shall be accessible on-line through use of an internet connection. Documentation shall allow for secure multiple-user access, simultaneously, on-line.

4. Before construction, the building pad, adjacent streets, roadways, parkways, driveways, curbs, sidewalks, landscaping, adjacent utilities and adjacent structures surrounding the building pad and site shall be documented. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive architectural drawings. If site work or pad preparation is extensive, this
documentation may be required immediately before construction and at several pre-determined intervals before building work commences.

5. Construction progress for all trades shall be tracked at pre-determined intervals, but not less than once every thirty (30) calendar days (“Progressions”). Progression documentation shall track both the exterior and interior construction of the building. Exterior Progressions shall track 360 degrees around the site and each building. Interior Progressions shall track interior improvements beginning when stud work commences and continuing until Project completion.

6. As-built condition of utilities and site utilities shall be documented prior to placing concrete and/or backfilling. This process shall include all underground and in-slab utilities within the building(s) envelope(s) and utility runs in the immediate vicinity of the building(s) envelope(s). This may also include utilities enclosed in slab-on-deck in multi-story buildings. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive site utility plans.

7. As-built conditions of electrical and all other systems shall be documented post-inspection and pre-insulation, sheet rock or dry wall installation. This process shall include all finished systems located in the walls and ceilings of all buildings at the Project. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive architectural drawings.

8. As-built conditions of exterior skin and elevations shall be documented with an increased concentration of digital photographs as directed by the COTR in order to capture pre-determined focal points, such as electrical penetrations. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive architectural drawings.

9. As-built finished conditions of the interior of each building including floors, ceilings and walls shall be documented at certificate of occupancy or equivalent, or just prior to occupancy, or both, as directed by the COTR. Overlapping photographic techniques shall be used to insure maximum coverage. Indexing and navigation accomplished through interactive architectural drawings.

10. Miscellaneous events that occur during any Contractor site visit, or events captured by the Department of Veterans Affairs independently, shall be dated, labeled and inserted into a Section in the navigation structure entitled “Slideshows,” allowing this information to be stored in the same “place” as the formal scope.

11. Customizable project-specific digital photographic documentation of other details or milestones. Indexing and navigation accomplished through interactive architectural plans.

12. Monthly (29 max) exterior progressions (360 degrees around the project) and slideshows (all elevations and building envelope). The slideshows allow for the inclusion of Department of Veterans Affairs pictures, aerial photographs, and timely images which do not fit into any regular monthly photo path.

13. Weekly (21 Max) Site Progressions - Photographic documentation capturing the project at different stages of construction. These progressions shall capture underground utilities, excavation, grading, backfill, landscaping and road construction throughout the duration of the project.

14. Regular (8 max) interior progressions of all walls of the entire project to begin at time of substantial framed or as directed by the COTR through to completion.

15. Detailed Exact-Built of all Slabs for all project slab pours just prior to placing concrete or as directed by the COTR.

16. Detailed Interior exact built overlapping photos of the entire building to include documentation of all electrical systems in every wall and ceiling, to be conducted after rough-ins are complete, just prior to insulation and or drywall, or as directed by COTR.
17. Finished detailed Interior exact built overlapping photos of all walls, ceilings, and floors to be scheduled by COTR prior to occupancy.

18. In event a greater or lesser number of images than specified above are required by the COTR, adjustment in contract price will be made in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).

E. Images shall be taken by a commercial photographer and must show distinctly, at as large a scale as possible, all parts of work embraced in the picture.

F. Coordination of photo shoots is accomplished through COTR. Contractor shall also attend construction team meetings as necessary. Contractor’s operations team shall provide regular updates regarding the status of the documentation, including photo shoots concluded, the availability of new Progressions or Exact-Builts viewable on-line and anticipated future shoot dates.

G. Contractor shall provide all on-line domain/web hosting, security measures, and redundant server back-up of the documentation.

H. Contractor shall provide technical support related to using the system or service.

I. Upon completion of the project, final copies of the documentation (the “Permanent Record”) with the indexing and navigation system embedded (and active) shall be provided in an electronic media format, typically a DVD or external hard-drive. Permanent Record shall have Building Information Modeling (BIM) interface capabilities. On-line access terminates upon delivery of the Permanent Record.

1.31 FINAL ELEVATION DIGITAL IMAGES

A. * A minimum of four (4) images of each elevation shall be taken with a minimum 6 MP camera, by a professional photographer with different settings to allow the COTR to select the image to be printed. All images are provided to the RE on a CD.

B. * Photographs shall be taken upon completion, including landscaping. They shall be taken on a clear sunny day to obtain sufficient detail to show depth and to provide clear, sharp pictures. Pictures shall be 400 mm x 500 mm (16 by 20 inches), printed on regular weight paper, matte finish archival grade photographic paper and produced by a RA4 process from the digital image with a minimum 300 PPI. Identifying data shall be carried on label affixed to back of photograph without damage to photograph and shall be similar to that provided for final construction photographs.

C. Furnish six (6) 400 mm x 500 mm (16 by 20 inch) color prints of the following buildings constructed under this project (elevations as selected by the RE from the images taken above). Photographs shall be artistically composed showing full front elevations. All images shall become property of the Government. Each of the selected six prints shall be place in a frame with a minimum of 2 inches of appropriate matting as a border. Provide a selection of a minimum of 3 different frames from which the SRE will select one style to frame all six prints. Photographs with frames shall be delivered to the COTR in boxes suitable for shipping.

1. Building 1/1AC
2. Building 2
3. Building 3
4. Building 4
5. Building 5
6. Building 6
7. Building 7
8. Building 13
9. Building 17
10. Building 58
11. Building 61
12. Building 64
13. Building 65
14. Building 71
15. Building 81
16. Building 82
17. Building 85
18. Building 86
19. Building 88
20. Building T-6
21. Building T-8

1.32 HISTORIC PRESERVATION

A. Where the Contractor or any of the Contractor's employees, prior to, or during the construction work, are advised of or discover any possible archeological, historical and/or cultural resources, the Contractor shall immediately notify the COTR verbally, and then with a written follow up.

1.33 VA TRIRIGA CPMS

VA contractors, selected by award to perform work, are required to get access to the VA TRIRIGA CPMS. The TRIRIGA CPMS is the management and collaborative environment that the VA uses for all Major, Minor and Non-Recurring Maintenance (NRM) projects within the Office of Construction & Facilities Management (CFM), Veterans Health Administration (VHA), National Cemetery Administration (NCA), and the Veterans Benefits Administration (VBA).

The contractor is solely responsible for acquiring access to the VA TRIRIGA CPMS.

To gain access to the VA TRIRIGA CPMS the contractor is encouraged to follow the licensing process outline as specified below:

A. Requirement: TRIRIGA is the management and collaborative environment that VA uses for all construction projects. VA requires its contractors to procure TRIRIGA access as part of the cost of performance for a VA construction related contract.

B. Access Request and Payment can be made through the following URL
   https://valicensing.oncfi.com/

C. Inquiries or to request additional services, contact the following:
   Federal Account Manager
   Computerized Facility Integrations, LLC
   18000 West Nine Mile Road
   Suite 700
   Southfield, MI 48075

   Phone: 248-557-4234 Extension 6010; 410-292-7006

D. Process:
   1. Once the contractor has been notified by VA of the award and a unique contract number, the contractor can enter a request for access to TRIRIGA at URL https://valicensing.oncfi.com/
   2. CFI will process the request for access and payment. CFI will create the USER ID and a password. Security provisions required to align the contractor to the Contract Number will be entered and an email will be generated and submitted to the requestor.
   3. CFI will also provide standard terms and conditions related to the transaction and use agreement.

- - - END - - -
PART 1 - GENERAL

1.1 DESCRIPTION:
A. The Contractor shall develop a Critical Path Method (CPM) plan and schedule demonstrating fulfillment of the contract requirements (Project Schedule), and shall keep the Project Schedule up-to-date in accordance with the requirements of this section and shall utilize the plan for scheduling, coordinating and monitoring work under this contract (including all activities of subcontractors, equipment vendors and suppliers). Conventional Critical Path Method (CPM) technique shall be utilized to satisfy both time and cost applications.

1.2 CONTRACTOR'S REPRESENTATIVE:
A. The Contractor shall designate an authorized representative responsible for the Project Schedule including preparation, review and progress reporting with and to the Contracting Officer's Representative (COTR).
B. The Contractor's representative shall have direct project control and complete authority to act on behalf of the Contractor in fulfilling the requirements of this specification section.
C. The Contractor's representative shall have the option of developing the project schedule within their organization or to engage the services of an outside consultant. If an outside scheduling consultant is utilized, Section 1.3 of this specification will apply.

1.3 CONTRACTOR'S CONSULTANT:
A. The Contractor shall submit a qualification proposal to the COTR, within 10 days of bid acceptance. The qualification proposal shall include:
   1. The name and address of the proposed consultant.
   2. Information to show that the proposed consultant has the qualifications to meet the requirements specified in the preceding paragraph.
   3. A representative sample of prior construction projects, which the proposed consultant has performed complete project scheduling services. These representative samples shall be of similar size and scope.
B. The Contracting Officer has the right to approve or disapprove the proposed consultant, and will notify the Contractor of the VA decision within seven calendar days from receipt of the qualification proposal. In case of disapproval, the Contractor shall resubmit another consultant within 10 calendar days for renewed consideration. The Contractor shall have their scheduling consultant approved prior to submitting any schedule for approval.

1.4 COMPUTER PRODUCED SCHEDULES
A. The contractor shall provide monthly, to the Department of Veterans Affairs (VA), all computer-produced time/cost schedules and reports generated from monthly project updates. This monthly computer service will include: three copies of up to five different reports (inclusive of all pages) available within the user defined reports of the scheduling software approved by the Contracting Officer; a hard copy listing of all project schedule changes, and associated data, made at the update and an electronic file of this data; and the resulting monthly updated schedule in PDM format. These must be submitted with and substantively support the contractor's monthly payment request and the signed look ahead report. The COTR shall identify the five different report formats that the contractor shall provide.
B. The contractor shall be responsible for the correctness and timeliness of the computer-produced reports. The Contractor shall also responsible for the accurate and timely submittal of the updated project schedule and all CPM data necessary to produce the computer reports and payment request that is specified.
C. The VA will report errors in computer-produced reports to the Contractor's representative within ten calendar days from receipt of reports. The Contractor shall reprocess the computer-produced reports and associated diskette(s), when requested by the Contracting Officer’s representative, to correct errors which affect the payment and schedule for the project.
1.5 THE COMPLETE PROJECT SCHEDULE SUBMITTAL

A. Within 45 calendar days after receipt of Notice to Proceed, the Contractor shall submit for the Contracting Officer's review; three blue line copies of the interim schedule on sheets of paper 765 x 1070 mm (30 x 42 inches) and an electronic file in the previously approved CPM schedule program. The submittal shall also include three copies of a computer-produced activity/event ID schedule showing project duration; phase completion dates; and other data, including event cost. Each activity/event on the computer-produced schedule shall contain as a minimum, but not limited to, activity/event ID, activity/event description, duration, budget amount, early start date, early finish date, late start date, late finish date and total float. Work activity/event relationships shall be restricted to finish-to-start or start-to-start without lead or lag constraints. Activity/event date constraints, not required by the contract, will not be accepted unless submitted to and approved by the Contracting Officer. The contractor shall make a separate written detailed request to the Contracting Officer identifying these date constraints and secure the Contracting Officer's written approval before incorporating them into the network diagram. The Contracting Officer's separate approval of the Project Schedule shall not excuse the contractor of this requirement. Logic events (non-work) will be permitted where necessary to reflect proper logic among work events, but must have zero duration. The complete working schedule shall reflect the Contractor's approach to scheduling the complete project. The final Project Schedule in its original form shall contain no contract changes or delays which may have been incurred during the final network diagram development period and shall reflect the entire contract duration as defined in the bid documents. These changes/delays shall be entered at the first update after the final Project Schedule has been approved. The Contractor should provide their requests for time and supporting time extension analysis for contract time as a result of contract changes/delays, after this update, and in accordance with Article, ADJUSTMENT OF CONTRACT COMPLETION.

B. Within 30 calendar days after receipt of the complete project interim Project Schedule and the complete final Project Schedule, the Contracting Officer or his representative, will do one or both of the following:

C. Notify the Contractor concerning his actions, opinions, and objections.

D. A meeting with the Contractor at or near the job site for joint review, correction or adjustment of the proposed plan will be scheduled if required. Within 14 calendar days after the joint review, the Contractor shall revise and shall submit three blue line copies of the revised Project Schedule, three copies of the revised computer-produced activity/event ID schedule and a revised electronic file as specified by the Contracting Officer. The revised submission will be reviewed by the Contracting Officer and, if found to be as previously agreed upon, will be approved.

E. The approved baseline schedule and the computer-produced schedule(s) generated there from shall constitute the approved baseline schedule until subsequently revised in accordance with the requirements of this section.

F. The Complete Project Schedule shall contain approximately 270 calendar days work activities/events.

1.6 WORK ACTIVITY/EVENT COST DATA

A. The Contractor shall cost load all work activities/events except procurement activities. The cumulative amount of all cost loaded work activities/events (including alternates) shall equal the total contract price. Prorate overhead, profit and general conditions on all work activities/events for the entire project length. The contractor shall generate from this information cash flow curves indicating graphically the total percentage of work activity/event dollar value scheduled to be in place on early finish, late finish. These cash flow curves will be used by the Contracting Officer to assist him in determining approval or disapproval of the cost loading. Negative work activity/event cost data will not be acceptable, except on VA issued contract changes.

B. The Contractor shall cost load work activities/events for guarantee period services, test, balance and adjust various systems in accordance with the provisions in Article, FAR 52.232 –
5 (PAYMENT UNDER FIXED PRICE CONSTRUCTION CONTRACTS) and VAAR 852.236 – 83 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS).

C. In accordance with FAR 52.236 – 1 (PERFORMANCE OF WORK BY THE CONTRACTOR) and VAAR 852.236 – 72 (PERFORMANCE OF WORK BY THE CONTRACTOR), the Contractor shall submit, simultaneously with the cost per work activity/event of the construction schedule required by this Section, a responsibility code for all activities/events of the project for which the Contractor’s forces will perform the work.

D. The Contractor shall cost load work activities/events for all BID ITEMS including ASBESTOS ABATEMENT. The sum of each BID ITEM work shall equal the value of the bid item in the Contractors’ bid.

1.7 PROJECT SCHEDULE REQUIREMENTS

A. Show on the project schedule the sequence of work activities/events required for complete performance of all items of work. The Contractor Shall:

1. Show activities/events as:
   a. Contractor's time required for submittal of shop drawings, templates, fabrication, delivery and similar preconstruction work.
   b. Contracting Officer's and Architect Engineer's review and approval of shop drawings, equipment schedules, samples, template, or similar items.
   c. Interruption of VA Facilities utilities, delivery of Government furnished equipment, and rough-in drawings, project phasing and any other specification requirements.
   d. Test, balance and adjust various systems and pieces of equipment, maintenance and operation manuals, instructions and preventive maintenance tasks.
   e. VA inspection and acceptance activity/event with a minimum duration of five work days at the end of each phase and immediately preceding any VA move activity/event required by the contract phasing for that phase.

2. Show not only the activities/events for actual construction work for each trade category of the project, but also trade relationships to indicate the movement of trades from one area, floor, or building, to another area, floor, or building, for at least five trades who are performing major work under this contract.

3. Break up the work into activities/events of a duration no longer than 20 work days each or one reporting period, except as to non-construction activities/events (i.e., procurement of materials, delivery of equipment, concrete and asphalt curing) and any other activities/events for which the COTR may approve the showing of a longer duration. The duration for VA approval of any required submittal, shop drawing, or other submittals will not be less than 20 work days.

4. Describe work activities/events clearly, so the work is readily identifiable for assessment of completion. Activities/events labeled "start," "continue," or "completion," are not specific and will not be allowed. Lead and lag time activities will not be acceptable.

5. The schedule shall be generally numbered in such a way to reflect either discipline, phase or location of the work.

B. The Contractor shall submit the following supporting data in addition to the project schedule:

1. The appropriate project calendar including working days and holidays.

2. The planned number of shifts per day.

3. The number of hours per shift.

4. Failure of the Contractor to include this data shall delay the review of the submittal until the Contracting Officer is in receipt of the missing data.

C. To the extent that the Project Schedule or any revised Project Schedule shows anything not jointly agreed upon, it shall not be deemed to have been approved by the COTR. Failure to include any element of work required for the performance of this contract shall not excuse the Contractor from completing all work required within any applicable completion date of each phase regardless of the COTR’s approval of the Project Schedule.
D. Compact Disk Requirements and CPM Activity/Event Record Specifications: Submit to the VA an electronic file(s) containing one file of the data required to produce a schedule, reflecting all the activities/events of the complete project schedule being submitted.

1.8 PAYMENT TO THE CONTRACTOR:

A. Monthly, the contractor shall submit an application and certificate for payment using VA Form 10-6001a reflecting updated schedule activities and cost data in accordance with the provisions of the following Article, PAYMENT AND PROGRESS REPORTING, as the basis upon which progress payments will be made pursuant to Article, FAR 52.232 – 5 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS) and VAAR 852.236 – 83 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS). The Contractor shall be entitled to a monthly progress payment upon approval of estimates as determined from the currently approved updated project schedule. Monthly payment requests shall include: a listing of all agreed upon project schedule changes and associated data; and an electronic file (s) of the resulting monthly updated schedule.

B. Approval of the Contractor’s monthly Application for Payment shall be contingent, among other factors, on the submittal of a satisfactory monthly update of the project schedule.

1.9 PAYMENT AND PROGRESS REPORTING

A. Monthly schedule update meetings will be held on dates mutually agreed to by the COTR and the Contractor. Contractor and their CPM consultant (if applicable) shall attend all monthly schedule update meetings. The Contractor shall accurately update the Project Schedule and all other data required and provide this information to the COTR three work days in advance of the schedule update meeting. Job progress will be reviewed to verify:
1. Actual start and/or finish dates for updated/completed activities/events.
2. Remaining duration for each activity/event started, or scheduled to start, but not completed.
3. Logic, time and cost data for change orders, and supplemental agreements that are to be incorporated into the Project Schedule.
4. Changes in activity/event sequence and/or duration which have been made, pursuant to the provisions of following Article, ADJUSTMENT OF CONTRACT COMPLETION.
5. Completion percentage for all completed and partially completed activities/events.
6. Logic and duration revisions required by this section of the specifications.
7. Activity/event duration and percent complete shall be updated independently.

B. After completion of the joint review, the contractor shall generate an updated computer-produced calendar-dated schedule and supply the Contracting Officer’s representative with reports in accordance with the Article, COMPUTER PRODUCED SCHEDULES, specified.

C. After completing the monthly schedule update, the contractor’s representative or scheduling consultant shall rerun all current period contract change(s) against the prior approved monthly project schedule. The analysis shall only include original workday durations and schedule logic agreed upon by the contractor and COTR for the contract change(s). When there is a disagreement on logic and/or durations, the Contractor shall use the schedule logic and/or durations provided and approved by the COTR. After each rerun update, the resulting electronic project schedule data file shall be appropriately identified and submitted to the VA in accordance to the requirements listed in Articles 1.4 and 1.7. This electronic submission is separate from the regular monthly project schedule update requirements and shall be submitted to the COTR within fourteen (14) calendar days of completing the regular schedule update. Before inserting the contract changes durations, care must be taken to ensure that only the original durations will be used for the analysis, not the reported durations after progress. In addition, once the final network diagram is approved, the contractor must recreate all manual progress payment updates on this approved network diagram and associated reruns for contract changes in each of these update periods as outlined above for regular update periods. This will require detailed record keeping for each of the manual progress payment updates.

D. Following approval of the CPM schedule, the VA, the General Contractor, its approved CPM Consultant, RE office representatives, and all subcontractors needed, as determined by the
SRE, shall meet to discuss the monthly updated schedule. The main emphasis shall be to address work activities to avoid slippage of project schedule and to identify any necessary actions required to maintain project schedule during the reporting period. The Government representatives and the Contractor should conclude the meeting with a clear understanding of those work and administrative actions necessary to maintain project schedule status during the reporting period. This schedule coordination meeting will occur after each monthly project schedule update meeting utilizing the resulting schedule reports from that schedule update. If the project is behind schedule, discussions should include ways to prevent further slippage as well as ways to improve the project schedule status, when appropriate.

1.10 RESPONSIBILITY FOR COMPLETION
   A. If it becomes apparent from the current revised monthly progress schedule that phasing or contract completion dates will not be met, the Contractor shall execute some or all of the following remedial actions:
      1. Increase construction manpower in such quantities and crafts as necessary to eliminate the backlog of work.
      2. Increase the number of working hours per shift, shifts per working day, working days per week, the amount of construction equipment, or any combination of the foregoing to eliminate the backlog of work.
      3. Reschedule the work in conformance with the specification requirements.
   B. Prior to proceeding with any of the above actions, the Contractor shall notify and obtain approval from the COTR for the proposed schedule changes. If such actions are approved, the representative schedule revisions shall be incorporated by the Contractor into the Project Schedule before the next update, at no additional cost to the Government.

1.11 CHANGES TO THE SCHEDULE
   A. Within 30 calendar days after VA acceptance and approval of any updated project schedule, the Contractor shall submit a revised electronic file(s) and a list of any activity/event changes including predecessors and successors for any of the following reasons:
      1. Delay in completion of any activity/event or group of activities/events, which may be involved with contract changes, strikes, unusual weather, and other delays will not relieve the Contractor from the requirements specified unless the conditions are shown on the CPM as the direct cause for delaying the project beyond the acceptable limits.
      2. Delays in submittals, or deliveries, or work stoppage are encountered which make rescheduling of the work necessary.
      3. The schedule does not represent the actual prosecution and progress of the project.
      4. When there is, or has been, a substantial revision to the activity/event costs regardless of the cause for these revisions.
   B. CPM revisions made under this paragraph which affect the previously approved computer produced schedules for Government furnished equipment, vacating of areas by the VA Facility, contract phase(s) and sub phase(s), utilities furnished by the Government to the Contractor, or any other previously contracted item, shall be furnished in writing to the Contracting Officer for approval.
   C. Contracting Officer’s approval for the revised project schedule and all relevant data is contingent upon compliance with all other paragraphs of this section and any other previous agreements by the Contracting Officer or the VA representative.
   D. The cost of revisions to the project schedule resulting from contract changes will be included in the proposal for changes in work as specified in FAR 52.243 – 4 (Changes) and VAAR 852.236 – 88 (Changes – Supplemental), and will be based on the complexity of the revision or contract change, man hours expended in analyzing the change, and the total cost of the change.
   E. The cost of revisions to the Project Schedule not resulting from contract changes is the responsibility of the Contractor.
1.12 ADJUSTMENT OF CONTRACT COMPLETION

A. The contract completion time will be adjusted only for causes specified in this contract. Request for an extension of the contract completion date by the Contractor shall be supported with a justification, CPM data and supporting evidence as the COTR may deem necessary for determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract. Submission of proof based on revised activity/event logic, durations (in work days) and costs is obligatory to any approvals. The schedule must clearly display that the Contractor has used, in full, all the float time available for the work involved in this request. The Contracting Officer's determination as to the total number of days of contract extension will be based upon the current computer produced calendar dated schedule for the time period in question and all other relevant information.

B. Actual delays in activities/events which, according to the computer produced calendar dated schedule, do not affect the extended and predicted contract completion dates shown by the critical path in the network, will not be the basis for a change to the contract completion date. The Contracting Officer will within a reasonable time after receipt of such justification and supporting evidence, review the facts and advise the Contractor in writing of the Contracting Officer's decision.

C. The Contractor shall submit each request for a change in the contract completion date to the Contracting Officer in accordance with the provisions specified under FAR 52.243 – 4 (Changes) and VAAR 852.236 – 88 (Changes – Supplemental). The Contractor shall include, as a part of each change order proposal, a sketch showing all CPM logic revisions, duration (in work days) changes, and cost changes, for work in question and its relationship to other activities on the approved network diagram.

D. All delays due to non-work activities/events such as RFI's, WEATHER, STRIKES, and similar non-work activities/events shall be analyzed on a month by month basis.

PART 2 - PRODUCTS (NOT USED)
PART 3 - EXECUTION (NOT USED)

- - - END - - -
PART 1 - GENERAL

1. GENERAL:

A. Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in GENERAL CONDITIONS.

B. For the purposes of this contract, samples (including laboratory samples to be tested), test reports, certificates, and manufacturers' literature and data shall also be subject to the previously referenced requirements. The following text refers to all items collectively as SUBMITTALS.

C. Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been approved, no change in brand or make will be permitted unless:
   1. Satisfactory written evidence is presented to, and approved by Contracting Officer, that manufacturer cannot make scheduled delivery of approved item or;
   2. Item delivered has been rejected and substitution of a suitable item is an urgent necessity or;
   3. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Government.

D. Forward submittals in sufficient time to permit proper consideration and approval action by Government. Time submission to assure adequate lead time for procurement of contract required items. Delays attributable to untimely and rejected submittals (including any laboratory samples to be tested) will not serve as a basis for extending contract time for completion.

E. Submittals will be reviewed for compliance with contract requirements by Architect-Engineer, and action thereon will be taken by Resident Engineer on behalf of the Contracting Officer.

F. Upon receipt of submittals, Architect-Engineer will assign a file number thereto. Contractor, in any subsequent correspondence, shall refer to this file and identification number to expedite replies relative to previously approved or disapproved submittals.

G. The Government reserves the right to require additional submittals, whether or not particularly mentioned in this contract. If additional submittals beyond those required by the contract are furnished pursuant to request therefor by Contracting Officer, adjustment in contract price and time will be made in accordance with Articles titled CHANGES (FAR 52.243-4) and CHANGES SUPPLEMENT (VAAR 852.236-88) of the GENERAL CONDITIONS.

H. Schedules called for in specifications and shown on shop drawings shall be submitted for use and information of Department of Veterans Affairs and Architect-Engineer. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The Contracting Officer and Architect-Engineer assumes no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.

I. Submittals must be submitted by Contractor only and shipped prepaid. Contracting Officer assumes no responsibility for checking quantities or exact numbers included in such submittals.
   1. Submit other samples in single units unless otherwise specified. Submit shop drawings, schedules, manufacturers' literature and data, and certificates in quadruplicate, except where a greater number is specified.
   2. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor. Letter shall be sent via first class mail or FAX and shall contain the list of items, name of Medical Center, name of Contractor, contract number, applicable specification paragraph numbers, applicable drawing numbers (and other information required for exact identification of location for each item), manufacturer and brand, ASTM or Federal Specification Number (if any) and such additional information as may be
required by specifications for particular item being furnished. In addition, catalogs shall be marked to indicate specific items submitted for approval.

a. A copy of letter must be enclosed with items, and any items received without identification letter will be considered "unclaimed goods" and held for a limited time only.

b. Each sample, certificate, manufacturers' literature and data shall be labeled to indicate the name and location of the, name of Contractor, manufacturer, brand, contract number and ASTM or Federal Specification Number as applicable and location(s) on project.

c. Required certificates shall be signed by an authorized representative of manufacturer or supplier of material, and by Contractor.

J. In addition to complying with the applicable requirements specified in preceding Article 1.9, samples which are required to have Laboratory Tests (those preceded by symbol "LT" under the separate sections of the specification shall be tested, at the expense of Contractor, in a commercial laboratory approved by Contracting Officer.

1. Laboratory shall furnish Contracting Officer with a certificate stating that it is fully equipped and qualified to perform intended work, is fully acquainted with specification requirements and intended use of materials and is an independent establishment in no way connected with organization of Contractor or with manufacturer or supplier of materials to be tested.

2. Certificates shall also set forth a list of comparable projects upon which laboratory has performed similar functions during past five years.

3. Samples and laboratory tests shall be sent directly to approved commercial testing laboratory.

4. Contractor shall send a copy of transmittal letter to both COTR and to Architect-Engineer simultaneously with submission of material to a commercial testing laboratory.

5. Contractor shall forward a copy of transmittal letter to COTR simultaneously with submission to a commercial testing laboratory.

6. Laboratory test reports shall be sent directly to COTR for appropriate action.

7. Laboratory reports shall list contract specification test requirements and a comparative list of the laboratory test results. When tests show that the material meets specification requirements, the laboratory shall so certify on test report.

8. Laboratory test reports shall also include a recommendation for approval or disapproval of tested item.

K. If submittal samples have been disapproved, resubmit new samples as soon as possible after notification of disapproval. Such new samples shall be marked "Resubmitted Sample" in addition to containing other previously specified information required on label and in transmittal letter.

L. Approved samples will be kept on file by the COTR at the site until completion of contract, at which time such samples will be delivered to Contractor as Contractor's property. Where noted in technical sections of specifications, approved samples in good condition may be used in their proper locations in contract work. At completion of contract, samples that are not approved will be returned to Contractor only upon request and at Contractor's expense. Such request should be made prior to completion of the contract. Disapproved samples that are not requested for return by Contractor will be discarded after completion of contract.

M. Submittal drawings (shop, or setting drawings) and schedules, required for work of various trades, shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by Contractor certifying to such check.

1. For each drawing required, submit one legible photographic paper or vellum reproducible.

2. Reproducible shall be full size.

3. Each drawing shall have marked thereon, proper descriptive title, including Medical Center location, project number, manufacturer's number, reference to contract drawing number, detail Section Number, and Specification Section Number.
4. A space 120 mm by 125 mm (4-3/4 by 5 inches) shall be reserved on each drawing to accommodate approval or disapproval stamp.

5. Submit drawings, ROLLED WITHIN A MAILING TUBE, fully protected for shipment.

6. One reproducible print of approved or disapproved shop drawings will be forwarded to Contractor.

7. When work is directly related and involves more than one trade, shop drawings shall be submitted to Architect-Engineer under one cover.

N. Samples (except laboratory samples), shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to

   _Enginuity – Belay / POWER_

   ____________________________
   (Architect-Engineer)
   __731 Commerce Street, Suite 2

   ____________________________
   (A/E P.O. Address)
   __Tacoma, WA 98402

   ____________________________
   (City, State and Zip Code)

O. At the time of transmittal to the Architect-Engineer, the Contractor shall also send a copy of the complete submittal directly to the Resident Engineer.

P. Samples (except laboratory samples) for approval shall be sent to Architect-Engineer, in care of Resident Engineer, VA Medical Center,

   ____________________________
   (P.O. Address)
   __Roseburg, OR 97471

   ____________________________
   (City, State and Zip Code)

SECTION 2 - PRODUCT DATA (NOT USED)
SECTION 3 - EXECUTION (NOT USED)

- - - END - - -
### SAFETY REQUIREMENTS

#### TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 APPLICABLE PUBLICATIONS</td>
<td>3</td>
</tr>
<tr>
<td>1.2 DEFINITIONS</td>
<td>5</td>
</tr>
<tr>
<td>1.3 REGULATORY REQUIREMENTS</td>
<td>6</td>
</tr>
<tr>
<td>1.4 ACCIDENT PREVENTION PLAN (APP)</td>
<td>6</td>
</tr>
<tr>
<td>1.5 ACTIVITY HAZARD ANALYSES (AHAS)</td>
<td>12</td>
</tr>
<tr>
<td>1.6 PRECONSTRUCTION CONFERENCE</td>
<td>13</td>
</tr>
<tr>
<td>1.7 SITE SAFETY AND HEALTH OFFICER’ (SSHOS) AND “COMPETENT PERSON” (CP)</td>
<td>14</td>
</tr>
<tr>
<td>1.8 TRAINING</td>
<td>15</td>
</tr>
<tr>
<td>1.9 INSPECTIONS</td>
<td>16</td>
</tr>
<tr>
<td>1.10 ACCIDENTS, OSHA 300 LOGS, AND MAN-HOURS</td>
<td>17</td>
</tr>
<tr>
<td>1.11 PERSONAL PROTECTIVE EQUIPMENT (PPE)</td>
<td>18</td>
</tr>
<tr>
<td>1.12 INFECTION CONTROL</td>
<td>19</td>
</tr>
<tr>
<td>1.13 TUBERCULOSIS SCREENING</td>
<td>28</td>
</tr>
<tr>
<td>1.14 FIRE SAFETY</td>
<td>29</td>
</tr>
<tr>
<td>1.15 ELECTRICAL</td>
<td>30</td>
</tr>
<tr>
<td>1.16 FALL PROTECTION</td>
<td>34</td>
</tr>
<tr>
<td>1.17 SCAFFOLDS AND OTHER WORK PLATFORMS</td>
<td>35</td>
</tr>
<tr>
<td>1.18 EXCAVATION AND TRENCHES</td>
<td>36</td>
</tr>
<tr>
<td>1.19 NOT USED</td>
<td>37</td>
</tr>
<tr>
<td>1.20 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)</td>
<td>37</td>
</tr>
<tr>
<td>1.21 CONFINED SPACE ENTRY</td>
<td>37</td>
</tr>
<tr>
<td>1.22 WELDING AND CUTTING</td>
<td>37</td>
</tr>
<tr>
<td>1.23 LADDERS</td>
<td>38</td>
</tr>
<tr>
<td>1.24 FLOOR &amp; WALL OPENINGS</td>
<td>38</td>
</tr>
</tbody>
</table>

- - - END - - -
PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS:

A. Latest publications listed below form part of this Article to extent referenced. Publications are referenced in text by basic designations only.

B. American Society of Safety Engineers (ASSE):
   1. A10.1-2011 Pre-Project & Pre-Task Safety and Health Planning
   2. A10.34-2012 Protection of the Public on or Adjacent to Construction Sites
   3. A10.38-2013 Basic Elements of an Employer’s Program to Provide a Safe and Healthful Work Environment American National Standard Construction and Demolition Operations

C. American Society for Testing and Materials (ASTM):
   1. E84-2013 Surface Burning Characteristics of Building Materials

D. The Facilities Guidelines Institute (FGI):

E. National Fire Protection Association (NFPA):
   1. 10-2013 Standard for Portable Fire Extinguishers
   2. 30-2012 Flammable and Combustible Liquids Code
   3. 51B-2014 Standard for Fire Prevention During Welding, Cutting and Other Hot Work
   4. 70-2014 National Electrical Code
   5. 70B-2013 Recommended Practice for Electrical Equipment Maintenance
   6. 70E-2012 Standard for Electrical Safety in the Workplace
   7. 99-2012 Health Care Facilities Code
   8. 241-2013 Standard for Safeguarding Construction, Alteration, and Demolition Operations

F. The Joint Commission (TJC)
   1. TJC Manual Comprehensive Accreditation and Certification Manual

G. U.S. Nuclear Regulatory Commission
   1. 10 CFR 20 Standards for Protection Against Radiation

H. U.S. Occupational Safety and Health Administration (OSHA):
   1. 29 CFR 1904 Reporting and Recording Injuries & Illnesses
   2. 29 CFR 1910 Safety and Health Regulations for General Industry
   3. 29 CFR 1926 Safety and Health Regulations for Construction Industry
   4. CPL 2-0.124 Multi-Employer Citation Policy

I. VHA Directive 2005-007

1.2 DEFINITIONS:

A. OSHA “Competent Person” (CP). One who is capable of identifying existing and predictable hazards in the surroundings and working conditions which are unsanitary, hazardous or dangerous to employees, and who has the authorization to take prompt corrective measures to eliminate them (see 29 CFR 1926.32(f)).

B. “Qualified Person” means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training and experience, has successfully demonstrated his ability to solve or resolve problems relating to the subject matter, the work, or the project.

C. High Visibility Accident. Any mishap which may generate publicity or high visibility.

D. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.

E. Recordable Injuries or Illnesses. Any work-related injury or illness that results in:
   1. Death, regardless of the time between the injury and death, or the length of the illness;
2. Days away from work (any time lost after day of injury/illness onset);
3. Restricted work;
4. Transfer to another job;
5. Medical treatment beyond first aid;
6. Loss of consciousness; or
7. A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.

1.3 REGULATORY REQUIREMENTS:
A. In addition to the detailed requirements included in the provisions of this contract, comply with 29 CFR 1926, comply with 29 CFR 1910 as incorporated by reference within 29 CFR 1926, comply with ASSE A10.34, and all applicable federal, state, and local laws, ordinances, criteria, rules and regulations. Submit matters of interpretation of standards for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern except with specific approval and acceptance by the COTR.

1.4 ACCIDENT PREVENTION PLAN (APP):
A. The APP (aka Construction Safety & Health Plan) shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and ensure it is site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all worksite safety and health of each subcontractor(s). Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out.
B. The APP shall be prepared as follows:
1. Written in English by a qualified person who is employed by the Prime Contractor articulating the specific work and hazards pertaining to the contract (model language can be found in ASSE A10.33). Specifically articulating the safety requirements found within these VA contract safety specifications.
2. Address both the Prime Contractors and the subcontractors work operations.
3. State measures to be taken to control hazards associated with materials, services, or equipment provided by suppliers.
4. Address all the elements/sub-elements and in order as follows:
   a. SIGNATURE SHEET. Title, signature, and phone number of the following:
      1) Plan preparer (Qualified Person such as corporate safety staff person or contracted Certified Safety Professional with construction safety experience);
      2) Plan approver (company/corporate officers authorized to obligate the company);
      3) Plan concurrence (e.g., Chief of Operations, Corporate Chief of Safety, Corporate Industrial Hygienist, project manager or superintendent, project safety professional). Provide concurrence of other applicable corporate and project personnel (Contractor).
   b. BACKGROUND INFORMATION. List the following:
      1) Contractor;
      2) Contract number;
      3) Project name;
      4) Brief project description, description of work to be performed, and location; phases of work anticipated (these will require an AHA).
   c. STATEMENT OF SAFETY AND HEALTH POLICY.
      1) Provide a copy of current corporate/company Safety and Health Policy Statement, detailing commitment to providing a safe and healthful workplace for all employees. The Contractor's written safety program goals, objectives, and accident experience goals for this contract should be provided.
d. RESPONSIBILITIES AND LINES OF AUTHORITIES. Provide the following:

1) A statement of the employer’s ultimate responsibility for the implementation of his SOH program;
2) Identification and accountability of personnel responsible for safety at both corporate and project level. Contracts specifically requiring safety or industrial hygiene personnel shall include a copy of their resumes.
3) The names of Competent and/or Qualified Person(s) and proof of competency/qualification to meet specific OSHA Competent/Qualified Person(s) requirements must be attached;
4) Requirements that no work shall be performed unless a designated competent person is present on the job site;
5) Requirements for pre-task Activity Hazard Analysis (AHAs);
6) Lines of authority;
7) Policies and procedures regarding noncompliance with safety requirements (to include disciplinary actions for violation of safety requirements) should be identified;

e. SUBCONTRACTORS AND SUPPLIERS. If applicable, provide procedures for coordinating SOH activities with other employers on the job site:

1) Identification of subcontractors and suppliers (if known);
2) Safety responsibilities of subcontractors and suppliers.

f. TRAINING.

1) Site-specific SOH orientation training at the time of initial hire or assignment to the project for every employee before working on the project site is required.
2) Mandatory training and certifications that are applicable to this project (e.g., explosive actuated tools, crane operator, rigger, crane signal person, fall protection, electrical lockout/NFPA 70E, machine/equipment lockout, confined space, etc…) and any requirements for periodic retraining/recertification are required.
3) Procedures for ongoing safety and health training for supervisors and employees shall be established to address changes in site hazards/conditions.
4) OSHA 10-hour training is required for all workers on site and the OSHA 30-hour training is required for Trade Competent Persons (CPs)

g. SAFETY AND HEALTH INSPECTIONS.

1) Specific assignment of responsibilities for a minimum daily job site safety and health inspection during periods of work activity: Who will conduct (e.g., “Site Safety and Health CP”), proof of inspector’s training/qualifications, when inspections will be conducted, procedures for documentation, deficiency tracking system, and follow-up procedures.
2) Any external inspections/certifications that may be required (e.g., contracted CSP or CSHT)

h. ACCIDENT INVESTIGATION & REPORTING. The Contractor shall conduct mishap investigations of all OSHA Recordable Incidents. The APP shall include accident/incident investigation procedure & identify person(s) responsible to provide the following to the Government Designated Authority:

1) Exposure data (man-hours worked);
2) Accident investigations, reports, and logs.

i. PLANS (PROGRAMS, PROCEDURES) REQUIRED. Based on a risk assessment of contracted activities and on mandatory OSHA compliance programs, the Contractor shall address all applicable occupational risks in site-specific compliance and accident prevention plans. These Plans shall include but are not be limited to procedures for addressing the risks associates with the following:

1) Emergency response ;
2) Contingency for severe weather;
3) Fire Prevention ;
4) Medical Support;
5) Posting of emergency telephone numbers;
6) Prevention of alcohol and drug abuse;
7) Site sanitation (housekeeping, drinking water, toilets);
8) Night operations and lighting;
9) Hazard communication program;
10) Welding/Cutting "Hot" work;
11) Electrical Safe Work Practices (Electrical LOTO/NFPA 70E);
12) General Electrical Safety
13) Hazardous energy control (Machine LOTO);
14) Site-Specific Fall Protection & Prevention;
15) Asbestos abatement;
16) Lead abatement;
17) Respiratory protection;
18) Health hazard control program;
19) Demolition plan (to include engineering survey);

C. Submit the APP to the COTR for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP.

D. Once accepted by the COTR the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.

E. Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the COTR. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34) and the environment.

1.5 ACTIVITY HAZARD ANALYSES (AHAS):

A. 1. AHAs are also known as Job Hazard Analyses, Job Safety Analyses, and Activity Safety Analyses. Before beginning each work activity involving a type of work presenting hazards not experienced in previous project operations or where a new work crew or sub-contractor is to perform the work, the Contractor(s) performing that work activity shall prepare an AHA (Example electronic AHA forms can be found on the US Army Corps of Engineers web site)

B. 2. AHAs shall define the activities being performed and identify the work sequences, the specific anticipated hazards, site conditions, equipment, materials, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level of risk.

C. 3. Work shall not begin until the AHA for the work activity has been accepted by the COTR and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.
   1. The names of the Competent/Qualified Person(s) required for a particular activity (for example, excavations, scaffolding, fall protection, other activities as specified by OSHA and/or other State and Local agencies) shall be identified and included in the AHA. Certification of their competency/qualification shall be submitted to the Government Designated Authority (GDA) for acceptance prior to the start of that work activity.
   2. The AHA shall be reviewed and modified as necessary to address changing site conditions, operations, or change of competent/qualified person(s).
      a. If more than one Competent/Qualified Person is used on the AHA activity, a list of names shall be submitted as an attachment to the AHA. Those listed must be Competent/Qualified for the type of work involved in the AHA and familiar with current site safety issues.
b. If a new Competent/Qualified Person (not on the original list) is added, the list shall be updated (an administrative action not requiring an updated AHA). The new person shall acknowledge in writing that he or she has reviewed the AHA and is familiar with current site safety issues.

3. Submit AHAs to the COTR for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES for review at least 15 calendar days prior to the start of each phase. Subsequent AHAs as shall be formatted as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

4. The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.

5. Develop the activity hazard analyses using the project schedule as the basis for the activities performed. All activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier, or subcontractor and provided to the prime contractor for review and approval and then submitted to COTR.

1.6 PRECONSTRUCTION CONFERENCE:

A. Contractor representatives who have a responsibility or significant role in implementation of the accident prevention program, as required by 29 CFR 1926.20(b)(1), on the project shall attend the preconstruction conference to gain a mutual understanding of its implementation. This includes the project superintendent, subcontractor superintendents, and any other assigned safety and health professionals.

B. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.

C. Deficiencies in the submitted APP will be brought to the attention of the Contractor within 20 days of submittal, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.

1.7 SITE SAFETY AND HEALTH OFFICER” (SSHO) AND “COMPETENT PERSON” (CP):

A. The Prime Contractor shall designate a minimum of one SSHO at each project site that will be identified as the SSHO to administer the Contractor's safety program and government-accepted Accident Prevention Plan. Each subcontractor shall designate a minimum of one CP in compliance with 29 CFR 1926 (b)(2) that will be identified as a CP to administer their individual safety programs.

B. Further, all specialized Competent Persons for the work crews will be supplied by the respective contractor as required by 29 CFR 1926 (i.e. Asbestos, Electrical, Cranes, & Derricks, Demolition, Fall Protection, Fire Safety/Life Safety, Ladder, Rigging, Scaffolds, and Trenches/Excavations).

C. These Competent Persons can have collateral duties as the subcontractor's superintendent and/or work crew lead persons as well as fill more than one specialized CP role (i.e. Asbestos, Electrical, Cranes, & Derricks, Demolition, Fall Protection, Fire Safety/Life Safety, Ladder, Rigging, Scaffolds, and Trenches/Excavations).

D. The SSHO or an equally-qualified Designated Representative/alternate will maintain a presence on the site during construction operations in accordance with FAR Clause 52.236-6: Superintendence by the Contractor. CPs will maintain presence during their construction activities in accordance with above mentioned clause. A listing of the designated SSHO and all known CPs shall be submitted prior to the start of work as part of the APP with the training documentation and/or AHA as listed in Section 1.8 below.
SECTION 01 3526 - SAFETY REQUIREMENTS

E. 5. The repeated presence of uncontrolled hazards during a contractor’s work operations will result in the designated CP as being deemed incompetent and result in the required removal of the employee in accordance with FAR Clause 52.236-5: Material and Workmanship, Paragraph (c).

1.8 TRAINING:

A. The designated Prime Contractor SSHO must meet the requirements of all applicable OSHA standards and be capable (through training, experience, and qualifications) of ensuring that the requirements of 29 CFR 1926.16 and other appropriate Federal, State and local requirements are met for the project. As a minimum the SSHO must have completed the OSHA 30-hour Construction Safety class and have five (5) years of construction industry safety experience or three (3) years if he/she possesses a Certified Safety Professional (CSP) or certified Construction Safety and Health Technician (CSHT) certification or have a safety and health degree from an accredited university or college.

B. All designated CPs shall have completed the OSHA 30-hour Construction Safety course within the past 5 years.

C. In addition to the OSHA 30 Hour Construction Safety Course, all CPs with high hazard work operations such as operations involving asbestos, electrical, cranes, demolition, work at heights/fall protection, fire safety/life safety, ladder, rigging, scaffolds, and trenches/excavations shall have a specialized formal course in the hazard recognition & control associated with those high hazard work operations. Documented “repeat” deficiencies in the execution of safety requirements will require retaking the requisite formal course.

D. All other construction workers shall have the OSHA 10-hour Construction Safety Outreach course and any necessary safety training to be able to identify hazards within their work environment.

E. Submit training records associated with the above training requirements to the COTR for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 __20__ calendar days prior to the date of the preconstruction conference for acceptance.

F. Prior to any worker for the contractor or subcontractors beginning work, they shall undergo a safety briefing provided by the SSHO or his/her designated representative. As a minimum, this briefing shall include information on the site-specific hazards, construction limits, VAMC safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of VAMC equipment, emergency procedures, accident reporting etc... Documentation shall be provided to the COTR that individuals have undergone contractor’s safety briefing.

G. Ongoing safety training will be accomplished in the form of weekly documented safety meeting.

1.9 INSPECTIONS:

A. The SSHO shall conduct frequent and regular safety inspections (daily) of the site and each of the subcontractors CPs shall conduct frequent and regular safety inspections (daily) of the their work operations as required by 29 CFR 1926.20(b)(2). Each week, the SSHO shall conduct a formal documented inspection of the entire construction areas with the subcontractors’ “Trade Safety and Health CPs” present in their work areas. Coordinate with, and report findings and corrective actions weekly to the Government Designated Authority.

B. A Certified Safety Professional (CSP) with specialized knowledge in construction safety or a certified Construction Safety and Health Technician (CSHT) shall randomly conduct a monthly site safety inspection. The CSP or CSHT can be a corporate safety professional or independently contracted. The CSP or CSHT will provide their certificate number on the required report for verification as necessary.

C. Results of the inspection will be documented with tracking of the identified hazards to abatement.

D. The Government Designated Authority will be notified immediately prior to start of the inspection and invited to accompany the inspection.
E. Identified hazard and controls will be discussed to come to a mutual understanding to ensure abatement and prevent future reoccurrence.

F. A report of the inspection findings with status of abatement will be provided to the COTR within one week of the onsite inspection.

1.10 ACCIDENTS, OSHA 300 LOGS, AND MAN-HOURS:

A. Notify the COTR as soon as practical, but no more than four hours after any accident meeting the definition of OSHA Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than $5,000, or any weight handling equipment accident. Within notification include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Government Designated Authority determine whether a government investigation will be conducted.

B. Conduct an accident investigation for recordable injuries and illnesses, for Medical Treatment defined in paragraph DEFINITIONS, and property damage accidents resulting in at least $20,000 in damages, to establish the root cause(s) of the accident. Complete the VA Form 2162, and provide the report to the COTR within 5 calendar days of the accident. The Government Designated Authority will provide copies of any required or special forms.

C. A summation of all man-hours worked by the contractor and associated sub-contractors for each month will be reported to the COTR monthly.

D. A summation of all OSHA recordable accidents experienced on site by the contractor and associated sub-contractors for each month will be provided to the COTR monthly. The contractor and associated sub-contractors' OSHA 300 logs will be made available to the COTR as requested.

1.11 PERSONAL PROTECTIVE EQUIPMENT (PPE):

A. PPE is governed in all areas by the nature of the work the employee is performing. For example, specific PPE required for performing work on electrical equipment is identified in NFPA 70E, Standard for Electrical Safety in the Workplace.

B. Mandatory PPE includes:
   1. Hard Hats – unless written authorization is given by the COTR in circumstances of work operations that have limited potential for falling object hazards such as during finishing work or minor remodeling. With authorization to relax the requirement of hard hats, if a worker becomes exposed to an overhead falling object hazard, then hard hats would be required in accordance with the OSHA regulations.
   2. Safety glasses - unless written authorization is given by the COTR appropriate safety glasses meeting the ANSI Z.87.1 standard must be worn by each person on site.
   3. Appropriate Safety Shoes – based on the hazards present, safety shoes meeting the requirements of ASTM F2413-11 shall be worn by each person on site unless written authorization is given by the COTR.
   4. Hearing protection - Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks.

1.12 INFECTION CONTROL

A. Infection Control is critical in all medical center facilities. Interior construction activities causing disturbance of existing dust, or creating new dust, must be conducted within ventilation-controlled areas that minimize the flow of airborne particles into patient areas. Exterior construction activities causing disturbance of soil or creates dust in some other manner must be controlled.

B. An AHA associated with infection control will be performed by VA personnel in accordance with FGI Guidelines (i.e. Infection Control Risk Assessment (ICRA)). The ICRA procedure found on the American Society for Healthcare Engineering (ASHE) website will be utilized. Risk classifications of Class II or lower will require approval by the COTR, Project Manager, Facility
Safety Manager, Facility Safety Officer, Contracting Officer Representative, and Government Designated Authority before beginning any construction work. Risk classifications of Class III or higher will require a permit before beginning any construction work. Infection Control permits will be issued by the COTR and Project Engineer, however, work outside the primary project scope area may vary. The required infection control precautions with each class are as follows:

1. **Class I requirements:**
   a. **During Construction Work:**
      1) Notify the COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, Contracting Officer Representative, and Government Designated Authority.
      2) Execute work by methods to minimize raising dust from construction operations.
      3) Ceiling tiles: Immediately replace a ceiling tiles displaced for visual inspection.
   b. **Upon Completion:**
      1) Clean work area upon completion of task
      2) Notify the COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, Contracting Officer Representative, and Government Designated Authority.

2. **Class II requirements:**
   a. **During Construction Work:**
      1) Notify the COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, Contracting Officer Representative, and Government Designated Authority.
      2) Provide active means to prevent airborne dust from dispersing into atmosphere such as wet methods or tool mounted dust collectors where possible.
      3) Water mist work surfaces to control dust while cutting.
      4) Seal unused doors with duct tape.
      5) Block off and seal air vents.
      6) Remove or isolate HVAC system in areas where work is being performed.
   b. **Upon Completion:**
      1) Wipe work surfaces with cleaner/disinfectant.
      2) Contain construction waste before transport in tightly covered containers.
      3) Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area.
      4) Upon completion, restore HVAC system where work was performed
      5) Notify the COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, Contracting Officer Representative, and Government Designated Authority.

3. **Class III requirements:**
   a. **During Construction Work:**
      1) Obtain permit from the COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, Contracting Officer Representative, and Government Designated Authority.
      2) Remove or Isolate HVAC system in area where work is being done to prevent contamination of duct system.
      3) Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. Install construction barriers and ceiling protection carefully, outside of normal work hours.
      4) Maintain negative air pressure, 0.01 inches of water gauge, within work site utilizing HEPA equipped air filtration units and continuously monitored with a digital display, recording and alarm instrument, which must be calibrated on installation, maintained with periodic calibration and monitored by the contractor.
      5) Contain construction waste before transport in tightly covered containers.
      6) Cover transport receptacles or carts. Tape covering unless solid lid.
   b. **Upon Completion:**
1) Do not remove barriers from work area until completed project is inspected by the COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, Contracting Officer Representative, and Government Designated Authority and thoroughly cleaned by the VA Environmental Services Department.

2) Remove construction barriers and ceiling protection carefully to minimize spreading of dirt and debris associated with construction, outside of normal work hours.

3) Vacuum work area with HEPA filtered vacuums.

4) Wet mop area with cleaner/disinfectant.

5) Upon completion, restore HVAC system where work was performed.

6) Return permit to the COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, Contracting Officer Representative, or Government Designated Authority.

4. Class IV requirements:
   a. During Construction Work:
      1) Obtain permit from the COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, Contracting Officer Representative, and Government Designated Authority.
      2) Isolate HVAC system in area where work is being done to prevent contamination of duct system.
      3) Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. Install construction barriers and ceiling protection carefully, outside of normal work hours.
      4) Maintain negative air pressure within work site utilizing HEPA equipped air filtration units.
      5) Seal holes, pipes, conduits, and punctures.
      6) Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave work site.
      7) All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area.
   b. Upon Completion:
      1) Do not remove barriers from work area until completed project is inspected by the COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, Contracting Officer Representative, and Government Designated Authority with thorough cleaning by the VA Environmental Services Dept.
      2) Remove construction barriers and ceiling protection carefully to minimize spreading of dirt and debris associated with construction, outside of normal work hours.
      3) Contain construction waste before transport in tightly covered containers.
      4) Cover transport receptacles or carts. Tape covering unless solid lid.
      5) Vacuum work area with HEPA filtered vacuums.
      6) Wet mop area with cleaner/disinfectant.
      7) Upon completion, restore HVAC system where work was performed.
      8) Return permit to the COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, Contracting Officer Representative, or Government Designated Authority.

C. Barriers shall be erected as required based upon classification (Class III & IV requires barriers) and shall be constructed as follows:
   1. Class III and IV - closed door with masking tape applied over the frame and door is acceptable for projects that can be contained in a single room.
2. Construction, demolition or reconstruction not capable of containment within a single room must have the following barriers erected and made presentable on hospital occupied side:
   a. Class III & IV (where dust control is the only hazard, and an agreement is reached with the COTR and Medical Center) - Airtight plastic barrier that extends from the floor to ceiling. Seams must be sealed with duct tape to prevent dust and debris from escaping.
   b. Class III & IV - Drywall barrier erected with joints covered or sealed to prevent dust and debris from escaping.
   c. Class III & IV - Seal all penetrations in existing barrier airtight.
   d. Class III & IV - Barriers at penetration of ceiling envelopes, chases and ceiling spaces to stop movement air and debris.
   e. Class IV only - Anteroom or double entrance openings that allow workers to remove protective clothing or vacuum off existing clothing.
   f. Class III & IV - At elevators shafts or stairways within the field of construction, overlapping flap minimum of two feet wide of polyethylene enclosures for personnel access.

D. Products and Materials:
1. Sheet Plastic: Fire retardant polystyrene, 6-mil thickness meeting local fire codes.
2. Barrier Doors: self-closing, one-hour, two-hour, and fire-rated solid core wood in steel frame, painted.
3. Drywall: dustproof, one-hour, two-hour, and fire-rated.
4. High Efficiency Particulate Air-Equipped filtration machine rated at 95% capture of 0.3 microns including pollen, mold spores and dust particles. HEPA filters should have ASHRAE 85 or other prefilter to extend the useful life of the HEPA. Provide both primary and secondary filtrations units. Maintenance of equipment and replacement of the HEPA filters and other filters will be in accordance with manufacturer’s instructions.
5. Exhaust Hoses: Heavy duty, flexible steel reinforced; Ventilation Blower Hose.
6. Adhesive Walk-off Mats: Provide minimum size mats of 24 inches x 36 inches.
7. Disinfectant: Hospital-approved disinfectant or equivalent product.

E. Before any construction on site begins, all contractor personnel involved in the construction or renovation activity shall be educated and trained in infection prevention measures established by the medical center.

F. A dust control program will be establish and maintained as part of the contractor’s infection preventive measures in accordance with the FGI Guidelines for Design and Construction of Healthcare Facilities. Prior to start of work, prepare a plan detailing project-specific dust protection measures with associated product data, including periodic status reports, and submit to COTR, Project Engineer, and Facility CSC for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

G. Medical center Infection Control personnel will monitor for airborne disease (e.g. aspergillosis) during construction. A baseline of conditions will be established by the medical center prior to the start of work and periodically during the construction stage to determine impact of construction activities on indoor air quality with safe thresholds established.

H. In general, the following preventive measures shall be adopted during construction to keep down dust and prevent mold.
1. Contractor shall verify that construction exhaust to exterior is not reintroduced to the medical center through intake vents, or building openings. HEPA filtration is required where the exhaust dust may reenter the medical center.
2. Exhaust hoses shall be exhausted so that dust is not reintroduced to the medical center.
3. Adhesive Walk-off/Carpet Walk-off Mats shall be used at all interior transitions from the construction area to occupied medical center area. These mats shall be changed as often as required to maintain clean work areas directly outside construction area at all times.
4. Vacuum and wet mop all transition areas from construction to the occupied medical center at the end of each workday. Vacuum shall utilize HEPA filtration. Maintain surrounding area frequently. Remove debris as it is created. Transport these outside the construction area in containers with tightly fitting lids.

5. The contractor shall not haul debris through patient-care areas without prior approval of the COTR and the Medical Center. When, approved, debris shall be hauled in enclosed dust proof containers or wrapped in plastic and sealed with duct tape. No sharp objects should be allowed to cut through the plastic. Wipe down the exterior of the containers with a damp rag to remove dust. All equipment, tools, material, etc. transported through occupied areas shall be made free from dust and moisture by vacuuming and wipe down.

6. There shall be no standing water during construction. This includes water in equipment drip pans and open containers within the construction areas. All accidental spills must be cleaned up and dried within 12 hours. Remove and dispose of porous materials that remain damp for more than 72 hours.

7. At completion, remove construction barriers and ceiling protection carefully, outside of normal work hours. Vacuum and clean all surfaces free of dust after the removal.

I. Final Cleanup:
1. Upon completion of project, or as work progresses, remove all construction debris from above ceiling, vertical shafts and utility chases that have been part of the construction.
2. Perform HEPA vacuum cleaning of all surfaces in the construction area. This includes walls, ceilings, cabinets, furniture (built-in or free standing), partitions, flooring, etc.
3. All new air ducts shall be cleaned prior to final inspection.

J. Exterior Construction
1. Contractor shall verify that dust will not be introduced into the medical center through intake vents, or building openings. HEPA filtration on intake vents is required where dust may be introduced.
2. Dust created from disturbance of soil such as from vehicle movement will be wetted with use of a water truck as necessary.
3. All cutting, drilling, grinding, sanding, or disturbance of materials shall be accomplished with tools equipped with either local exhaust ventilation (i.e. vacuum systems) or wet suppression controls.

1.13 TUBERCULOSIS SCREENING
A. Contractor shall provide written certification that all contract employees assigned to the work site have had a pre-placement tuberculin screening within 90 days prior to assignment to the worksite and been found have negative TB screening reactions. Contractors shall be required to show documentation of negative TB screening reactions for any additional workers who are added after the 90-day requirement before they will be allowed to work on the work site.

NOTE: This can be the Center for Disease Control (CDC) and Prevention and two-step skin testing or a Food and Drug Administration (FDA)-approved blood test.
1. Contract employees manifesting positive screening reactions to the tuberculin shall be examined according to current CDC guidelines prior to working on VHA property.
2. Subsequently, if the employee is found without evidence of active (infectious) pulmonary TB, a statement documenting examination by a physician shall be on file with the employer (construction contractor), noting that the employee with a positive tuberculin screening test is without evidence of active (infectious) pulmonary TB.
3. If the employee is found with evidence of active (infectious) pulmonary TB, the employee shall require treatment with a subsequent statement to the fact on file with the employer before being allowed to return to work on VHA property.

1.14 FIRE SAFETY
A. Fire Safety Plan: Establish and maintain a site-specific fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, Contracting Officer Representative, and Government
Designated Authority for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. This plan may be an element of the Accident Prevention Plan.

B. Site and Building Access: Maintain free and unobstructed access to facility emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.

C. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings and new construction by distances in accordance with NFPA 241. For small facilities with less than 6 m (20 feet) exposing overall length, separate by 3m (10 feet).

D. Temporary Construction Partitions:
   1. Install and maintain temporary construction partitions to provide smoke-tight separations between construction areas, the areas that are described in phasing requirements, and adjoining areas. Construct partitions of gypsum board or treated plywood (flame spread rating of 25 or less in accordance with ASTM E84) on both sides of fire retardant treated wood or metal steel studs. Extend the partitions through suspended ceilings to floor slab deck or roof. Seal joints and penetrations. At door openings, install Class C, ¾ hour fire/smoke rated doors with self-closing devices.
   2. Install two-hour rated temporary construction partitions as shown on drawings to maintain integrity of existing exit stair enclosures, exit passageways, fire-rated enclosures of hazardous areas, horizontal exits, smoke barriers, vertical shafts and openings enclosures.
   3. Close openings in smoke barriers and fire-rated construction to maintain fire ratings. Seal penetrations with listed through-penetration firestop materials in accordance with Section 07 84 00, FIRESTOPPING.

E. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.

F. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, Contracting Officer Representative, and Government Designated Authority.

G. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, Contracting Officer Representative, and Government Designated Authority.

H. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.


J. Standpipes: Install and extend standpipes up with each floor in accordance with 29 CFR 1926 and NFPA 241. Do not charge wet standpipes subject to freezing until weather protected.

K. Sprinklers: Install, test and activate new automatic sprinklers prior to removing existing sprinklers.

L. Existing Fire Protection: Do not impair automatic sprinklers, smoke and heat detection, and fire alarm systems, except for portions immediately under construction, and temporarily for connections. Provide fire watch for impairments more than 4 hours in a 24-hour period. Request interruptions in accordance with Article, OPERATIONS AND STORAGE AREAS, and coordinate with COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, Contracting Officer Representative, and Government Designated Authority. All existing or temporary fire protection systems (fire alarms, sprinklers) located in construction areas shall be tested as coordinated with the medical center. Parameters for the testing and results of any tests performed shall be recorded by the medical center and copies provided to the COTR.
M. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, Contracting Officer Representative, and Government Designated Authority.

N. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with COTR and Facility Safety Office.
1. Obtain permits from COTR, Facility Safety Manager, and Facility Safety Officer at least 72 hours in advance. Hot work permit can be dated for an extended period.
2. Designate contractor's responsible project-site fire prevention program manager to permit hot work.

O. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, Contracting Officer Representative, and Government Designated Authority.

P. Smoking: Smoking is prohibited in and adjacent to construction areas inside existing buildings and additions under construction. In separate and detached buildings under construction, smoking is prohibited except in designated smoking rest areas.

Q. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.

R. If required, submit documentation to the COTR, Facility Safety Office, COR, and Government Designated Authority that personnel have been trained in the fire safety aspects of working in areas with impaired structural or compartmentalization features.

1.15 ELECTRICAL

A. All electrical work shall comply with NFPA 70 (NEC), NFPA 70B, NFPA 70E, 29 CFR Part 1910 Subpart J - General Environmental Controls, 29 CFR Part 1910 Subpart S - Electrical, and 29 CFR 1926 Subpart K in addition to other references required by contract.

B. All qualified persons performing electrical work under this contract shall be licensed journeyman or master electricians. All apprentice electricians performing under this contract shall be deemed unqualified persons unless they are working under the immediate supervision of a licensed electrician or master electrician.

C. All electrical work will be accomplished de-energized and in the Electrically Safe Work Condition (refer to NFPA 70E for Work Involving Electrical Hazards, including Exemptions to Work Permit). Any Contractor, subcontractor or temporary worker who fails to fully comply with this requirement is subject to immediate termination in accordance with FAR clause 52.236-5(c). Only in rare circumstances where achieving an electrically safe work condition prior to beginning work would increase or cause additional hazards, or is infeasible due to equipment design or operational limitations is energized work permitted. The Chief Engineer, Chief of Facilities Management, COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, Contracting Officer Representative, and Government Designated Authority with approval of the Medical Center Director will make the determination if the circumstances would meet the exception outlined above. An AHA specific to energized work activities will be developed, reviewed, and accepted prior to the start of that work.
1. Development of a Hazardous Electrical Energy Control Procedure is required prior to de-energization. A single Simple Lockout/Tagout Procedure for multiple work operations can only be used for work involving qualified person(s) de-energizing one set of conductors or circuit part source. Task specific Complex Lockout/Tagout Procedures are required at all other times.
2. Verification of the absence of voltage after de-energization and lockout/Tagout is considered “energized electrical work” (live work) under NFPA 70E, and shall only be performed by qualified persons wearing appropriate shock protective (voltage rated) gloves and arc rate personal protective clothing and equipment, using Underwriters Laboratories (UL) tested and appropriately rated contact electrical testing instruments or equipment appropriate for the environment in which they will be used.
3. Personal Protective Equipment (PPE) and electrical testing instruments will be readily available for inspection by the Chief Engineer, Chief of Facilities Management, COTR,
D. Before beginning any electrical work, an Activity Hazard Analysis (AHA) will be conducted to include Shock Hazard and Arc Flash Hazard analyses (NFPA Tables can be used only as a last alternative and it is strongly suggested a full Arc Flash Hazard Analyses be conducted). Work shall not begin until the AHA for the work activity has been accepted by the COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, Contracting Officer Representative, and Government Designated Authority and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.

E. Ground-fault circuit interrupters. All 120-volt, single-phase 15- and 20-ampere receptacle outlets on construction sites shall have approved ground-fault circuit interrupters for personnel protection. “Assured Equipment Grounding Conductor Program” only is not allowed.

1.16 FALL PROTECTION
A. The fall protection (FP) threshold height requirement is 6 ft (1.8 m) for ALL WORK, unless specified differently or the OSHA 29 CFR 1926 requirements are more stringent, to include steel erection activities, systems-engineered activities (prefabricated) metal buildings, residential (wood) construction and scaffolding work.
1. The use of a Safety Monitoring System (SMS) as a fall protection method is prohibited.
2. The use of Controlled Access Zone (CAZ) as a fall protection method is prohibited.
3. A Warning Line System (WLS) may ONLY be used on floors or flat or low-sloped roofs (between 0 - 18.4 degrees or 4:12 slope) and shall be erected around all sides of the work area (See 29 CFR 1926.502(f) for construction of WLS requirements). Working within the WLS does not require FP. No worker shall be allowed in the area between the roof or floor edge and the WLS without FP. FP is required when working outside the WLS.
4. Fall protection while using a ladder will be governed by the OSHA requirements.

1.17 SCAFFOLDS AND OTHER WORK PLATFORMS
A. All scaffolds and other work platforms construction activities shall comply with 29 CFR 1926 Subpart L.
B. The fall protection (FP) threshold height requirement is 6 ft (1.8 m) as stated in Section 1.16.
C. The following hierarchy and prohibitions shall be followed in selecting appropriate work platforms.
1. Scaffolds, platforms, or temporary floors shall be provided for all work except that can be performed safely from the ground or similar footing.
2. Ladders less than 20 feet may be used as work platforms only when use of small hand tools or handling of light material is involved.
3. Ladder jacks, lean-to, and prop-scaffolds are prohibited.
4. Emergency descent devices shall not be used as working platforms.
D. Contractors shall use a scaffold tagging system in which all scaffolds are tagged by the Competent Person. Tags shall be color-coded: green indicates the scaffold has been inspected and is safe to use; red indicates the scaffold is unsafe to use. Tags shall be readily visible, made of materials that will withstand the environment in which they are used, be legible and shall include:
1. The Competent Person’s name and signature;
2. Dates of initial and last inspections.
E. Mast Climbing work platforms: When access ladders, including masts designed as ladders, exceed 20 ft (6 m) in height, positive fall protection shall be used.

1.18 EXCAVATION AND TRENCHES
A. All excavation and trenching work shall comply with 29 CFR 1926 Subpart P.
B. All excavations and trenches 5 feet in depth or greater shall require a written trenching and excavation permit. The permit shall be completed and provided to the COTR, Project Manager,
Facility Safety Manager, Facility Safety Officer, and Government Designated Authority prior to commencing work for the day. At the end of the day, the permit shall be closed out and provided to the COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, and Government Designated Authority. The permit shall be maintained onsite and include the following:

1. Determination of soil classification
2. Indication that utilities have been located and identified. If utilities could not be located after all reasonable attempt, then excavating operations will proceed cautiously.
3. Indication of selected excavation protective system.
4. Indication that the spoil pile will be stored at least 2 feet from the edge of the excavation and safe access provided within 25 feet of the workers.
5. Indication of assessment for a potential toxic, explosive, or oxygen deficient atmosphere.

C. If not using an engineered protective system such as a trench box, shielding, shoring, or other Professional Engineer designed system and using a sloping or benching system, soil classification cannot be Solid Rock or Type A. All soil will be classified as Type B or Type C and sloped or benched in accordance with Appendix B of 29 CFR 1926.

1.19 NOT USED

1.20 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

A. All installation, maintenance, and servicing of equipment or machinery shall comply with 29 CFR 1910.147 except for specifically referenced operations in 29 CFR 1926 such as concrete & masonry equipment [1926.702(j)], heavy machinery & equipment [1926.600(a)(3)(i)], and process safety management of highly hazardous chemicals (1926.64). Control of hazardous electrical energy during the installation, maintenance, or servicing of electrical equipment shall comply with Section 1.15 to include NFPA 70E and other VA specific requirements discussed in the section.

1.21 CONFINED SPACE ENTRY

A. All confined space entry shall comply with 29 CFR 1910.146 except for specifically referenced operations in 29 CFR 1926 such as excavations/trenches [1926.651(g)].

B. A site-specific Confined Space Entry Plan (including permitting process) shall be developed and submitted to the COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, Contracting Officer Representative, and Government Designated Authority.

1.22 WELDING AND CUTTING

A. As specified in section 1.14, Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with the COTR, Project Manager, Facility Safety Manager, Facility Safety Officer, and Government Designated Authority.
1. Submit Hot work permits to the COTR, at least 72 hours in advance.
2. Designate contractor’s responsible project-site fire prevention program manager to permit hot work.

1.23 LADDERS

A. All Ladder use shall comply with 29 CFR 1926 Subpart X.
B. All portable ladders shall be of sufficient length and shall be placed so that workers will not stretch or assume a hazardous position.
C. Manufacturer safety labels shall be in place on ladders
D. Step Ladders shall not be used in the closed position
E. Top steps or cap of step ladders shall not be used as a step
F. Portable ladders, used as temporary access, shall extend at least 3 ft (0.9 m) above the upper landing surface.
   1. When a 3 ft (0.9-m) extension is not possible, a grasping device (such as a grab rail) shall be provided to assist workers in mounting and dismounting the ladder.
2. In no case shall the length of the ladder be such that ladder deflection under a load would, by itself, cause the ladder to slip from its support.

G. Ladders shall be inspected for visible defects on a daily basis and after any occurrence that could affect their safe use. Broken or damaged ladders shall be immediately tagged "DO NOT USE," or with similar wording, and withdrawn from service until restored to a condition meeting their original design.

1.24 FLOOR & WALL OPENINGS

A. All floor and wall openings shall comply with 29 CFR 1926 Subpart M.

B. Floor and roof holes/openings are any that measure over 2 in (51 mm) in any direction of a walking/working surface which persons may trip or fall into or where objects may fall to the level below. See 21.F for covering and labeling requirements. Skylights located in floors or roofs are considered floor or roof hole/openings.

C. All floor, roof openings or hole into which a person can accidentally walk or fall through shall be guarded either by a railing system with toeboards along all exposed sides or a load-bearing cover. When the cover is not in place, the opening or hole shall be protected by a removable guardrail system or shall be attended when the guarding system has been removed, or other fall protection system.

1. Covers shall be capable of supporting, without failure, at least twice the weight of the worker, equipment and material combined.

2. Covers shall be secured when installed, clearly marked with the word "HOLE", "COVER" or "Danger, Roof Opening-Do Not Remove" or color-coded or equivalent methods (e.g., red or orange "X"). Workers must be made aware of the meaning for color coding and equivalent methods.

3. Roofing material, such as roofing membrane, insulation or felts, covering or partly covering openings or holes, shall be immediately cut out. No hole or opening shall be left unattended unless covered.

4. Non-load-bearing skylights shall be guarded by a load-bearing skylight screen, cover, or railing system along all exposed sides.

5. Workers are prohibited from standing/walking on skylights.

- - - END - - -
PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the availability and source of references and standards specified in the project manual under paragraphs APPLICABLE PUBLICATIONS and/or shown on the drawings.

1.2 AVAILABILITY OF SPECIFICATIONS LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS FPMR PART 101-29 (FAR 52.211-1) (AUG 1998)

A. The GSA Index of Federal Specifications, Standards and Commercial Item Descriptions, FPMR Part 101-29 and copies of specifications, standards, and commercial item descriptions cited in the solicitation may be obtained for a fee by submitting a request to – GSA Federal Supply Service, Specifications Section, Suite 8100, 470 East L'Enfant Plaza, SW, Washington, DC 20407, Telephone (202) 619-8925, Facsimile (202) 619-8978.

B. If the General Services Administration, Department of Agriculture, or Department of Veterans Affairs issued this solicitation, a single copy of specifications, standards, and commercial item descriptions cited in this solicitation may be obtained free of charge by submitting a request to the addressee in paragraph (a) of this provision. Additional copies will be issued for a fee.

1.3 AVAILABILITY FOR EXAMINATION OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-4) (JUN 1988)

A. The specifications and standards cited in this solicitation can be examined at the following location:

1. DEPARTMENT OF VETERANS AFFAIRS
   Office of Construction & Facilities Management
   Facilities Quality Service (00CFM1A)
   425 Eye Street N.W, (sixth floor)
   Washington, DC 20001
   Telephone Numbers: (202) 632-5249 or (202) 632-5178
   Between 9:00 AM - 3:00 PM

1.4 AVAILABILITY OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-3) (JUN 1988)

A. The specifications cited in this solicitation may be obtained from the associations or organizations listed below.

B. AGC - Associated General Contractors of America http://www.agc.org

C. AIA - American Institute of Architects http://www.aia.org


F. EGSA - Electrical Generating Systems Association http://www.egsa.org

G. EEI - Edison Electric Institute http://www.eei.org

H. EPA - Environmental Protection Agency http://www.epa.gov


J. FM - Factory Mutual Insurance http://www.fmglobal.com

K. GA - Gypsum Association http://www.gypsum.org

L. IEEE - Institute of Electrical and Electronics Engineers http://www.ieee.org

M. http://www.ieee.org/imparBN IMSA - International Municipal Signal Association

http://www.imsasafety.org
N. IPCAEA - Insulated Power Cable Engineers Association
O. NBS - National Bureau of Standards (See NIST)
P. NEC - National Electric Code (See NFPA)
Q. NEMA - National Electrical Manufacturers Association http://www.nema.org
S. OSHA - Occupational Safety and Health Administration Department of Labor http://www.osha.gov
T. UBC - The Uniform Building Code (See ICBO)
U. UL - Underwriters’ Laboratories Incorporated http://www.ul.com
V. ULC - Underwriters’ Laboratories of http://www.ulc.ca

SECTION 2 - PRODUCTS (NOT USED)
SECTION 3 - EXECUTION (NOT USED)

- - - END - - -
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION:
   A. This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained by the Department of Veterans Affairs.

1.2 APPLICABLE PUBLICATIONS:
   A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   B. American Society for Testing and Materials (ASTM):
      1. C33/C33M-11a Standard Specification for Concrete Aggregates
      2. C39/C39M-12 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
      4. C138/C138M-10b Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
      5. C173/C173M-10b Standard Test Method for Air Content of freshly Mixed Concrete by the Volumetric Method

1.3 REQUIREMENTS:
   A. Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory’s scope of accreditation must include the appropriate ASTM standards (i.e.; E329, C1077, D3666, D3740, A880, E543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the “Corporate Office.”
   B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by COTR. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of Resident Engineer to such failure.
   C. Written Reports: Testing laboratory shall submit test reports to COTR, Contractor, unless other arrangements are agreed to in writing by the COTR. Submit reports of tests that fail to meet construction contract requirements on colored paper.
   D. Verbal Reports: Give verbal notification to COTR immediately of any irregularity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONCRETE:
   A. Batch Plant Inspection and Materials Testing:
      1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of Resident Engineer with concurrence of Contracting Officer and perform periodic inspections thereafter as determined by Resident Engineer.
      2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to Resident Engineer.
      3. Sample and test mix ingredients as necessary to insure compliance with specifications.
4. Sample and test aggregates daily and as necessary for moisture content. Test the dry rodded weight of the coarse aggregate whenever a sieve analysis is made, and when it appears there has been a change in the aggregate.

5. Certify, in duplicate, ingredients and proportions and amounts of ingredients in concrete conform to approved trial mixes. When concrete is batched or mixed off immediate building site, certify (by signing, initialing or stamping thereon) on delivery slips (duplicate) that ingredients in truckload mixes conform to proportions of aggregate weight, cement factor, and water-cement ratio of approved trial mixes.

B. Field Inspection and Materials Testing:

1. Provide a technician at site of placement at all times to perform concrete sampling and testing.

2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor’s expense. Any rejected concrete that is placed will be subject to removal.

3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 m³ (50 cubic yards) or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. After good concrete quality control has been established and maintained as determined by Resident Engineer make three cylinders for each 80 m³ (100 cubic yards) or less of each concrete type, and at least three cylinders from any one day's pour for each concrete type. Label each cylinder with an identification number. Resident Engineer may require additional cylinders to be molded and cured under job conditions.

4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day’s pumping operations to determine change in slump.

5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m³ (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m³ (100 cubic yards) at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.

6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.

7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.

8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.

9. Verify that specified mixing has been accomplished.

10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:
   a. When ambient air temperature falls below 4.4 degrees C (40 degrees F), record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
   b. When ambient air temperature rises above 29.4 degrees C (85 degrees F), record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.

11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.
12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.

13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.


15. Observe preparations for placement of concrete:
   a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
   b. Inspect preparation of construction, expansion, and isolation joints.

16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.

17. Observe concrete mixing:
   a. Monitor and record amount of water added at project site.
   b. Observe minimum and maximum mixing times.

18. Measure concrete flatwork for levelness and flatness as follows:
   a. Perform Floor Tolerance Measurements FF and FL in accordance with ASTM E1155. Calculate the actual overall F-numbers using the inferior/superior area method.
   b. Perform all floor tolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.
   c. Provide the Contractor and the Resident Engineer with the results of all profile tests, including a running tabulation of the overall FF and FL values for all slabs installed to date, within 72 hours after each slab installation.

19. Other inspections:
   a. Grouting under base plates.
   b. Grouting anchor bolts and reinforcing steel in hardened concrete.

C. Laboratory Tests of Field Samples:
   1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by Resident Engineer. Compile laboratory test reports as follows: Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.
   2. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.
   3. Furnish certified compression test reports (duplicate) to Resident Engineer. In test report, indicate the following information:
      a. Cylinder identification number and date cast.
      b. Specific location at which test samples were taken.
      c. Type of concrete, slump, and percent air.
      d. Compressive strength of concrete in MPa (psi).
      e. Weight of lightweight structural concrete in kg/m3 (pounds per cubic feet).
      f. Weather conditions during placing.
      g. Temperature of concrete in each test cylinder when test cylinder was molded.
      h. Maximum and minimum ambient temperature during placing.
      i. Ambient temperature when concrete sample in test cylinder was taken.
      j. Date delivered to laboratory and date tested.

3.2 REINFORCEMENT:
   A. Review mill test reports furnished by Contractor.
   B. Perform sampling at fabricating plant. Take two samples from each 23 t (25 tons) or fraction thereof of each size of reinforcing steel No. 10 thru No. 57 (No. 3 thru No. 18).
   C. Make one tensile and one bend test in accordance with ASTM A370 from each pair of samples obtained.
D. Written report shall include, in addition to test results, heat number, manufacturer, type and grade of steel, and bar size.

E. Perform tension tests of mechanical and welded splices in accordance with ASTM A370.

3.3 TYPE OF TEST:

E. Concrete:
   1. Making and Curing Concrete Test Cylinders (ASTM C31) ___30___
   2. Compressive Strength, Test Cylinders (ASTM C39) ___20___
   3. Concrete Slump Test (ASTM C143) ___10___
   4. Concrete Air Content Test (ASTM C173) ___10___
   5. Abrasion (ASTM C33) ___6___

   - - - END - - -
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION
A. This section specifies the control of environmental pollution and damage that the Contractor must consider for air, water, and land resources. It includes management of visual aesthetics, noise, solid waste, radiant energy, and radioactive materials, as well as other pollutants and resources encountered or generated by the Contractor. The Contractor is obligated to consider specified control measures with the costs included within the various contract items of work.

B. Environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which:
1. Adversely affect human health or welfare,
2. Unfavorably alter ecological balances of importance to human life,
3. Effect other species of importance to humankind, or;
4. Degrade the utility of the environment for aesthetic, cultural, and historical purposes.

C. Definitions of Pollutants:
2. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.
3. Sediment: Soil and other debris that has been eroded and transported by runoff water.
4. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, and agricultural operations and from community activities.
5. Surface Discharge: The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "water of the United States" and would require a permit to discharge water from the governing agency.
6. Rubbish: Combustible and noncombustible wastes such as paper, boxes, glass and crockery, metal and lumber scrap, tin cans, and bones.
7. Sanitary Wastes:
   a. Sewage: Domestic sanitary sewage and human and animal waste.
   b. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.2 QUALITY CONTROL
A. Establish and maintain quality control for the environmental protection of all items set forth herein.

B. Record on daily reports any problems in complying with laws, regulations, and ordinances. Note any corrective action taken.

1.3 REFERENCES
A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. U.S. National Archives and Records Administration (NARA): 33 CFR 328 Definitions

1.4 SUBMITTALS
A. In accordance with Section, 01 3323 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, the Contractor shall meet with the Resident Engineer to discuss the proposed Environmental Protection Plan and to develop mutual understanding relative to details of environmental protection. Not more than 20 days after the meeting, the Contractor shall prepare and submit to the COTR and the Contracting Officer for
approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:

a. Name(s) of person(s) within the Contractor's organization who is (are) responsible for ensuring adherence to the Environmental Protection Plan.

b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site.

c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.

d. Description of the Contractor's environmental protection personnel training program.

e. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control, noise control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.

f. Methods for protection of features to be preserved within authorized work areas including trees, shrubs, vines, grasses, ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, and archeological and cultural resources.

g. Procedures to provide the environmental protection that comply with the applicable laws and regulations. Describe the procedures to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures as described in the Environmental Protection Plan.

h. Permits, licenses, and the location of the solid waste disposal area.

i. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, or stockpiles of excess or spoil materials. Include as part of an Erosion Control Plan approved by the District Office of the U.S. Soil Conservation Service and the Department of Veterans Affairs.

j. Environmental Monitoring Plans for the job site including land, water, air, and noise.

k. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion Control Plan.

B. Approval of the Contractor's Environmental Protection Plan will not relieve the Contractor of responsibility for adequate and continued control of pollutants and other environmental protection measures.

1.5 PROTECTION OF ENVIRONMENTAL RESOURCES

A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire period of this contract. Confine activities to areas defined by the specifications and drawings.

B. Protection of Land Resources: Prior to construction, identify all land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, and land forms without permission from the Resident Engineer. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or where special emergency use is permitted.

1. Work Area Limits: Prior to any construction, mark the areas that require work to be performed under this contract. Mark or fence isolated areas within the general work area that are to be saved and protected. Protect monuments, works of art, and markers before construction operations begin. Convey to all personnel the purpose of marking and protecting all necessary objects.

2. Protection of Landscape: Protect trees, shrubs, vines, grasses, land forms, and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved techniques.

a. Box and protect from damage existing trees and shrubs to remain on the construction site.
b. Immediately repair all damage to existing trees and shrubs by trimming, cleaning, and painting with antiseptic tree paint.

c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.

9. Handle and dispose of solid wastes in such a manner that will prevent contamination of the environment. Place solid wastes (excluding clearing debris) in containers that are emptied on a regular schedule. Transport all solid waste off Government property and dispose of waste in compliance with Federal, State, and local requirements.

10. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.

11. Handle discarded materials other than those included in the solid waste category as directed by the Resident Engineer.

C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.

1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in retention ponds allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.

2. Control movement of materials and equipment at stream crossings during construction to prevent violation of water pollution control standards of the Federal, State, or local government.

3. Monitor water areas affected by construction.

D. Protection of Fish and Wildlife Resources: Keep construction activities under surveillance, management, and control to minimize interference with, disturbance of, or damage to fish and wildlife. Prior to beginning construction operations, list species that require specific attention along with measures for their protection.

E. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the State of // insert Name of State and title of State Air Pollution Statue, Rule, or Regulation // and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.

1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials (such as from asphaltic batch plants) at all times, including weekends, holidays, and hours when work is not in progress.

2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators, or other methods are permitted to control particulates in the work area.


4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.

F. Reduction of Noise: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the Resident Engineer. Maintain noise-produced work at or below the decibel levels and within the time periods specified.

1. Perform construction activities involving repetitive, high-level impact noise only between 8:00a.m. and 6:00p.m unless otherwise permitted by local ordinance or the Resident
Engineer. Repetitive impact noise on the property shall not exceed the following dB limitations:

<table>
<thead>
<tr>
<th>Time Duration of Impact Noise</th>
<th>Sound Level in dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 12 minutes in any hour</td>
<td>70</td>
</tr>
<tr>
<td>Less than 30 seconds of any hour</td>
<td>85</td>
</tr>
<tr>
<td>Less than three minutes of any hour</td>
<td>80</td>
</tr>
<tr>
<td>Less than 12 minutes of any hour</td>
<td>75</td>
</tr>
</tbody>
</table>

2. Provide sound deadening devices on equipment and take noise abatement measures that are necessary to comply with the requirements of this contract, consisting of, but not limited to, the following:

a. Maintain maximum permissible construction equipment noise levels at 15 m (50 feet) (dBA):
   1) Concrete Mixers 75
   2) Concrete Pumps 75
   3) Cranes / Boom Truck 75
   4) Jack Hammers 75
   5) Rock Drills 80
   6) Pneumatic Tools 80
   7) Saws 75
   8) Vibrators 75

b. Use shields or other physical barriers to restrict noise transmission.
c. Provide soundproof housings or enclosures for noise producing machinery.
d. Use efficient silencers on equipment air intakes.
e. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.
f. Line hoppers and storage bins with sound deadening material.
g. Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.

G. Measure sound level for noise exposure due to the construction at least once every five successive working days while work is being performed above 55 dB(A) noise level. Measure noise exposure at the property line or 15 m (50 feet) from the noise source, whichever is greater. Measure the sound levels on the A weighing network of a General Purpose sound level meter at slow response. To minimize the effect of reflective sound waves at buildings, take measurements at 900 to 1800 mm (three to six feet) in front of any building face. Submit the recorded information to the Resident Engineer noting any problems and the alternatives for mitigating actions.

H. Restoration of Damaged Property: If any direct or indirect damage is done to public or private property (interior or exterior of building, or on the site) resulting from any act, omission, neglect, or misconduct, the Contractor shall restore the damaged property to a condition equal to that existing before the damage at no additional cost to the Government. Repair, rebuild, or restore property as directed or make good such damage in an acceptable manner.

I. Final Clean up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition satisfactory to the COTR. Cleaning shall include off the station disposal of all items and materials not required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations.

SECTION 2 - PRODUCTS (NOT USED)

SECTION 3 - EXECUTION (NOT USED)
TEMPORARY INTERIOR SIGNAGE

PART 1 GENERAL
1.1 DESCRIPTION
A. This section specifies temporary interior signs.

PART 2 PRODUCTS
2.1 TEMPORARY SIGNS
A. Fabricate from 50 Kg (110 pound) mat finish white paper.
B. Cut to 100 mm (4-inch) wide by 300 mm (12 inch) long size tag.
C. Punch 3 mm (1/8-inch) diameter hole centered on 100 mm (4-inch) dimension of tag. Edge of hole spaced approximately 13 mm (1/2-inch) from one end on tag.
D. Reinforce hole on both sides with gummed cloth washer or other suitable material capable of preventing tie pulling through paper edge.
E. Ties: Steel wire 0.3 mm (0.0120-inch) thick, attach to tag with twist tie, leaving 150 mm (6-inch) long free ends.

PART 3 EXECUTION
3.1 INSTALLATION
A. Install temporary signs attached to room door frame or room door knob, lever, or pull for doors on corridor openings.
B. Mark on signs with felt tip marker having approximately 3 mm (1/8-inch) wide stroke for clearly legible numbers or letters.
C. Identify room with numbers as designated on floor plans.

3.2 LOCATION
A. Install on doors that have room, corridor, and space numbers shown.
B. Doors that do not require signs are as follows:
   1. Corridor barrier doors (cross-corridor) in corridor with same number.
   2. Folding doors or partitions.
   3. Toilet or bathroom doors within and between rooms.
   4. Communicating doors in partitions between rooms with corridor entrance doors.
   5. Closet doors within rooms.
C. Replace missing, damaged, or illegible signs.

- - - END - - -
CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the requirements for the management of non-hazardous building construction and demolition waste.

B. Waste disposal in landfills shall be minimized to the greatest extent possible. Of the inevitable waste that is generated, as much of the waste material as economically feasible shall be salvaged, recycled or reused.

C. Contractor shall use all reasonable means to divert construction and demolition waste from landfills and incinerators, and facilitate their salvage and recycle not limited to the following:
   1. Waste Management Plan development and implementation.
   2. Techniques to minimize waste generation.
   4. Salvage of existing materials and items for reuse or resale.
   5. Recycling of materials that cannot be reused or sold.

D. At a minimum the following waste categories shall be diverted from landfills:
   1. Inert (e.g., concrete, masonry and asphalt).
   2. Clean dimensional wood and palette wood.
   4. Engineered wood products (plywood, particle board and I-joists, etc.).
   5. Metal products (e.g., steel, wire, beverage containers, copper, etc.).
   6. Cardboard, paper and packaging.
   8. Plastics (e.g., ABS, PVC).
   9. Carpet and/or pad.
  10. Gypsum board.
  11. Insulation.
  12. Paint.
  13. Fluorescent lamps.

1.2 RELATED WORK

A. Section 01 0000, GENERAL REQUIREMENTS.
B. Section 02 4100, DEMOLITION.
C. Section 02 8333, LEAD BASED PAINT REMOVAL AND DISPOSAL.
D. Section 02 8211, TRADITIONAL ASBESTOS ABATEMENT.
E. Drawings, the provisions of the Agreement, the General Conditions, and Division 1 specification sections apply to work in this section.

1.3 QUALITY ASSURANCE

A. Contractor shall practice efficient waste management when sizing, cutting and installing building products. Processes shall be employed to ensure the generation of as little waste as possible. Construction /Demolition waste includes products of the following:
   1. Excess or unusable construction materials.
   2. Packaging used for construction products.
   3. Poor planning and/or layout.
   5. Over ordering.
   6. Weather damage.
   7. Contamination.
   8. Mishandling.
B. Establish and maintain the management of non-hazardous building construction and demolition waste set forth herein. Conduct a site assessment to estimate the types of materials that will be generated by demolition and construction.

C. Contractor shall develop and implement procedures to recycle construction and demolition waste to a minimum of 50 percent.

D. Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling. Any revenues or savings obtained from salvage or recycling shall accrue to the contractor.

E. Contractor shall provide all demolition, removal and legal disposal of materials. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by local, state, federal regulations. The Whole Building Design Guide website http://www.wbdg.org/tools/cwm.php provides a Construction Waste Management Database that contains information on companies that haul, collect, and process recyclable debris from construction projects.

F. Contractor shall assign a specific area to facilitate separation of materials for reuse, salvage, recycling, and return. Such areas are to be kept neat and clean and clearly marked in order to avoid contamination or mixing of materials.

G. Contractor shall provide on-site instructions and supervision of separation, handling, salvaging, recycling, reuse and return methods to be used by all parties during waste generating stages.

H. Record on daily reports any problems in complying with laws, regulations and ordinances with corrective action taken.

I. To achieve these goals the contractor shall develop for review a Waste Management Plan for this Project.

J. Sub-contractors must report all waste, including how much waste is diverted from the landfill but is not controlled through the on-site collection system being monitored by the CWM Plan.

1.4 TERMINOLOGY

A. Class III Landfill: A landfill that accepts non-hazardous resources such as household, commercial and industrial waste resulting from construction, remodeling, repair and demolition operations.

B. Clean: Untreated and unpainted; uncontaminated with adhesives, oils, solvents, mastics and like products.

C. Construction and Demolition Waste (C&D): Includes all non-hazardous resources resulting from construction, remodeling, alterations, repair, and demolition operations. C&D waste includes, but is not limited to, building materials, demolition rubble, landscaping materials, soils, packaging materials, debris, and trash.

D. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

E. Dismantle: The process of parting out a building in such a way as to preserve the usefulness of its materials and components.

F. Disposal: Acceptance of solid wastes at a legally operating facility for the purpose of land filling (includes Class III landfills and inert fills).

G. Hazardous waste: Any material or byproduct of construction that is regulated by the Environmental Protection Agency and that may not be disposed of in landfill or other waste end-source without adherence to applicable laws.

H. Inert Backfill Site: A location, other than inert fill or other disposal facility, to which inert materials are taken for the purpose of filling an excavation, shoring or other soil engineering operation.

I. Inert Fill: A facility that can legally accept inert waste, such as asphalt and concrete exclusively for the purpose of disposal.
J. Inert Solids/Inert Waste: Non-liquid solid resources including, but not limited to, soil and concrete that does not contain hazardous waste or soluble pollutants at concentrations in excess of water-quality objectives established by a regional water board, and does not contain significant quantities of decomposable solid resources.

K. Landfill: Public or private business involved in the practice of trash disposal.

L. Material Recovery Facility (MRF): A general term used to describe a waste-sorting facility. Mechanical, hand-separation, or combination of both procedures are used to recover recyclable materials from other waste, which is then disposed of as trash.

M. Mixed Debris: Loads that include commingled recyclable and non-recyclable materials generated at the construction site.

N. Mixed Debris Recycling Facility: A solid resource processing facility that accepts loads of mixed construction and demolition debris for the purpose of recovering re-usable and recyclable materials and disposing non-recyclable materials.

O. Owner: For the purpose of this Section, "Owner" refers to the VA.

P. Permitted Waste Hauler: A company that holds a valid permit to collect and transport solid wastes from individuals or businesses for the purpose of recycling or disposal.

Q. Proper Disposal: As defined by the jurisdiction receiving the waste.

R. Recycling: The process of sorting, cleansing, treating, and reconstituting materials for the purpose of using the altered form in the manufacture of a new product. Recycling does not include burning, incinerating or thermally destroying solid waste.
   1. On-site Recycling - Materials that are sorted and processed on site for use in an altered state in the work, i.e. concrete crushed for use as a sub-base in paving.
   2. Off-site Recycling - Materials hauled to a location and used in an altered form in the manufacture of new products.

S. Recycling Facility: An operation that can legally accept materials for the purpose of processing the materials into an altered form for the manufacture of new products. Depending on the types of materials accepted and operating procedures, a recycling facility may or may not be required to have a solid waste facilities permit or be regulated by the local enforcement agency. Depending on the type of facility, it may accept source-separated waste or co-mingled waste or both.

T. Recycling Services: Types of services include:
   1. Source-Separated: Construction waste is sorted on the jobsite in separate containers as it is generated. The recycling hauler takes the materials directly to a recycler or a transfer site.
   2. Co-mingled: This service allows contractors to put select recyclables such as wood, cardboard, and metal in one container. The recycling hauler takes the materials to a sorting facility where the materials are separated for recycling.

U. Reuse: Materials that are recovered for use in the same form, on-site or off-site.

V. Return: To give back reusable items or unused products to vendors for credit.

W. Salvage: To remove waste materials from the site for resale or re-use by a third party.

X. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation in the Work.

Y. Source-Separated Materials: Materials that are sorted by type at the site for the purpose of reuse and recycling.

Z. Solid Waste: Materials that have been designated as non-recyclable and are discarded for the purposes of disposal.

AA. Transfer Station: A facility that can legally accept solid waste for the purpose of temporarily storing the materials for re-loading onto other trucks and transporting them to a landfill for disposal, or recovering some materials for re-use or recycling.
AB. Trash (or Garbage or Rubbish): That part of the waste that cannot be returned, reused, recycled, or reused.

AC. Waste: For the purpose of this section, the term applies to all excess building materials. Waste includes materials that can be salvaged, returned, recycled, or reused.

1.5 SUBMITTALS
   A. In accordance with Section 01 3323, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, furnish the following:
   B. Prepare and submit to the Resident Engineer a written demolition debris management plan. The plan shall include, but not be limited to, the following information:
   C. Procedures to be used for debris management.
   D. Techniques to be used to minimize waste generation.
   E. Analysis of the estimated job site waste to be generated:
   F. List of each material and quantity to be salvaged, reused, recycled.
   G. List of each material and quantity proposed to be taken to a landfill.
   H. Detailed description of the Means/Methods to be used for material handling.
   I. On site: Material separation, storage, protection where applicable.
   J. Off site: Transportation means and destination. Include list of materials.
   K. Description of materials to be site-separated and self-hauled to designated facilities.
   L. Description of mixed materials to be collected by designated waste haulers and removed from the site.
   M. The names and locations of mixed debris reuse and recycling facilities or sites.
   N. The names and locations of trash disposal landfill facilities or sites.
   O. Documentation that the facilities or sites are approved to receive the materials.
   P. Designated Manager responsible for instructing personnel, supervising, documenting and administer over meetings relevant to the Waste Management Plan.
   Q. Monthly summary of construction and demolition debris diversion and disposal, quantifying all materials generated at the work site and disposed of or diverted from disposal through recycling.

1.6 APPLICABLE PUBLICATIONS
   A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced by the basic designation only. In the event that criteria requirements conflict, the most stringent requirements shall be met.

1.7 RECORDS
   A. Maintain records to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration.

PART 2 - PRODUCTS
2.1 MATERIALS (NOT USED)

PART 3 - EXECUTION
3.1 PLAN IMPLEMENTATION
   A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
   B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.
C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
   1. Distribute waste management plan to everyone concerned within three days of submittal return.
   2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
   3. Provide education for all on-site workers on efficient waste reduction and waste management when, sizing, cutting, and installing products and materials.
   4. Use meetings, signage, and subcontractor agreements to communicate the goals of the waste reduction plan. Consider incorporating the meetings with the safety meetings.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.

E. Provide a central cutting area to facilitate re-use of existing cutoffs and to consolidate scrap for recycling.

F. Hazardous wastes shall be separated, stored, disposed of according to local, state, federal regulations.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
   1. Clean salvaged items.
   2. Store items in a secure area until installation.
   3. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Permitted on Project site.

C. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Hazardous Materials:
   1. Materials separated for recycling must be clean: materials must not contain contaminants such as lead-based paint, asbestos, PCB’s, or Freon.
   2. Manage hazardous waste materials separately from recyclable materials.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
   1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
      a. Make sure bins are in convenient locations as close as possible to where material is being generated.
      b. Inspect containers and bins for contamination and remove contaminated materials if found.
   2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner’s property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE
A. General: Send all recyclable demolition waste that cannot be salvaged to re-used to permitted recycling facility.
B. Asphalt Concrete Paving: Break up and transport paving to permitted recycling facility.
C. Clean concrete: Break up and transport paving to permitted recycling facility.
   1. Where applicable, crush concrete and screen to comply with requirements in Section 02 4100 DEMOLITION for use as satisfactory soil for fill or sub-base.
D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
   1. Clean and stack undamaged, whole masonry units on wood pallets.
E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
F. Metals: Separate metals by type and send to permitted recycling facility.
   1. Remove and dispose of bolts, nuts, washers, and other rough hardware.
G. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
H. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
I. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
   1. Store clean, dry carpet and pad in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.
J. Carpet Tile: Remove debris, trash, and adhesive.
   1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.
K. Green Waste: Send to permitted recycling facility.

3.5 RECYCLING CONSTRUCTION WASTE
A. Packaging:
   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   3. Untreated Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
   4. Untreated Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
B. Site-Clearing Waste: chip brush, branches, and trees on-site or at permitted recycling facility.
C. Wood Materials:
   1. Untreated Clean Cut-Offs of Lumber: Grind or chip into small pieces.
   2. Untreated Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
   3. Treated lumber: Dispose of at a permitted contaminated solid waste disposal site.
   4. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location for recycling.

3.6 DISPOSAL
A. Contractor shall be responsible for transporting and disposing of materials that cannot be delivered to a source-separated or mixed materials recycling facility to a transfer station or disposal facility that can accept the materials in accordance with state and federal regulations.
1. Except as otherwise specified, do not allow waste materials that are to be disposed of to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Construction or demolition materials with no practical reuse or that cannot be salvaged or recycled shall be disposed of at a landfill or incinerator.

3.7 REPORT
   A. With each application for progress payment, submit a summary of construction and demolition debris diversion and disposal including beginning and ending dates of period covered.
   B. Quantify all materials diverted from landfill disposal through salvage or recycling during the period with the receiving parties, dates removed, transportation costs, weight tickets, manifests, invoices. Include the net total costs or savings for each salvaged or recycled material.
   C. Quantify all materials disposed of during the period with the receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices. Include the net total costs for each disposal.

3.8 ATTACHMENTS
   A. Waste Management Plan
   B. Table 1: Waste Identification
   C. Table 2: Waste Reduction Work Plan
   D. Table 3: Cost/Revenue Analysis
WASTE MANAGEMENT PLAN

Project Title: <Insert Project Title>
Job No.: <Insert Job Number>
Waste Management Coordinator: <Insert Name, Title, and contact information>
Recycling Requirement - To recycle/salvage <Insert Percentage> of waste generated on the site.
<table>
<thead>
<tr>
<th>Material</th>
<th>Estimated Quantity</th>
<th>Estimated Tons *</th>
<th>Point of Generation</th>
<th>Comments/Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Average volume-to-weight conversions are:
  Mixed waste: 5.7 yards/ton
  Wood:  6.7 yards/ton
  Cardboard: 20 yards/ton
  Drywall:  4 yards/ton
  Rubble:  1.4 yards/ton
### TABLE 2: WASTE REDUCTION WORK PLAN

<table>
<thead>
<tr>
<th>Material</th>
<th>S/R/D *</th>
<th>Estimated Quantity S/R/D (tons)</th>
<th>Actual Quantity S/R/D (tons)</th>
<th>Handling and Transport Procedures</th>
<th>Destination (Name, address, phone number) **</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* S = Salvage, R = Recycle, D = Dispose  
** For materials sent for recycling or disposal, send to facilities currently permitted by the Authority having Jurisdiction.  
No solid waste management permit required for on-site processing of clean waste concrete, provided the processed product meets the "inert fill material" definition in Chapter 342H, HRS.  
Solid Waste Management Permit required if destination site accepts for processing such waste materials (eg. Clean waste concrete) from others sites.
### TABLE 3: COST/REVENUE ANALYSIS

<table>
<thead>
<tr>
<th>Material</th>
<th>(1) Estimated Cost of Disposal</th>
<th>(2) Estimated Revenue from Salvage/Recycle</th>
<th>(3) Estimated Cost of Salvage/Recycle</th>
<th>Estimated Net Savings/Cost (1) + (2) - (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- - - END - - -
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
      1. Substantial Completion procedures.
         a. Final completion procedures.
         b. Warranties.
         c. Final cleaning.
         d. Repair of the Work.

1.3 ACTION SUBMITTALS
   A. Product Data: For cleaning agents.
   B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
   C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS
   A. Certificates of Release: From authorities having jurisdiction.
   B. Certificate of Insurance: For continuing coverage.
   C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS
   A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES
   A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
   B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
      1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
      2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
      3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
      4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
         a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
      5. Submit test/adjust/balance records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
   1. Advise Owner of pending insurance changeover requirements.
   2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
   3. Complete startup and testing of systems and equipment.
   4. Perform preventive maintenance on equipment used prior to Substantial Completion.
   5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. 6. Advise Owner of changeover in heat and other utilities.
   7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
   8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
   9. Complete final cleaning requirements, including touchup painting.
  10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
   2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
   1. Submit a final Application for Payment according to "Payment Procedures."
   2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
   4. Submit pest-control final inspection report.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction
   1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

3. Include the following information at the top of each page:
   a. Project name.
   b. Date.
   c. Name of Architect.
   d. Name of Contractor.
   e. Page number.

4. Submit list of incomplete items in the following format:
   c. Three paper copies. Architect – Engineer(s) will return two copies.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
   2. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
   3. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
   4. Identify each binder on the front and spine with the typed or printed title
      a. "WARRANTIES," Project name, and name of Contractor.
      b. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
   5. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
   1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the Washington Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
   a. Clean Project site, in areas disturbed by construction activities, of rubbish, waste material, litter, and other foreign substances.
   b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
   d. Remove tools, construction equipment, machinery, and surplus material from Project site.
   e. Remove snow and ice to provide safe access to building.
   f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
   g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   h. Sweep concrete floors broom clean in unoccupied spaces.
   i. Remove labels that are not permanent.
   j. Wipe surfaces of electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
   k. Leave Project clean and ready for occupancy.

2. Construction Waste Disposal: Comply with waste disposal requirements per the local jurisdiction. Insert an article on continuing inspections or consultations by Contractor if required. Possibly insert a schedule of approximate times for inspections.

3.2 REPAIR OF THE WORK
   A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
   B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

   Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials. Restore this paragraph (Leave in specs)2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces.
   a. Replace finishes and surfaces that that already show evidence of repair or restoration.
   b. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

- - - END - - -
GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 COMMISSIONING DESCRIPTION

A. This Section 01 9100 GENERAL COMMISSIONING REQUIREMENTS shall form the basis of the construction phase commissioning process and procedures. The Commissioning Agent shall add, modify, and refine the commissioning procedures, as approved by the Department of Veterans Affairs (VA), to suit field conditions and actual manufacturer's equipment, incorporate test data and procedure results, and provide detailed scheduling for all commissioning tasks.

B. Various sections of the project specifications require equipment startup, testing, and adjusting services. Requirements for startup, testing, and adjusting services specified in the Division 26, Division 27, Division 28, series sections of these specifications are intended to be provided in coordination with the commissioning services and are not intended to duplicate services. The Contractor shall coordinate the work required by individual specification sections with the commissioning services requirements specified herein.

C. Where individual testing, adjusting, or related services are required in the project specifications and not specifically required by this commissioning requirements specification, the specified services shall be provided and copies of documentation, as required by those specifications shall be submitted to the VA and the Commissioning Agent to be indexed for future reference.

D. Where training or educational services for VA are required and specified in other sections of the specifications, including but not limited to Division 26, Division 27, Division 28, and Division 31 series sections of the specification, these services are intended to be provided in addition to the training and educational services specified herein.

E. Commissioning is a systematic process of verifying that the building systems perform interactively according to the construction documents and the VA's operational needs. The commissioning process shall encompass and coordinate the system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training. Commissioning during the construction and post-occupancy phases is intended to achieve the following specific objectives according to the contract documents:
   1. Verify that the applicable equipment and systems are installed in accordance with the contract documents and according to the manufacturer's recommendations.
   2. Verify and document proper integrated performance of equipment and systems.
   3. Verify that Operations & Maintenance documentation is complete.
   4. Verify that all components requiring servicing can be accessed, serviced and removed without disturbing nearby components including ducts, piping, cabling or wiring.
   5. Verify that the VA's operating personnel are adequately trained to enable them to operate, monitor, adjust, maintain, and repair building systems in an effective and energy-efficient manner.
   6. Document the successful achievement of the commissioning objectives listed above.

F. The commissioning process does not take away from or reduce the responsibility of the Contractor to provide a finished and fully functioning product.

1.2 CONTRACTUAL RELATIONSHIPS

A. For this construction project, the Department of Veterans Affairs contracts with a Contractor to provide construction services. The contracts are administered by the VA Contracting Officer and the COTR as the designated representative of the Contracting Officer. On this project, the authority to modify the contract in any way is strictly limited to the authority of the Contracting Officer.

B. In this project, only two contract parties are recognized and communications on contractual issues are strictly limited to VA COTR and the Contractor. It is the practice of the VA to require that communications between other parties to the contracts (Subcontractors and Vendors) be conducted through the COTR and Contractor. It is also the practice of the VA that
communications between other parties of the project (Commissioning Agent and Architect/Engineer) be conducted through the COTR.

C. Whole Building Commissioning is a process that relies upon frequent and direct communications, as well as collaboration between all parties to the construction process. By its nature, a high level of communication and cooperation between the Commissioning Agent and all other parties (Architects, Engineers, Subcontractors, Vendors, third party testing agencies, etc.) is essential to the success of the Commissioning effort.

D. With these fundamental practices in mind, the commissioning process described herein has been developed to recognize that, in the execution of the Commissioning Process, the Commissioning Agent must develop effective methods to communicate with every member of the construction team involved in delivering commissioned systems while simultaneously respecting the exclusive contract authority of the Contracting Officer and COTR. Thus, the procedures outlined in this specification must be executed within the following limitations:

1. No communications (verbal or written) from the Commissioning Agent shall be deemed to constitute direction that modifies the terms of any contract between the Department of Veterans Affairs and the Contractor.

2. Commissioning Issues identified by the Commissioning Agent will be delivered to the COTR and copied to the designated Commissioning Representatives for the Contractor and subcontractors on the Commissioning Team for information only in order to expedite the communication process. These issues must be understood as the professional opinion of the Commissioning Agent and as suggestions for resolution.

3. In the event that any Commissioning Issues and suggested resolutions are deemed by the COTR to require either an official interpretation of the construction documents or require a modification of the contract documents, the Contracting Officer or COTR will issue an official directive to this effect.

4. All parties to the Commissioning Process shall be individually responsible for alerting the COTR of any issues that they deem to constitute a potential contract change prior to acting on these issues.

5. Authority for resolution or modification of design and construction issues rests solely with the Contracting Officer or COTR, with appropriate technical guidance from the Architect/Engineer and/or Commissioning Agent.

1.3 RELATED WORK
A. Section 01 0000 GENERAL REQUIREMENTS.
B. Section 01 3216 PROJECT SCHEDULES
C. Section 01 3323 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
D. Section 26 0800 COMMISSIONING OF ELECTRICAL SYSTEMS.

1.4 SUMMARY
A. This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.

B. The commissioning activities have been developed to support the VA requirements to meet guidelines for Federal Leadership in Environmental, Energy, and Economic Performance.

1.5 ACRONYMS
A. Acronym   Meaning
B. A/E  Architect / Engineer Design Team
C. AHJ  Authority Having Jurisdiction
D. ASHRAE Association Society for Heating Air Condition and Refrigeration Engineers
E. BOD  Basis of Design
F. BSC  Building Systems Commissioning
G. CCTV  Closed Circuit Television
1.6 DEFINITIONS

A. Acceptance Phase Commissioning: Commissioning tasks executed after most construction has been completed, most Site Observations and Static Tests have been completed and Pre-Functional Testing has been completed and accepted. The main commissioning activities performed during this phase are verification that the installed systems are functional by conducting Systems Functional Performance tests and Owner Training.

B. Accuracy: The capability of an instrument to indicate the true value of a measured quantity.
C. Back Check: A back check is a verification that an agreed upon solution to a design comment has been adequately addressed in a subsequent design review.

D. Basis of Design (BOD): The Engineer’s Basis of Design is comprised of two components: the Design Criteria and the Design Narrative; these documents record the concepts, calculations, decisions, and product selections used to meet the Owner’s Project Requirements (OPR) and to satisfy applicable regulatory requirements, standards, and guidelines.

E. Benchmarks: Benchmarks are the comparison of a building’s energy usage to other similar buildings and to the building itself. For example, ENERGY STAR Portfolio Manager is a frequently used and nationally recognized building energy benchmarking tool.

F. Building Information Modeling (BIM): Building Information Modeling is a parametric database which allows a building to be designed and constructed virtually in 3D, and provides reports both in 2D views and as schedules. This electronic information can be extracted and reused for pre-populating facility management CMMS systems. Building Systems Commissioning (BSC): NEBB acronym used to designate its commissioning program.

G. Calibrate: The act of comparing an instrument of unknown accuracy with a standard of known accuracy to detect, correlate, report, or eliminate by adjustment any variation in the accuracy of the tested instrument.

H. CCTV: Closed circuit Television. Normally used for security surveillance and alarm detections as part of a special electrical security system.

I. COBie: Construction Operations Building Information Exchange (COBie) is an electronic industry data format used to transfer information developed during design, construction, and commissioning into the Computer Maintenance Management Systems (CMMS) used to operate facilities. See the Whole Building Design Guide website for further information (http://www.wbdg.org/resources/cobie.php)

J. Commissionability: Defines a design component or construction process that has the necessary elements that will allow a system or component to be effectively measured, tested, operated and commissioned.

K. Commissioning Agent (CxA): The qualified Commissioning Professional who administers the Cx process by managing the Cx team and overseeing the Commissioning Process. Where CxA is used in this specification it means the Commissioning Agent, members of his staff or appointed members of the commissioning team. Note that LEED uses the term Commissioning Authority in lieu of Commissioning Agent.

L. Commissioning Checklists: Lists of data or inspections to be verified to ensure proper system or component installation, operation, and function. Verification checklists are developed and used during all phases of the commissioning process to verify that the Owner’s Project Requirements (OPR) is being achieved.

M. Commissioning Design Review: The commissioning design review is a collaborative review of the design professionals design documents for items pertaining to the following: owner’s project requirements; basis of design; operability and maintainability (O&M) including documentation; functionality; training; energy efficiency, control systems’ sequence of operations including building automation system features; commissioning specifications and the ability to functionally test the systems.

N. Commissioning Issue: A condition identified by the Commissioning Agent or other member of the Commissioning Team that adversely affects the commissionability, operability, maintainability, or functionality of a system, equipment, or component. A condition that is in conflict with the Contract Documents and/or performance requirements of the installed systems and components. (See also – Commissioning Observation).

O. Commissioning Manager (CxM): A qualified individual appointed by the Contractor to manage the commissioning process on behalf of the Contractor.
P. Commissioning Observation: An issue identified by the Commissioning Agent or other member of the Commissioning Team that does not conform to the project OPR, contract documents or standard industry best practices. (See also Commissioning Issue)

Q. Commissioning Plan: A document that outlines the commissioning process, commissioning scope and defines responsibilities, processes, schedules, and the documentation requirements of the Commissioning Process.

R. Commissioning Process: A quality focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its systems, components, and assemblies are planned, designed, installed, tested, can be operated, and maintained to meet the Owner's Project Requirements.

S. Commissioning Report: The final commissioning document which presents the commissioning process results for the project. Cx reports include an executive summary, the commissioning plan, issue log, correspondence, and all appropriate check sheets and test forms.

T. Commissioning Representative (CxR): An individual appointed by a sub-contractor to manage the commissioning process on behalf of the sub-contractor.

U. Commissioning Specifications: The contract documents that detail the objective, scope and implementation of the commissioning process as developed in the Commissioning Plan.

V. Commissioning Team: Individual team members whose coordinated actions are responsible for implementing the Commissioning Process.

W. Construction Phase Commissioning: All commissioning efforts executed during the construction process after the design phase and prior to the Acceptance Phase Commissioning.

X. Contract Documents (CD): Contract documents include design and construction contracts, price agreements and procedure agreements. Contract Documents also include all final and complete drawings, specifications and all applicable contract modifications or supplements.

Y. Construction Phase Commissioning (CPC): All commissioning efforts executed during the construction process after the design phase and prior to the Acceptance Phase Commissioning.

Z. Coordination Drawings: Drawings showing the work of all trades that are used to illustrate that equipment can be installed in the space allocated without compromising equipment function or access for maintenance and replacement. These drawings graphically illustrate and dimension manufacturers’ recommended maintenance clearances. On mechanical projects, coordination drawings include structural steel, ductwork, major piping and electrical conduit and show the elevations and locations of the above components.

AA. Data Logging: The monitoring and recording of temperature, flow, current, status, pressure, etc. of equipment using stand-alone data recorders.

AB. Deferred System Test: Tests that cannot be completed at the end of the acceptance phase due to ambient conditions, schedule issues or other conditions preventing testing during the normal acceptance testing period.

AC. Deficiency: See “Commissioning Issue”.

AD. Design Criteria: A listing of the VA Design Criteria outlining the project design requirements, including its source. These are used during the design process to show the design elements meet the OPR.

AE. Design Intent: The overall term that includes the OPR and the BOD. It is a detailed explanation of the ideas, concepts, and criteria that are defined by the owner to be important. The design intent documents are utilized to provide a written record of these ideas, concepts and criteria.

AF. Design Narrative: A written description of the proposed design solutions that satisfy the requirements of the OPR.

AG. Design Phase Commissioning (DPC): All commissioning tasks executed during the design phase of the project.
AH. Environmental Systems: Systems that use a combination of mechanical equipment, airflow, water flow and electrical energy to provide heating, ventilating, air conditioning, humidification, and dehumidification for the purpose of human comfort or process control of temperature and humidity.

AI. Executive Summary: A section of the Commissioning report that reviews the general outcome of the project. It also includes any unresolved issues, recommendations for the resolution of unresolved issues and all deferred testing requirements.

AJ. Functionality: This defines a design component or construction process which will allow a system or component to operate or be constructed in a manner that will produce the required outcome of the OPR.

AK. Functional Test Procedure (FTP): A written protocol that defines methods, steps, personnel, and acceptance criteria for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

AL. Industry Accepted Best Practice: A design component or construction process that has achieved industry consensus for quality performance and functionality. Refer to the current edition of the NEBB Design Phase Commissioning Handbook for examples.

AM. Installation Verification: Observations or inspections that confirm the system or component has been installed in accordance with the contract documents and to industry accepted best practices.

AN. Integrated System Testing: Integrated Systems Testing procedures entail testing of multiple integrated systems performance to verify proper functional interface between systems. Typical Integrated Systems Testing includes verifying that building systems respond properly to loss of utility, transfer to emergency power sources, re-transfer from emergency power source to normal utility source; interface between HVAC controls and Fire Alarm systems for equipment shutdown, interface between Fire Alarm system and elevator control systems for elevator recall and shutdown; interface between Fire Alarm System and Security Access Control Systems to control access to spaces during fire alarm conditions; and other similar tests as determined for each specific project.

AO. Issues Log: A formal and ongoing record of problems or concerns – and their resolution – that have been raised by members of the Commissioning Team during the course of the Commissioning Process.

AP. Lessons Learned Workshop: A workshop conducted to discuss and document project successes and identify opportunities for improvements for future projects.

AQ. Maintainability: A design component or construction process that will allow a system or component to be effectively maintained. This includes adequate room for access to adjust and repair the equipment. Maintainability also includes components that have readily obtainable repair parts or service.

AR. Manual Test: Testing using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the 'observation').

AS. Owner’s Project Requirements (OPR): A written document that details the project requirements and the expectations of how the building and its systems will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

AT. Peer Review: A formal in-depth review separate from the commissioning review processes. The level of effort and intensity is much greater than a typical commissioning facilitation or extended commissioning review. The VA usually hires an independent third-party (called the IDIQ A/E) to conduct peer reviews.

AU. Precision: The ability of an instrument to produce repeatable readings of the same quantity under the same conditions. The precision of an instrument refers to its ability to produce a tightly grouped set of values around the mean value of the measured quantity.
AV. Pre-Design Phase Commissioning: Commissioning tasks performed prior to the commencement of design activities that includes project programming and the development of the commissioning process for the project.

AW. Pre-Functional Checklist (PFC): A form used by the contractor to verify that appropriate components are onsite, correctly installed, set up, calibrated, functional and ready for functional testing.

AX. Pre-Functional Test (PFT): An inspection or test that is done before functional testing. PFT’s include installation verification and system and component start up tests.

AY. Procedure or Protocol: A defined approach that outlines the execution of a sequence of work or operations. Procedures are used to produce repeatable and defined results.

AZ. Range: The upper and lower limits of an instrument’s ability to measure the value of a quantity for which the instrument is calibrated.

BA. Resolution: This word has two meanings in the Cx Process. The first refers to the smallest change in a measured variable that an instrument can detect. The second refers to the implementation of actions that correct a tested or observed deficiency.

BB. Site Observation Visit: On-site inspections and observations made by the Commissioning Agent for the purpose of verifying component, equipment, and system installation, to observe contractor testing, equipment start-up procedures, or other purposes.

BC. Site Observation Reports (SO): Reports of site inspections and observations made by the Commissioning Agent. Observation reports are intended to provide early indication of an installation issue which will need correction or analysis.

BD. Special System Inspections: Inspections required by a local code authority prior to occupancy and are not normally a part of the commissioning process.

BE. Static Tests: Tests or inspections that validate a specified static condition such as pressure testing. Static tests may be specification or code initiated.

BF. Start Up Tests: Tests that validate the component or system is ready for automatic operation in accordance with the manufactures requirements.

BG. Systems Manual: A system-focused composite document that includes all information required for the owners operators to operate the systems.

BH. Test Procedure: A written protocol that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

BI. Testing: The use of specialized and calibrated instruments to measure parameters such as: temperature, pressure, vapor flow, air flow, fluid flow, rotational speed, electrical characteristics, velocity, and other data in order to determine performance, operation, or function.

BJ. Testing, Adjusting, and Balancing (TAB): A systematic process or service applied to heating, ventilating and air-conditioning (HVAC) systems and other environmental systems to achieve and document air and hydronic flow rates. The standards and procedures for providing these services are referred to as “Testing, Adjusting, and Balancing” and are described in the Procedural Standards for the Testing, Adjusting and Balancing of Environmental Systems, published by NEBB or AABC.

BK. Thermal Scans: Thermographic pictures taken with an Infrared Thermographic Camera. Thermographic pictures show the relative temperatures of objects and surfaces and are used to identify leaks, thermal bridging, thermal intrusion, electrical overload conditions, moisture containment, and insulation failure.

BL. Training Plan: A written document that details, in outline form the expectations of the operator training. Training agendas should include instruction on how to obtain service, operate, startup, shutdown and maintain all systems and components of the project.

BM. Trending: Monitoring over a period of time with the building automation system.

BN. Unresolved Commissioning Issue: Any Commissioning Issue that, at the time that the Final Report or the Amended Final Report is issued that has not been either resolved by the
construction team or accepted by the VA. Validation: The process by which work is verified as complete and operating correctly:

1. First party validation occurs when a firm or individual verifying the task is the same firm or individual performing the task.
2. Second party validation occurs when the firm or individual verifying the task is under the control of the firm performing the task or has other possibilities of financial conflicts of interest in the resolution (Architects, Designers, General Contractors and Third Tier Subcontractors or Vendors).
3. Third party validation occurs when the firm verifying the task is not associated with or under control of the firm performing or designing the task.

BO. Verification: The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the Owner's Project Requirements.

BP. Warranty Phase Commissioning: Commissioning efforts executed after a project has been completed and accepted by the Owner. Warranty Phase Commissioning includes follow-up on verification of system performance, measurement and verification tasks and assistance in identifying warranty issues and enforcing warranty provisions of the construction contract.

BQ. Warranty Visit: A commissioning meeting and site review where all outstanding warranty issues and deferred testing is reviewed and discussed.

BR. Whole Building Commissioning: Commissioning of building systems such as Building Envelope, HVAC, Electrical, Special Electrical (Fire Alarm, Security & Communications), Plumbing and Fire Protection as described in this specification.

1.7 SYSTEMS TO BE COMMISSIONED

A. Commissioning of a system or systems specified for this project is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel, is required in cooperation with the VA and the Commissioning Agent.

B. The following systems will be commissioned as part of this project:

1. Specialties
   Electrical connections

2. Electrical
   Medium-Voltage Electrical Distribution Systems
   Medium-Voltage Switchgear, Medium-Voltage Switches, Underground ductbank and distribution, Pad-Mount Transformers, Medium-Voltage Load Interrupter Switches,
   Grounding & Bonding Systems
   Witness 3rd party testing, review reports
   Electric Power Monitoring Systems
   Metering, sub-metering, power monitoring systems, PLC control systems
   Electrical System Protective Device Study
   Review reports, verify field settings
   consistent with Study
   Secondary Unit Substations
   Medium-voltage components, transformers, low-voltage distribution, verify breaker testing results (injection current, etc)
   Low-Voltage Distribution System
   Normal power distribution system, Life-safety power distribution system, critical power distribution system, equipment power distribution system, switchboards, distribution panels, panelboards, verify breaker testing results (injection current, etc)
   Emergency Power Generation Systems
   Generators, Generator paralleling switchgear, automatic transfer switches, PLC and other control systems
   Lighting & Lighting Control** Systems
   Emergency lighting, occupancy sensors, lighting control systems, architectural dimming systems, theatrical dimming systems, exterior lighting and controls
   Cathodic Protection Systems
   Review 3rd party testing results.
   Lightning Protection System
   Witness 3rd party testing, review reports
3. Integrated Systems Tests
   Loss of Power Response  Loss of power to building, loss of power to campus, restoration of power to building, restoration of power to campus.

1.8 COMMISSIONING TEAM
   A. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project Superintendent and subcontractors, installers, schedulers, suppliers, and specialists deemed appropriate by the Department of Veterans Affairs (VA) and Commissioning Agent.

   B. Members Appointed by Contractor:
      1. Commissioning Agent: The Contractor shall retain the services of a third-party Commissioning Agent to oversee the activities of the Commissioning. The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process.
      2. Contractor’s Commissioning Manager: The designated person, company, or entity that plans, schedules and coordinates the commissioning activities for the construction team.
      3. Contractor’s Commissioning Representative(s): Individual(s), each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions.

   C. Members Appointed by VA:
      1. User: Representatives of the facility user and operation and maintenance personnel.
      2. A/E: Representative of the Architect and engineering design professionals.

1.9 VA’S COMMISSIONING RESPONSIBILITIES
   A. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to, the following:
      1. Coordination meetings.
      2. Training in operation and maintenance of systems, subsystems, and equipment.
      3. Testing meetings.
      5. Demonstration of operation of systems, subsystems, and equipment.

   B. Provide the Construction Documents, prepared by Architect and approved by VA, to the Commissioning Agent and for use in managing the commissioning process, developing the commissioning plan, systems manuals, and reviewing the operation and maintenance training plan.

1.10 CONTRACTOR’S COMMISSIONING RESPONSIBILITIES
   A. Appoint a third party individual, company or firm to act as the Commissioning Agent.
   A. The Contractor shall assign a Commissioning Manager to manage commissioning activities of the Contractor, and subcontractors.

   B. The Contractor shall ensure that the commissioning responsibilities outlined in these specifications are included in all subcontracts and that subcontractors comply with the requirements of these specifications.

   C. The Contractor shall ensure that each installing subcontractor shall assign representatives with expertise and authority to act on behalf of the subcontractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:
      1. Participate in commissioning coordination meetings.
      2. Conduct operation and maintenance training sessions in accordance with approved training plans.
      3. Verify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
      4. Evaluate commissioning issues and commissioning observations identified in the Commissioning Issues Log, field reports, test reports or other commissioning documents.
In collaboration with entity responsible for system and equipment installation, recommend corrective action.

5. Review and comment on commissioning documentation.
7. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to Commissioning Agent for incorporation into the commissioning plan.
8. Provide information to the Commissioning Agent for developing commissioning plan.
9. Participate in training sessions for VA's operation and maintenance personnel.
10. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures to conduct Systems Functional Performance Testing of installed systems.

1.11 COMMISSIONING AGENT'S RESPONSIBILITIES

A. Organize and lead the commissioning team.
B. Prepare the commissioning plan. See Paragraph 1.11-A of this specification Section for further information.
C. Review and comment on selected submittals from the Contractor for general conformance with the Construction Documents. Review and comment on the ability to test and operate the system and/or equipment, including providing gages, controls and other components required to operate, maintain, and test the system. Review and comment on performance expectations of systems and equipment and interfaces between systems relating to the Construction Documents.
D. At the beginning of the construction phase, conduct an initial construction phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; Pre-Functional Checklists, Systems Functional Performance Testing; and project completion.
E. Convene commissioning team meetings for the purpose of coordination, communication, and conflict resolution; discuss status of the commissioning processes. Responsibilities include arranging for facilities, preparing agenda and attendance lists, and notifying participants. The Commissioning Agent shall prepare and distribute minutes to commissioning team members and attendees within five workdays of the commissioning meeting.
F. Observe construction and report progress, observations and issues. Observe systems and equipment installation for adequate accessibility for maintenance and component replacement or repair, and for general conformance with the Construction Documents.
G. Prepare Project specific Pre-Functional Checklists and Systems Functional Performance Test procedures.
H. Coordinate Systems Functional Performance Testing schedule with the Contractor.
I. Witness selected systems startups.
J. Verify selected Pre-Functional Checklists completed and submitted by the Contractor.
L. Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning report.
M. Review and comment on operation and maintenance (O&M) documentation and systems manual outline for compliance with the Contract Documents. Operation and maintenance documentation requirements are specified in Paragraph 1.25, Section 01 0000 GENERAL REQUIREMENTS.
N. Review operation and maintenance training program developed by the Contractor. Verify training plans provide qualified instructors to conduct operation and maintenance training.
O. Prepare commissioning Field Observation Reports.
P. Prepare the Final Commissioning Report.
Q. Return to the site at 10 months into the 12 month warranty period and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal Systems Functional Performance Testing. Also interview facility staff and identify problems or concerns they have operating the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

R. Assemble the final commissioning documentation, including the Final Commissioning Report and Addendum to the Final Commissioning Report.

1.12 COMMISSIONING DOCUMENTATION

A. Commissioning Plan: A document, prepared by Commissioning Agent, that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process, and shall include, but is not limited, to the following:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports. Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes. Submittal dates shall include the latest date approved submittals must be received without adversely affecting commissioning plan.

2. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.

3. Identification of systems and equipment to be commissioned.

4. Schedule of Commissioning Coordination meetings.

5. Identification of items that must be completed before the next operation can proceed.

6. Description of responsibilities of commissioning team members.

7. Description of observations to be made.

8. Schedule for commissioning activities with dates coordinated with overall construction schedule.


10. Process and schedule for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.


B. Systems Functional Performance Test Procedures: The Commissioning Agent will develop Systems Functional Performance Test Procedures for each system to be commissioned, including subsystems, or equipment and interfaces or interlocks with other systems. Systems Functional Performance Test Procedures will include a separate entry, with space for comments, for each item to be tested. Preliminary Systems Functional Performance Test Procedures will be provided to the VA, Architect/Engineer, and Contractor for review and comment. The Systems Performance Test Procedure will include test procedures for each mode of operation and provide space to indicate whether the mode under test responded as required. Each System Functional Performance Test procedure, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:

1. Name and identification code of tested system.

2. Test number.

3. Time and date of test.

4. Indication of whether the record is for a first test or retest following correction of a problem or issue.

5. Dated signatures of the person performing test and of the witness, if applicable.

6. Individuals present for test.


8. Issue number, if any, generated as the result of test.
C. Pre-Functional Checklists: The Commissioning Agent will prepare Pre-Functional Checklists. Pre-Functional Checklists shall be completed and signed by the Contractor, verifying that systems, subsystems, equipment, and associated controls are ready for testing. The Commissioning Agent will spot check Pre-Functional Checklists to verify accuracy and readiness for testing. Inaccurate or incomplete Pre-Functional Checklists shall be returned to the Contractor for correction and resubmission.

D. Test and Inspection Reports: The Commissioning Agent will record test data, observations, and measurements on Systems Functional Performance Test Procedure. The report will also include recommendation for system acceptance or non-acceptance. Photographs, forms, and other means appropriate for the application shall be included with data. Commissioning Agent Will compile test and inspection reports and test and inspection certificates and include them in systems manual and commissioning report.

E. Corrective Action Documents: The Commissioning Agent will document corrective action taken for systems and equipment that fail tests. The documentation will include any required modifications to systems and equipment and/or revisions to test procedures, if any. The Commissioning Agent will witness and document any retesting of systems and/or equipment requiring corrective action and document retest results.

F. Commissioning Issues Log: The Commissioning Agent will prepare and maintain Commissioning Issues Log that describes Commissioning Issues and Commissioning Observations that are identified during the Commissioning process. These observations and issues include, but are not limited to, those that are at variance with the Contract Documents. The Commissioning Issues Log will identify and track issues as they are encountered, the party responsible for resolution, progress toward resolution, and document how the issue was resolved. The Master Commissioning Issues Log will also track the status of unresolved issues.

1. Creating an Commissioning Issues Log Entry:
   a. Identify the issue with unique numeric or alphanumeric identifier by which the issue may be tracked.
   b. Assign a descriptive title for the issue.
   c. Identify date and time of the issue.
   d. Identify test number of test being performed at the time of the observation, if applicable, for cross reference.
   e. Identify system, subsystem, and equipment to which the issue applies.
   f. Identify location of system, subsystem, and equipment.
   g. Include information that may be helpful in diagnosing or evaluating the issue.
   h. Note recommended corrective action.
   i. Identify commissioning team member responsible for corrective action.
   j. Identify expected date of correction.
   k. Identify person that identified the issue.

2. Documenting Issue Resolution:
   a. Log date correction is completed or the issue is resolved.
   b. Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue, if any.
   c. Identify changes to the Contract Documents that may require action.
   d. State that correction was completed and system, subsystem, and equipment are ready for retest, if applicable.
   e. Identify person(s) who corrected or resolved the issue.
   f. Identify person(s) verifying the issue resolution.

G. Final Commissioning Report: The Commissioning Agent will document results of the commissioning process, including unresolved issues, and performance of systems, subsystems, and equipment. The Commissioning Report will indicate whether systems, subsystems, and equipment have been properly installed and are performing according to the Contract Documents. This report will be used by the Department of Veterans Affairs when determining that systems will be accepted. This report will be used to evaluate systems,
subsystems, and equipment and will serve as a future reference document during VA occupancy and operation. It shall describe components and performance that exceed requirements of the Contract Documents and those that do not meet requirements of the Contract Documents. The commissioning report will include, but is not limited to, the following:

1. Lists and explanations of substitutions; compromises; variances with the Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. Design Narrative documentation maintained by the Commissioning Agent.
2. Commissioning plan.
3. Pre-Functional Checklists completed by the Contractor, with annotation of the Commissioning Agent review and spot check.
4. Systems Functional Performance Test Procedures, with annotation of test results and test completion.
6. Listing of deferred and off season test(s) not performed, including the schedule for their completion.

H. Addendum to Final Commissioning Report: The Commissioning Agent will prepare an Addendum to the Final Commissioning Report near the end of the Warranty Period. The Addendum will indicate whether systems, subsystems, and equipment are complete and continue to perform according to the Contract Documents. The Addendum to the Final Commissioning Report shall include, but is not limited to, the following:

1. Documentation of deferred and off season test(s) results.
2. Completed Systems Functional Performance Test Procedures for off season test(s).
3. Documentation that unresolved system performance issues have been resolved.
4. Updated Commissioning Issues Log, including status of unresolved issues.
5. Identification of potential Warranty Claims to be corrected by the Contractor.

I. Systems Manual: The Commissioning Agent will gather required information and compile the Systems Manual. The Systems Manual will include, but is not limited to, the following:

1. Design Narrative, including system narratives, schematics, single-line diagrams, flow diagrams, equipment schedules, and changes made throughout the Project.
2. Reference to Final Commissioning Plan.
4. Approved Operation and Maintenance Data as submitted by the Contractor.

1.13 SUBMITTALS

A. Preliminary Commissioning Plan Submittal: The Commissioning Agent has prepared a Preliminary Commissioning Plan based on the final Construction Documents. The Preliminary Commissioning Plan is included as an Appendix to this specification section. The Preliminary Commissioning Plan is provided for information only. It contains preliminary information about the following commissioning activities:

1. The Commissioning Team: A list of commissioning team members by organization.
2. Systems to be commissioned. A detailed list of systems to be commissioned for the project. This list also provides preliminary information on systems/equipment submittals to be reviewed by the Commissioning Agent; preliminary information on Pre-Functional Checklists that are to be completed; preliminary information on Systems Performance Testing, including information on testing sample size (where authorized by the VA).
3. Commissioning Team Roles and Responsibilities: Preliminary roles and responsibilities for each Commissioning Team member.
4. Commissioning Documents: A preliminary list of commissioning-related documents, include identification of the parties responsible for preparation, review, approval, and action on each document.
5. Commissioning Activities Schedule: Identification of Commissioning Activities, including Systems Functional Testing, the expected duration and predecessors for the activity.
6. Pre-Functional Checklists: Preliminary Pre-Functional Checklists for equipment, components, subsystems, and systems to be commissioned. These Preliminary Pre-
7. Systems Functional Performance Test Procedures: Preliminary step-by-step System Functional Performance Test Procedures to be used during Systems Functional Performance Testing. These Preliminary Systems Functional Performance procedures provide information on the level of testing rigor, and the level of Contractor support required during performance of system's testing.

B. Final Commissioning Plan Submittal: Based on the Final Construction Documents and the Contractor's project team, the Commissioning Agent will prepare the Final Commissioning Plan as described in this section. The Commissioning Agent will submit three hard copies and three sets of electronic files of Final Commissioning Plan. The Contractor shall review the Commissioning Plan and provide any comments to the VA. The Commissioning Agent will incorporate review comments into the Final Commissioning Plan as directed by the VA.

C. Systems Functional Performance Test Procedure: The Commissioning Agent will submit preliminary Systems Functional Performance Test Procedures to the Contractor, and the VA for review and comment. The Contractor shall return review comments to the VA and the Commissioning Agent. The VA will also return review comments to the Commissioning Agent. The Commissioning Agent will incorporate review comments into the Final Systems Functional Test Procedures to be used in Systems Functional Performance Testing.

D. Pre-Functional Checklists: The Commissioning Agent will submit Pre-Functional Checklists to be completed by the Contractor.

E. Test and Inspection Reports: The Commissioning Agent will submit test and inspection reports to the VA with copies to the Contractor and the Architect/Engineer.

F. Corrective Action Documents: The Commissioning Agent will submit corrective action documents to the VA COTR with copies to the Contractor and Architect.

G. Preliminary Commissioning Report Submittal: The Commissioning Agent will submit three electronic copies of the preliminary commissioning report. One electronic copy, with review comments, will be returned to the Commissioning Agent for preparation of the final submittal.

H. Final Commissioning Report Submittal: The Commissioning Agent will submit four sets of electronically formatted information of the final commissioning report to the VA. The final submittal will incorporate comments as directed by the VA.

I. Data for Commissioning:
   1. The Commissioning Agent will request in writing from the Contractor specific information needed about each piece of commissioned equipment or system to fulfill requirements of the Commissioning Plan.
   2. The Commissioning Agent may request further documentation as is necessary for the commissioning process or to support other VA data collection requirements, including Construction Operations Building Information Exchange (COBIE), Building Information Modeling (BIM), etc.

1.14 COMMISSIONING PROCESS

A. The Commissioning Agent will be responsible for the overall management of the commissioning process as well as coordinating scheduling of commissioning tasks with the VA and the Contractor. As directed by the VA, the Contractor shall incorporate Commissioning tasks, including, but not limited to, Systems Functional Performance Testing (including predecessors) with the Master Construction Schedule.

B. Within ___10_____ days of contract award, the Contractor shall designate a specific individual as the Commissioning Manager (CxM) to manage and lead the commissioning effort on behalf of the Contractor. The Commissioning Manager shall be the single point of contact and communications for all commissioning related services by the Contractor.

C. Within ___20______ days of contract award, the Contractor shall ensure that each subcontractor designates specific individuals as Commissioning Representatives (CXR) to be responsible for commissioning related tasks. The Contractor shall ensure the designated...
Commissioning Representatives participate in the commissioning process as team members providing commissioning testing services, equipment operation, adjustments, and corrections if necessary. The Contractor shall ensure that all Commissioning Representatives shall have sufficient authority to direct their respective staff to provide the services required, and to speak on behalf of their organizations in all commissioning related contractual matters.

1.15 QUALITY ASSURANCE

A. Instructor Qualifications: Factory authorized service representatives shall be experienced in training, operation, and maintenance procedures for installed systems, subsystems, and equipment.

B. Test Equipment Calibration: The Contractor shall comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test instruments. Instruments shall have been calibrated within six months prior to use.

1.16 COORDINATION

A. Management: The Commissioning Agent will coordinate the commissioning activities with the VA and Contractor. The Commissioning Agent will submit commissioning documents and information to the VA. All commissioning team members shall work together to fulfill their contracted responsibilities and meet the objectives of the contract documents.

B. Scheduling: The Contractor shall work with the Commissioning Agent and the VA to incorporate the commissioning activities into the construction schedule. The Commissioning Agent will provide sufficient information (including, but not limited to, tasks, durations and predecessors) on commissioning activities to allow the Contractor and the VA to schedule commissioning activities. All parties shall address scheduling issues and make necessary notifications in a timely manner in order to expedite the project and the commissioning process. The Contractor shall update the Master Construction as directed by the VA.

C. Initial Schedule of Commissioning Events: The Commissioning Agent will provide the initial schedule of primary commissioning events in the Commissioning Plan and at the commissioning coordination meetings. The Commissioning Plan will provide a format for this schedule. As construction progresses, more detailed schedules will be developed by the Contractor with information from the Commissioning Agent.

D. Commissioning Coordinating Meetings: The Commissioning Agent will conduct periodic Commissioning Coordination Meetings of the commissioning team to review status of commissioning activities, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities.

E. Pretesting Meetings: The Commissioning Agent will conduct pretest meetings of the commissioning team to review startup reports, Pre-Functional Checklist results, Systems Functional Performance Testing procedures, testing personnel and instrumentation requirements.

F. Systems Functional Performance Testing Coordination: The Contractor shall coordinate testing activities to accommodate required quality assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting. The Contractor shall coordinate the schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. The Contractor shall provide all standard and specialized testing equipment required to perform Systems Functional Performance Testing. Test equipment required for Systems Functional Performance Testing will be identified in the detailed System Functional Performance Test Procedure prepared by the Commissioning Agent.

B. Data logging equipment and software required to test equipment shall be provided by the Contractor.
C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5 °C (1.0 °F) and a resolution of ± 0.1 °C (0.2 °F). Pressure sensors shall have an accuracy of ± 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and following any repairs to the equipment. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 COMMISSIONING PROCESS ROLES AND RESPONSIBILITIES

A. The following table outlines the roles and responsibilities for the Commissioning Team members during the Construction Phase:

<table>
<thead>
<tr>
<th>Category</th>
<th>Task Description</th>
<th>CxA</th>
<th>RE</th>
<th>A/E</th>
<th>PC</th>
<th>O&amp;M</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meetings</td>
<td>Construction Commission Kick Off meeting</td>
<td>L</td>
<td>A</td>
<td>P</td>
<td>P</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Commissioning Meetings</td>
<td>L</td>
<td>A</td>
<td>P</td>
<td>P</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Project Progress Meetings</td>
<td>P</td>
<td>A</td>
<td>P</td>
<td>L</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controls Meeting</td>
<td>L</td>
<td>A</td>
<td>P</td>
<td>P</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Coordination</td>
<td>Coordinate with [OGC's, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support the OPR and BOD.</td>
<td>L</td>
<td>A</td>
<td>P</td>
<td>P</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Cx Plan &amp; Spec</td>
<td>Final Commissioning Plan</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Schedules</td>
<td>Duration Schedule for Commissioning Activities</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>OPR and BOD</td>
<td>Maintain OPR on behalf of Owner</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maintain BOD/DID on behalf of Owner</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Document Reviews</td>
<td>TAB Plan Review</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Submittal and Shop Drawing Review</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>L</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Review Contractor Equipment Startup Checklists</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Review Change Orders, ASI, and RFI</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>
### Construction Phase - Commissioning Roles and Responsibilities

<table>
<thead>
<tr>
<th>Category</th>
<th>Task Description</th>
<th>CxA</th>
<th>RE</th>
<th>A/E</th>
<th>PC</th>
<th>O&amp;M</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Observations</td>
<td>Witness Factory Testing</td>
<td>P</td>
<td>A</td>
<td>P</td>
<td>L</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Construction Observation Site Visits</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Final Pre-Functional Checklists</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Final Functional Performance Test Protocols</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Activities</td>
<td>Issues Resolution Meetings</td>
<td>P</td>
<td>A</td>
<td>P</td>
<td>L</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Reports and Logs</td>
<td>Status Reports</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maintain Commissioning Issues Log</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>O</td>
<td></td>
</tr>
</tbody>
</table>

**Abbreviations:**
- CxA = Commissioning Agent
- RE = COTR
- A/E = Design Architect/Engineer
- PC = Prime Contractor
- O&M = Government Facility O&M
- L = Lead
- P = Participate
- A = Approve
- R = Review
- O = Optional

### Acceptance Phase - Commissioning Roles and Responsibilities

<table>
<thead>
<tr>
<th>Category</th>
<th>Task Description</th>
<th>CxA</th>
<th>RE</th>
<th>A/E</th>
<th>PC</th>
<th>O&amp;M</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meetings</td>
<td>Commissioning Meeting</td>
<td>L</td>
<td>A</td>
<td>P</td>
<td>P</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pre-Test Coordination Meeting</td>
<td>L</td>
<td>A</td>
<td>P</td>
<td>P</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Coordination</td>
<td>Coordinate with [OGC's, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support OPR and BOD</td>
<td>L</td>
<td>A</td>
<td>P</td>
<td>P</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Cx Plan &amp; Spec</td>
<td>Maintain/Update Commissioning Plan</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>O</td>
<td></td>
</tr>
</tbody>
</table>
### Acceptance Phase - Commissioning Roles and Responsibilities

<table>
<thead>
<tr>
<th>Schedules</th>
<th>Prepare Functional Test Schedule</th>
<th>L</th>
<th>A</th>
<th>R</th>
<th>R</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document Reviews</td>
<td>Review Completed Pre-Functional Checklists</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Pre-Functional Checklist Verification</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Review Operations &amp; Maintenance Manuals</td>
<td>R</td>
<td>A</td>
<td>R</td>
<td>L</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Training Plan Review</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Review TAB Report</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>O</td>
</tr>
<tr>
<td>Site Observations</td>
<td>Construction Observation Site Visits</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Witness Selected Equipment Startup</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>O</td>
</tr>
<tr>
<td>Functional Test Protocols</td>
<td>TAB Verification</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Systems Functional Performance Testing</td>
<td>L</td>
<td>A</td>
<td>P</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>Retesting</td>
<td>L</td>
<td>A</td>
<td>P</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Technical Activities</td>
<td>Issues Resolution Meetings</td>
<td>P</td>
<td>A</td>
<td>P</td>
<td>L</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Systems Training</td>
<td>P</td>
<td>A</td>
<td>R</td>
<td>L</td>
<td>P</td>
</tr>
<tr>
<td>Reports and Logs</td>
<td>Maintain Commissioning Issues Log</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Final Commissioning Report</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Prepare Systems Manuals</td>
<td>L</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
</tbody>
</table>

**Abbreviations:**
- CxA = Commissioning Agent
- RE = COTR
- A/E = Design Architect/Engineer
- PC = Prime Contractor
- O&M = Government Facility O&M
- L = Lead
- P = Participate
- A = Approve
- R = Review
- O = Optional

---

### Warranty Phase - Commissioning Roles & Responsibilities

<table>
<thead>
<tr>
<th>Category</th>
<th>Task Description</th>
<th>CxA</th>
<th>RE</th>
<th>A/E</th>
<th>PC</th>
<th>O&amp;M</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Test Protocols</td>
<td>Deferred and/or seasonal testing</td>
<td>L</td>
<td>A</td>
<td>O</td>
<td>P</td>
<td>P</td>
<td></td>
</tr>
</tbody>
</table>
3.2 STARTUP, INITIAL CHECKOUT, AND PRE-FUNCTIONAL CHECKLISTS

A. The following procedures shall apply to all equipment and systems to be commissioned, according to Part 1, Systems to Be Commissioned.

1. Pre-Functional Checklists are important to ensure that the equipment and systems are hooked up and operational. These ensure that Systems Functional Performance Testing may proceed without unnecessary delays. Each system to be commissioned shall have a full Pre-Functional Checklist completed by the Contractor prior to Systems Functional Performance Testing. No sampling strategies are used.

   a. The Pre-Functional Checklist will identify the trades responsible for completing the checklist. The Contractor shall ensure the appropriate trades complete the checklists.

   b. The Commissioning Agent will review completed Pre-Functional Checklists and field-verify the accuracy of the completed checklist using sampling techniques.

2. Startup and Initial Checkout Plan: The Contractor shall develop detailed startup plans for all equipment. The primary role of the Contractor in this process is to ensure that there is written documentation that each of the manufacturer recommended procedures have been completed. Parties responsible for startup shall be identified in the Startup Plan and in the checklist forms.

   a. The Contractor shall develop the full startup plan by combining (or adding to) the checklists with the manufacturer’s detailed startup and checkout procedures from the O&M manual data and the field checkout sheets normally used by the Contractor. The plan shall include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.

   b. The full startup plan shall at a minimum consist of the following items:

      1) The Pre-Functional Checklists.

      2) The manufacturer’s standard written startup procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.

      3) The manufacturer’s normally used field checkout sheets.

   c. The Commissioning Agent will submit the full startup plan to the VA and Contractor for review. Final approval will be by the VA.

   d. The Contractor shall review and evaluate the procedures and the format for documenting them, noting any procedures that need to be revised or added.
3. Sensor and Actuator Calibration
   a. All field installed temperature, relative humidity, CO2 and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described in Division 21, Division 22, Division 23, Division 26, Division 27, and Division 28 specifications.
   b. All procedures used shall be fully documented on the Pre-Functional Checklists or other suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.

4. Execution of Equipment Startup
   a. Four weeks prior to equipment startup, the Contractor shall schedule startup and checkout with the VA and Commissioning Agent. The performance of the startup and checkout shall be directed and executed by the Contractor.
   b. The Commissioning Agent will observe the startup procedures for selected pieces of primary equipment.
   c. The Contractor shall execute startup and provide the VA and Commissioning Agent with a signed and dated copy of the completed startup checklists, and contractor tests.
   d. Only individuals that have direct knowledge and witnessed that a line item task on the Startup Checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

3.3 DEFICIENCIES, NONCONFORMANCE, AND APPROVAL IN CHECKLISTS AND STARTUP
   A. The Contractor shall clearly list any outstanding items of the initial startup and Pre-Functional Checklist procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies shall be provided to the VA and the Commissioning Agent within two days of completion.
   B. The Commissioning Agent will review the report and submit comments to the VA. The Commissioning Agent will work with the Contractor to correct and verify deficiencies or uncompleted items. The Commissioning Agent will involve the VA and others as necessary. The Contractor shall correct all areas that are noncompliant or incomplete in the checklists in a timely manner, and shall notify the VA and Commissioning Agent as soon as outstanding items have been corrected. The Contractor shall submit an updated startup report and a Statement of Correction on the original noncompliance report. When satisfactorily completed, the Commissioning Agent will recommend approval of the checklists and startup of each system to the VA.
   C. The Contractor shall be responsible for resolution of deficiencies as directed the VA.

3.4 PHASED COMMISSIONING
   A. The project may require startup and initial checkout to be executed in phases. This phasing shall be planned and scheduled in a coordination meeting of the VA, Commissioning Agent, and the Contractor. Results will be added to the master construction schedule and the commissioning schedule.

3.5 DDC SYSTEM TRENDING FOR COMMISSIONING
   A. Trending is a method of testing as a standalone method or to augment manual testing. The Contractor shall trend any and all points of the system or systems at intervals specified below.
   B. Alarms are a means to notify the system operator that abnormal conditions are present in the system. Alarms shall be structured into three tiers – Critical, Priority, and Maintenance.
     1. Critical alarms are intended to be alarms that require the immediate attention of and action by the Operator. These alarms shall be displayed on the Operator Workstation in a popup style window that is graphically linked to the associated unit’s graphical display. The popup style window shall be displayed on top of any active window within the screen, including non DDC system software.
2. Priority level alarms are to be printed to a printer which is connected to the Operator’s Work Station located within the engineer’s office. Additionally Priority level alarms shall be able to be monitored and viewed through an active alarm application. Priority level alarms are alarms which shall require reaction from the operator or maintenance personnel within a normal work shift, and not immediate action.

3. Maintenance alarms are intended to be minor issues which would require examination by maintenance personnel within the following shift. These alarms shall be generated in a scheduled report automatically by the DDC system at the start of each shift. The generated maintenance report will be printed to a printer located within the engineer’s office.

C. The Contractor shall provide a wireless internet network in the building for use during controls programming, checkout, and commissioning. This network will allow project team members to more effectively program, view, manipulate and test control devices while being in the same room as the controlled device.

D. The Contractor shall provide graphical trending through the DDC control system of systems being commissioned. Trending requirements are indicated below and included with the Systems Functional Performance Test Procedures. Trending shall occur before, during and after Systems Functional Performance Testing. The Contractor shall be responsible for producing graphical representations of the trended DDC points that show each system operating properly during steady state conditions as well as during the System Functional Testing. These graphical reports shall be submitted to the COTR and Commissioning Agent for review and analysis before, during dynamic operation, and after Systems Functional Performance Testing. The Contractor shall provide, but not limited to, the following trend requirements and trend submissions:

1. Pre-testing, Testing, and Post-testing – Trend reports of trend logs and graphical trend plots are required as defined by the Commissioning Agent. The trend log points, sampling rate, graphical plot configuration, and duration will be dictated by the Commissioning Agent. At any time during the Commissioning Process the Commissioning Agent may recommend changes to aspects of trending as deemed necessary for proper system analysis. The Contractor shall implement any changes as directed by the COTR. Any pre-test trend analysis comments generated by the Commissioning Team should be addressed and resolved by the Contractor, as directed by the COTR, prior to the execution of Systems Functional Performance Testing.

2. Dynamic plotting – The Contractor shall also provide dynamic plotting during Systems Functional Performance testing at frequent intervals for points determined by the Systems Functional Performance Test Procedure. The graphical plots will be formatted and plotted at durations listed in the Systems Functional Performance Test Procedure.

3. Graphical plotting - The graphical plots shall be provided with a dual y-axis allowing 15 or more trend points (series) plotted simultaneously on the graph with each series in distinct color. The plots will further require title, axis naming, legend etc. all described by the Systems Functional Performance Test Procedure. If this cannot be sufficiently accomplished directly in the Direct Digital Control System then it is the responsibility of the Contractor to plot these trend logs in Microsoft Excel.

4. The following tables indicate the points to be trended and alarmed by system. The Operational Trend Duration column indicates the trend duration for normal operations. The Testing Trend Duration column indicates the trend duration prior to Systems Functional Performance Testing and again after Systems Functional Performance Testing. The Type column indicates point type: AI = Analog Input, AO = Analog Output, DI = Digital Input, DO = Digital Output, Calc = Calculated Point. In the Trend Interval Column, COV = Change of Value. The Alarm Type indicates the alarm priority; C = Critical, P = Priority, and M = Maintenance. The Alarm Range column indicates when the point is considered in the alarm state. The Alarm Delay column indicates the length of time the point must remain in an alarm state before the alarm is recorded in the DDC. The intent is to allow minor, short-duration events to be corrected by the DDC system prior to recording an alarm.
E. The Contractor shall provide the following information prior to Systems Functional Performance Testing. Any documentation that is modified after submission shall be recorded and resubmitted to the COTR and Commissioning Agent.
   1. Point-to-Point checkout documentation;
   2. Sensor field calibration documentation including system name, sensor/point name, measured value, DDC value, and Correction Factor.
   3. A sensor calibration table listing the referencing the location of procedures to following in the O&M manuals, and the frequency at which calibration should be performed for all sensors, separated by system, subsystem, and type. The calibration requirements shall be submitted both in the O&M manuals and separately in a standalone document containing all sensors for inclusion in the commissioning documentation. The following table is a sample that can be used as a template for submission.
      a. SYSTEM
      b. Sensor Calibration Frequency O&M Calibration Procedure Reference
      c. Discharge air temperature Once a year Volume I Section D.3.aa
      d. Discharge static pressure Every 6 months Volume II Section A.1.c
   4. Loop tuning documentation and constants for each loop of the building systems. The documentation shall be submitted in outline or table separated by system, control type (e.g. heating valve temperature control); proportional, integral and derivative constants, interval (and bias if used) for each loop. The following table is a sample that can be used as a template for submission.

3.6 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

A. This paragraph applies to Systems Functional Performance Testing of systems for all referenced specification Divisions.

B. Objectives and Scope: The objective of Systems Functional Performance Testing is to demonstrate that each system is operating according to the Contract Documents. Systems Functional Performance Testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of noncompliant performance are identified and corrected, thereby improving the operation and functioning of the systems. In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load, fire alarm and emergency power) where there is a specified system response. The Contractor shall verify each sequence in the sequences of operation. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.

C. Development of Systems Functional Performance Test Procedures: Before Systems Functional Performance Test procedures are written, the Contractor shall submit all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Using the testing parameters and requirements found in the Contract Documents and approved submittals and shop drawings, the Commissioning Agent will develop specific Systems Functional Test Procedures to verify and document proper operation of each piece of equipment and system to be commissioned. The Contractor shall assist the Commissioning Agent in developing the Systems Functional Performance Test procedures as requested by the Commissioning Agent i.e. by answering questions about equipment, operation, sequences, etc. Prior to execution, the Commissioning Agent will provide a copy of the Systems Functional Performance Test procedures to the VA, the Architect/Engineer, and the Contractor, who shall review the tests for feasibility, safety, equipment and warranty protection.

D. Purpose of Test Procedures: The purpose of each specific Systems Functional Performance Test is to verify and document compliance with the stated criteria of acceptance given on the test form. Representative test formats and examples are found in the Commissioning Plan for this project. (The Commissioning Plan is issued as a separate document and is available for review.) The test procedure forms developed by the Commissioning Agent will include, but not be limited to, the following information:
1. System and equipment or component name(s)
2. Equipment location and ID number
3. Unique test ID number, and reference to unique Pre-Functional Checklists and startup documentation, and ID numbers for the piece of equipment
4. Date
5. Project name
6. Participating parties
7. A copy of the specification section describing the test requirements
8. A copy of the specific sequence of operations or other specified parameters being verified
9. Formulas used in any calculations
10. Required pretest field measurements
11. Instructions for setting up the test.
12. Special cautions, alarm limits, etc.
13. Specific step-by-step procedures to execute the test, in a clear, sequential and repeatable format
14. Acceptance criteria of proper performance with a Yes / No check box to allow for clearly marking whether or not proper performance of each part of the test was achieved.
15. A section for comments.
16. Signatures and date block for the Commissioning Agent. A place for the Contractor to initial to signify attendance at the test.

E. Test Methods: Systems Functional Performance Testing shall be achieved by manual testing (i.e. persons manipulate the equipment and observe performance) and/or by monitoring the performance and analyzing the results using the control system’s trend log capabilities or by standalone data loggers. The Contractor and Commissioning Agent shall determine which method is most appropriate for tests that do not have a method specified.

1. Simulated Conditions: Simulating conditions (not by an overwritten value) shall be allowed, although timing the testing to experience actual conditions is encouraged wherever practical.
2. Overwritten Values: Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
3. Simulated Signals: Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
4. Altering Setpoints: Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the Air Conditioning compressor lockout initiate at an outside air temperature below 12 C (54 F), when the outside air temperature is above 12 C (54 F), temporarily change the lockout setpoint to be 2 C (4 F) above the current outside air temperature.
5. Indirect Indicators: Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification shall be completed during systems startup and initial checkout.

F. Setup: Each function and test shall be performed under conditions that simulate actual conditions as closely as is practically possible. The Contractor shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the
test, the Contractor shall return all affected building equipment and systems, due to these temporary modifications, to their pretest condition.

G. Sampling: No sampling is allowed in completing Pre-Functional Checklists. Sampling is allowed for Systems Functional Performance Test Procedures execution. The Commissioning Agent will determine the sampling rate. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the Commissioning Agent may stop the testing and require the Contractor to perform and document a checkout of the remaining units, prior to continuing with Systems Functional Performance Testing of the remaining units.

H. Cost of Retesting: The cost associated with expanded sample System Functional Performance Tests shall be solely the responsibility of the Contractor. Any required retesting by the Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.

I. Coordination and Scheduling: The Contractor shall provide a minimum of 7 days’ notice to the Commissioning Agent and the VA regarding the completion schedule for the Pre-Functional Checklists and startup of all equipment and systems. The Commissioning Agent will schedule Systems Functional Performance Tests with the Contractor and VA. The Commissioning Agent will witness and document the Systems Functional Performance Testing of systems. The Contractor shall execute the tests in accordance with the Systems Functional Performance Test Procedure.

J. Testing Prerequisites: In general, Systems Functional Performance Testing will be conducted only after Pre-Functional Checklists have been satisfactorily completed. The control system shall be sufficiently tested and approved by the Commissioning Agent and the VA before it is used to verify performance of other components or systems. The air balancing and water balancing shall be completed before Systems Functional Performance Testing of air-related or water-related equipment or systems are scheduled. Systems Functional Performance Testing will proceed from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems will be checked.

K. Problem Solving: The Commissioning Agent will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the Contractor.

3.7 DOCUMENTATION, NONCONFORMANCE AND APPROVAL OF TESTS

A. Documentation: The Commissioning Agent will witness, and document the results of all Systems Functional Performance Tests using the specific procedural forms developed by the Commissioning Agent for that purpose. Prior to testing, the Commissioning Agent will provide these forms to the VA and the Contractor for review and approval. The Contractor shall include the filled out forms with the O&M manual data.

B. Nonconformance: The Commissioning Agent will record the results of the Systems Functional Performance Tests on the procedure or test form. All items of nonconformance issues will be noted and reported to the VA on Commissioning Field Reports and/or the Commissioning Master Issues Log.

1. Corrections of minor items of noncompliance identified may be made during the tests. In such cases, the item of noncompliance and resolution shall be documented on the Systems Functional Test Procedure.

2. Every effort shall be made to expedite the systems functional Performance Testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the Commissioning Agent shall not be pressured into overlooking noncompliant work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so by direction from the VA.

3. As the Systems Functional Performance Tests progresses and an item of noncompliance is identified, the Commissioning Agent shall discuss the issue with the Contractor and the VA.
4. When there is no dispute on an item of noncompliance, and the Contractor accepts responsibility to correct it:
   a. The Commissioning Agent will document the item of noncompliance and the Contractor's response and/or intentions. The Systems Functional Performance Test then continues or proceeds to another test or sequence. After the day's work is complete, the Commissioning Agent will submit a Commissioning Field Report to the VA. The Commissioning Agent will also note items of noncompliance and the Contractor's response in the Master Commissioning Issues Log. The Contractor shall correct the item of noncompliance and report completion to the VA and the Commissioning Agent.
   b. The need for retesting will be determined by the Commissioning Agent. If retesting is required, the Commissioning Agent and the Contractor shall reschedule the test and the test shall be repeated.

5. If there is a dispute about item of noncompliance, regarding whether it is an item of noncompliance, or who is responsible:
   a. The item of noncompliance shall be documented on the test form with the Contractor's response. The item of noncompliance with the Contractor's response shall also be reported on a Commissioning Field Report and on the Master Commissioning Issues Log.
   b. Resolutions shall be made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive and acceptance authority is with the Department of Veterans Affairs.
   c. The Commissioning Agent will document the resolution process.
   d. Once the interpretation and resolution have been decided, the Contractor shall correct the item of noncompliance, report it to the Commissioning Agent. The requirement for retesting will be determined by the Commissioning Agent. If retesting is required, the Commissioning Agent and the Contractor shall reschedule the test. Retesting shall be repeated until satisfactory performance is achieved.

C. Cost of Retesting: The cost to retest a System Functional Performance Test shall be solely the responsibility of the Contractor. Any required retesting by the Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.

D. Failure Due to Manufacturer Defect: If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform in compliance with the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance specifications, all identical units may be considered unacceptable by the VA. In such case, the Contractor shall provide the VA with the following:
   1. Within one week of notification from the VA, the Contractor shall examine all other identical units making a record of the findings. The findings shall be provided to the VA within two weeks of the original notice.
   2. Within two weeks of the original notification, the Contractor shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
   3. The VA shall determine whether a replacement of all identical units or a repair is acceptable.
   4. Two examples of the proposed solution shall be installed by the Contractor and the VA shall be allowed to test the installations for up to one week, upon which the VA will decide whether to accept the solution.
   5. Upon acceptance, the Contractor shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

E. Approval: The Commissioning Agent will note each satisfactorily demonstrated function on the test form. Formal approval of the Systems Functional Performance Test shall be made later
after review by the Commissioning Agent and by the VA. The Commissioning Agent will evaluate each test and report to the VA using a standard form. The VA will give final approval on each test using the same form, and provide signed copies to the Commissioning Agent and the Contractor.

3.8 DEFERRED TESTING

A. Unforeseen Deferred Systems Functional Performance Tests: If any Systems Functional Performance Test cannot be completed due to the building structure, required occupancy condition or other conditions, execution of the Systems Functional Performance Testing may be delayed upon approval of the VA. These Systems Functional Performance Tests shall be conducted in the same manner as the seasonal tests as soon as possible. Services of the Contractor to conduct these unforeseen Deferred Systems Functional Performance Tests shall be negotiated between the VA and the Contractor.

B. Deferred Seasonal Testing: Deferred Seasonal Systems Functional Performance Tests are those that must be deferred until weather conditions are closer to the systems design parameters. The Commissioning Agent will review systems parameters and recommend which Systems Functional Performance Tests should be deferred until weather conditions more closely match systems parameters. The Contractor shall review and comment on the proposed schedule for Deferred Seasonal Testing. The VA will review and approve the schedule for Deferred Seasonal Testing. Deferred Seasonal Systems Functional Performance Tests shall be witnessed and documented by the Commissioning Agent. Deferred Seasonal Systems Functional Performance Tests shall be executed by the Contractor in accordance with these specifications.

3.9 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

A. Training Preparation Conference: Before operation and maintenance training, the Commissioning Agent will convene a training preparation conference to include VA's COTR, VA's Operations and Maintenance personnel, and the Contractor. The purpose of this conference will be to discuss and plan for Training and Demonstration of VA Operations and Maintenance personnel.

B. The Contractor shall provide training and demonstration as required by other Division 21, Division 22, Division 23, Division 26, Division 27, Division 28, and Division 31 sections. The Training and Demonstration shall include, but is not limited to, the following:
1. Review the Contract Documents.
2. Review installed systems, subsystems, and equipment.
3. Review instructor qualifications.
4. Review instructional methods and procedures.
5. Review training module outlines and contents.
6. Review course materials (including operation and maintenance manuals).
7. Review and discuss locations and other facilities required for instruction.
8. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.
9. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

C. Training Module Submittals: The Contractor shall submit the following information to the VA and the Commissioning Agent:
1. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module. At completion of training, submit two complete training manuals for VA's use.
2. Qualification Data: Submit qualifications for facilitator and/or instructor.
3. Attendance Record: For each training module, submit list of participants and length of instruction time.
4. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

5. Demonstration and Training Recording:
   a. General: Engage a qualified commercial photographer to record demonstration and training. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice. At beginning of each training module, record each chart containing learning objective and lesson outline.
   b. Video Format: Provide high quality color DVD color on standard size DVD disks.
   c. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
   d. Narration: Describe scenes on video recording by audio narration by microphone while demonstration and training is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.
   e. Submit two copies within seven days of end of each training module.

6. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding videotape. Include name of Project and date of videotape on each page.

D. Quality Assurance:
   1. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
   2. Instructor Qualifications: A factory authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.
   3. Photographer Qualifications: A professional photographer who is experienced photographing construction projects.

E. Training Coordination:
   1. Coordinate instruction schedule with VA's operations. Adjust schedule as required to minimize disrupting VA's operations.
   2. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
   3. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by the VA.

F. Instruction Program:
   1. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
      a. Electrical service and distribution, including switchgear, transformers, switchboards, panelboards, uninterruptible power supplies, and motor controls.
      b. Packaged engine generators, including synchronizing switchgear Switchboards, and transfer switches.

G. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participants are expected to master. For each module, include instruction for the following:
   1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
      a. System, subsystem, and equipment descriptions.
      b. Performance and design criteria if Contractor is delegated design responsibility.
c. Operating standards.
d. Regulatory requirements.
e. Equipment function.
f. Operating characteristics.
g. Limiting conditions.
h. Performance curves.

2. Documentation: Review the following items in detail:
   a. Emergency manuals.
b. Operations manuals.
c. Maintenance manuals.
d. Project Record Documents.
e. Identification systems.
f. Warranties and bonds.
g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
b. Instructions on stopping.
c. Shutdown instructions for each type of emergency.
d. Operating instructions for conditions outside of normal operating limits.
e. Sequences for electric or electronic systems.
f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:
   a. Startup procedures.
b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:
   a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:
   a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning.
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:
   a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

H. Training Execution:
1. Preparation: Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual. Set up instructional equipment at instruction location.
2. Instruction:
   a. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Department of Veterans Affairs for number of participants, instruction times, and location.
   b. Instructor: Engage qualified instructors to instruct VA's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
      1) The Commissioning Agent will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
      2) The VA will furnish an instructor to describe VA's operational philosophy.
      3) The VA will furnish the Contractor with names and positions of participants.
3. Scheduling: Provide instruction at mutually agreed times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with the VA and the Commissioning Agent with at least seven days' advance notice.
4. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral, or a written, performance-based test.
5. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

I. Demonstration and Training Recording:
1. General: Engage a qualified commercial photographer to record demonstration and training. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice. At beginning of each training module, record each chart containing learning objective and lesson outline.
2. Video Format: Provide high quality color DVD color on standard size DVD disks.
3. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
4. Narration: Describe scenes on videotape by audio narration by microphone while demonstration and training is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.

--- END ---
SECTION 02 4100 - DEMOLITION

DESTRUCTION

PART 1  GENERAL

1.1  DESCRIPTION:
A. This section specifies demolition and removal of buildings, portions of buildings, utilities, other structures and debris from trash dumps shown.

1.2  RELATED WORK:
A. Demolition and removal of.
B. Safety Requirements: Section 01 3526 Safety Requirements Article, ACCIDENT PREVENTION PLAN (APP).
C. Disconnecting utility services prior to demolition: Section 01 0000, GENERAL REQUIREMENTS.
D. Reserved items that are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.
E. Asbestos Removal: Section 02 8211, TRADITIONAL ASBESTOS ABATEMENT.
F. Lead Paint: Section 02 8333, LEAD-BASED PAINT REMOVAL AND DISPOSAL.
G. Environmental Protection: Section 01 5719, TEMPORARY ENVIRONMENTAL CONTROLS.
H. Construction Waste Management: Section 01 7419 CONSTRUCTION WASTE MANAGEMENT.
I. Infectious Control: Section 01 0000, GENERAL REQUIREMENTS, Article 1.7, INFECTION PREVENTION MEASURES.

1.3  PROTECTION:
A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 0000, GENERAL REQUIREMENTS, Article PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS.
C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.
D. Provide enclosed dust chutes with control gates from each floor to carry debris to truck beds and govern flow of material into truck. Provide overhead bridges of tight board or prefabricated metal construction at dust chutes to protect persons and property from falling debris.
E. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.
F. In addition to previously listed fire and safety rules to be observed in performance of work, include following:
G. No wall or part of wall shall be permitted to fall outwardly from structures.
H. Maintain at least one stairway in each structure in usable condition to highest remaining floor. Keep stairway free of obstructions and debris until that level of structure has been removed.
I. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
J. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.
K. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the VAMC; any damaged items shall be repaired or replaced as approved by the COTR. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have COTR’s approval.

L. The work shall comply with the requirements of Section 01 5719, TEMPORARY ENVIRONMENTAL CONTROLS.

M. The work shall comply with the requirements of Section 01 0000, GENERAL REQUIREMENTS, Article 1.7 INFECTION PREVENTION MEASURES.

1.4 UTILITY SERVICES:
A. Demolish and remove outside utility service lines shown to be removed.
B. Remove abandoned outside utility lines that would interfere with installation of new utility lines and new construction.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 DEMOLITION:
A. Completely demolish and remove buildings and structures, including all appurtenances related or connected thereto, as noted below:
B. As required for installation of new utility service lines.
C. To full depth within an area defined by hypothetical lines located 1500 mm (5 feet) outside building lines of new structures.
D. Debris, including brick, concrete, stone, metals and similar materials shall become property of Contractor and shall be disposed of by him daily, off the Medical Center to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the COTR. Break up concrete slabs below grade that do not require removal from present location into pieces not exceeding 600 mm (24 inches) square to permit drainage. Contractor shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations.
E. In removing buildings and structures of more than two stories, demolish work story by story starting at highest level and progressing down to third floor level. Demolition of first and second stories may proceed simultaneously.
F. Remove and legally dispose of all materials, other than earth to remain as part of project work, from any trash dumps shown. Materials removed shall become property of contractor and shall be disposed of in compliance with applicable federal, state or local permits, rules and/or regulations be hauled to VA specified disposal site. All materials in the indicated trash dump areas, including above surrounding grade and extending to a depth of 1500mm (5feet) below surrounding grade, shall be included as part of the lump sum compensation for the work of this section. Materials that are located beneath the surface of the surrounding ground more than 1500 mm (5 feet), or materials that are discovered to be hazardous, shall be handled as unforeseen. The removal of hazardous material shall be referred to Hazardous Materials specifications.
G. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the...
COTR. When Utility lines are encountered that are not indicated on the drawings, the COTR shall be notified prior to further work in that area.

3.2 CLEANUP:

A. On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to COTR. Cleanup shall include disposal of all items and materials not required to remain property of the Government as well as all debris and rubbish resulting from demolition operations.

- - - END - - -
# TRADITIONAL ASBESTOS ABATEMENT

## TABLE OF CONTENTS

1.1 SUMMARY OF THE WORK ............................................................................................................... 5
1.1.1 CONTRACT DOCUMENTS AND RELATED REQUIREMENTS ............................................................... 5
1.1.2 EXTENT OF WORK .................................................................................................................................. 5
1.1.3 RELATED WORK ..................................................................................................................................... 6
1.1.4 TASKS ............................................................................................................................................. 6
1.1.5 CONTRACTORS USE OF PREMISES ........................................................................................... 6
1.2 VARIATIONS IN QUANTITY .............................................................................................................. 6
1.3 STOP ASBESTOS REMOVAL ........................................................................................................... 7
1.4 DEFINITIONS ..................................................................................................................................... 7
1.4.1 GENERAL ........................................................................................................................................ 7
1.4.2 GLOSSARY ..................................................................................................................................... 7
1.4.3 REFERENCED STANDARDS ORGANIZATIONS ........................................................................... 12
1.5 APPLICABLE CODES AND REGULATIONS ..................................................................................... 14
1.5.1 GENERAL APPLICABILITY OF CODES, REGULATIONS, AND STANDARDS ............................ 14
1.5.2 Asbestos Abatement CONTRACTOR RESPONSIBILITY........................................................... 14
1.5.3 FEDERAL REQUIREMENTS .......................................................................................................... 14
1.5.4 STATE REQUIREMENTS ............................................................................................................... 14
1.5.5 LOCAL REQUIREMENTS ............................................................................................................... 15
1.5.6 STANDARDS ................................................................................................................................... 15
1.5.7 EPA GUIDANCE DOCUMENTS ...................................................................................................... 15
1.5.8 NOTICES ......................................................................................................................................... 15
1.5.9 PERMITS/LICENSES ...................................................................................................................... 15
1.5.10 POSTING AND FILING OF REGULATIONS ................................................................................. 15
1.5.11 VA RESPONSIBILITIES ................................................................................................................ 15
1.5.12 EMERGENCY ACTION PLAN AND ARRANGEMENTS ............................................................... 16
1.5.13 PRE-CONSTRUCTION MEETING ................................................................................................ 16
1.6 PROJECT COORDINATION .............................................................................................................. 17
1.6.1 PERSONNEL ................................................................................................................................... 17
1.7 RESPIRATORY PROTECTION ........................................................................................................... 18
1.7.1 GENERAL - RESPIRATORY PROTECTION PROGRAM ........................................................... 18
1.7.2 RESPIRATORY PROTECTION PROGRAM COORDINATOR ................................................... 18
1.7.3 SELECTION AND USE OF RESPIRATORS ................................................................................... 18
1.7.4 MINIMUM RESPIRATORY PROTECTION ................................................................................... 18

653-10-531 VA Roseburg Correct Electrical Deficiencies 02 8211
100% Design Submittal 2017/03/10 1 of 51
3.1.3.2 NEGATIVE AIR MACHINES (HEPA UNITS) .......................................................... 30
3.1.3.3 PRESSURE DIFFERENTIAL .......................................................... 31
3.1.3.4 MONITORING .................................................. 31
3.1.3.5 AUXILIARY GENERATOR .............................................. 32
3.1.3.6 SUPPLEMENTAL MAKE-UP AIR INLETS ............................................ 32
3.1.3.7 TESTING THE SYSTEM .................................................. 32
3.1.3.8 DEMONSTRATION OF THE NEGATIVE PRESSURE Filtration SYSTEM .................................. 32
3.1.3.9 USE OF THE NEGATIVE PRESSURE FILTRATION SYSTEM DURING ABATEMENT OPERATIONS .............................................................. 32
3.1.3.10 DISMANTLING THE SYSTEM .................................................... 33
3.1.4 CONTAINMENT BARRIERS AND COVERINGS IN THE REGULATED AREA ................. 33
3.1.4.1 GENERAL .......................................................... 33
3.1.4.2 PREPARATION PRIOR TO SEALING THE REGULATED AREA ................................................. 33
3.1.4.3 CONTROLLING ACCESS TO THE REGULATED AREA ...... 33
3.1.4.4 CRITICAL BARRIERS .................................................. 33
3.1.4.5 PRIMARY BARRIERS .................................................. 34
3.1.4.6 SECONDARY BARRIERS .................................................. 34
3.1.4.7 EXTENSION OF THE REGULATED AREA ............................................... 34
3.1.4.8 FIRESTOPPING .................................................. 34
3.1.5 Sanitary facilities .......................................................... 34
3.1.6 PERSONAL PROTECTIVE EQUIPMENT .................................................. 34
3.1.7 Pre-cleaning .......................................................... 35
3.1.8 PRE-ABATEMENT ACTIVITIES .................................................. 35
3.1.8.1 PRE-ABATEMENT Meeting .................................................. 35
3.1.8.2 PRE-ABATEMENT CONSTRUCTION AND OPERATIONS ......................................................... 36
3.1.8.3 PRE-ABATEMENT INSPECTIONS AND PREPARATIONS ......................................................... 36
3.2 REMOVAL OF ACM .......................................................... 36
3.2.1 WETTING ACM .................................................. 36
3.2.2 SECONDARY BARRIER AND WALKWAYS .................................................. 37
3.2.3 WET REMOVAL OF ACM .................................................. 37
3.2.4 WET REMOVAL OF AMOSITE .................................................. 38
3.2.5 REMOVAL OF ACM/DIRT FLOORS AND OTHER SPECIAL PROCEDURES .................................................. 38
3.3 LOCKDOWN ENCAPSULATION .................................................. 39
3.3.1 GENERAL .......................................................... 39
3.3.2 DELIVERY AND STORAGE .................................................. 39
3.3.3 WORKER PROTECTION .................................................. 39
3.3.4 ENCAPSULATION OF SCRATCH COAT PLASTER OR PIPING .................................................. 39
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3.5</td>
<td>SEALING EXPOSED EDGES</td>
<td>40</td>
</tr>
<tr>
<td>3.4</td>
<td>DISPOSAL OF ACM WASTE MATERIALS</td>
<td>40</td>
</tr>
<tr>
<td>3.4.1</td>
<td>GENERAL</td>
<td>40</td>
</tr>
<tr>
<td>3.4.2</td>
<td>PROCEDURES</td>
<td>40</td>
</tr>
<tr>
<td>3.5</td>
<td>PROJECT DECONTAMINATION</td>
<td>40</td>
</tr>
<tr>
<td>3.5.1</td>
<td>GENERAL</td>
<td>40</td>
</tr>
<tr>
<td>3.5.2</td>
<td>REGULATED AREA CLEARANCE</td>
<td>41</td>
</tr>
<tr>
<td>3.5.3</td>
<td>WORK DESCRIPTION</td>
<td>41</td>
</tr>
<tr>
<td>3.5.4</td>
<td>PRE-DECONTAMINATION CONDITIONS</td>
<td>41</td>
</tr>
<tr>
<td>3.5.5</td>
<td>FIRST CLEANING</td>
<td>41</td>
</tr>
<tr>
<td>3.5.6</td>
<td>PRE-CLEARANCE INSPECTION AND TESTING</td>
<td>41</td>
</tr>
<tr>
<td>3.5.7</td>
<td>LOCKDOWN ENCAPSULATION OF ABATED SURFACES</td>
<td>41</td>
</tr>
<tr>
<td>3.6</td>
<td>FINAL VISUAL INSPECTION AND AIR CLEARANCE TESTING</td>
<td>41</td>
</tr>
<tr>
<td>3.6.1</td>
<td>GENERAL</td>
<td>41</td>
</tr>
<tr>
<td>3.6.2</td>
<td>FINAL VISUAL INSPECTION</td>
<td>42</td>
</tr>
<tr>
<td>3.6.3</td>
<td>FINAL AIR CLEARANCE TESTING</td>
<td>42</td>
</tr>
<tr>
<td>3.6.4</td>
<td>FINAL AIR CLEARANCE PROCEDURES</td>
<td>42</td>
</tr>
<tr>
<td>3.6.5</td>
<td>CLEARANCE SAMPLING USING PCM – LESS THAN 260LF/160SF</td>
<td>43</td>
</tr>
<tr>
<td>3.6.6</td>
<td>LABORATORY TESTING OF TEM SAMPLES</td>
<td>43</td>
</tr>
<tr>
<td>3.7</td>
<td>ABATEMENT CLOSEOUT AND CERTIFICATE OF COMPLIANCE</td>
<td>43</td>
</tr>
<tr>
<td>3.7.1</td>
<td>COMPLETION OF ABATEMENT WORK</td>
<td>43</td>
</tr>
<tr>
<td>3.7.2</td>
<td>CERTIFICATE OF COMPLETION BY CONTRACTOR</td>
<td>44</td>
</tr>
<tr>
<td>3.7.3</td>
<td>WORK SHIFTS</td>
<td>44</td>
</tr>
<tr>
<td>3.7.4</td>
<td>RE-INSULATION</td>
<td>44</td>
</tr>
<tr>
<td>ATTACHMENT #1</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>ATTACHMENT #2</td>
<td></td>
<td>47</td>
</tr>
<tr>
<td>ATTACHMENT #4</td>
<td></td>
<td>51</td>
</tr>
</tbody>
</table>
INSTRUCTIONS TO ARCHITECT/ENGINEER AND INDUSTRIAL HYGIENE CONSULTANT

SECTION 02 8211
CLASS I NEGATIVE PRESSURE ENCLOSURE ASBESTOS ABATEMENT SPECIFICATIONS

1. These specifications provide general guidance to personnel given the task of designing and executing a Class I negative pressure enclosure asbestos abatement project. Each abatement is a unique situation and therefore must be tailored for that project. This specification incorporates current regulatory requirements and current best abatement practices, procedures and technology. The Architect/Engineer and/or the Industrial Hygiene consultants may provide additional specification additions or deletions to this specification that, in their professional judgment, will ensure a safe and effective approach to a specific abatement project while maintaining compliance with applicable regulations and VA policy. Any changes must be clearly marked on/attached to this document prior to finalization of the specification so that the changes will be adequately considered in the review process by the VA.

2. These specifications are to be used in conjunction with asbestos abatement contractor selection criteria; special instructions package; and general construction provisions.

3. Paragraphs that are not preceded by a number code are indented as instructions to the specifications writer and identified by the notation "Spec Writer Notes". These paragraphs must be deleted from the final document.

4. Within the text of the specifications, there may be optional procedures which the specification writer could include in the final specification. Procedures which are not chosen must be deleted by the specification writer. Optional text is shown by the notation (/text/).

5. The specification writer, VPIH/CIH, CPIH/CIH, and A/E must be aware of and read the AEQA 10-95 since it details common errors in specification and contract documents for asbestos project. This would be especially helpful if a survey is being conducted prior to an abatement project. A full AHERA survey of the facility would be needed prior to renovation activities, however, if demolition of the facility is planned, a NESHAP survey of the facility would need to be performed.

PART 1 - GENERAL

1.1 SUMMARY OF THE WORK

1.1.1 CONTRACT DOCUMENTS AND RELATED REQUIREMENTS

Drawings, general provisions of the contract, including general and supplementary conditions and other Division 01 specifications, shall apply to the work of this section. The contract documents show the work to be done under the contract and related requirements and conditions impacting the project. Related requirements and conditions include applicable codes and regulations, notices and permits, existing site conditions and restrictions on use of the site, requirements for partial owner occupancy during the work, coordination with other work and the phasing of the work. In the event the Asbestos Abatement Contractor discovers a conflict in the contract documents and/or requirements or codes, the conflict must be brought to the immediate attention of the Contracting Officer for resolution. Whenever there is a conflict or overlap in the requirements, the most stringent shall apply. Any actions taken by the Contractor without obtaining guidance from the Contracting Officer shall become the sole risk and responsibility of the Asbestos Abatement Contractor. All costs incurred due to such action are also the responsibility of the Asbestos Abatement Contractor.

1.1.2 EXTENT OF WORK

A. Below is a brief description of the estimated quantities of asbestos containing materials to be abated. These quantities are for informational purposes only and are based on the best
information available at the time of the specification preparation. The Contractor shall satisfy himself as the actual quantities to be abated. Nothing in this section may be interpreted as limiting the extent of work otherwise required by this contract and related documents.

B. Removal, clean-up and disposal of asbestos containing materials (ACM) and asbestos/waste contaminated elements in an appropriate regulated area for the following approximate quantities:

- ( ) linear meters (feet) of <50 mm (2") diameter pipe insulation
- ( ) linear meters (feet) of 50 - 150 mm (2" - 6") diameter pipe insulation
- ( ) linear meters (feet) of >150 mm (6") diameter pipe insulation
- ( ) fittings 50 - 150 mm (2" - 6") in diameter
- ( ) square meters (feet) of boiler/tank insulation
- ( ) square meters (feet) of plaster ceiling/wall
- ( ) square meters (feet) of sprayed-on insulation
- ( ) cubic meters (feet) of contaminated soil/materials
- ( ) other // specify

C. Encapsulation of ACM in the following quantities:

D. Enclosure of ACM in the following quantities:

1.1.3 RELATED WORK

A. Section 02 41 00, DEMOLITION.
B. Division 09 FINISHES

1.1.4 TASKS

The work tasks are summarized briefly as follows:

A. Pre-abatement activities including pre-abatement meeting(s), inspection(s), notifications, permits, submittal approvals, regulated area preparations, emergency procedures arrangements, and standard operating procedures for asbestos abatement work.
B. Abatement activities including removal, encapsulation, enclosure, clean-up and disposal of ACM waste, recordkeeping, security, monitoring, and inspections.
C. Cleaning and decontamination activities including final visual inspection, air monitoring and certification of decontamination.

1.1.5 CONTRACTORS USE OF PREMISES

A. The Contractor and Contractor’s personnel shall cooperate fully with the VA representative/consultant to facilitate efficient use of buildings and areas within buildings. The Contractor shall perform the work in accordance with the VA specifications, drawings, phasing plan and in compliance with any/all applicable Federal, State and Local regulations and requirements.
B. The Contractor shall use the existing facilities in the building strictly within the limits indicated in contract documents as well as the approved VA Design and Construction Procedures. VA Design and Construction Procedures drawings of partially occupied buildings will show the limits of regulated areas; the placement of decontamination facilities; the temporary location of bagged waste ACM; the path of transport to outside the building; and the temporary waste storage area for each building/regulated area. Any variation from the arrangements shown on drawings shall be secured in writing from the VA representative through the pre-abatement plan of action. The following limitations of use shall apply to existing facilities shown on drawings:

1.2 VARIATIONS IN QUANTITY

The quantities and locations of ACM as indicated on the drawings and the extent of work included in this section are estimated which are limited by the physical constraints imposed by occupancy of the buildings and accessibility to ACM. Accordingly, minor variations (+/- 5%) in quantities of
ACM within the regulated area are considered as having no impact on contract price and time requirements of this contract. Where additional work is required beyond the above variation, the contractor shall provide unit prices for newly discovered ACM and those prices shall be used for additional work required under the contractor.

1.3 STOP ASBESTOS REMOVAL

If the Contracting Officer; their field representative; (the facility Safety Officer/Manager or their designee, or the VA Professional Industrial Hygienist/Certified Industrial Hygienist (VPIH/CIH) presents a verbal Stop Asbestos Removal Order, the Contractor/Personnel shall immediately stop all asbestos removal and maintain HEPA filtered negative pressure air flow in the containment and adequately wet any exposed ACM. If a verbal Stop Asbestos Removal Order is issued, the VA shall follow-up with a written order to the Contractor as soon as it is practicable. The Contractor shall not resume any asbestos removal activity until authorized to do so in writing by the VA Contracting Officer. A stop asbestos removal order may be issued at any time the VA Contracting Officer determines abatement conditions/activities are not within VA specification, regulatory requirements or that an imminent hazard exists to human health or the environment. Work stoppage will continue until conditions have been corrected to the satisfaction of the VA. Standby time and costs for corrective actions will be borne by the Contractor, including the VPIH/CIH time. The occurrence of any of the following events shall be reported immediately by the Contractor’s competent person to the VA Contracting Office or field representative using the most expeditious means (e.g., verbal or telephonic), followed up with written notification to the Contracting Officer as soon as practical. The Contractor shall immediately stop asbestos removal/disturbance activities and initiate fiber reduction activities:

A. Airborne PCM analysis results equal to or greater than 0.01 f/cc outside a regulated area or >0.05 f/cc inside a regulated area;
B. breach or break in regulated area containment barrier(s);
C. less than −0.02" WCG pressure in the regulated area;
D. serious injury/death at the site;
E. fire/safety emergency at the site;
F. respiratory protection system failure;
G. power failure or loss of wetting agent; or
H. any visible emissions observed outside the regulated area.

1.4 DEFINITIONS

1.4.1 GENERAL

Definitions and explanations here are neither complete nor exclusive of all terms used in the contract documents, but are general for the work to the extent they are not stated more explicitly in another element of the contract documents. Drawings must be recognized as diagrammatic in nature and not completely descriptive of the requirements indicated therein.

1.4.2 GLOSSARY

**Abatement** - Procedures to control fiber release from asbestos-containing materials. Includes removal, encapsulation, enclosure, demolition, and renovation activities related to asbestos containing materials (ACM).

**Aerosol** - Solid or liquid particulate suspended in air.

**Adequately wet** - Sufficiently mixed or penetrated with liquid to prevent the release of particulates. If visible emissions are observed coming from the ACM, then that material has not been adequately wetted.

**Aggressive method** - Removal or disturbance of building material by sanding, abrading, grinding, or other method that breaks, crumbles, or disintegrates intact ACM.

**Aggressive sampling** - EPA AHERA defined clearance sampling method using air moving equipment such as fans and leaf blowers to aggressively disturb and maintain in the air residual fibers after abatement.
Aircell - Pipe or duct insulation made of corrugated cardboard which contains asbestos.
Air monitoring - The process of measuring the fiber content of a known volume of air collected over a specified period of time. The NIOSH 7400 Method, Issue 2 is used to determine the fiber levels in air. For personal samples and clearance air testing using Phase Contrast Microscopy (PCM) analysis. NIOSH Method 7402 can be used when it is necessary to confirm fibers counted by PCM as being asbestos. The AHERA TEM analysis may be used for background, area samples and clearance samples when required by this specification, or at the discretion of the VPIH/CIH as appropriate.
Air sample filter - The filter used to collect fibers which are then counted. The filter is made of mixed cellulose ester membrane for PCM (Phase Contrast Microscopy) and polycarbonate for TEM (Transmission Electron Microscopy)
Amended water - Water to which a surfactant (wetting agent) has been added to increase the penetrating ability of the liquid.
Asbestos - Includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated or altered. Asbestos also includes PACM, as defined below.
Asbestos Hazard Abatement Plan (AHAP) - Asbestos work procedures required to be submitted by the contractor before work begins.
Asbestos-containing material (ACM) - Any material containing more than one percent of asbestos.
Asbestos contaminated elements (ACE) - Building elements such as ceilings, walls, lights, or ductwork that are contaminated with asbestos.
Asbestos-contaminated soil (ACS) - Soil found in the work area or in adjacent areas such as crawlspaces or pipe tunnels which is contaminated with asbestos-containing material debris and cannot be easily separated from the material.
Asbestos-containing waste (ACW) material - Asbestos-containing material or asbestos contaminated objects requiring disposal.
Asbestos Project Monitor - Some states require that any person conducting asbestos abatement clearance inspections and clearance air sampling be licensed as an asbestos project monitor.
Asbestos waste decontamination facility - A system consisting of drum/bag washing facilities and a temporary storage area for cleaned containers of asbestos waste. Used as the exit for waste and equipment leaving the regulated area. In an emergency, it may be used to evacuate personnel.
Authorized person - Any person authorized by the VA, the Contractor, or government agency and required by work duties to be present in regulated areas.
Authorized visitor - Any person approved by the VA; the contractor; or any government agency representative having jurisdiction over the regulated area (e.g., OSHA, Federal and State EPA.
Barrier - Any surface the isolates the regulated area and inhibits fiber migration from the regulated area.
Containment Barrier - An airtight barrier consisting of walls, floors, and/or ceilings of sealed plastic sheeting which surrounds and seals the outer perimeter of the regulated area.
Critical Barrier - The barrier responsible for isolating the regulated area from adjacent spaces, typically constructed of plastic sheeting secured in place at openings such as doors, windows, or any other opening into the regulated area.
Primary Barrier - Plastic barriers placed over critical barriers and exposed directly to abatement work.
Secondary Barrier - Any additional plastic barriers used to isolate and provide protection from debris during abatement work.
Breathing zone - The hemisphere forward of the shoulders with a radius of about 150 - 225 mm (6 - 9 inches) from the worker's nose.
Bridging encapsulant - An encapsulant that forms a layer on the surface of the ACM.
Building/facility owner - The legal entity, including a lessee, which exercises control over management and recordkeeping functions relating to a building and/or facility in which asbestos activities take place.
Bulk testing - The collection and analysis of suspect asbestos containing materials.
Certified Industrial Hygienist (CIH) - A person certified in the comprehensive practice of industrial hygiene by the American Board of Industrial Hygiene.

Class I asbestos work - Activities involving the removal of Thermal System Insulation (TSI) and surfacing ACM and Presumed Asbestos Containing Material (PACM).

Class II asbestos work - Activities involving the removal of ACM which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastic.

Clean room/Changing room - An uncontaminated room having facilities for the storage of employee's street clothing and uncontaminated materials and equipment.

Clearance sample - The final air sample taken after all asbestos work has been done and visually inspected. Performed by the VA's professional industrial hygiene consultant/Certified Industrial Hygienist (VPIH/CIH).

Closely resemble - The major workplace conditions which have contributed to the levels of historic asbestos exposure, are no more protective than conditions of the current workplace.

Competent person - In addition to the definition in 29 CFR 1926.32(f), one who is capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, who has the authority to take prompt corrective measures to eliminate them, as specified in 29 CFR 1926.32(f); in addition, for Class I and II work who is specially trained in a training course which meets the criteria of EPA's Model Accreditation Plan (40 CFR 763) for supervisor.

Contractor's Professional Industrial Hygienist (CPIH/CIH) - The asbestos abatement contractor's industrial hygienist. The industrial hygienist must meet the qualification requirements of a PIH and may be a certified industrial hygienist (CIH).

Count - Refers to the fiber count or the average number of fibers greater than five microns in length with a length-to-width (aspect) ratio of at least 3 to 1, per cubic centimeter of air.

Crawlspace – An area which can be found either in or adjacent to the work area. This area has limited access and egress and may contain asbestos materials and/or asbestos contaminated soil.

Decontamination area/unit - An enclosed area adjacent to and connected to the regulated area and consisting of an equipment room, shower room, and clean room, which is used for the decontamination of workers, materials, and equipment that are contaminated with asbestos.

Demolition - The wrecking or taking out of any load-supporting structural member and any related razing, removing, or stripping of asbestos products.

VA Total – means a building or substantial part of the building is completely removed, torn or knocked down, bulldozed, flattened, or razed, including removal of building debris.

Disposal bag - Typically 6 mil thick sift-proof, dustproof, leak-tight container used to package and transport asbestos waste from regulated areas to the approved landfill. Each bag/container must be labeled/marked in accordance with EPA, OSHA and DOT requirements.

Disturbance - Activities that disrupt the matrix of ACM or PACM, crumble or pulverize ACM or PACM, or generate visible debris from ACM or PACM. Disturbance includes cutting away small amounts of ACM or PACM, no greater than the amount that can be contained in one standard sized glove bag or waste bag in order to access a building component. In no event shall the amount of ACM or PACM so disturbed exceed that which can be contained in one glove bag or disposal bag which shall not exceed 60 inches in length or width.

Drum - A rigid, impermeable container made of cardboard fiber, plastic, or metal which can be sealed in order to be sift-proof, dustproof, and leak-tight.

Employee exposure - The exposure to airborne asbestos that would occur if the employee were not wearing respiratory protection equipment.

Encapsulant - A material that surrounds or embeds asbestos fibers in an adhesive matrix and prevents the release of fibers.

Encapsulation - Treating ACM with an encapsulant.

Enclosure - The construction of an air tight, impermeable, permanent barrier around ACM to control the release of asbestos fibers from the material and also eliminate access to the material.
**Equipment room** - 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.

**Fiber** - A particulate form of asbestos, 5 microns or longer, with a length to width (aspect) ratio of at least 3 to 1.

**Fibers per cubic centimeter (f/cc)** - Abbreviation for fibers per cubic centimeter, used to describe the level of asbestos fibers in air.

**Filter** - Media used in respirators, vacuums, or other machines to remove particulate from air.

**Firestopping** - Material used to close the open parts of a structure in order to prevent a fire from spreading.

**Friable asbestos containing material** - Any material containing more than one (1) percent or asbestos as determined using the method specified in appendix A, Subpart F, 40 CFR 763, section 1, Polarized Light Microscopy, that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.

**Glovebag** - Not more than a 60 x 60 inch impervious plastic bag-like enclosure affixed around an asbestos-containing material, with glove-like appendages through which materials and tools may be handled.

**High efficiency particulate air (HEPA) filter** - An ASHRAE MERV 17 filter capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometers in diameter.

**HEPA vacuum** - Vacuum collection equipment equipped with a HEPA filter system capable of collecting and retaining asbestos fibers.

**Homogeneous area** - An area of surfacing, thermal system insulation or miscellaneous ACM that is uniform in color, texture and date of application.

**HVAC** - Heating, Ventilation and Air Conditioning

**Industrial hygienist (IH)** - A professional qualified by education, training, and experience to anticipate, recognize, evaluate and develop controls for occupational health hazards. Meets definition requirements of the American Industrial Hygiene Association (AIHA).

**Industrial hygienist technician (IH Technician)** - A person working under the direction of an IH or CIH who has special training, experience, certifications and licenses required for the industrial hygiene work assigned. Some states require that an industrial hygienist technician conducting asbestos abatement clearance inspection and clearance air sampling be licensed as an asbestos project monitor.

**Intact** - The ACM has not crumbled, been pulverized, or otherwise deteriorated so that the asbestos is no longer likely to be bound with its matrix.

**Lockdown** - Applying encapsulant, after a final visual inspection, on all abated surfaces at the conclusion of ACM removal prior to removal of critical barriers.

**National Emission Standards for Hazardous Air Pollutants (NESHAP)** - EPA’s rule to control emissions of asbestos to the environment (40 CFR part 61, Subpart M).

**Negative initial exposure assessment** - A demonstration by the employer which complies with the criteria in 29 CFR 1926.1101 (f)(2)(iii), that employee exposure during an operation is expected to be consistently below the PEL.

**Negative pressure** - Air pressure which is lower than the surrounding area, created by exhausting air from a sealed regulated area through HEPA equipped filtration units. OSHA requires maintaining -0.02" water column gauge inside the negative pressure enclosure.

**Negative pressure respirator** - A respirator in which the air pressure inside the facepiece is negative during inhalation relative to the air pressure outside the respirator facepiece.

**Non-friable ACM** - Material that contains more than 1 percent asbestos but cannot be crumbled, pulverized, or reduced to powder by hand pressure.

**Organic vapor cartridge** - The type of cartridge used on air purifying respirators to remove organic vapor hazardous air contaminants.

**Outside air** - The air outside buildings and structures, including, but not limited to, the air under a bridge or in an open ferry dock.

**Owner/operator** - Any person who owns, leases, operates, controls, or supervises the facility being demolished or renovated or any person who owns, leases, operates, controls, or supervises the demolition or renovation operation, or both.
Penetrating encapsulant - Encapsulant that is absorbed into the ACM matrix without leaving a surface layer.

Personal sampling/monitoring - Representative air samples obtained in the breathing zone for one or more workers within the regulated area using a filter cassette and calibrated air sampling pump to determine asbestos exposure.

Permissible exposure limit (PEL) - The level of exposure OSHA allows for an 8 hour time weighted average. For asbestos fibers, the eight (8) hour time weighted average PEL is 0.1 fibers per cubic centimeter (0.1 f/cc) of air and the 30-minute Excursion Limit is 1.0 fibers per cubic centimeter (1 f/cc).

Personal protective equipment (PPE) – equipment designed to protect user from injury and/or specific job hazard. Such equipment may include protective clothing, hard hats, safety glasses, and respirators.

Pipe tunnel – An area, typically located adjacent to mechanical spaces or boiler rooms in which the pipes servicing the heating system in the building are routed to allow the pipes to access heating elements. These areas may contain asbestos pipe insulation, asbestos fittings, or asbestos-contaminated soil.

Polarized light microscopy (PLM) - Light microscopy using dispersion staining techniques and refractive indices to identify and quantify the type(s) of asbestos present in a bulk sample.

Polyethylene sheeting - Strong plastic barrier material 4 to 6 mils thick, semi-transparent, flame retardant per NFPA 241.

Positive/negative fit check - A method of verifying the seal of a facepiece respirator by temporarily occluding the filters and breathing in (inhaling) and then temporarily occluding the exhalation valve and breathing out (exhaling) while checking for inward or outward leakage of the respirator respectively.

Presumed ACM (PACM) - Thermal system insulation, surfacing, and flooring material installed in buildings prior to 1981. If the building owner has actual knowledge, or should have known through the exercise of due diligence that other materials are ACM, they too must be treated as PACM. The designation of PACM may be rebutted pursuant to 29 CFR 1926.1101 (b).

Professional IH - An IH who meets the definition requirements of AIHA; meets the definition requirements of OSHA as a "Competent Person" at 29 CFR 1926.1101 (b); has completed two specialized EPA approved courses on management and supervision of asbestos abatement projects; has formal training in respiratory protection and waste disposal; and has a minimum of four projects of similar complexity with this project of which at least three projects serving as the supervisory IH. The PIH may be either the VA’s PIH (VPIH) or Contractor’s PIH (CPIH/CIH).

Project designer - A person who has successfully completed the training requirements for an asbestos abatement project designer as required by 40 CFR 763 Appendix C, Part I; (B)(5).

Assigned protection factor - A value assigned by OSHA/NIOSH to indicate the expected protection provided by each respirator class, when the respirator is properly selected and worn correctly. The number indicates the reduction of exposure level from outside to inside the respirator facepiece.

Qualitative fit test (QLFT) - A fit test using a challenge material that can be sensed by the wearer if leakage in the respirator occurs.

Quantitative fit test (QNFT) - A fit test using a challenge material which is quantified outside and inside the respirator thus allowing the determination of the actual fit factor.

Regulated area - An area established by the employer to demarcate where Class I, II, III asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work may accumulate; and a work area within which airborne concentrations of asbestos exceed, or there is a reasonable possibility they may exceed the PEL.

Regulated ACM (RACM) - Friable ACM; Category I non-friable ACM that has become friable; Category I non-friable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading or; Category II non-friable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of the demolition or renovation operation.

Removal - All operations where ACM, PACM and/or RACM is taken out or stripped from structures or substrates, including demolition operations.
Renovation - Altering a facility or one or more facility components in any way, including the stripping or removal of asbestos from a facility component which does not involve demolition activity.

Repair - Overhauling, rebuilding, reconstructing, or reconditioning of structures or substrates, including encapsulation or other repair of ACM or PACM attached to structures or substrates.

Shower room - The portion of the PDF where personnel shower before leaving the regulated area.

Supplied air respirator (SAR) - A respiratory protection system that supplies minimum Grade D respirable air per ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989.

Surfacing ACM - A material containing more than 1 percent asbestos that is sprayed, troweled on or otherwise applied to surfaces for acoustical, fireproofing and other purposes.

Surfactant - A chemical added to water to decrease water's surface tension thus making it more penetrating into ACM.

Thermal system ACM - A material containing more than 1 percent asbestos applied to pipes, fittings, boilers, breeching, tanks, ducts, or other structural components to prevent heat loss or gain.

Transmission electron microscopy (TEM) - A microscopy method that can identify and count asbestos fibers.

VA Professional Industrial Hygienist (VPIH/CIH) – The Department of Veterans Affairs Professional Industrial Hygienist must meet the qualifications of a PIH, and may be a Certified Industrial Hygienist (CIH).

VA Representative - The VA official responsible for on-going project work.

Visible emissions - Any emissions, which are visually detectable without the aid of instruments, coming from ACM/PACM/RACM/ACS or ACM waste material.

Waste/Equipment decontamination facility (W/EDF) – The area in which equipment is decontaminated before removal from the regulated area.

Waste generator - Any owner or operator whose act or process produces asbestos-containing waste material.

Waste shipment record - The shipping document, required to be originated and signed by the waste generator, used to track and substantiate the disposition of asbestos-containing waste material.

Wet cleaning - The process of thoroughly eliminating, by wet methods, any asbestos contamination from surfaces or objects.

1.4.3 REFERENCED STANDARDS ORGANIZATIONS

The following acronyms or abbreviations as referenced in contract/specification documents are defined to mean the associated names. Names and addresses may be subject to change.

A. VA Department of Veterans Affairs
   810 Vermont Avenue, NW
   Washington, DC 20420

B. AIHA American Industrial Hygiene Association
   2700 Prosperity Avenue, Suite 250
   Fairfax, VA 22031
   703-849-8888

C. ANSI American National Standards Institute
   1430 Broadway
   New York, NY 10018
   212-354-3300

D. ASTM American Society for Testing and Materials
   1916 Race St.
Philadelphia, PA 19103
215-299-5400

E. CFR Code of Federal Regulations
Government Printing Office
Washington, DC 20420

F. CGA Compressed Gas Association
1235 Jefferson Davis Highway
Arlington, VA 22202
703-979-0900

G. CS Commercial Standard of the National Institute of Standards and Technology (NIST)
U. S. Department of Commerce
Government Printing Office
Washington, DC 20420

H. EPA Environmental Protection Agency
401 M St., SW
Washington, DC 20460
202-382-3949

I. MIL-STD Military Standards/Standardization Division
Office of the Assistant Secretary of Defense
Washington, DC 20420

J. NIST National Institute for Standards and Technology
U. S. Department of Commerce
Gaithersburg, MD 20234
301-921-1000

K. NEC National Electrical Code (by NFPA)

L. NEMA National Electrical Manufacturer's Association
2101 L Street, N.W.
Washington, DC 20037

M. NFPA National Fire Protection Association
1 Batterymarch Park
P.O. Box 9101
Quincy, MA 02269-9101
800-344-3555

N. NIOSH National Institutes for Occupational Safety and Health
4676 Columbia Parkway
Cincinnati, OH 45226
513-533-8236

O. OSHA Occupational Safety and Health Administration
U.S. Department of Labor
Government Printing Office
Washington, DC 20402

P. UL Underwriters Laboratory
333 Pfingsten Rd.
1.5 APPLICABLE CODES AND REGULATIONS

1.5.1 GENERAL APPLICABILITY OF CODES, REGULATIONS, AND STANDARDS

A. All work under this contract shall be done in strict accordance with all applicable Federal, State, and local regulations, standards and codes governing asbestos abatement, and any other trade work done in conjunction with the abatement. All applicable codes, regulations and standards are adopted into this specification and will have the same force and effect as this specification.

B. The most recent edition of any relevant regulation, standard, document or code shall be in effect. Where conflict among the requirements or with these specifications exists, the most stringent requirement(s) shall be utilized.

C. Copies of all standards, regulations, codes and other applicable documents, including this specification and those listed in Section 1.5 shall be available at the worksite in the clean change area of the worker decontamination system.

1.5.2 ASBESTOS ABATEMENT CONTRACTOR RESPONSIBILITY

The Asbestos Abatement Contractor (Contractor) shall assume full responsibility and liability for compliance with all applicable Federal, State and Local regulations related to any and all aspects of the asbestos abatement project. The Contractor is responsible for providing and maintaining training, accreditations, medical exams, medical records, personal protective equipment (PPE) including respiratory protection including respirator fit testing, as required by applicable Federal, State and Local regulations. The Contractor shall hold the VA and VPIH/CIH consultants harmless for any Contractor's failure to comply with any applicable work, packaging, transporting, disposal, safety, health, or environmental requirement on the part of himself, his employees, or his subcontractors. The Contractor will incur all costs of the CPIH/CIH, including all sampling/analytical costs to assure compliance with OSHA/EPA/State requirements related to failure to comply with the regulations applicable to the work.

1.5.3 FEDERAL REQUIREMENTS

Federal requirements which govern of asbestos abatement include, but are not limited to, the following regulations.

A. Occupational Safety and Health Administration (OSHA)
   1. Title 29 CFR 1926.1101 - Construction Standard for Asbestos
   2. Title 29 CFR 1910 Subpart I - Personal Protective Equipment
   3. Title 29 CFR 1910.134 - Respiratory Protection
   4. Title 29 CFR 1926 - Construction Industry Standards
   5. Title 29 CFR 1910.1020 - Access to Employee Exposure and Medical Records
   7. Title 29 CFR 1910 Subpart K - Medical and First Aid

B. Environmental Protection Agency (EPA):
   2. 40 CFR 763.80 - Asbestos Hazard Emergency Response Act (AHERA)

C. Department of Transportation (DOT)
   Title 49 CFR 100 - 185 – Transportation

1.5.4 STATE REQUIREMENTS

State requirements that apply to the asbestos abatement work, disposal, clearance, etc., include, but are not limited to, the following:

S
1.5.5 LOCAL REQUIREMENTS

If local requirements are more stringent than federal or state standards, the local standards are to be followed.

1.5.6 STANDARDS

A. Standards which govern asbestos abatement activities include, but are not limited to, the following:

B. Standards which govern encapsulation work include, but are not limited to the following:
   1. American Society for Testing and Materials (ASTM)

C. Standards which govern the fire and safety concerns in abatement work include, but are not limited to, the following:
   2. NFPA 701 - Standard Methods for Fire Tests for Flame Resistant Textiles and Film.

1.5.7 EPA GUIDANCE DOCUMENTS

A. EPA guidance documents which discuss asbestos abatement work activities are listed below. These documents are made part of this section by reference. EPA publications can be ordered from (800) 424-9065.
   B. Guidance for Controlling ACM in Buildings (Purple Book) EPA 560/5-85-024
   C. Asbestos Waste Management Guidance EPA 530-SW-85-007
   D. A Guide to Respiratory Protection for the Asbestos Abatement Industry EPA-560-OPTS-86-001
   E. Guide to Managing Asbestos in Place (Green Book) TS 799 20T July 1990

1.5.8 NOTICES

A. State and Local agencies: Send written notification as required by state and local regulations including the local fire department prior to beginning any work on ACM as follows:
B. Copies of notifications shall be submitted to the VA for the facility's records in the same time frame notification are given to EPA, State, and Local authorities.

1.5.9 PERMITS/LICENSES

A. The contractor shall apply for and have all required permits and licenses to perform asbestos abatement work as required by Federal, State, and Local regulations.

1.5.10 POSTING AND FILING OF REGULATIONS

A. Maintain two (2) copies of applicable federal, state, and local regulations. Post one copy of each in the clean room at the regulated area where workers will have daily access to the regulations and keep another copy in the Contractor's office.

1.5.11 VA RESPONSIBILITIES

Prior to commencement of work:

A. Notify occupants adjacent to regulated areas of project dates and requirements for relocation, if needed. Arrangements must be made prior to starting work for relocation of desks, files, equipment and personal possessions to avoid unauthorized access into the regulated area. Note:
Notification of adjacent personnel is required by OSHA in 29 CFR 1926.1101 (k) to prevent unnecessary or unauthorized access to the regulated area.

**B.** Submit to the Contractor results of background air sampling; including location of samples, person who collected the samples, equipment utilized, calibration data and method of analysis. During abatement, submit to the Contractor, results of bulk material analysis and air sampling data collected during the course of the abatement. This information shall not release the Contractor from any responsibility for OSHA compliance.

### 1.5.12 EMERGENCY ACTION PLAN AND ARRANGEMENTS

**A.** An Emergency Action Plan shall be developed prior to commencing abatement activities and shall be agreed to by the Contractor and the VA. The Plan shall meet the requirements of 29 CFR 1910.38 (a);(b).

**B.** Emergency procedures shall be in written form and prominently posted in the clean room and equipment room of the decontamination unit. Everyone, prior to entering the regulated area, must read and sign these procedures to acknowledge understanding of the regulated area layout, location of emergency exits and emergency procedures.

**C.** Emergency planning shall include written notification of police, fire, and emergency medical personnel of planned abatement activities; work schedule; layout of regulated area; and access to the regulated area, particularly barriers that may affect response capabilities.

**D.** Emergency planning shall include consideration of fire, explosion, hazardous atmospheres, electrical hazards, slips/trips and falls, confined spaces, and heat stress illness. Written procedures for response to emergency situations shall be developed and employee training in procedures shall be provided.

**E.** Employees shall be trained in regulated area/site evacuation procedures in the event of workplace emergencies.

1. For non life-threatening situations - employees injured or otherwise incapacitated shall decontaminate following normal procedures with assistance from fellow workers, if necessary, before exiting the regulated area to obtain proper medical treatment.

2. For life-threatening injury or illness, worker decontamination shall take least priority after measures to stabilize the injured worker, remove them from the regulated area, and secure proper medical treatment.

**F.** Telephone numbers of any/all emergency response personnel shall be prominently posted in the clean room, along with the location of the nearest telephone.

**G.** The Contractor shall provide verification of first aid/CPR training for personnel responsible for providing first aid/CPR. OSHA requires medical assistance within 3-4 minutes of a life-threatening injury/illness. Bloodborne Pathogen training shall also be verified for those personnel required to provide first aid/CPR.

**H.** The Emergency Action Plan shall provide for a Contingency Plan in the event that an incident occurs that may require the modification of the standard operating procedures during abatement. Such incidents include, but are not limited to, fire; accident; power failure; negative pressure failure; and supplied air system failure. The Contractor shall detail procedures to be followed in the event of an incident assuring that asbestos abatement work is stopped and wetting is continued until correction of the problem.

### 1.5.13 PRE-CONSTRUCTION MEETING

Prior to commencing the work, the Contractor shall meet with the VA Certified Industrial Hygienist (VPCIH) to present and review, as appropriate, the items following this paragraph. The Contractor’s Competent Person(s) who will be on-site shall participate in the pre-start meeting. The pre-start meeting is to discuss and determine procedures to be used during the project. At this meeting, the Contractor shall provide:

**A.** Proof of Contractor licensing.

**B.** Proof the Competent Person(s) is trained and accredited and approved for working in this State. Verification of the experience of the Competent Person(s) shall also be presented.
C. A list of all workers who will participate in the project, including experience and verification of training and accreditation.
D. A list of and verification of training for all personnel who have current first-aid/CPR training. A minimum of one person per shift must have adequate training.
E. Current medical written opinions for all personnel working on-site meeting the requirements of 29 CFR 1926.1101 (m).
F. Current fit-tests for all personnel wearing respirators on-site meeting the requirements of 29 CFR 1926.1101 (h) and Appendix C.
G. A copy of the Contractor's Asbestos Hazard Abatement Plan. In these procedures, the following information must be detailed, specific for this project.
   1. Regulated area preparation procedures;
   2. Notification requirements procedure of Contractor as required in 29 CFR 1926.1101 (d);
   3. Decontamination area set-up/layout and decontamination procedures for employees;
   4. Abatement methods/procedures and equipment to be used;
   5. Personal protective equipment to be used;
H. At this meeting the Contractor shall provide all submittals as required.
I. Procedures for handling, packaging and disposal of asbestos waste.

1.6 PROJECT COORDINATION

The following are the minimum administrative and supervisory personnel necessary for coordination of the work.

1.6.1 PERSONNEL

A. Administrative and supervisory personnel shall consist of a qualified Competent Person(s) as defined by OSHA in the Construction Standards and the Asbestos Construction Standard; Contractor Professional Industrial Hygienist and Industrial Hygiene Technicians. These employees are the Contractor's representatives responsible for compliance with these specifications and all other applicable requirements.
B. Non-supervisory personnel shall consist of an adequate number of qualified personnel to meet the schedule requirements of the project. Personnel shall meet required qualifications. Personnel utilized on-site shall be pre-approved by the VA representative. A request for approval shall be submitted for any person to be employed during the project giving the person's name; social security number; qualifications; accreditation card with color picture; Certificate of Worker's Acknowledgment; and Affidavit of Medical Surveillance and Respiratory Protection and current Respirator Fit Test.
C. Minimum qualifications for Contractor and assigned personnel are:
   1. The Contractor has conducted within the last three (3) years, three (3) projects of similar complexity and dollar value as this project; has not been cited and penalized for serious violations of federal (and state as applicable) EPA and OSHA asbestos regulations in the past three (3) years; has adequate liability/occurrence insurance for asbestos work as required by the state; is licensed in applicable states; has adequate and qualified personnel available to complete the work; has comprehensive standard operating procedures for asbestos work; has adequate materials, equipment and supplies to perform the work.
   2. The Competent Person has four (4) years of abatement experience of which two (2) years were as the Competent Person on the project; meets the OSHA definition of a Competent Person; has been the Competent Person on two (2) projects of similar size and complexity as this project within the past three (3) years; has completed EPA AHERA/OSHA/State/Local training requirements/accreditation(s) and refreshers; and has all required OSHA documentation related to medical and respiratory protection.
   3. The Contractor Professional Industrial Hygienist/CIH (CPIH/CIH) shall have five (5) years of monitoring experience and supervision of asbestos abatement projects; has participated as senior IH on five (5) abatement projects, three (3) of which are similar in size and complexity as this project; has developed at least one complete standard operating procedure for asbestos abatement; has trained abatement personnel for three (3) years; has specialized
EPA AHERA/OSHA training in asbestos abatement management, respiratory protection, waste disposal and asbestos inspection; has completed the NIOSH 582 Course or equivalent, Contractor/Supervisor course; and has appropriate medical/respiratory protection records/documentation.

4. The Abatement Personnel shall have completed the EPA AHERA/OSHA abatement worker course; have training on the standard operating procedures of the Contractor; has one year of asbestos abatement experience within the past three (3) years of similar size and complexity; has applicable medical and respiratory protection documentation; has certificate of training/current refresher and State accreditation/license.

All personnel should be in compliance with OSHA construction safety training as applicable and submit certification.

1.7 RESPIRATORY PROTECTION

1.7.1 GENERAL - RESPIRATORY PROTECTION PROGRAM

The Contractor shall develop and implement a written Respiratory Protection Program (RPP) which is in compliance with the January 8, 1998 OSHA requirements found at 29 CFR 1926.1101 and 29 CFR 1910.Subpart I;134. ANSI Standard Z88.2-1992 provides excellent guidance for developing a respiratory protection program. All respirators used must be NIOSH approved for asbestos abatement activities. The written RPP shall, at a minimum, contain the basic requirements found at 29 CFR 1910.134 (c)(1)(i - ix) - Respiratory Protection Program.

1.7.2 RESPIRATORY PROTECTION PROGRAM COORDINATOR

The Respiratory Protection Program Coordinator (RPPC) must be identified and shall have two (2) years experience coordinating RPP of similar size and complexity. The RPPC must submit a signed statement attesting to the fact that the program meets the above requirements.

1.7.3 SELECTION AND USE OF RESPIRATORS

The procedure for the selection and use of respirators must be submitted to the VA as part of the Contractor's qualifications. The procedure must written clearly enough for workers to understand. A copy of the Respiratory Protection Program must be available in the clean room of the decontamination unit for reference by employees or authorized visitors.

1.7.4 MINIMUM RESPIRATORY PROTECTION

Minimum respiratory protection shall be a full face powered air purifying respirator when fiber levels are maintained consistently at or below 0.5 f/cc. A higher level of respiratory protection may be provided or required, depending on fiber levels. Respirator selection shall meet the requirements of 29 CFR 1926.1101 (h); Table 1, except as indicated in this paragraph. Abatement personnel must have a respirator for their exclusive use.

1.7.5 MEDICAL WRITTEN OPINION

No employee shall be allowed to wear a respirator unless a physician or other licensed health care professional has provided a written determination they are medically qualified to wear the class of respirator to be used on the project while wearing whole body impermeable garments and subjected to heat or cold stress.

1.7.6 RESPIRATOR FIT TEST

All personnel wearing respirators shall have a current qualitative/quantitative fit test which was conducted in accordance with 29 CFR 1910.134 (f) and Appendix A. Quantitative fit tests shall be done for PAPRs which have been put into a motor/blower failure mode.
1.7.7 RESPIRATOR FIT CHECK

The Competent Person shall assure that the positive/negative pressure user seal check is done each time the respirator is donned by an employee. Head coverings must cover respirator head straps. Any situation that prevents an effective facepiece to face seal as evidenced by failure of a user seal check shall preclude that person from wearing a respirator inside the regulated area until resolution of the problem.

1.7.8 MAINTENANCE AND CARE OF RESPIRATORS

The Respiratory Protection Program Coordinator shall submit evidence and documentation showing compliance with 29 CFR 1910.134 (h) Maintenance and Care of Respirators.

1.7.9 SUPPLIED AIR SYSTEMS

If a supplied air system is used, the system shall meet all requirements of 29 CFR 1910.134 and the ANSI/Compressed Gas Association (CGA) Commodity Specification for Air current requirements for Type 1 - Grade D breathing air. Low pressure systems are not allowed to be used on asbestos abatement projects. Supplied Air respirator use shall be in accordance with EPA/NIOSH publication EPA-560-OPTS-86-001 "A Guide to Respiratory Protection for the Asbestos Abatement Industry". The competent person on site will be responsible for the supplied air system to ensure the safety of the worker.

1.8 WORKER PROTECTION

1.8.1 TRAINING OF ABATEMENT PERSONNEL

Prior to beginning any abatement activity, all personnel shall be trained in accordance with OSHA 29 CFR 1926.1101 (k)(9) and any additional State/Local requirements. Training must include, at a minimum, the elements listed at 29 CFR 1926.1101 (k)(9)(viii). Training shall have been conducted by a third party, EPA/State approved trainer meeting the requirements of EPA 40 CFR 763 Appendix C (AHERA MAP). Initial training certificates and current refresher and accreditation proof must be submitted for each person working at the site.

1.8.2 MEDICAL EXAMINATIONS

Medical examinations meeting the requirements of 29 CFR 1926.1101 (m) shall be provided for all personnel working in the regulated area, regardless of exposure levels. A current physician's written opinion as required by 29 CFR 1926.1101 (m)(4) shall be provided for each person and shall include in the medical opinion the person has been evaluated for working in a heat and cold stress environment while wearing personal protective equipment (PPE) and is able to perform the work without risk of material health impairment.

1.8.3 REGULATED AREA ENTRY PROCEDURE

The Competent Person shall ensure that each time workers enter the regulated area; they remove ALL street clothes in the clean room of the decontamination unit and put on new disposable coveralls, head coverings, a clean respirator, and then proceed through the shower room to the equipment room where they put on non-disposable required personal protective equipment.

1.8.4 DECONTAMINATION PROCEDURE

The Competent Person shall require all personnel to adhere to following decontamination procedures whenever they leave the regulated area.

A. When exiting the regulated area, remove disposable coveralls, and ALL other clothes, disposable head coverings, and foot coverings or boots in the equipment room.

B. Still wearing the respirator and completely naked, proceed to the shower. Showering is MANDATORY. Care must be taken to follow reasonable procedures in removing the respirator to
avoid inhaling asbestos fibers while showering. The following procedure is required as a minimum:

1. Thoroughly wet body including hair and face. If using a PAPR hold blower above head to keep filters dry.
2. With respirator still in place, thoroughly decontaminate body, hair, respirator face piece, and all other parts of the respirator except the blower and battery pack on a PAPR. Pay particular attention to cleaning the seal between the face and respirator facepiece and under the respirator straps.
3. Take a deep breath, hold it and/or exhale slowly, completely wetting hair, face, and respirator. While still holding breath, remove the respirator and hold it away from the face before starting to breathe.

C. Carefully decontaminate the facepiece of the respirator inside and out. If using a PAPR, shut down using the following sequence: a) first cap inlets to filters; b) turn blower off to keep debris collected on the inlet side of the filter from dislodging and contaminating the outside of the unit; c) thoroughly decontaminate blower and hoses; d) carefully decontaminate battery pack with a wet rag being cautious of getting water in the battery pack thus preventing destruction.

(This procedure is not a substitute for respirator cleaning!)

D. Shower and wash body completely with soap and water. Rinse thoroughly.
E. Rinse shower room walls and floor to drain prior to exiting.

F. Proceed from shower to clean room; dry off and change into street clothes or into new disposable work clothing.

1.8.5 REGULATED AREA REQUIREMENTS

The Competent Person shall meet all requirements of 29 CFR 1926.1101 (o) and assure that all requirements for regulated areas at 29 CFR 1926.1101 (e) are met. All personnel in the regulated area shall not be allowed to eat, drink, smoke, chew tobacco or gum, apply cosmetics, or in any way interfere with the fit of their respirator.

1.9 DECONTAMINATION FACILITIES

1.9.1 DESCRIPTION

Provide each regulated area with separate personnel decontamination facilities (PDF) and waste/equipment decontamination facilities (W/EDF). Ensure that the PDF are the only means of ingress and egress to the regulated area and that all equipment, bagged waste, and other material exit the regulated area only through the W/EDF.

1.9.2 GENERAL REQUIREMENTS

All personnel entering or exiting a regulated area must go through the PDF and shall follow the requirements at 29 CFR 1926.1101 (j)(1) and these specifications. All waste, equipment and contaminated materials must exit the regulated area through the W/EDF and be decontaminated in accordance with these specifications. Walls and ceilings of the PDF and W/EDF must be constructed of a minimum of 3 layers of 6 mil opaque fire retardant polyethylene sheeting and be securely attached to existing building components and/or an adequate temporary framework. A minimum of 3 layers of 6 mil poly shall also be used to cover the floor under the PDF and W/EDF units. Construct doors so that they overlap and secure to adjacent surfaces. Weight inner doorway sheets with layers of duct tape so that they close quickly after release. Put arrows on sheets so they show direction of travel and overlap. If the building adjacent area is occupied, construct a solid barrier on the occupied side(s) to protect the sheeting and reduce potential for non-authorized personnel entering the regulated area.

1.9.3 TEMPORARY FACILITIES TO THE PDF AND W/EDF

The Competent Person shall provide temporary water service connections to the PDF and W/EDF. Backflow prevention must be provided at the point of connection to the VA system. Water supply must be of adequate pressure and meet requirements of 29 CFR 1910.141(d)(3). Provide
adequate temporary overhead electric power with ground fault circuit interruption (GFCI) protection. Provide a sub-panel equipped with GFCI protection for all temporary power in the clean room. Provide adequate lighting to provide a minimum of 50 foot candles in the PDF and W/EDF. Provide temporary heat, if needed, to maintain 70°F throughout the PDF and W/EDF.

1.9.4 PERSONNEL DECONTAMINATION FACILITY (PDF)

The Competent Person shall provide a PDF consisting of shower room which is contiguous to a clean room and equipment room which is connected to the regulated area. The PDF must be sized to accommodate the number of personnel scheduled for the project. The shower room, located in the center of the PDF, shall be fitted with as many portable showers as necessary to insure all employees can complete the entire decontamination procedure within 15 minutes. The PDF shall be constructed of opaque poly for privacy. The PDF shall be constructed to eliminate any parallel routes of egress without showering.

1. Clean Room: The clean room must be physically and visually separated from the rest of the building to protect the privacy of personnel changing clothes. The clean room shall be constructed of at least 3 layers of 6 mil opaque fire retardant poly to provide an air tight room. Provide a minimum of 2 - 900 mm (3 foot) wide 6 mil poly opaque fire retardant doorways. One doorway shall be the entry from outside the PDF and the second doorway shall be to the shower room of the PDF. The floor of the clean room shall be maintained in a clean, dry condition. Shower overflow shall not be allowed into the clean room. Provide 1 storage locker per person. A portable fire extinguisher, minimum 10 pounds capacity, Type ABC, shall be provided in accordance with OSHA and NFPA Standard 10. All persons entering the regulated area shall remove all street clothing in the clean room and dress in disposable protective clothing and respiratory protection. Any person entering the clean room does so either from the outside with street clothing on or is coming from the shower room completely naked and thoroughly washed. Females required to enter the regulated area shall be ensured of their privacy throughout the entry/exit process by posting guards at both entry points to the PDF so no male can enter or exit the PDF during her stay in the PDF.

2. Shower Room: The Competent Person shall assure that the shower room is a completely water tight compartment to be used for the movement of all personnel from the clean room to the equipment room and for the showering of all personnel going from the equipment room to the clean room. Each shower shall be constructed so water runs down the walls of the shower and into a drip pan. Install a freely draining smooth floor on top of the shower pan. The shower room shall be separated from the rest of the building and from the clean room and equipment room using air tight walls made from at least 3 layers of 6 mil opaque fire retardant poly. The shower shall be equipped with a shower head and controls, hot and cold water, drainage, soap dish and continuous supply of soap, and shall be maintained in a sanitary condition throughout its use. The controls shall be arranged so an individual can shower without assistance. Provide a flexible hose shower head, hose bibs and all other items shown on Shower Schematic. Waste water will be pumped to a drain after being filtered through a minimum of a 100 micron sock in the shower drain; a 20 micron filter; and a final 5 micron filter. Filters will be changed a minimum of daily or more often as needed. Filter changes must be done in the shower to prevent loss of contaminated water. Hose down all shower surfaces after each shift and clean any debris from the shower pan. Residue is to be disposed of as asbestos waste.

3. Equipment Room: The Competent Person shall provide an equipment room which shall be an air tight compartment for the storage of work equipment/tools, reusable personal protective equipment, except for a respirator and for use as a gross decontamination area for personnel exiting the regulated area. The equipment room shall be separated from the regulated area by a minimum 3 foot wide door made with 2 layers of 6 mil opaque fire retardant poly. The equipment room shall be separated from the regulated area, the shower room and the rest of the building by air tight walls and ceiling constructed of a minimum of 3 layers of 6 mil opaque fire retardant poly. Damp wipe all surfaces of the equipment room after each shift change. Provide an additional loose layer of 6 mil fire retardant poly per shift change and remove this.
layer after each shift. If needed, provide a temporary electrical sub-panel equipped with GFCI in the equipment room to accommodate any equipment required in the regulated area.

4. The PDF shall be as follows: Clean room at the entrance followed by a shower room followed by an equipment room leading to the regulated area. Each doorway in the PDF shall be a minimum of 2 layers of 6 mil opaque fire retardant poly.

1.9.5 WASTE/EQUIPMENT DECONTAMINATION FACILITY (W/EDF)

The Competent Person shall provide an W/EDF consisting of a wash room, holding room, and clean room for removal of waste, equipment and contaminated material from the regulated area. Personnel shall not enter or exit the W/EDF except in the event of an emergency. Clean debris and residue in the W/EDF daily. All surfaces in the W/EDF shall be wiped/hosed down after each shift and all debris shall be cleaned from the shower pan. The W/EDF shall consist of the following:

1. Wash Down Station: Provide an enclosed shower unit in the regulated area just outside the Wash Room as an equipment bag and container cleaning station.

2. Wash Room: Provide a wash room for cleaning of bagged or containerized asbestos containing waste materials passed from the regulated area. Construct the wash room using 50 x 100 mm (2" x 4") wood framing and 3 layers of 6 mil fire retardant poly. Locate the wash room so that packaged materials, after being wiped clean, can be passed to the Holding Room. Doorways in the wash room shall be constructed of 2 layers of 6 mil fire retardant poly.

3. Holding Room: Provide a holding room as a drop location for bagged materials passed from the wash room. Construct the holding room using 50 x 100 mm (2" x 4") wood framing and 3 layers of 6 mil fire retardant poly. The holding room shall be located so that bagged material cannot be passed from the wash room to the clean room unless it goes through the holding room. Doorways in the holding room shall be constructed of 2 layers of 6 mil fire retardant poly.

4. Clean Room: Provide a clean room to isolate the holding room from the exterior of the regulated area. Construct the clean room using 2 x 4 wood framing and 2 layers of 6 mil fire retardant poly. The clean room shall be located so as to provide access to the holding room from the building exterior. Doorways to the clean room shall be constructed of 2 layers of 6 mil fire retardant poly. When a negative pressure differential system is used, a rigid enclosure separation between the W/EDF clean room and the adjacent areas shall be provided.

5. The W/EDF shall be as follows: Wash Room leading to a Holding Room followed by a Clean Room leading to outside the regulated area. See diagram.
1.9.6 WASTE/EQUIPMENT DECONTAMINATION PROCEDURES

At the washdown station in the regulated area, thoroughly wet clean contaminated equipment and/or sealed polyethylene bags and pass into Wash Room after visual inspection. When passing anything into the Wash Room, close all doorways of the W/EDF, other than the doorway between the washdown station and the Wash Room. Keep all outside personnel clear of the W/EDF. Once inside the Wash Room, wet clean the equipment and/or bags. After cleaning and inspection, pass items into the Holding Room. Close all doorways except the doorway between the Holding Room and the Clean Room. Workers from the Clean Room/Exterior shall enter the Holding Room and remove the decontaminated/cleaned equipment/bags for removal and disposal. These personnel will not be required to wear PPE. At no time shall personnel from the clean side be allowed to enter the Wash Room.

PART 2 - PRODUCTS, MATERIALS AND EQUIPMENT

2.1 MATERIALS AND EQUIPMENT

2.1.1 GENERAL REQUIREMENTS

Prior to the start of work, the contractor shall provide and maintain a sufficient quantity of materials and equipment to assure continuous and efficient work throughout the duration of the project. Work shall not start unless the following items have been delivered to the site and the CPIH/CIH has submitted verification to the VA's representative.

A. All materials shall be delivered in their original package, container or bundle bearing the name of the manufacturer and the brand name (where applicable).

B. Store all materials subject to damage off the ground, away from wet or damp surfaces and under cover sufficient enough to prevent damage or contamination. Flammable and combustible materials cannot be stored inside buildings. Replacement materials shall be stored outside of the regulated area until abatement is completed.

C. The Contractor shall not block or hinder use of buildings by patients, staff, and visitors to the VA in partially occupied buildings by placing materials/equipment in any unauthorized location.

D. The Competent Person shall inspect for damaged, deteriorating or previously used materials. Such materials shall not be used and shall be removed from the worksite and disposed of properly.

E. Polyethylene sheeting for walls in the regulated area shall be a minimum of 4-mils. For floors and all other uses, sheeting of at least 6-mil shall be used in widths selected to minimize the frequency of joints. Fire retardant poly shall be used throughout.

F. The method of attaching polyethylene sheeting shall be agreed upon in advance by the Contractor and the VA and selected to minimize damage to equipment and surfaces. Method of attachment may include any combination of moisture resistant duct tape furring strips, spray glue, staples, nails, screws, lumber and plywood for enclosures or other effective procedures capable of sealing polyethylene to dissimilar finished or unfinished surfaces under both wet and dry conditions.

G. Polyethylene sheeting utilized for the PDF shall be opaque white or black in color, 6 mil fire retardant poly.
H. Installation and plumbing hardware, showers, hoses, drain pans, sump pumps and waste water filtration system shall be provided by the Contractor.

I. An adequate number of HEPA vacuums, scrapers, sprayers, nylon brushes, brooms, disposable mops, rags, sponges, staple guns, shovels, ladders and scaffolding of suitable height and length as well as meeting OSHA requirements, fall protection devices, water hose to reach all areas in the regulated area, airless spray equipment, and any other tools, materials or equipment required to conduct the abatement project. All electrically operated hand tools, equipment, electric cords shall be connected to GFCI protection.

J. Special protection for objects in the regulated area shall be detailed (e.g., plywood over carpeting or hardwood floors to prevent damage from scaffolds, water and falling material).

K. Disposal bags – 2 layers of 6 mil poly for asbestos waste shall be pre-printed with labels, markings and address as required by OSHA, EPA and DOT regulations.

L. The VA shall be provided an advance copy of the MSDS as required for all hazardous chemicals under OSHA 29 CFR 1910.1200 - Hazard Communication in the pre-start meeting submittal. Chlorinated compounds shall not be used with any spray adhesive, mastic remover or other product. Appropriate encapsulant(s) shall be provided.

M. OSHA DANGER demarcation signs, as many and as required by OSHA 29 CFR 1926.1101(k)(7) shall be provided and placed by the Competent Person. All other posters and notices required by Federal and State regulations shall be posted in the Clean Room.

N. Adequate and appropriate PPE for the project and number of personnel/shifts shall be provided. All personal protective equipment issued must be based on a written hazard assessment conducted under 29 CFR 1910.132(d).

2.2 MONITORING, INSPECTION AND TESTING

2.2.1 GENERAL

A. Perform throughout abatement work monitoring, inspection and testing inside and around the regulated area in accordance with the OSHA requirements and these specifications. OSHA requires that the employee exposure to asbestos must not exceed 0.1 fiber per cubic centimeter (f/cc) of air, averaged over an 8-hour work shift. The CPIH/CIH is responsible for and shall inspect and oversee the performance of the Contractor IH Technician. The IH Technician shall continuously inspect and monitor conditions inside the regulated area to ensure compliance with these specifications. In addition, the CPIH/CIH shall personally manage air sample collection, analysis, and evaluation for personnel, regulated area, and adjacent area samples to satisfy OSHA requirements. Additional inspection and testing requirements are also indicated in other parts of this specification.

B. The VA will employ an independent industrial hygienist (VPIH/CIH) consultant and/or use its own IH to perform various services on behalf of the VA. The VPIH/CIH will perform the necessary monitoring, inspection, testing, and other support services to ensure that VA patients, employees, and visitors will not be adversely affected by the abatement work, and that the abatement work proceeds in accordance with these specifications, that the abated areas or abated buildings have been successfully decontaminated. The work of the VPIH/CIH consultant in no way relieves the Contractor from their responsibility to perform the work in accordance with contract/specification requirements, to perform continuous inspection, monitoring and testing for the safety of their employees, and to perform other such services as specified. The cost of the VPIH/CIH and their services will be borne by the VA except for any repeat of final inspection and testing that may be required due to unsatisfactory initial results. Any repeated final inspections and/or testing, if required, will be paid for by the Contractor.

C. If fibers counted by the VPIH/CIH during abatement work, either inside or outside the regulated area, utilizing the NIOSH 7400 air monitoring method, exceed the specified respective limits, the Contractor shall stop work. The Contractor may request confirmation of the results by analysis of the samples by TEM. Request must be in writing and submitted to the VA's representative. Cost for the confirmation of results will be borne by the Contractor for both the collection and analysis of samples and for the time delay that may/does result for this confirmation. Confirmation sampling and analysis will be the responsibility of the CPIH with review and approval of the VPIH/CIH. An agreement between the CPIH/CIH and the VPIH/CIH shall be reached on the exact
details of the confirmation effort, in writing, including such things as the number of samples, location, collection, quality control on-site, analytical laboratory, interpretation of results and any follow-up actions. This written agreement shall be co-signed by the IH’s and delivered to the VA’s representative.

2.2.2 SCOPE OF SERVICES OF THE VPIH/CIH CONSULTANT

A. The purpose of the work of the VPIH/CIH is to: assure quality; adherence to the specification; resolve problems; prevent the spread of contamination beyond the regulated area; and assure clearance at the end of the project. In addition, their work includes performing the final inspection and testing to determine whether the regulated area or building has been adequately decontaminated. All air monitoring is to be done utilizing PCM/TEM. The VPIH/CIH will perform the following tasks:

1. Task 1: Establish background levels before abatement begins by collecting background samples. Retain samples for possible TEM analysis.
2. Task 2: Perform continuous air monitoring, inspection, and testing outside the regulated area during actual abatement work to detect any faults in the regulated area isolation and any adverse impact on the surroundings from regulated area activities.
3. Task 3: Perform unannounced visits to spot check overall compliance of work with contract/specifications. These visits may include any inspection, monitoring, and testing inside and outside the regulated area and all aspects of the operation except personnel monitoring.
4. Task 4: Provide support to the VA representative such as evaluation of submittals from the Contractor, resolution of conflicts, interpret data, etc.
5. Task 5: Perform, in the presence of the VA representative, final inspection and testing of a decontaminated regulated area at the conclusion of the abatement to certify compliance with all regulations and VA requirements/specifications.
6. Task 6: Issue certificate of decontamination for each regulated area and project report.

B. All documentation, inspection results and testing results generated by the VPIH/CIH will be available to the Contractor for information and consideration. The Contractor shall cooperate with and support the VPIH/CIH for efficient and smooth performance of their work.

C. The monitoring and inspection results of the VPIH/CIH will be used by the VA to issue any Stop Removal orders to the Contractor during abatement work and to accept or reject a regulated area or building as decontaminated.

2.2.3 MONITORING, INSPECTION AND TESTING BY CONTRACTOR CPIH/CIH

The Contractor’s CPIH/CIH is responsible for managing all monitoring, inspections, and testing required by these specifications, as well as any and all regulatory requirements adopted by these specifications. The CPIH/CIH is responsible for the continuous monitoring of all subsystems and procedures which could affect the health and safety of the Contractor’s personnel. Safety and health conditions and the provision of those conditions inside the regulated area for all persons entering the regulated area is the exclusive responsibility of the Contractor/Competent Person. The person performing the personnel and area air monitoring inside the regulated area shall be an IH Technician, who shall be trained and shall have specialized field experience in sampling and analysis. The IH Technician shall have successfully completed a NIOSH 582 Course or equivalent and provide documentation. The IH Technician shall participate in the AIHA Asbestos Analysis Registry or participate in the Proficiency Analytic Testing program of AIHA for fiber counting quality control assurance. The IH Technician shall also be an accredited EPA AHERA/State Contractor/Supervisor or Abatement Worker and Building Inspector. The IH Technician shall have participated in five abatement projects collecting personal and area samples as well as responsibility for documentation on substantially similar projects in size and scope. The analytic laboratory used by the Contractor to analyze the samples shall be AIHA accredited for asbestos PAT and approved by the VA prior to start of the project. A daily log shall be maintained by the CPIH/CIH or IH Technician, documenting all OSHA requirements for air personal monitoring for asbestos in 29 CFR 1926.1101(f), (g) and Appendix A. This log shall be
made available to the VA representative and the VPIH/CIH upon request. The log will contain, at a minimum, information on personnel or area samples, other persons represented by the sample, the date of sample collection, start and stop times for sampling, sample volume, flow rate, and fibers/cc. The CPIH/CIH shall collect and analyze samples for each representative job being done in the regulated area, i.e., removal, wetting, clean-up, and load-out. No fewer than two personal samples per shift shall be collected and one area sample per 1,000 square feet of regulated area where abatement is taking place and one sample per shift in the clean room area shall be collected. In addition to the continuous monitoring required, the CPIH/CIH will perform inspection and testing at the final stages of abatement for each regulated area as specified in the CPIH/CIH responsibilities. Additionally, the CPIH/CIH will monitor and record pressure readings within the containment daily with a minimum of two readings at the beginning and at the end of a shift, and submit the data in the daily report.

2.3 ASBESTOS HAZARD ABATEMENT PLAN

The Contractor shall have established an Asbestos Hazard Abatement Plan (AHAP) in printed form and loose leaf folder consisting of simplified text, diagrams, sketches, and pictures that establish and explain clearly the procedures to be followed during all phases of the work by the Contractor's personnel. The AHAP must be modified as needed to address specific requirements of this project and the specifications. The AHAP shall be submitted for review and approval to the VA prior to the start of any abatement work. The minimum topics and areas to be covered by the AHAPs are:

A. Minimum Personnel Qualifications
B. Emergency Action Plan/Contingency Plans and Arrangements
C. Security and Safety Procedures
D. Respiratory Protection/Personal Protective Equipment Program and Training
E. Medical Surveillance Program and Recordkeeping
F. Regulated Area Requirements - Containment Barriers/Isolation of Regulated Area
G. Decontamination Facilities and Entry/Exit Procedures (PDF and W/EDF)
H. Negative Pressure Systems Requirements
I. Monitoring, Inspections, and Testing
J. Removal Procedures for ACM
K. Removal of Contaminated Soil (if applicable)
L. Encapsulation Procedures for ACM
M. Disposal of ACM waste/equipment
N. Regulated Area Decontamination/Clean-up
O. Regulated Area Visual and Air Clearance
P. Project Completion/Closeout

2.4 SUBMITTALS

2.4.1 PRE-START MEETING SUBMITTALS

Submit to the VA a minimum of 14 days prior to the pre-start meeting the following for review and approval. Meeting this requirement is a prerequisite for the pre-start meeting for this project:

A. Submit a detailed work schedule for the entire project reflecting contract documents and the phasing/schedule requirements from the CPM chart.
B. Submit a staff organization chart showing all personnel who will be working on the project and their capacity/function. Provide their qualifications, training, accreditations, and licenses, as appropriate. Provide a copy of the "Certificate of Worker's Acknowledgment" and the "Affidavit of Medical Surveillance and Respiratory Protection" for each person.
C. Submit Asbestos Hazard Abatement Plan developed specifically for this project, incorporating the requirements of the specifications, prepared, signed and dated by the CPIH/CIH.
D. Submit the specifics of the materials and equipment to be used for this project with manufacturer names, model numbers, performance characteristics, pictures/diagrams, and number available for the following:
1. Supplied air system, negative air machines, HEPA vacuums, air monitoring pumps, calibration devices, pressure differential monitoring device and emergency power generating system.

2. Waste water filtration system, shower system, containment barriers.

3. Encapsulants, surfactants, hand held sprayers, airless sprayers, glovebags, and fire extinguishers.

4. Respirators, protective clothing, personal protective equipment.

5. Fire safety equipment to be used in the regulated area.

E. Submit the name, location, and phone number of the approved landfill; proof/verification the landfill is approved for ACM disposal; the landfill’s requirements for ACM waste; the type of vehicle to be used for transportation; and name, address, and phone number of subcontractor, if used. Proof of asbestos training for transportation personnel shall be provided.

F. Submit required notifications and arrangements made with regulatory agencies having regulatory jurisdiction and the specific contingency/emergency arrangements made with local health, fire, ambulance, hospital authorities and any other notifications/arrangements.

G. Submit the name, location and verification of the laboratory and/or personnel to be used for analysis of air and/or bulk samples. Personal air monitoring must be done in accordance with OSHA 29 CFR 1926.1101(f) and Appendix A. Area or clearance air monitoring shall be conducted in accordance with EPA AHERA protocols.

H. Submit qualifications verification: Submit the following evidence of qualifications. Make sure that all references are current and verifiable by providing current phone numbers and documentation.

   1. Asbestos Abatement Company: Project experience within the past 3 years; listing projects first most similar to this project: Project Name; Type of Abatement; Duration; Cost; Reference Name/Phone Number; Final Clearance; Completion Date

   2. List of project(s) halted by owner, A/E, IH, regulatory agency in the last 3 years: Project Name; Reason; Date; Reference Name/Number; Resolution

   3. List asbestos regulatory citations (e.g., OSHA), notices of violations (e.g., Federal and state EPA), penalties, and legal actions taken against the company including and of the company’s officers (including damages paid) in the last 3 years. Provide copies and all information needed for verification.

I. Submit information on personnel: Provide a resume; address each item completely; copies of certificates, accreditations, and licenses. Submit an affidavit signed by the CPIH/CIH stating that all personnel submitted below have medical records in accordance with OSHA 29 CFR 1926.1101(m) and 29 CFR 1910.20 and that the company has implemented a medical surveillance program and written respiratory protection program, and maintains recordkeeping in accordance with the above regulations. Submit the phone number and doctor/clinic/hospital used for medical evaluations.

   1. CPIH/CIH and IH Technician: Name; years of abatement experience; list of projects similar to this one; certificates, licenses, accreditations for proof of AHERA/OSHA specialized asbestos training; professional affiliations; number of workers trained; samples of training materials; samples of AHPs developed; medical opinion; and current respirator fit test.

   2. Competent Person(s)/Supervisor(s): Number; names; social security numbers; years of abatement experience as Competent Person/Supervisor; list of similar projects in size/complexity as Competent Person/Supervisor; as a worker; certificates, licenses, accreditations; proof of AHERA/OSHA specialized asbestos training; maximum number of personnel supervised on a project; medical opinion (asbestos surveillance and respirator use); and current respirator fit test.

   3. Workers: Numbers; names; social security numbers; years of abatement experience; certificates, licenses, accreditations; training courses in asbestos abatement and respiratory protection; medical opinion (asbestos surveillance and respirator use); and current respirator fit test.

J. Submit copies of State license for asbestos abatement; copy of insurance policy, including exclusions with a letter from agent stating in plain language the coverage provided and the fact that asbestos abatement activities are covered by the policy; copy of AHPs incorporating the requirements of this specification; information on who provides your training, how often; who provides medical surveillance, how often; who performs and how is personal air monitoring of
abatement workers conducted; a list of references of independent laboratories/IH's familiar with your air monitoring and standard operating procedures; and copies of monitoring results of the five referenced projects listed and analytical method(s) used.

K. Rented equipment must be decontaminated prior to returning to the rental agency.

L. Submit, before the start of work, the manufacturer's technical data for all types of encapsulants, all MSDS and application instructions.

2.4.2 SUBMITTALS DURING ABATEMENT

A. The Competent Person shall maintain and submit a daily log at the regulated area documenting the dates and times of the following: purpose, attendees and summary of meetings; all personnel entering/exiting the regulated area; document and discuss the resolution of unusual events such as barrier breeching, equipment failures, emergencies, and any cause for stopping work; and representative air monitoring and results/TWA's/EL's. Submit this information daily to the VPIH/CIH.

B. The CPIH/CIH shall document and maintain the inspection and approval of the regulated area preparation prior to start of work and daily during work.
   1. Removal of any poly barriers.
   2. Visual inspection/testing by the CPIH/CIH or IH Technician prior to application of lockdown encapsulant.
   4. Disposal of ACM waste materials; copies of Waste Shipment Records/landfill receipts to the VA's representative on a weekly basis.

2.4.3 SUBMITTALS AT COMPLETION OF ABATEMENT

The CPIH/CIH shall submit a project report consisting of the daily log book requirements and documentation of events during the abatement project including Waste Shipment Records signed by the landfill's agent. It will also include information on the containment and transportation of waste from the containment with applicable Chain of Custody forms. The report shall include a certificate of completion, signed and dated by the CPIH/CIH, in accordance with Attachment #1. All clearance and perimeter area samples must be submitted. The VA Representative will retain the abatement report after completion of the project and provide copies of the abatement report to VAMC Office of Engineer and the Safety Office.

2.5 ENCAPSULANTS

2.5.1 TYPES OF ENCAPSULANTS

A. The following four types of encapsulants, if used, must comply with comply with performance requirements as stated in paragraph 2.6.2:
   1. Removal encapsulant - used as a wetting agent to remove ACM.
   2. Bridging encapsulant - provides a tough, durable coating on ACM.
   3. Penetrating encapsulant - penetrates/encapsulates ACM at least 13 mm (1/2").
   4. Lockdown encapsulant - seals microscopic fibers on surfaces after ACM removal.

2.5.2 PERFORMANCE REQUIREMENTS

Encapsulants shall meet the latest requirements of EPA; shall not contain toxic or hazardous substances; or solvents; and shall comply with the following performance requirements:

A. General Requirements for all Encapsulants:
   1. ASTM E84: Flame spread of 25; smoke emission of 50.
   3. ASTM C732: Accelerated Aging Test; Life Expectancy - 20 years.
   4. ASTM E96: Permeability - minimum of 0.4 perms.

B. Bridging/Penetrating Encapsulants:
   1. ASTM E736: Cohesion/Adhesion Test - 24 kPa (50 lbs/ft²).
2. ASTM E119: Fire Resistance - 3 hours (Classified by UL for use on fibrous/cementitious fireproofing).
3. ASTM D2794: Gardner Impact Test; Impact Resistance - minimum 11.5 kg-mm (43 in/lb).
4. ASTM D522: Mandrel Bend Test; Flexibility - no rupture or cracking.

C. Lockdown Encapsulants:
1. ASTM E119: Fire resistance - 3 hours (tested with fireproofing over encapsulant applied directly to steel member).
2. ASTM E736: Bond Strength - 48 kPa (100 lbs/ft$^2$) (test compatibility with cementitious and fibrous fireproofing).
3. In certain situations, encapsulants may have to be applied to hot pipes/equipment. The encapsulant must be able to withstand high temperatures without cracking or off-gassing any noxious vapors during application.

2.5.3 CERTIFICATES OF COMPLIANCE

The Contractor shall submit to the VA representative certification from the manufacturer indicating compliance with performance requirements for encapsulants when applied according to manufacturer recommendations.

PART 3 - EXECUTION

3.1 REGULATED AREA PREPARATIONS

3.1.1 SITE SECURITY

A. Regulated area access is to be restricted only to authorized, trained/accredited and protected personnel. These may include the Contractor's employees, employees of Subcontractors, VA employees and representatives, State and local inspectors, and any other designated individuals. A list of authorized personnel shall be established prior to commencing the project and be posted in the clean room of the decontamination unit.

B. Entry into the regulated area by unauthorized individuals shall be reported immediately to the Competent Person by anyone observing the entry. The Competent Person shall immediately require any unauthorized person to leave the regulated area and then notify the VA Contracting Officer or VA Representative using the most expeditious means.

C. A log book shall be maintained in the clean room of the decontamination unit. Anyone who enters the regulated area must record their name, affiliation, time in, and time out for each entry.

D. Access to the regulated area shall be through a single decontamination unit. All other access (doors, windows, hallways, etc.) shall be sealed or locked to prevent entry or exit from the regulated area. The only exceptions for this requirement are the waste/equipment load-out area which shall be sealed except during the removal of containerized asbestos waste from the regulated area, and emergency exits. Emergency exits shall not be locked from the inside; however, they shall be sealed with poly sheeting and taped until needed. In any situation where exposure to high temperatures which may result in a flame hazard, fire retardant poly sheeting must be used.

E. The Contractor's Competent Person shall control site security during abatement operations in order to isolate work in progress and protect adjacent personnel. A 24 hour security system shall be provided at the entrance to the regulated area to assure that all entrants are logged in/out and that only authorized personnel are allowed entrance.

F. The Contractor will have the VA's assistance in notifying adjacent personnel of the presence, location and quantity of ACM in the regulated area and enforcement of restricted access by the VA's employees.

G. The regulated area shall be locked during non-working hours and secured by VA Representative or Competent Person. The VA Police should be informed of asbestos abatement regulated areas to provide security checks during facility rounds and emergency response.

3.1.2 SIGNAGE AND POWER MANAGEMENT
A. Post OSHA DANGER signs meeting the specifications of OSHA 29 CFR 1926.1101 at any location and approaches to the regulated area where airborne concentrations of asbestos may exceed the PEL. Signs shall be posted at a distance sufficiently far enough away from the regulated area to permit any personnel to read the sign and take the necessary measures to avoid exposure. Additional signs will be posted following construction of the regulated area enclosure.

B. Shut down and lock out/tag out electric power to the regulated area. Provide temporary power and lighting. Insure safe installation including GFCI of temporary power sources and equipment by compliance with all applicable electrical code and OSHA requirements for temporary electrical systems. Electricity shall be provided by the VA.

C. Shut down and lock out/tag out heating, cooling, and air conditioning system (HVAC) components that are in, supply or pass through the regulated area. Investigate the regulated area and agree on pre-abatement condition with the VA’s representative. Seal all intake and exhaust vents in the regulated area with duct tape and 2 layers of 6-mil poly. Also, seal any seams in system components that pass through the regulated area. Remove all contaminated HVAC system filters and place in labeled 6-mil polyethylene disposal bags for staging and eventual disposal as asbestos waste.

3.1.3 NEGATIVE PRESSURE FILTRATION SYSTEM

The Contractor shall provide enough HEPA negative air machines to effect > - 0.02” WCG pressure. The Competent Person shall determine the number of units needed for the regulated area by dividing the cubic feet in the regulated area by 15 and then dividing that result by the cubic feet per minute (CFM) for each unit to determine the number of units needed to effect > - 0.02” WCG pressure. Provide a standby unit in the event of machine failure and/or emergency in an adjacent area.

NIOSH has done extensive studies and has determined that negative air machines typically operate at ~50% efficiency. The contractor shall consider this in their determination of number of units needed to provide > - 0.02” WCG pressure. The contractor shall use double the number of machines, based on their calculations, or submit proof their machines operate at stated capacities, at a 2” pressure drop across the filters.

3.1.3.1 DESIGN AND LAYOUT

A. Before start of work submit the design and layout of the regulated area and the negative air machines. The submittal shall indicate the number of, location of and size of negative air machines. The point(s) of exhaust, air flow within the regulated area, anticipated negative pressure differential, and supporting calculations for sizing shall be provided. In addition, submit the following:

1. Method of supplying power to the units and designation/location of the panels.
2. Description of testing method(s) for correct air volume and pressure differential.
3. If auxiliary power supply is to be provided for the negative air machines, provide a schematic diagram of the power supply and manufacturer’s data on the generator and switch.

3.1.3.2 NEGATIVE AIR MACHINES (HEPA UNITS)

A. Negative Air Machine Cabinet: The cabinet shall be constructed of steel or other durable material capable of withstanding potential damage from rough handling and transportation. The width of the cabinet shall be less than 30” in order to fit in standard doorways. The cabinet must be factory sealed to prevent asbestos fibers from being released during use, transport, or maintenance. Any access to and replacement of filters shall be from the inlet end. The unit must be on casters or wheels.
B. Negative Air Machine Fan: The rating capacity of the fan must indicate the CFM under actual operating conditions. Manufacturer's typically use "free-air" (no resistance) conditions when rating fans. The fan must be a centrifugal type fan.

C. Negative Air Machine Final Filter: The final filter shall be a HEPA filter. The filter media must be completely sealed on all edges within a structurally rigid frame. The filter shall align with a continuous flexible gasket material in the negative air machine housing to form an air tight seal. Each HEPA filter shall be certified by the manufacturer to have an efficiency of not less than 99.97%. Testing shall have been done in accordance with Military Standard MIL-STD-282 and Army Instruction Manual 136-300-175A. Each filter must bear a UL586 label to indicate ability to perform under specified conditions. Each filter shall be marked with the name of the manufacturer, serial number, air flow rating, efficiency and resistance, and the direction of test air flow.

D. Negative Air Machine Pre-filters: The pre-filters, which protect the final HEPA filter by removing larger particles, are required to prolong the operating life of the HEPA filter. Two stages of pre-filtration are required. A first stage pre-filter shall be a low efficiency type for particles 10 µm or larger. A second stage pre-filter shall have a medium efficiency effective for particles down to 5 µm or larger. Pre-filters shall be installed either on or in the intake opening of the NAM and the second stage filter must be held in place with a special housing or clamps.

E. Negative Air Machine Instrumentation: Each unit must be equipped with a gauge to measure the pressure drop across the filters and to indicate when filters have become loaded and need to be changed. A table indicating the cfm for various pressure readings on the gauge shall be affixed near the gauge for reference or the reading shall indicate at what point the filters shall be changed, noting cfm delivery. The unit must have an elapsed time meter to show total hours of operation.

F. Negative Air Machine Safety and Warning Devices: An electrical/mechanical lockout must be provided to prevent the fan from being operated without a HEPA filter. Units must be equipped with an automatic shutdown device to stop the fan in the event of a rupture in the HEPA filter or blockage in the discharge of the fan. Warning lights are required to indicate normal operation; too high a pressure drop across filters; or too low of a pressure drop across filters.

G. Negative Air Machine Electrical: All electrical components shall be approved by the National Electrical Manufacturer's Association (NEMA) and Underwriters Laboratories (UL). Each unit must be provided with overload protection and the motor, fan, fan housing, and cabinet must be grounded.

H. It is essential that replacement HEPA filters be tested using an "in-line" testing method, to ensure the seal around the periphery was not damaged during replacement. Damage to the outer HEPA filter seal could allow contaminated air to bypass the HEPA filter and be discharged to an inappropriate location. Contractor will provide written documentation of test results for negative air machine units with HEPA filters changed by the contractor or documentation when changed and tested by the contractor filters.

3.1.3.3 PRESSURE DIFFERENTIAL

The fully operational negative air system within the regulated area shall continuously maintain a pressure differential of -0.02" water column gauge. Before any disturbance of any asbestos material, this shall be demonstrated to the VA by use of a pressure differential meter/manometer as required by OSHA 29 CFR 1926.1101(e)(5)(i). The Competent Person shall be responsible for providing, maintaining, and documenting the negative pressure and air changes as required by OSHA and this specification.

3.1.3.4 MONITORING

The pressure differential shall be continuously monitored and recorded between the regulated area and the area outside the regulated area with a monitoring device that
incorporates a strip chart recorder. The strip chart recorder shall become part of the project log and shall indicate at least -0.02” water column gauge for the duration of the project.

3.1.3.5 **AUXILIARY GENERATOR**

If the building is occupied during abatement, provide an auxiliary gasoline/diesel generator located outside the building in an area protected from the weather. In the event of a power failure of the general power grid and the VAMC emergency power grid, the generator must automatically start and supply power to a minimum of 50% of the negative air machines in operation.

3.1.3.6 **SUPPLEMENTAL MAKE-UP AIR INLETS**

Provide, as needed for proper air flow in the regulated area, in a location approved by the VA, openings in the plastic sheeting to allow outside air to flow into the regulated area. Auxiliary makeup air inlets must be located as far from the negative air machines as possible, off the floor near the ceiling, and away from the barriers that separate the regulated area from the occupied clean areas. Cover the inlets with weighted flaps which will seal in the event of failure of the negative pressure system.

3.1.3.7 **TESTING THE SYSTEM**

The negative pressure system must be tested before any ACM is disturbed in any way. After the regulated area has been completely prepared, the decontamination units set up, and the negative air machines installed, start the units up one at a time. Demonstrate and document the operation and testing of the negative pressure system to the VA using smoke tubes and a negative pressure gauge. Verification and documentation of adequate negative pressure differential across each barrier must be done at the start of each work shift.

3.1.3.8 **DEMONSTRATION OF THE NEGATIVE PRESSURE FILTRATION SYSTEM**

The demonstration of the operation of the negative pressure system to the VA shall include, but not be limited to, the following:

A. Plastic barriers and sheeting move lightly inward toward the regulated area.
B. Curtains of the decontamination units move inward regulated area.
C. There is a noticeable movement of air through the decontamination units. Use the smoke tube to demonstrate air movement from the clean room to the shower room to the equipment room to the regulated area.
D. Use smoke tubes to demonstrate air is moving across all areas in which work is to be done. Use a differential pressure gauge to indicate a negative pressure of at least -0.02” across every barrier separating the regulated area from the rest of the building. Modify the system as necessary to meet the above requirements.

3.1.3.9 **USE OF THE NEGATIVE PRESSURE FILTRATION SYSTEM DURING ABATEMENT OPERATIONS**

A. Start units before beginning any disturbance of ACM occurs. After work begins, the units shall run continuously, maintaining 4 actual air changes per hour at a negative pressure differential of -0.02” water column gauge, for the duration of the work until a final visual clearance and final air clearance has been successfully completed.

No negative air units shall be shut down at any time unless authorized by the VA Contracting Officer, verbally and in writing.

B. Pre-cleaning of ACM contaminated items shall be performed after the enclosure has been erected and negative pressure has been established in the work area. After items have been pre-cleaned and decontaminated, they may be removed...
from the work area for storage until the completion of abatement in the work area.

C. Abatement work shall begin at a location farthest from the units and proceed towards them. If an electric failure occurs, the Competent Person shall stop all abatement work and immediately begin wetting all exposed asbestos materials for the duration of the power outage. Abatement work shall not resume until power is restored and all units are operating properly again.

D. The negative air machines shall continue to run after all work is completed and until a final visual clearance and a final air clearance has been successfully completed for that regulated area.

3.1.3.10 DISMANTLING THE SYSTEM

After completion of the final visual and final air clearance has been obtained by the VPIH/CIH, the units may be shut down. The unit exterior surfaces shall have been completely decontaminated; pre-filters are not to be removed and the units inlet/outlet sealed with 2 layers of 6 mil poly immediately after shut down. No filter removal shall occur at the VA site following successful completion of site clearance. OSHA/EPA/DOT asbestos shall be attached to the units.

3.1.4 CONTAINMENT BARRIERS AND COVERINGS IN THE REGULATED AREA

3.1.4.1 GENERAL

Seal off the perimeter to the regulated area to completely isolate the regulated area from adjacent spaces. All surfaces in the regulated area must be covered to prevent contamination and to facilitate clean-up. Should adjacent areas become contaminated as a result of the work, shall immediately stop work and clean up the contamination at no additional cost to the VA. Provide firestopping and identify all fire barrier penetrations due to abatement work as specified in Section 3.1.4.8; FIRESTOPPING.

3.1.4.2 PREPARATION PRIOR TO SEALING THE REGULATED AREA

Place all tools, scaffolding, materials and equipment needed for working in the regulated area prior to erecting any plastic sheeting. All uncontaminated removable furniture, equipment and/or supplies shall be removed by the VA from the regulated area before commencing work. Any objects remaining in the regulated area shall be completely covered with 2 layers of 6-mil fire retardant poly sheeting and secured with duct tape. Lock out and tag out any HVAC/electrical systems in the regulated area.

3.1.4.3 CONTROLLING ACCESS TO THE REGULATED AREA

Access to the regulated area is allowed only through the personnel decontamination facility (PDF). All other means of access shall be eliminated and OSHA DANGER demarcation signs posted as required by OSHA. If the regulated area is adjacent to, or within view of an occupied area, provide a visual barrier of 6 mil opaque fire retardant poly to prevent building occupant observation. If the adjacent area is accessible to the public, the barrier must be solid and capable of withstanding the negative pressure.

3.1.4.4 CRITICAL BARRIERS

Completely separate any operations in the regulated area from adjacent areas using 2 layers of 6 mil fire retardant poly and duct tape. Individually seal with 2 layers of 6 mil poly and duct tape all HVAC openings into the regulated area. Individually seal all lighting fixtures, clocks, doors, windows, convectors, speakers, or any other
SECTION 02 8211 – TRADITIONAL ASBESTOS ABATEMENT

objects/openings in the regulated area. Heat must be shut off any objects covered with poly.

3.1.4.5 PRIMARY BARRIERS

A. Cover the regulated area with two layers of 6 mil fire retardant poly on the floors and two layers of 4 mil, fire retardant poly on the walls, unless otherwise directed in writing by the VA representative. Floor layers must form a right angle with the wall and turn up the wall at least 300 mm (12”). Seams must overlap at least 1800 mm (6’) and must be spray glued and taped. Install sheeting so that layers can be removed independently from each other. Carpeting shall be covered with three layers of 6 mil poly. Corrugated cardboard sheets must be placed between the bottom and middle layers of poly. Mechanically support and seal with duct tape and glue all wall layers.

B. If stairs and ramps are covered with 6 mil plastic, two layers must be used. Provide 19 mm (3/4") exterior grade plywood treads held in place with duct tape/glue on the plastic. Do not cover rungs or rails with any isolation materials.

3.1.4.6 SECONDARY BARRIERS

A loose layer of 6 mil shall be used as a drop cloth to protect the primary layers from debris generated during the abatement. This layer shall be replaced as needed during the work and at a minimum once per work day.

3.1.4.7 EXTENSION OF THE REGULATED AREA

If the enclosure of the regulated area is breached in any way that could allow contamination to occur, the affected area shall be included in the regulated area and constructed as per this section. Decontamination measures must be started immediately and continue until air monitoring indicates background levels are met.

3.1.4.8 FIRESTOPPING

A. Through penetrations caused by cables, cable trays, pipes, sleeves, conduits, etc. must be firestopped with a fire-rated firestop system providing an air tight seal.

B. Firestop materials that are not equal to the wall or ceiling penetrated shall be brought to the attention of the VA Representative. The contractor shall list all areas of penetration, the type of sealant used, and whether or not the location is fire rated. Any discovery of penetrations during abatement shall be brought to the attention of the VA representative immediately. All walls, floors and ceilings are considered fire rated unless otherwise determined by the VA Representative or Fire Marshall.

C. Any visible openings whether or not caused by a penetration shall be reported by the Contractor to the VA Representative for a sealant system determination. Firestops shall meet ASTM E814 and UL 1479 requirements for the opening size, penetrant, and fire rating needed.

3.1.5 SANITARY FACILITIES

The Contractor shall provide sanitary facilities for abatement personnel and maintain them in a clean and sanitary condition throughout the abatement project.

3.1.6 PERSONAL PROTECTIVE EQUIPMENT

Provide whole body clothing, head coverings, gloves and foot coverings and any other personal protective equipment as determined by conducting the hazard assessment required by OSHA at
29 CFR 1910.132 (d). The Competent Person shall ensure the integrity of personal protective equipment worn for the duration of the project. Duct tape shall be used to secure all suit sleeves to wrists and to secure foot coverings at the ankle.

### 3.1.7 PRE-CLEANING

The VA will provide water for abatement purposes. The Contractor shall connect to the existing VA system. The service to the shower(s) shall be supplied with backflow prevention.

Pre-cleaning of ACM contaminated items shall be performed after the enclosure has been erected and negative pressure has been established in the work area. All workers performing pre-cleaning activities must don appropriate personal protective equipment (PPE), as specified throughout this document and as approved in the Contractor’s work plan. After items have been pre-cleaned and decontaminated, they may be removed from the work area for storage until the completion of abatement in the work area.

Pre-clean all movable objects within the regulated area using a HEPA filtered vacuum and/or wet cleaning methods as appropriate. After cleaning, these objects shall be removed from the regulated area and carefully stored in an uncontaminated location. Drapes, clothing, upholstered furniture and other fabric items should be disposed of as asbestos contaminated waste. Cleaning these asbestos contaminated items utilizing HEPA vacuum techniques and off-premises steam cleaning is very difficult and cannot guarantee decontamination. Carpeting will be disposed of prior to abatement if in the regulated area. If ACM floor tile is attached to the carpet while the Contractor is removing the carpet that section of the carpet will be disposed of as asbestos waste.

Pre-clean all fixed objects in the regulated area using HEPA filtered vacuums and/or wet cleaning techniques as appropriate. Careful attention must be paid to machinery behind grills or gratings where access may be difficult but contamination may be significant. Also, pay particular attention to wall, floor and ceiling penetration behind fixed items. After pre-cleaning, enclose fixed objects with 2 layers of 6-mil poly and seal securely in place with duct tape. Objects (e.g., permanent fixtures, shelves, electronic equipment, laboratory tables, sprinklers, alarm systems, closed circuit TV equipment and computer cables) which must remain in the regulated area and that require special ventilation or enclosure requirements should be designated here along with specified means of protection. Contact the manufacturer for special protection requirements.

Pre-clean all surfaces in the regulated area using HEPA filtered vacuums and/or wet cleaning methods as appropriate. Do not use any methods that would raise dust such as dry sweeping or vacuuming with equipment not equipped with HEPA filters. Do not disturb asbestos-containing materials during this pre-cleaning phase.

### 3.1.8 PRE-ABATEMENT ACTIVITIES

#### 3.1.8.1 PRE-ABATEMENT MEETING

The VA representative, upon receipt, review, and substantial approval of all pre-abatement submittals and verification by the CPIH/CIH that all materials and equipment required for the project are on the site, will arrange for a pre-abatement meeting between the Contractor, the CPIH/CIH, Competent Person(s), the VA representative(s), and the VPIH/CIH. The purpose of the meeting is to discuss any aspect of the submittals needing clarification or amplification and to discuss any aspect of the project execution and the sequence of the operation. The Contractor shall be prepared to provide any supplemental information/documentation to the VA's representative regarding any submittals, documentation, materials or equipment. Upon satisfactory resolution of any outstanding issues, the VA's representative will issue a written order to proceed to the Contractor. No abatement work of any kind described in the following provisions shall be initiated prior to the VA written order to proceed.
3.1.8.2 PRE-ABATEMENT CONSTRUCTION AND OPERATIONS

A. Perform all preparatory work for the first regulated area in accordance with the approved work schedule and with this specification.

B. Upon completion of all preparatory work, the CPIH/CIH will inspect the work and systems and will notify the VA's representative when the work is completed in accordance with this specification. The VA's representative may inspect the regulated area and the systems with the VPIH/CIH and may require that upon satisfactory inspection, the Contractor's employees perform all major aspects of the approved AHAP(s), especially worker protection, respiratory systems, contingency plans, decontamination procedures, and monitoring to demonstrate satisfactory operation. The operational systems for respiratory protection and the negative pressure system shall be demonstrated for proper performance.

C. The CPIH/CIH shall document the pre-abatement activities described above and deliver a copy to the VA's representative.

D. Upon satisfactory inspection of the installation of and operation of systems the VA's representative will notify the Contractor in writing to proceed with the asbestos abatement work in accordance with this specification and all applicable regulations.

3.1.8.3 PRE-ABATEMENT INSPECTIONS AND PREPARATIONS

Before any work begins on the construction of the regulated area, the Contractor will:

A. Conduct a space-by-space inspection with an authorized VA representative and prepare a written inventory of all existing damage in those spaces where asbestos abatement will occur. Still or video photography may be used to supplement the written damage inventory. Document will be signed and certified as accurate by both parties.

B. The VA Representative, the Contractor, and the VPIH/CIH must be aware of AEQA 10-95 indicating the failure to identify asbestos in the areas listed as well as common issues when preparing specifications and contract documents. This is especially critical when demolition is planned, because AHERA surveys are non-destructive, and ACM may remain undetected. A NESHAPS (destructive) ACM inspection should be conducted on all building structures that will be demolished. Ensure the following areas are inspected on the project: lay-in ceilings concealing ACM; ACM behind walls/windows from previous renovations; inside utility chases/walls; transite piping/ductwork/sheets; behind radiators; lab fume hoods; transite lab countertops; roofing materials; below window sills; water/sewer lines; electrical conduit coverings; crawlspaces (previous abatement contamination); flooring/mastic covered by carpeting/new flooring; exterior insulated wall panels; on underground fuel tanks; and steam line trench coverings.

C. Ensure that all furniture, machinery, equipment, curtains, drapes, blinds, and other movable objects required to be removed from the regulated area have been cleaned and removed or properly protected from contamination.

D. If present and required, remove and dispose of carpeting from floors in the regulated area.

E. Inspect existing firestopping in the regulated area. Correct as needed.

3.2 REMOVAL OF ACM

3.2.1 WETTING ACM

A. Use amended water for the wetting of ACM prior to removal. The Competent Person shall assure the wetting of ACM meets the definition of "adequately wet" in the EPA NESHAP regulation and
OSHA’s “wet methods” for the duration of the project. A removal encapsulant may be used instead of amended water with written approval of the VA’s representative.

B. Amended Water: Provide water to which a surfactant has been added shall be used to wet the ACM and reduce the potential for fiber release during disturbance of ACM. The mixture must be equal to or greater than the wetting provided by water amended by a surfactant consisting one ounce of 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with 5 gallons (19L) of water.

C. Removal Encapsulant: When authorized by VA, provide a penetrating encapsulant designed specifically for the removal of ACM. The material must, when used, result in adequate wetting of the ACM and retard fiber release during removal.

3.2.2 SECONDARY BARRIER AND WALKWAYS

A. Install as a drop cloth a 6 mil poly sheet at the beginning of each work shift where removal is to be done during that shift. Completely cover floors and any walls within 10 feet (3 meters) of the area where work is to be done. Secure the secondary barrier with duct tape to prevent it from moving or debris from getting behind it. Remove the secondary barrier at the end of the shift or as work in the area is completed. Keep residue on the secondary barrier wetted. When removing, fold inward to prevent spillage and place in a disposal bag.

B. Install walkways using 6 mil black poly between the regulated area and the decontamination facilities (PDF and W/EDF) to protect the primary layers from contamination and damage. Install the walkways at the beginning of each shift and remove at the end of each shift.

3.2.3 WET REMOVAL OF ACM

A. Adequately and thoroughly wet the ACM to be removed prior to removal with amended water or when authorized by VA, removal encapsulant to reduce/prevent fiber release to the air. Adequate time (at a minimum two hours) must be allowed for the amended water or removal encapsulant to saturate the ACM. Abatement personnel must not disturb dry ACM. Use a fine spray of amended water or removal encapsulant. Saturate the material sufficiently to wet to the substrate without causing excessive dripping. The material must be sprayed repeatedly/continuously during the removal process in order to maintain adequately wet conditions. Removal encapsulants must be applied in accordance with the manufacturer’s written instructions. Perforate or carefully separate, using wet methods, an outer covering that is painted or jacketed in order to allow penetration and wetting of the material. Where necessary, carefully remove covering while wetting to minimize fiber release. In no event shall dry removal occur except when authorized in writing by the VPIH/CIH and VA when a greater safety hazard (e.g., electricity) is present.

B. If ACM does not wet well with amended water due to composition, coating or jacketing, remove as follows:
   1. Mist work area continuously with amended water whenever necessary to reduce airborne fiber levels.
   2. Remove saturated ACM in small sections. Do not allow material to dry out. As material is removed, bag material, while still wet into disposal bags. Twist the bag neck tightly, bend over (gooseneck) and seal with a minimum of three tight wraps of duct tape. Clean /decontaminate the outside of the bag of any residue and move to washdown station adjacent to W/EDF.
   3. Fireproofing or Architectural Finish on Scratch Coat: Spray with a fine mist of amended water or removal encapsulant. Allow time for saturation to the substrate. Do not over saturate causing excess dripping. Scrape material from substrate. Remove material in manageable quantities and control falling to staging or floor. If the falling distance is over 20 feet (6M), use a drop chute to contain material through descent. Remove residue remaining on the scratch coat after scraping is done using a stiff bristle hand brush. If a removal encapsulant is used, remove residue completely before the encapsulant dries. Periodically re-wet the substrate with amended water as needed to prevent drying of the material before the residue is removed from the substrate.
4. Fireproofing or Architectural Finish on Wire Lath: Spray with a fine mist of amended water or removal encapsulant. Allow time to completely saturate the material. Do not over saturate causing excess dripping. If the surface has been painted or otherwise coated, cut small holes as needed and apply amended water or removal encapsulant from above. Cut saturated wire lath into 2’ x 6’ (50mm x 150mm) sections and cut hanger wires. Roll up complete with ACM, cover in burlap and hand place in disposal bag. Do not drop to floor. After removal of lath/ACM, remove any overspray on decking and structure using stiff bristle nylon brushes. Depending on hardness of overspray, scrapers may be needed for removal.

5. Pipe/Tank/Vessel/Boiler Insulation: Remove the outer layer of wrap while spraying with amended water in order to saturate the ACM. Spray ACM with a fine mist of amended water or removal encapsulant. Allow time to saturate the material to the substrate. Cut bands holding pre-formed pipe insulation sections. Slit jacketing at the seams, remove and hand place in a disposal bag. Do not allow dropping to the floor. Remove molded fitting insulation/mud in large pieces and hand place in a disposal bag. Remove any residue on pipe or fitting with a stiff bristle nylon brush. In locations where pipe fitting insulation is removed from fibrous glass or other non-asbestos insulated straight runs of pipe, remove fibrous material at least 6” from the point it contacts the ACM.

3.2.4 WET REMOVAL OF AMOSITE

A. The following areas shown on drawings indicate locations of amosite ACM which will require local exhaust ventilation and collection as described below, in addition to wet removal. Provide specific description /locations/ drawings.

B. Provide local exhaust ventilation and collection systems to assure collection of amosite fibers at the point of generation. A 300 mm (12") flexible rigid non-collapsing duct shall be located no more than 600 mm (2’) from any scraping/brushing activity. Primary filters must be replaced every 30 minutes on the negative air machines. Each scraping/brushing activity must have a negative air machine devoted to it. For pre-molded pipe insulation or cutting wire lathe attach a 1200 mm (4’) square flared end piece on the intake of the duct. Support the duct horizontally at a point 600 mm (2’) below the work to effect capture. One person in the crew shall be assigned to operate the duct collection system on a continual basis.

C. Amosite does not wet well with amended water. Submit full information/documentation on the wetting agent proposed prior to start for review and approval by the VPIH/CIH and VA Contracting Officer. Insure that the material is worked on in small sections and is thoroughly and continuously wetted. Package as soon as possible while wet. Remove as required.

3.2.5 REMOVAL OF ACM/DIRT FLOORS AND OTHER SPECIAL PROCEDURES

A. MAJOR ABATEMENT ON DIRT FLOORS:
When working on dirt floors, remove all visible asbestos debris using wet methods after set-up of PDF, W/EDF, negative air systems as required. Perform work and decontaminate/clean-up; perform lockdown as needed and complete work as required in these specifications. The asbestos contaminated soil (ACS) shall be removed and/or enclosed.

SPEC WRITER NOTE: The extent of soil contamination; soil composition; access and clearance to the impacted area; future use and access; potential for flooding; as well as other site specific factors will dictate the appropriate option(s) for ACS. Drawings and descriptions should detail project areas.

Options for abatement of asbestos contaminated soil include: Removal of top 6 inches of soil; encapsulated the soil using shotcrete or other spray applied concrete materials. Considerations for which option to be used will be made by the VA representative. Factors which may affect which option to be used may include: access to the work area; height of the area (such as is there sufficient height to use concrete materials in the area, etc.) Soils covered with permanent barriers MUST HAVE PERMANENT
SIGNAGE INSTALLED TO WARN AGAINST PENETRATION ASSOCIATED WITH POTENTIAL DISTURBANCE OF ASBESTOS.

1. Remove ACS as shown on drawings to a minimum depth of 6 using wet methods. After wetting with amended water to minimize dust, shovel dirt into disposal bags. The CPIH/CIH shall closely monitor work conditions and take appropriate action to protect workers from over exposure to asbestos and heat stress. The minimum number of air changes per hour shall be six using negative air machines. Use special vacuum truck equipped with HEPA filtration to remove soil.

2. Enclosure of ACS using a concrete layer of 4” over the entire surface may also be done. Thoroughly dampen soil first with amended water before pouring concrete. Personnel shall be proficient in concrete finishing as well as asbestos trained.

B. Crawlspaces/Pipe Tunnels:
When working in crawlspaces or pipe tunnels, remove all visible asbestos debris using wet methods (if possible) after set-up of PDF, W/EDF, and after establishing negative air systems as required. Perform work and decontaminate/cleanup; perform lockdown as needed and complete work as required in these specifications. The asbestos contaminated soil (ACS) shall be removed and/or enclosed. Clearance requirements include confirmation sampling of affected soil by Polarized Light Microscopy (PLM). Clearance sampling requirements are specified in Sections 3.6.4 and 3.6.5.

3.3 LOCKDOWN ENCAPSULATION

3.3.1 GENERAL
Lockdown encapsulation is an integral part of the ACM removal. At the conclusion of ACM removal and before removal of the primary barriers, the contractor shall encapsulate all surfaces with a bridging encapsulant.

3.3.2 DELIVERY AND STORAGE
Deliver materials to the job site in original, new and unopened containers bearing the manufacturer's name and label as well as the following information: name of material, manufacturer's stock number, date of manufacture, thinning instructions, application instructions and the MSDS for the material.

3.3.3 WORKER PROTECTION
Before beginning work with any material for which an MSDS has been submitted, provide workers with any required personal protective equipment. The required personal protective equipment shall be used whenever exposure to the material might occur. In addition to OSHA/specification requirements for respiratory protection, a paint pre-filter and an organic vapor cartridge, at a minimum, shall be used in addition to the HEPA filter when an organic solvent based encapsulant is used. The CPIH/CIH shall be responsible for provision of adequate respiratory protection. Note: Flammable and combustible encapsulants shall not be used, unless authorized in writing by the VA.

3.3.4 ENCAPSULATION OF SCRATCH COAT PLASTER OR PIPING
A. Apply two coats of lockdown encapsulant to the scratch coat plaster or piping after all ACM has been removed. Apply in strict accordance with the manufacturer's instructions. Any deviation from the instructions must be approved by the VA's representative in writing prior to commencing the work.

B. Apply the lockdown encapsulant with an airless sprayer at a pressure and using a nozzle orifice as recommended by the manufacturer. Apply the first coat while the while the scratch coat is still damp from the asbestos removal process, after passing the visual inspection. If the surface has been allowed to dry, wet wipe or HEPA vacuum prior to spraying with encapsulant. Apply a second coat over the first coat in strict conformance with the manufacturer's instructions. Color
the lockdown encapsulant and contrast the color in the second coat so that visual confirmation of completeness and uniform coverage of each coat is possible. Adhere to the manufacturer's instructions for coloring. At the completion of the encapsulation, the surface must be a uniform third color produced by the mixture.

3.3.5 SEALING EXPOSED EDGES

Seal edges of ACM exposed by removal work which is inaccessible, such as a sleeve, wall penetration, etc., with two coats of bridging encapsulant. Prior to sealing, permit the exposed edges to dry completely to permit penetration of the bridging encapsulant. Apply in accordance with 3.3.4 (B).

3.4 DISPOSAL OF ACM WASTE MATERIALS

3.4.1 GENERAL

Dispose of waste ACM and debris which is packaged in accordance with these specifications, OSHA, EPA and DOT. The landfill requirements for packaging must also be met. Transport will be in compliance with 49 CFR 100–185 regulations. Disposal shall be done at an approved landfill. Disposal of non-friable ACM shall be done in accordance with applicable regulations.

3.4.2 PROCEDURES

A. The VA must be notified at least 24 hours in advance of any waste removed from the containment.
B. Asbestos waste shall be packaged and moved through the W/EDF into a covered transport container in accordance with procedures is this specification. Waste shall be double-bagged and wetted with amended water prior to disposal. Wetted waste can be very heavy. Bags shall not be overfilled. Bags shall be securely sealed to prevent accidental opening and/or leakage. The top shall be tightly twisted and goose necked prior to tightly sealing with at least three wraps of duct tape. Ensure that unauthorized persons do not have access to the waste material once it is outside the regulated area. All transport containers must be covered at all times when not in use. NESHAP signs must be on containers during loading and unloading. Material shall not be transported in open vehicles. If drums are used for packaging, the drums shall be labeled properly and shall not be re-used.
C. Waste Load Out: Waste load out shall be done in accordance with the procedures in W/EDF Decontamination Procedures. Sealed waste bags shall be decontaminated on exterior surfaces by wet cleaning and/or HEPA vacuuming before being placed in the second waste bag and sealed, which then must also be wet wiped or HEPA vacuumed.
D. Asbestos waste with sharp edged components, i.e., nails, screws, lath, strapping, tin sheeting, jacketing, metal mesh, etc., which might tear poly bags shall be wrapped securely in burlap before packaging and, if needed, use a poly lined fiber drum as the second container, prior to disposal.

3.5 PROJECT DECONTAMINATION

3.5.1 GENERAL

A. The entire work related to project decontamination shall be performed under the close supervision and monitoring of the CPIH/CIH.
B. If the asbestos abatement work is in an area which was contaminated prior to the start of abatement, the decontamination will be done by cleaning the primary barrier poly prior to its removal and cleanings of the surfaces of the regulated area after the primary barrier removal.
C. If the asbestos abatement work is in an area which was uncontaminated prior to the start of abatement, the decontamination will be done by cleaning the primary barrier poly prior to its removal, thus preventing contamination of the building when the regulated area critical barriers are removed.
3.5.2 REGULATED AREA CLEARANCE

Clearance air testing and other requirements which must be met before release of the Contractor and re-occupancy of the regulated area space are specified in Final Testing Procedures.

3.5.3 WORK DESCRIPTION

Decontamination includes the clearance air testing in the regulated area and the decontamination and removal of the enclosures/facilities installed prior to the abatement work including primary/critical barriers, PDF and W/EDF facilities, and negative pressure systems.

3.5.4 PRE-DECONTAMINATION CONDITIONS

A. Before decontamination starts, all ACM waste from the regulated area shall be collected and removed, and the loose 6 mil layer of poly removed while being adequately wetted with amended water and disposed of along with any gross debris generated by the work.

B. At the start of decontamination, the following shall be in place:
   1. Primary barriers consisting of 2 layers of 6 mil poly on the floor and 4 mil poly on the walls.
   2. Critical barriers consisting of 2 layers of 6 mil poly which is the sole barrier between the regulated area and openings to the rest of the building or outside.
   3. Decontamination facilities for personnel and equipment in operating condition and the negative pressure system in operation.

3.5.5 FIRST CLEANING

Carry out a first cleaning of all surfaces of the regulated area including items of remaining poly sheeting, tools, scaffolding, ladders/staging by wet methods and/or HEPA vacuuming. Do not use dry dusting/sweeping/air blowing methods. Use each surface of a wetted cleaning cloth one time only and then dispose of as contaminated waste. Continue this cleaning until there is no visible residue from abated surfaces or poly or other surfaces. Remove all filters in the air handling system and dispose of as ACM waste in accordance with these specifications. The negative pressure system shall remain in operation during this time. Additional cleaning(s) may be needed as determined by the CPIH/VPIH/CIH.

3.5.6 PRE-CLEARANCE INSPECTION AND TESTING

The CPIH/CIH and VPIH/CIH will perform a thorough and detailed visual inspection at the end of the cleaning to determine whether there is any visible residue in the regulated area. If the visual inspection is acceptable, the CPIH/CIH will perform pre-clearance sampling using aggressive clearance as detailed in 40 CFR 763 Subpart E (AHERA) Appendix A (Ill)(B)(7)(d). If the sampling results show values below 0.01 f/cc, then the Contractor shall notify the VA's representative of the results with a brief report from the CPIH/CIH documenting the inspection and sampling results and a statement verifying that the regulated area is ready for lockdown encapsulation. The VA reserves the right to utilize their own VPIH/CIH to perform a pre-clearance inspection and testing for verification.

3.5.7 LOCKDOWN ENCLOSURATION OF ABATED SURFACES

With the express written permission of the VA's representative, perform lockdown encapsulation of all surfaces from which asbestos was abated in accordance with the procedures in this specification. Negative pressure shall be maintained in the regulated area during the lockdown application.

3.6 FINAL VISUAL INSPECTION AND AIR CLEARANCE TESTING

3.6.1 GENERAL

Notify the VA representative 24 hours in advance for the performance of the final visual inspection and testing. The final visual inspection and testing will be performed by the VPIH/CIH starting after the final cleaning.
3.6.2 FINAL VISUAL INSPECTION

Final visual inspection will include the entire regulated area, the PDF, all poly sheeting, seals over HVAC openings, doorways, windows, and any other openings. If any debris, residue, dust or any other suspect material is detected, the final cleaning shall be repeated at no cost to the VA. Dust/material samples may be collected and analyzed at no cost to the VA at the discretion of the VPIH/CIH to confirm visual findings. When the regulated area is visually clean the final testing can be done.

3.6.3 FINAL AIR CLEARANCE TESTING

A. After an acceptable final visual inspection by the VPIH/CIH and VA Representative, the VPIH/CIH will perform the final clearance testing. Air samples will be collected and analyzed in accordance with procedures for AHERA in this specification. If work is less than 260 lf/160 sf/35 cf, 5 PCM samples shall be collected for clearance and a minimum of one field blank. If work is equal to or more than 260 lf/160 sf/35 cf, AHERA TEM sampling shall be performed for clearance. TEM analysis shall be done in accordance with procedures for EPA AHERA in this specification. If the release criteria are not met, the Contractor shall repeat the final cleaning and continue decontamination procedures until clearance is achieved. **All Additional inspection and testing costs will be borne by the Contractor.**

B. If release criteria are met, proceed to perform the abatement closeout and to issue the certificate of completion in accordance with these specifications.

3.6.4 FINAL AIR CLEARANCE PROCEDURES

A. Contractor’s Release Criteria: Work in a regulated area is complete when the regulated area is visually clean and airborne fiber levels have been reduced to or below 0.01 f/cc as measured by the AHERA PCM protocol, or 70 AHERA structures per square millimeter (s/mm²) by AHERA TEM.

B. Air Monitoring and Final Clearance Sampling: To determine if the elevated airborne fiber counts encountered during abatement operations have been reduced to the specified level, the VPIH/CIH will secure samples and analyze them according to the following procedures:

1. Fibers Counted: “Fibers” referred to in this section shall be either all fibers regardless of composition as counted in the NIOSH 7400 PCM method or asbestos fibers counted using the AHERA TEM method.

2. Aggressive Sampling: All final air testing samples shall be collected using aggressive sampling techniques except where soil is not encapsulated or enclosed. Samples will be collected on 0.8µ MCE filters for PCM analysis and 0.45µ Polycarbonate filters for TEM. A minimum of 1200 Liters of using calibrated pumps shall be collected for clearance samples. Before pumps are started, initiate aggressive air mixing sampling as detailed in 40 CFR 763 Subpart E (AHERA) Appendix A (III)(B)(7)(d). Air samples will be collected in areas subject to normal air circulation away from corners, obstructed locations, and locations near windows, doors, or vents. After air sampling pumps have been shut off, circulating fans shall be shut off. The negative pressure system shall continue to operate.

3. Final clearance for soil that is not encapsulated, samples will be collected on 0.8µ MCE filters for PCM analysis and 0.45µ Polycarbonate filters for TEM. A minimum of 1200 Liters of using calibrated pumps shall be collected for clearance samples. Air clearance of work areas where contaminated soil has been removed is in addition to the requirement for clearance by bulk sample analysis discussed within these specifications. There will be no aggressive air sampling for the clearance of soil due to the fact that aggressive air sampling may overload the cassettes.

4. Random samples shall be collected from areas of soil which have been abated to ensure that the soil has been properly decontaminated. The total number of samples to be collected from the soil areas shall be; <1000 SF of soil – 3 samples; >1000 to <5000 SF of soil – 5 samples; and >5000 SF of soil – 7 samples. The soil samples shall be collected in a statistically random manner and shall be analyzed by PLM method. The clearance level to determine the
soil clean is <1% asbestos by weight as analyzed by PLM method. If this level is achieved, the soil areas shall be considered clear. If the levels are >1% asbestos, the areas shall be re-cleaned until the sample results are <1%.

3.6.5 CLEARANCE SAMPLING USING PCM – LESS THAN 260LF/160SF:
A. The VPIH/CIH will perform clearance samples as indicated by the specification.
B. The NIOSH 7400 PCM method will be used for clearance sampling with a minimum collection volume of 1200 Liters of air. A minimum of 5 PCM clearance samples shall be collected. All samples must be equal to or less than 0.01 f/cc to clear the regulated area.
C. Random samples shall be collected from areas of soil which have been abated to ensure that the soil has been properly decontaminated. The total number of samples to be collected from the soil areas shall be: <1000 SF of soil – 3 samples; >1000 to <5000 SF of soil – 5 samples; and >5000 SF of soil – 7 samples. The soil samples shall be collected in a statistically random manner and shall be analyzed by PLM method. The clearance level to determine the soil clean is <1% asbestos by weight as analyzed by PLM method. If this level is achieved, the soil areas shall be considered clear. If the levels are >1% asbestos, the areas shall be re-cleaned until the sample results are <1%.

3.6.6 CLEARANCE SAMPLING USING TEM – EQUAL TO OR MORE THAN 260LF/160SF: TEM
A. Clearance requires 13 samples be collected; 5 inside the regulated area; 5 outside the regulated area; and 3 field blanks.
B. The TEM method will be used for clearance sampling with a minimum collection volume of 1200 Liters of air. A minimum of 13 clearance samples shall be collected. All samples must be equal to or less than 70 AHERA structures per square millimeter (s/mm$^2$) AHERA TEM.

3.6.7 LABORATORY TESTING OF PCM CLEARANCE SAMPLES
The services of an AIHA accredited laboratory will be employed by the VA to perform analysis for the PCM air samples. The accredited laboratory shall be successfully participating in the AIHA Proficiency Analytical Testing (PAT) program. Samples will be sent daily by the VPIH/CIH so that verbal/faxed reports can be received within 24 hours. A complete record, certified by the laboratory, of all air monitoring tests and results will be furnished to the VA’s representative and the Contractor.

3.6.8 LABORATORY TESTING OF TEM SAMPLES
Samples shall be sent by the VPIH/CIH to a NIST accredited laboratory for analysis by TEM. The laboratory shall be successfully participating in the NIST Airborne Asbestos Analysis (TEM) program. Verbal/faxed results from the laboratory shall be available within 24 hours after receipt of the samples. A complete record, certified by the laboratory, of all TEM results shall be furnished to the VA's representative and the Contractor.

3.6.9 LABORATORY TESTING OF BULK SAMPLES
Samples shall be sent by the VPIH/CIH or CPIH/CIH to a NIST accredited laboratory for analysis by PLM. The laboratory shall be successfully participating in the NIST Bulk Asbestos Analysis (PLM) program. Verbal/faxed results from the laboratory shall be available within 24 hours after receipt of the samples. A complete record, certified by the laboratory, of all TEM results shall be furnished to the VA's representative and the Contractor.

3.7 ABATEMENT CLOSEOUT AND CERTIFICATE OF COMPLIANCE

3.7.1 COMPLETION OF ABATEMENT WORK
After thorough decontamination, seal negative air machines with 2 layers of 6 mil poly and duct tape to form a tight seal at the intake/outlet ends before removal from the regulated area.
Complete asbestos abatement work upon meeting the regulated area visual and air clearance criteria and fulfilling the following:

A. Remove all equipment and materials from the project area.
B. Dispose of all packaged ACM waste as required.
C. Repair or replace all interior finishes damaged during the abatement work, as required.
D. Fulfill other project closeout requirements as required in this specification.

3.7.2 CERTIFICATE OF COMPLETION BY CONTRACTOR

The CPIH/CIH shall complete and sign the "Certificate of Completion" in accordance with Attachment 1 at the completion of the abatement and decontamination of the regulated area.

3.7.3 WORK SHIFTS

All work shall be done during administrative hours (8:00 AM to 4:30 PM) Monday -Friday excluding Federal Holidays. Any change in the work schedule must be approved in writing by the VA Representative.

3.7.4 RE-INSULATION

If required as part of the contract, replace all asbestos containing insulation/fire-proofing with suitable non-asbestos material. Provide MSDS's for all replacement materials in advance of installation for VA approval. Refer to Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
ATTACHMENT #1
CERTIFICATE OF COMPLETION

DATE: ____________________ VA Project #: ________________________________
PROJECT NAME: _______________ Abatement Contractor: _______________
VAMC/ADDRESS: ______________________________________________________

1. I certify that I have personally inspected, monitored and supervised the abatement work of (specify regulated area or Building):
   which took place from / / to / / 

2. That throughout the work all applicable requirements/regulations and the VA's specifications were met.

3. That any person who entered the regulated area was protected with the appropriate personal protective equipment and respirator and that they followed the proper entry and exit procedures and the proper operating procedures for the duration of the work.

4. That all employees of the Abatement Contractor engaged in this work were trained in respiratory protection, were experienced with abatement work, had proper medical surveillance documentation, were fit-tested for their respirator, and were not exposed at any time during the work to asbestos without the benefit of appropriate respiratory protection.

5. That I performed and supervised all inspection and testing specified and required by applicable regulations and VA specifications.

6. That the conditions inside the regulated area were always maintained in a safe and healthy condition and the maximum fiber count never exceeded 0.5 f/cc, except as described below.

7. That all abatement work was done in accordance with OSHA requirements and the manufacturer's recommendations.

CPIH/CIH Signature/Date: ........................................................................................................................
CPIH/CIH Print Name: ..............................................................................................................................
Abatement Contractor Signature/Date: .....................................................................................................
Abatement Contractor Print Name: .........................................................................................................
ATTACHMENT #2
CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

PROJECT NAME: _____________________________________________ DATE: ____________

PROJECT ADDRESS: _____________________________________________

ABATEMENT CONTRACTOR'S NAME: ________________________________

WORKING WITH ASBESTOS CAN BE HAZARDOUS TO YOUR HEALTH. INHALING ASBESTOS HAS BEEN LINKED WITH VARIOUS TYPES OF CANCERS. IF YOU SMOKE AND INHALE ASBESTOS FIBERS, YOUR CHANCES OF DEVELOPING LUNG CANCER IS GREATER THAN THAT OF THE NON-SMOKING PUBLIC.

Your employer's contract with the owner for the above project requires that: You must be supplied with the proper personal protective equipment including an adequate respirator and be trained in its use. You must be trained in safe and healthy work practices and in the use of the equipment found at an asbestos abatement project. You must receive/have a current medical examination for working with asbestos. These things shall be provided at no cost to you. By signing this certificate you are indicating to the owner that your employer has met these obligations.

RESPIRATORY PROTECTION: I have been trained in the proper use of respirators and have been informed of the type of respirator to be used on the above indicated project. I have a copy of the written Respiratory Protection Program issued by my employer. I have been provided for my exclusive use, at no cost, with a respirator to be used on the above indicated project.

TRAINING COURSE: I have been trained by a third party, State/EPA accredited trainer in the requirements for an AHERA/OSHA Asbestos Abatement Worker training course, 32 hours minimum duration. I currently have a valid State accreditation certificate. The topics covered in the course include, as a minimum, the following:

- Physical Characteristics and Background Information on Asbestos
- Potential Health Effects Related to Exposure to Asbestos
- Employee Personal Protective Equipment
- Establishment of a Respiratory Protection Program
- State of the Art Work Practices
- Personal Hygiene
- Additional Safety Hazards
- Medical Monitoring
- Air Monitoring
- Relevant Federal, State and Local Regulatory Requirements, Procedures, and Standards
- Asbestos Waste Disposal

MEDICAL EXAMINATION: I have had a medical examination within the past 12 months which was paid for by my employer. This examination included: health history, occupational history, pulmonary function test, and may have included a chest x-ray evaluation. The physician issued a positive written opinion after the examination.

Signature: ________________________________

Printed Name: ________________________________

Social Security Number: ________________________________

Witness: ________________________________

653-10-531 VA Roseburg Correct Electrical Deficiencies 02 8211
100% Design Submittal 2017/03/10 47 of 51
ATTACHMENT #3

AFFIDAVIT OF MEDICAL SURVEILLANCE, RESPIRATORY PROTECTION AND TRAINING/ACCREDITATION

VA PROJECT NAME AND NUMBER: ________________________________

VA MEDICAL FACILITY: ________________________________

ABATEMENT CONTRACTOR’S NAME AND ADDRESS: ________________________________

1. I verify that the following individual

   Name: ________________________________ Social Security Number: ________________________________

   who is proposed to be employed in asbestos abatement work associated with the above project by the named Abatement Contractor, is included in a medical surveillance program in accordance with 29 CFR 1926.1101(m), and that complete records of the medical surveillance program as required by 29 CFR 1926.1101(m)(n) and 29 CFR 1910.20 are kept at the offices of the Abatement Contractor at the following address.

   Address: ________________________________

2. I verify that this individual has been trained, fit-tested and instructed in the use of all appropriate respiratory protection systems and that the person is capable of working in safe and healthy manner as expected and required in the expected work environment of this project.

3. I verify that this individual has been trained as required by 29 CFR 1926.1101(k). This individual has also obtained a valid State accreditation certificate. Documentation will be kept on-site.

4. I verify that I meet the minimum qualifications criteria of the VA specifications for a CPIH.

   Signature of CPIH/CIH: ________________________________ Date: __________________

   Printed Name of CPIH/CIH: ________________________________

   Signature of Contractor: ________________________________ Date: __________________

   Printed Name of Contractor: ________________________________
ATTACHMENT #4

ABATEMENT CONTRACTOR/COMPETENT PERSON(S) REVIEW AND ACCEPTANCE OF THE VA'S ASBESTOS SPECIFICATIONS

VA Project Location: ____________________________________________________________

VA Project #: _______________________________________________________________

VA Project Description: _______________________________________________________

This form shall be signed by the Asbestos Abatement Contractor Owner and the Asbestos Abatement Contractor's Competent Person(s) prior to any start of work at the VA related to this Specification. If the Asbestos Abatement Contractor's/Competent Person(s) has not signed this form, they shall not be allowed to work on-site.

I, the undersigned, have read VA’s Asbestos Specification regarding the asbestos abatement requirements. I understand the requirements of the VA’s Asbestos Specification and agree to follow these requirements as well as all required rules and regulations of OSHA/EPA/DOT and State/Local requirements. I have been given ample opportunity to read the VA’s Asbestos Specification and have been given an opportunity to ask any questions regarding the content and have received a response related to those questions. I do not have any further questions regarding the content, intent and requirements of the VA’s Asbestos Specification.

At the conclusion of the asbestos abatement, I will certify that all asbestos abatement work was done in accordance with the VA’s Asbestos Specification and all ACM was removed properly and no fibrous residue remains on any abated surfaces.

Abatement Contractor Owner’s Signature________________________Date___________

Abatement Contractor Competent Person(s)______________________________Date__________

- - - END - - -
LEAD-BASED PAINT REMOVAL AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Removing and disposal of lead-based paint at interior and exterior locations indicated in existing conditions report.

1.2 RELATED REQUIREMENTS
   A. Hazardous Material Abatement: Section 02 8211, TRADITIONAL ASBESTOS ABATEMENT.
   B. Demolition Disturbing Lead-Based Paint: Section 02 4100, DEMOLITION.
   C. Surface Preparation Disturbing Lead-Based Paint: Section 09 9100, PAINTING.

1.3 DEFINITIONS
   A. Action Level: Employee exposure, without regard to use of respirator, to lead airborne concentration of 30 micrograms per cubic meter (0.03 parts per million) of air averaged over 8-hour period. As used in this section, "30 micrograms per cubic meter of air (0.03 parts per million)" refers to action level.
   B. Area Monitoring: Sampling of lead concentrations within lead control area and inside physical boundaries which are representative of airborne lead concentrations which may reach breathing zone of personnel potentially exposed to lead.
   C. Breathing Zone: Area within hemisphere, forward of shoulders, with 150 mm to 225 mm (6 to 9 inches) radius and center at nose or mouth of employee.
   D. Certified Industrial Hygienist (CIH): As used in this section, refers to an Industrial Hygienist employed by Contractor.
   E. Change Rooms and Shower Facilities: Rooms within designated physical boundary around lead control area equipped with separate storage facilities for clean protective work clothing and equipment and for street clothes which prevent cross-contamination.
   F. Competent Person: Person capable of identifying lead hazards in work area and authorized by contractor to take corrective action.
   G. Decontamination Room: Room for removal of contaminated personal protective equipment (PPE).
   H. Eight-Hour Time Weighted Average (TWA): Airborne concentration of lead averaged over 8-hour workday to which an employee is exposed.
   I. High Efficiency Particulate Air (HEPA) Filter Equipment: HEPA filtered vacuuming equipment with UL 586 filter system capable of collecting and retaining lead-contaminated paint dust. HEPA filter means 99.97 percent efficient against 0.3 micron (0.012 mil) size particles.
   J. Lead: Metallic lead, inorganic lead compounds, and organic lead soaps. Excluded from this definition are other organic lead compounds.
K. Lead Control Area: Enclosed area or structure with full containment to prevent spreading lead dust, paint chips, and debris from lead-based paint removal operations. Lead control area is isolated by physical boundaries to prevent unauthorized entry of personnel.

L. Lead Permissible Exposure Limit (PEL): Fifty micrograms per cubic meter (0.05 parts per million) of air as 8-hour time weighted average as determined by 29 CFR Part 1910.1025. When employee is exposed for more than 8 hours per work day, determine PEL by following formula. PEL micrograms/cubic meter (parts per million) of air = 400/No. of hrs. worked per day.

M. Personnel Monitoring: Sampling of lead concentrations within employee breathing zone to determine 8-hour time weighted average concentration according to 29 CFR Part 1910.1025. Take samples representative of employee's work tasks.

N. Physical Boundary: Area physically roped or partitioned off around enclosed lead control area to limit unauthorized entry of personnel. As used in this section, “inside boundary” shall mean same as “outside lead control area.”

1.4 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. American National Standards Institute (ANSI):

   1. 29 CFR Part 1910 - Occupational Safety and Health Standards.
   2. 29 CFR Part 1926 - Safety and Health Regulations for Construction.

D. Underwriters Laboratories (UL):
   1. 586-09 - High-Efficiency, Particulate, Air Filter Units.
1.5 PRE-REMOVAL MEETINGS

A. Conduct pre-removal meeting at project site minimum 30 days before beginning Work of this section.

1. Required Participants:
   a. Contracting Officer's Representative.
   b. Certified Industrial Hygienist.
   d. Contractor.
   e. Paint removal contractor.
   f. Other installers responsible for finishing resulting surfaces.

2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
   a. Respiratory protection program.
   b. Hazard communication program.
   c. Hazardous waste management plan.
   d. Safety and health regulation compliance.
   e. Employee training.
   f. Removal schedule.
   g. Removal sequence.
   h. Preparatory work.
   i. Protection before, during, and after removal.
   j. Removal.
   k. Inspecting and testing.
   l. Other items affecting successful completion.

3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.6 SUBMITTALS

A. Submittal Procedures: Section 01 3323, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:
   1. Description of each product.
      a. Paint removal products.
      b. Vacuum filters.
      c. Respirators.
   2. Safety data sheet for each paint removal product.
   3. Installation instructions.
      a. Paint removal products.

C. Test Reports: Submit testing laboratory reports.
1. Submit air monitoring results within three working days, signed by testing laboratory employee performing air monitoring, employee analyzing sample, and CIH.

D. Certificates: Certify completed training.
1. Submit certificate for each employee signed and dated by CIH and employee stating employee was trained.

E. Qualifications: Substantiate qualifications comply with specifications.
1. Paint removal contractor.
2. Testing laboratory.
   a. Name, address, and telephone number.
   b. Current evidence of participation in NIOSH PAT Program.
   c. Copy of current AIHA accreditation certificate.
3. Industrial hygienist.
   a. Name, address, and telephone number.
   b. Resume showing previous experience.
   c. Copy of current ABIH CIH certification.
4. Paint disposal facility.
   a. Name, address, and telephone number.
   b. Current license or authorization to receive and dispose lead contaminated waste.

F. Record Documents:
1. Completed and signed hazardous waste manifest from waste transporter.
2. Paint disposal facility receipts and disposition reports.
3. Certification of medical examinations.
4. Employee training certification.

1.7 QUALITY ASSURANCE
A. Safety and Health Regulation Compliance:
1. Comply with laws, ordinances, rules, and regulations of federal, state, and local authorities having jurisdiction regarding removing, handling, storing, transporting, and disposing lead waste materials.
   b. Notify Contracting Officer's Representative and request resolution of conflicts between regulations and specified requirements before starting work.
2. Comply with the following local laws, ordinances, criteria, rules and regulations regarding removing, handling, storing, transporting, and disposing lead-contaminated materials:

B. Paint Removal Contractor: Experienced contractor, registered or licensed by applicable state agency regulating lead-based paint removal.
C. Testing Laboratory: State certified independent testing laboratory experienced in airborne lead monitoring, testing, and reporting.
1. Successful participant in NIOSH Proficiency Analytical Testing (PAT) Program within prior 12 months.

2. Accredited by American Industrial Hygiene Association (AIHA).

D. Certified Industrial Hygienist: Certified as CIH by American Board of Industrial Hygiene in comprehensive practice and responsible for:
   1. Certify Training.
   2. Review and approve lead-based paint removal plan for conformance to applicable referenced standards.
   3. Inspect lead-based paint removal work for conformance with approved plan.
   4. Direct monitoring.
   5. Ensure work is performed according to specifications.
   6. Ensure personnel and environment hazardous exposures are adequately controlled.

E. Paint Disposal Facility: State certified disposal facility qualified to receive and dispose lead-based paint.

F. Lead-based Paint Removal Plan:
   1. Submit detailed, site-specific plan describing lead-based paint removal procedures.
   2. Include sketch showing location, size, and details of lead control areas, decontamination rooms, change rooms, shower facilities, and mechanical ventilation system.
   3. Include eating, drinking, and restroom procedures, interface of trades, work sequencing, collected wastewater and paint debris disposal plan, air sampling plan, respirators, protective equipment, and detailed description of containment methods ensuring airborne lead concentrations do not exceed action level outside lead control area.
      a. Eating, drinking, and smoking are not acceptable within lead control area.
   4. Include air sampling, training and strategy, sampling methodology, frequency, duration, and qualifications of air monitoring personnel.

   1. Provide each employee negative pressure or other appropriate respirator.
      a. Test fit each employee's respirator at initial fitting and maximum 6 month intervals, as required by 29 CFR Part 1926.62.


I. Hazardous Waste Management Plan: Establish and implement plan according to applicable requirements of Federal, State, and local hazardous waste regulations including the following:
   1. Identification of hazardous wastes associated with work.
   2. Estimated quantities of generated and disposed waste.
3. Names and qualifications of each contractor transporting, storing, treating, and disposing wastes. Include facility location and 24-hour point of contact. Provide two copies of EPA state and local hazardous waste permit applications permits and EPA Identification numbers.
4. Names and qualifications (experience and training) of personnel working on-site with hazardous wastes.
5. List of required waste handling equipment including cleaning, volume reduction, and transport equipment.
6. Spill prevention, containment, and cleanup contingency implementation measures.
7. Work plan and schedule for waste containment, removal, and disposal with daily waste cleaned up and containerization.

1.8 WARRANTY
A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 PAINT REMOVAL PRODUCTS
A. Chemical Stripper: Biodegradable, non-toxic, capable of removing existing paint layers in one application, and acceptable to CIH.

2.2 ACCESSORIES
A. Waste Collection Drums: 49 CFR Part 178; Type 1A2, steel, removable head, 200 L (55 gal.) capacity, capable of containing waste without loss.
B. Vacuum Cleaner: HEPA filtered type.
C. Scrapers:
   1. Metal type for use on metal, concrete, and masonry surfaces.
   2. Plastic type for use on wood, plaster, gypsum board, and other surfaces.
D. Rinse Water: Potable.
E. Cleaning Cloths: Cotton.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Before exposure to lead-contaminated dust, provide workers with comprehensive medical examination required by 29 CFR Part 1926.62 (I) (1) (i) and (ii).
   1. Exemption: Examination is not required when employee medical records show last examination required by 29 CFR Part 1926.62(I) was completed within previous 12 months.
B. Maintain complete and accurate employee medical records according to 29 CFR Part 1910.20.
C. Train each employee performing paint removal, disposal, and air sampling operations according to 29 CFR Part 1926.62.
   1. Certify training is completed before employee is permitted to work on project and enter lead control area.

3.2 PREPARATION

A. Protect existing work indicated to remain.
   1. Perform paint removal work without damaging and contaminating adjacent work.
   2. Restore damage and contamination to original condition.

B. Notify Contracting Officer 20 days before starting paint removal work.

C. Lead Control Area Requirements:
   1. Establish lead control area by completely enclosing lead-based paint removal work area with containment screens.
   2. Contain removal operations using negative pressure full containment system with minimum one change room and HEPA filtered exhaust.

D. Boundary Requirements: Provide physical boundaries around lead control area by roping off area designated on drawings or providing curtains, portable partitions or other enclosures to ensure that airborne lead concentrations do not meet or exceed action level outside of lead control area.

E. Heating, Ventilating and Air Conditioning (HVAC) Systems: Shut down, lock out, and isolate HVAC systems supplying exhausting, and passing through lead control areas. Seal HVAC inlets and outlet within lead control area with 6-mil plastic sheet and tape. Tape seal seams in HVAC components passing through lead control area.

F. Change Room and Shower Facilities: Provide clean change rooms and shower facilities within physical boundary around lead control area according to 29 CFR Part 1926.62.

G. Mechanical Ventilation System:
   1. Provide ventilation system to control personnel exposure to lead according to 29 CFR Part 1926.57.
   2. Design, construct, install, and maintain HEPA filtered fixed local exhaust ventilation system according to ANSI Z9.2 and approved by CIH.
   3. Exhaust ventilation air to exterior wherever possible.
   4. When exhaust ventilation air must be recirculated into work area, provide HEPA filter with reliable back-up filter and controls to monitor lead concentration in return air and to bypass recirculation system automatically when system fails.

H. Personnel Protection: Provide and use required protective clothing and equipment within lead control area.
I. Warning Signs: Provide warning signs complying with 29 CFR Part 1926.62 at lead control area approaches. Locate signs so personnel read signs and take necessary precautions before entering lead control area.

3.3 WORK PROCEDURES

A. Remove lead-based paint according to approved lead-based paint removal plan.

1. Perform work only in presence of CIH or Industrial Hygienist (IH) Technician under direction of CIH ensuring continuous inspection of work in progress and direction of air monitoring activities.

B. Use procedures and equipment required to limit occupational and environmental lead exposure when lead-based paint is removed according to 29 CFR Part 1926.62.

C. Dispose removed paint and waste according to Environmental Protection Agency (EPA), federal, state, and local requirements.

D. Personnel Exiting Procedures:

1. When personnel exit lead control area, comply with the following procedures:
   a. Vacuum exposed clothing surfaces.
   b. Remove protective clothing and equipment in decontamination room. Place clothing in approved impermeable disposal bag.
   c. Shower.
   d. Dress in clean clothes before leaving lead control area.

E. Monitoring - General:

1. Monitor airborne lead concentrations according to 29 CFR Part 1910.1025 by testing laboratory as directed by CIH.
2. Take personal air monitoring samples on employees anticipated to have greatest exposure risk as determined by CIH. Additionally, take air monitoring samples on minimum 25 percent of work crew or minimum of two employees, whichever is greater, during each work shift.
3. Submit results of air monitoring samples, signed by CIH, within 16 hours after taking air samples. Notify Contracting Officer's Representative immediately of lead exposure at or exceeding action level outside of lead control area.

F. Monitoring During Paint Removal:

1. Perform personal and area monitoring during entire paint removal operation.
2. Conduct area monitoring at physical boundary daily for each work shift to ensure unprotected personnel are not exposed above action level anytime.
3. For outdoor operations, take at least one sample on each shift leeward of lead control area. When adjacent areas are contaminated, clean area of contamination and have CIH visually inspect and certify lead contamination is cleaned.

4. Stop work when outside boundary lead levels meet or exceed action level. Notify Contracting Officer’s Representative, immediately.

5. Correct conditions causing increased lead concentration as directed by CIH.

6. Review sampling data collected during work stoppage to determine if conditions require additional work method modifications as determined by CIH.

7. Resume paint removal when approved by CIH.

3.4 LEAD-BASED PAINT REMOVAL

A. Remove paint within areas indicated on drawings completely exposing substrate. Minimize damage to substrate.

B. Comply with paint removal processes described lead paint removal plan.

C. Lead-Based Paint Removal: Select processes for each application to minimize work area lead contamination and waste.

3.5 SUBSTRATE SURFACE PREPARATION

A. Protect substrates from deterioration and contamination until refinished.
   1. Protect metal substrates from flash rusting.

B. Prepare and paint substrates according to Section 09 91 00, PAINTING.

3.6 FIELD QUALITY CONTROL

A. Field Tests: Performed by testing laboratory specified in Section 01 4529, TESTING LABORATORY SERVICES.

B. Perform sampling and testing for:
   1. Air monitoring.
   2. Lead based paint.

3.7 CLEANING AND DISPOSAL

A. Cleaning:
   1. Maintain lead control area surfaces free of accumulating paint chips and dust. Confine dust, debris, and waste to work area.
   2. Vacuum clean work area daily, at end of each shift, and when paint removal operation is complete.

B. CIH Certification: Certify in writing that inside and outside lead control area air monitoring samples are less than action level, employee respiratory protection was adequate, the work was performed according to 29 CFR Part 1926.62, and no visible accumulations of lead-based paint and dust remain on worksite.
1. Do not remove lead control area or roped-off boundary and warning signs before Contracting Officer's Representative's receipt of CIH's certification.

2. Reclean areas showing dust or residual paint chips.

C. Testing: Where indicated and when directed by Contracting Officer's Representative, test lead-based paint residue and used abrasive according to 40 CFR Part 261 for hazardous waste.

D. Waste Collection:
   1. Collect lead-contaminated materials including waste, scrap, debris, bags, containers, equipment, and clothing, which may produce airborne lead contamination.
   2. Place lead contaminated materials in waste disposal drums. Label each drum identifying waste type according to 49 CFR Part 172 and date waste materials were first put into drum. Obtain and complete the Uniform Hazardous Waste Manifest forms. Comply with land disposal restriction notification requirements required by 40 CFR Part 268.
   3. Coordinate temporary storage location on project site with Contracting Officer's Representative.

E. Waste Disposal:
   1. Minimum 14 days before delivery, notify COTR who will arrange for job site inspection of drums and manifests by // paint disposal facility personnel // ______ //.
   2. Contracting Officer's Representative will arrange hazardous wastes removal, transport and delivery to // paint disposal facility // ______ // to ensure drums do not remain on project site longer than 90 calendar days from drum label date.

F. Waste Disposal:
   1. Do not store hazardous waste drums in temporary storage location longer than 90 calendar days from drum label date.
   2. Remove, transport, and deliver drums to paint disposal facility.
      a. Obtain signed receipt including date, time, quantity, and description of materials received according to 40 CFR Part 262.
      b. Obtain final report of materials disposition after disposal completion.

- - - E N D - - -
CAST-IN-PLACE CONCRETE (SHORT-FORM)

PART 1 - GENERAL

1.1. DESCRIPTION:
This section specifies cast-in-place structural concrete and material and mixes for other concrete.

1.2. RELATED WORK:
   A. Materials testing and inspection during construction: Section 01 4529, TESTING LABORATORY SERVICES.

1.3. TOLERANCES:
   A. ACI 117
   B. Slab Finishes: ACI 117, F-number method in accordance with ASTM E 1155.

1.4. REGULATORY REQUIREMENTS:
   A. AC- SP-66 ACI Detailing Manual
   B. ACI 318 – Building Code Requirements for Reinforced Concrete.

1.5. SUBMITTALS:
   A. Submit in accordance with Section 01 3323, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
   B. Concrete Mix Design.
   C. Shop Drawings: Reinforcing steel: Complete shop drawings.
   D. Manufacturer's Certificates: Air-entraining admixture, chemical admixtures, curing compounds.

1.6. TOLERANCES:
   A. ACI 117.
   B. Slab Finishes: ACI 117, F-number method in accordance with ASTM E1155.

1.7. APPLICABLE PUBLICATIONS:
   A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
   B. American Concrete Institute (ACI):
      117-10 Specification for Tolerances for Concrete Construction, Materials and Commentary
      211.1-91(R2009) Standard Practice for Proportions for Normal, Heavyweight, and Mass Concrete
      211.2-98(R2004) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
      301-10 Specifications for Structural Concrete
      305.1-06 Specification for Hot Weather Concreting
      SP-66-04 ACI Detailing Manual
      318-11 Building Code Requirements for Structural Concrete and Commentary
      347-04 Guide to Formwork for Concrete
   C. American Society for Testing and Materials (ASTM):
PART 2 - PRODUCTS

2.1. FORMS:

Wood, plywood, metal, or other materials, approved by COTR, of grade or type suitable to obtain type of finish specified.

2.2. MATERIALS:

A. Portland Cement: ASTM C150, Type I or II.

B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalis, and loss on ignition (LOI) not to exceed 5 percent.
C. Coarse Aggregate: ASTM C33, Size 67. Size 467 may be used for footings and walls over 300 mm (12 inches) thick. Coarse aggregate for applied topping and metal pan stair fill shall be Size 7.

D. Fine Aggregate: ASTM C33.

E. Mixing Water: Fresh, clean, and potable.


G. Chemical Admixtures: ASTM C494.

H. Reinforcing Steel: ASTM A615 or ASTM A996, deformed. See structural drawings for grade.


K. Sheet Materials for Curing Concrete: ASTM C171.

L. Abrasive Aggregates: Aluminum oxide grains or emery grits.

M. Liquid Densifier/Sealer: 100 percent active colorless aqueous silicate solution.

N. Grout, Non-Shrinking: Premixed ferrous or non-ferrous, mixed and applied in accordance with manufacturer's recommendations. Grout shall show no settlement or vertical drying shrinkage at 3 days or thereafter based on initial measurement made at time of placement, and produce a compressive strength of at least 18mpa (2500 psi) at 3 days and 35mpa (5000 psi) at 28 days.

2.3 CONCRETE MIXES:

A. Design of concrete mixes using materials specified shall be the responsibility of the Contractor as set forth under Option C of ASTM C94.

B. Compressive strength at 28 days shall be not less than 25mpa (3000 psi).

C. Establish strength of concrete by testing prior to beginning concreting operation. Test consists of average of three cylinders made and cured in accordance with ASTM C192 and tested in accordance with ASTM C39.

D. Maximum slump for vibrated concrete is 100 mm (4 inches) tested in accordance with ASTM C143.

E. Cement and water factor (See Table I):

<table>
<thead>
<tr>
<th>Concrete: Strength</th>
<th>Non-Air-Entrained</th>
<th>Air-Entrained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. 28 Day Comp. Str. MPa (psi)</td>
<td>Min. Cement kg/m³ (lbs/c. yd)</td>
<td>Max. Water Cement Ratio</td>
</tr>
<tr>
<td>35 (5000)¹,³</td>
<td>375 (630)</td>
<td>0.45</td>
</tr>
<tr>
<td>30 (4000)¹,³</td>
<td>325 (550)</td>
<td>0.55</td>
</tr>
<tr>
<td>25 (3000)¹,³</td>
<td>280 (470)</td>
<td>0.65</td>
</tr>
<tr>
<td>25 (3000)¹,²</td>
<td>300 (500)</td>
<td>-</td>
</tr>
</tbody>
</table>
1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 8.3 MPa (1200 psi) in excess of \( f'c \). For concrete strengths above 35 Mpa (5000 psi), the proposed mix design shall achieve a compressive strength 9.7 MPa (1400 psi) in excess of \( f'c \).

2. Lightweight Structural Concrete. Pump mixes may require higher cement values.

3. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.

4. Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.

F. Air-entrainment is required for all exterior concrete and as required for Section 32 0523, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS. Air content shall conform with the following table:

<table>
<thead>
<tr>
<th>Nominal Maximum Size of Coarse Aggregate</th>
<th>Total Air Content Percentage by Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 mm (3/8 in)</td>
<td>6 to 10</td>
</tr>
<tr>
<td>13 mm (1/2 in)</td>
<td>5 to 9</td>
</tr>
<tr>
<td>19 mm (3/4 in)</td>
<td>4 to 8</td>
</tr>
<tr>
<td>25 mm (1 in)</td>
<td>3 1/2 to 6 1/2</td>
</tr>
<tr>
<td>40 mm (1 1/2 in)</td>
<td>3 to 6</td>
</tr>
</tbody>
</table>

2.4. BATCHING & MIXING:

A. Store, batch, and mix materials as specified in ASTM C94.

1. Job-Mixed: Concrete mixed at job site shall be mixed in a batch mixer in manner specified for stationary mixers in ASTM C94.

2. Ready-Mixed: Ready-mixed concrete comply with ASTM C94, except use of non-agitating equipment for transporting concrete to the site will not be permitted. With each load of concrete delivered to project, ready-mixed concrete producer shall furnish, in duplicate, certification as required by ASTM C94.

3. Mixing structural lightweight concrete: Charge mixer with 2/3 of total mixing water and all of the aggregate. Mix ingredients for not less than 30 seconds in a stationary mixer or not less than 10 revolutions at mixing speed in a truck mixer. Add remaining mixing water and other ingredients and continue mixing. Above procedure may be modified as recommended by aggregate producer.

PART 3 - EXECUTION

3.1 FORMWORK:
A. Installations conform to ACI 347. Sufficiently tight to hold concrete without leakage, sufficiently braced to withstand vibration of concrete, and to carry, without appreciable deflection, all dead and live loads to which they may be subjected.

B. Treating and Wetting: Treat or wet contact forms as follows:
   1. Coat plywood and board forms with non-staining form sealer. In hot weather cool forms by wetting with cool water just before concrete is placed.
   2. Clean and coat removable metal forms with light form oil before reinforcement is placed. In hot weather cool metal forms by thoroughly wetting with water just before placing concrete.
   3. Use sealer on reused plywood forms as specified for new material.

C. Inserts, sleeves, and similar items: Items specified as furnished under this and other sections of specifications and required to be in their final position at time concrete is placed shall be properly located, accurately positioned and built into construction, and maintained securely in place.

D. Construction Tolerances:
   1. Contractor is responsible for setting and maintaining concrete formwork to assure erection of completed work within tolerances specified to accommodate installation or other rough and finish materials. Remedial work necessary for correcting excessive tolerances is the responsibility of the Contractor. Erected work that exceeds specified tolerance limits shall be remedied or removed and replaced, at no additional cost to the Government.
   2. Permissible surface irregularities for various classes of materials are defined as "finishes" in specification sections covering individual materials. They are to be distinguished from tolerances specified which are applicable to surface irregularities of structural elements.

3.2. REINFORCEMENT:
Details of concrete reinforcement, unless otherwise shown, in accordance with aci 318 and aci sp-66. Support and securely tie reinforcing steel to prevent displacement during placing of concrete.

3.3. VAPOUR BARRIER:
   A. Place 100 mm (4 inches) of fine granular fill over the vapor barrier to act as a blotter for concrete slab.
   B. Lap joints 150 mm (6 inches) and seal with a compatible pressure-sensitive tape.
   C. Patch punctures and tears.

3.4. PLACING CONCRETE:
   A. Remove water from excavations before concrete is placed. Remove hardened concrete, debris and other foreign materials from interior of forms, and from inside of mixing and conveying equipment. Obtain approval of COTR before placing concrete. Provide screeds at required elevations for concrete slabs.
B. Before placing new concrete on or against concrete which has set, existing surfaces shall be roughened and cleaned free from all laitance, foreign matter, and loose particles.

C. Convey concrete from mixer to final place of deposit by method which will prevent segregation or loss of ingredients. Do not deposit in work concrete that has attained its initial set or has contained its water or cement more than 1 1/2 hours. Do not allow concrete to drop freely more than 1500 mm (5 feet) in unexposed work nor more than 900 mm (3 feet) in exposed work. Place and consolidate concrete in horizontal layers not exceeding 300 mm (12 inches) in thickness. Consolidate concrete by spading, rodding, and mechanical vibrator. Do not secure vibrator to forms or reinforcement. Vibration shall be carried on continuously with placing of concrete.

D. Hot weather placing of concrete: Follow recommendations of ACI 305R to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete.

E. Cold weather placing of concrete: Follow recommendations of ACI 306R, to prevent freezing of thin sections less than 300 mm (12 inches) and to permit concrete to gain strength properly, except that use of calcium chloride shall not be permitted without written approval from COTR.

3.5. PROTECTION AND CURING:
Protect exposed surfaces of concrete from premature drying, wash by rain or running water, wind, mechanical injury, and excessively hot or cold temperature. Curing method shall be subject to approval by COTR.

3.6. FORM REMOVAL:
Forms remain in place until concrete has a sufficient strength to carry its own weight and loads supported. Removal of forms at any time is the Contractor’s sole responsibility.

3.7. SURFACE PREPARATION:
Immediately after forms have been removed and work has been examined and approved by COTR, remove loose materials, and patch all stone pockets, surface honeycomb, or similar deficiencies with cement mortar made with 1 part Portland cement and 2 to 3 parts sand.

3.8. FINISHES:
A. Vertical and Overhead Surface Finishes:
1. Unfinished Areas: Vertical and overhead concrete surfaces exposed in unfinished areas, above suspended ceilings in manholes, and other unfinished areas exposed or concealed will not require additional finishing.
2. Interior and Exterior Exposed Areas (to be painted): Fins, burrs and similar projections on surface shall be knocked off flush by mechanical means approved by COTR and rubbed lightly with a fine abrasive stone or hone. Use an ample amount of water during rubbing without working up a lather of mortar or changing texture of concrete.
3. Interior and Exterior Exposed Areas (finished): Finished areas, unless otherwise shown, shall be given a grout finish of uniform color and shall have a smooth finish treated as follows:
   a. After concrete has hardened and laitance, fins and burrs have been removed, scrub concrete with wire brushes. Clean stained concrete surfaces by use of a hone or stone.
   b. Apply grout composed of 1 part portland cement and 1 part clean, fine sand (smaller than 600 micro-m (No. 30) sieve). Work grout into surface of concrete with cork floats or fiber brushes until all pits and honeycomb are filled.
   c. After grout has hardened, but still plastic, remove surplus grout with a sponge rubber float and by rubbing with clean burlap.
   d. In hot, dry weather use a fog spray to keep grout wet during setting period. Complete finish for any area in same day. Confine limits of finished areas to natural breaks in wall surface. Do not leave grout on concrete surface overnight.

   3.9. SLAB FINISHES:

   1. Scratch Finish: Slab surfaces to receive a bonded applied cementitious application shall all be thoroughly raked or wire broomed after partial setting (within 2 hours after placing) to roughen surface to insure a permanent bond between base slab and applied cementitious materials.

   2. Floating: Allow water brought to surface by float used for rough finishing to evaporate before surface is again floated or troweled. Do not sprinkle dry cement on surface to absorb water.

   3. Float Finish: Equipment pads, and slabs to receive non-cementitious materials, except as specified, shall be screened and floated to a smooth dense finish. After first floating, while surface is still soft, surfaces shall be checked for alignment using a straightedge or template. Correct high spots by cutting down with a trowel or similar tool and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections on floated finish by rubbing or dry grinding. Refloat the slab to a uniform sandy texture.

   4. Steel Trowel Finish: Applied toppings, All monolithic concrete floor slabs exposed in finished work and for which no other finish is shown or specified shall be steel troweled. Final steel troweling to secure a smooth, dense surface shall be delayed as long as possible, generally when the surface can no longer be dented with finger. During final troweling, tilt steel trowel at a slight angle and exert heavy pressure on trowel to compact cement paste and form a dense, smooth surface. Finished surface shall be free of trowel marks, uniform in texture and appearance.

   5. Broom Finish: Finish all exterior slabs with a bristle brush moistened with clear water after the surfaces have been floated.
6. Finished slab flatness (FF) and levelness (FL) values comply with the following minimum requirements:

<table>
<thead>
<tr>
<th>Slab on grade &amp; Shored suspended slabs</th>
<th>Unshored suspended slabs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specified overall value $F_F 25/F_L 20$</td>
<td>Specified overall value $F_F 25$</td>
</tr>
<tr>
<td>Minimum local value $F_F 17/F_L 15$</td>
<td>Minimum local value $F_F 17$</td>
</tr>
</tbody>
</table>

3.10. **SURFACE TREATMENTS:**
A. Surface treatments shall be mixed and applied in accordance with manufacturer's printed instructions.
B. Liquid Densifier/Sealer: Use on all exposed concrete floors and concrete floors to receive carpeting.

3.11. **APPLIED TOPPING:**
A. Separate concrete topping with thickness and strength shown with only enough water to insure a stiff, workable, plastic mix.
B. Continuously place applied topping until entire section is complete, struck off with straightedge, compact by rolling or tamping, float and steel trowel to a hard smooth finish.

--- END ---
VAMC: Department of Veteran's Affairs – Roseburg, OR
Location: 913 NW Garden Valley Boulevard, Roseburg, OR 97471
Project no. and Name: VA 643-10-531, VA Roseburg Correct Electrical Deficiencies
Submission
Date:
PART I – GENERAL

1.1 DESCRIPTION
This section contains a coordinated system in which requirements for materials specified in other sections shown are identified by abbreviated material names and finish codes in the room finish schedule or shown for other locations.

1.2 MANUFACTURERS
Manufacturer’s trade names and numbers used herein are only to identify colors, finishes, textures and patterns. Products of other manufacturer’s equivalent to colors, finishes, textures and patterns of manufacturers listed that meet requirements of technical specifications will be acceptable upon approval in writing by contracting officer for finish requirements.

1.3 SUBMITALS
Submit in accordance with SECTION 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES-provide quadruplicate samples for color approval of materials and finishes specified in this section.

1.4 APPLICABLE PUBLICATIONS
A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in text by basic designation only.
B. MASTER PAINTING INSTITUTE: (MPI)

PART 2 - PRODUCTS

2.1 DIGITAL COLOR PHOTOS
A. Size 24 x 35 mm.
B. Labeled for:
   1. Building name and Number.
   2. Room Name and Number.
DESIGNER NOTE: Specify only 03300 or 03301 when coated with a cementitious paint or special form work patterns are required.

### 2.2 DIVISION 03 – CONCRETE

**A. SECTION 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM)**

<table>
<thead>
<tr>
<th>Surface</th>
<th>Finish Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>Match Existing</td>
</tr>
</tbody>
</table>

### 2.3 DIVISION 05 – METALS

DESIGNER NOTE: Include structural steel items only when exposed to view.

**A. SECTION 05 40 00, COLD-FORMED METAL FRAMING**

<table>
<thead>
<tr>
<th>Finish</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Match Existing</td>
<td>Match Existing</td>
</tr>
</tbody>
</table>

### 2.4 DIVISION 09 - FINISHES

**A. SECTION 09 23 00, GYPSUM PLASTERING**

<table>
<thead>
<tr>
<th>Finish code</th>
<th>Integral</th>
<th>Color</th>
<th>Manufacturer</th>
<th>Mfg. Color Name/No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>GWB PL</td>
<td></td>
<td>Match Existing</td>
<td>Per Specifications</td>
<td>Per Specifications</td>
</tr>
</tbody>
</table>
B. SECTION 09 24 00, PORTLAND CEMENT PLASTERING

<table>
<thead>
<tr>
<th>Finish code</th>
<th>Integral</th>
<th>Color</th>
<th>Manufacturer</th>
<th>Mfg. Color Name/No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PORT CEM PL</td>
<td></td>
<td>Match Existing</td>
<td>Per Specifications</td>
<td>Per Specifications</td>
</tr>
</tbody>
</table>

C. SECTION 09 26 00, VENEER PLASTERING

<table>
<thead>
<tr>
<th>Finish code</th>
<th>Integral</th>
<th>Color</th>
<th>Manufacturer</th>
<th>Mfg. Color Name/No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>VP</td>
<td></td>
<td>Match Existing</td>
<td>Per Specifications</td>
<td>Per Specifications</td>
</tr>
</tbody>
</table>

D. SECTION 09 91 00, PAINT AND COATINGS

1. MPI Gloss and Sheen Standards
Gloss Level 1  a traditional matte finish-flat  max 5 units, and  max 10 units
Gloss Level 2  a high side sheen flat-“a velvet-like” finish  max 10 units, and  10-35 units
Gloss Level 3  a traditional “egg-shell like” finish  10-25 units, and  10-35 units
Gloss Level 4  a “satin-like” finish  20-35 units, and  min. 35 units
Gloss Level 5  a traditional semi-gloss  35-70 units
Gloss Level 6  a traditional gloss  70-85 units
Gloss Level 7  a high gloss  more than 85 units

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>------------------</td>
<td>------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>P</td>
<td>S</td>
<td>Semi</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>S</td>
<td>Opaque</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>S</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CC</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. 5 DIVISON 26 - ELECTRICAL

PART III EXECUTION

3.1 FINISH SCHEDULES & MISCELLANEOUS ABBREVIATIONS

<table>
<thead>
<tr>
<th>Term</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access Flooring</td>
<td>AF</td>
</tr>
<tr>
<td>Accordion Folding Partition</td>
<td>AFP</td>
</tr>
<tr>
<td>Acoustical Ceiling</td>
<td>AT</td>
</tr>
<tr>
<td>Acoustical Ceiling, Special Faced</td>
<td>AT (SP)</td>
</tr>
<tr>
<td>Acoustical Metal Pan Ceiling</td>
<td>AMP</td>
</tr>
<tr>
<td>Acoustical Wall Panel</td>
<td>AWP</td>
</tr>
<tr>
<td>Acoustical Wall Treatment</td>
<td>AWT</td>
</tr>
<tr>
<td>Acoustical Wallcovering</td>
<td>AWF</td>
</tr>
<tr>
<td>Anodized Aluminum Colored</td>
<td>AAC</td>
</tr>
<tr>
<td>Anodized Aluminum Natural Finish</td>
<td>AA</td>
</tr>
<tr>
<td>Baked On Enamel</td>
<td>BE</td>
</tr>
<tr>
<td>Brick Face</td>
<td>BR</td>
</tr>
<tr>
<td>Brick Flooring</td>
<td>BF</td>
</tr>
<tr>
<td>Brick Paving</td>
<td>BP</td>
</tr>
<tr>
<td>Carpet</td>
<td>CP</td>
</tr>
<tr>
<td>Carpet Athletic Flooring</td>
<td>CAF</td>
</tr>
<tr>
<td>Carpet Module Tile</td>
<td>CPT</td>
</tr>
<tr>
<td>Ceramic Glazed Facing Brick</td>
<td>CGFB</td>
</tr>
<tr>
<td>Ceramic Mosaic Tile</td>
<td>FTCT</td>
</tr>
<tr>
<td>Concrete</td>
<td>C</td>
</tr>
<tr>
<td>Concrete Masonry Unit</td>
<td>CMU</td>
</tr>
<tr>
<td>Divider Strips Marble</td>
<td>DS MB</td>
</tr>
<tr>
<td>Epoxy Coating</td>
<td>EC</td>
</tr>
<tr>
<td>Epoxy Resin Flooring</td>
<td>ERF</td>
</tr>
<tr>
<td>Existing</td>
<td>E</td>
</tr>
<tr>
<td>Exposed Divider Strips</td>
<td>EXP</td>
</tr>
<tr>
<td>Exterior</td>
<td>EXT</td>
</tr>
<tr>
<td>Exterior Finish System</td>
<td>EFS</td>
</tr>
<tr>
<td>Exterior Paint</td>
<td>EXT-P</td>
</tr>
<tr>
<td>Exterior Stain</td>
<td>EXT-ST</td>
</tr>
<tr>
<td>Fabric Wallcovering</td>
<td>WF</td>
</tr>
<tr>
<td>Facing Tile</td>
<td>SCT</td>
</tr>
<tr>
<td>Feature Strips</td>
<td>FS</td>
</tr>
<tr>
<td>Floor Mats &amp; Frames</td>
<td>FM</td>
</tr>
<tr>
<td>Floor Tile, Mosaic</td>
<td>FT</td>
</tr>
<tr>
<td>Fluorocarbon</td>
<td>FC</td>
</tr>
<tr>
<td>Folding Panel Partition</td>
<td>FP</td>
</tr>
<tr>
<td>Foot Grille</td>
<td>FG</td>
</tr>
<tr>
<td>Glass Masonry Unit</td>
<td>GUMU</td>
</tr>
<tr>
<td>Glazed Face CMU</td>
<td>GCMU</td>
</tr>
<tr>
<td>Glazed Structural Facing Tile</td>
<td>SFTU</td>
</tr>
<tr>
<td>Granite</td>
<td>GT</td>
</tr>
<tr>
<td>Gypsum Wallboard</td>
<td>GWB</td>
</tr>
<tr>
<td>High Glazed Coating</td>
<td>SC</td>
</tr>
<tr>
<td>Latex Mastic Flooring</td>
<td>LM</td>
</tr>
<tr>
<td>Material</td>
<td>Symbol</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Linear Metal Ceiling</td>
<td>LMC</td>
</tr>
<tr>
<td>Linear Wood Ceiling</td>
<td>LWC</td>
</tr>
<tr>
<td>Marble</td>
<td>MB</td>
</tr>
<tr>
<td>Material</td>
<td>MAT</td>
</tr>
<tr>
<td>Mortar</td>
<td>M</td>
</tr>
<tr>
<td>Multi-Color Coating</td>
<td>MC</td>
</tr>
<tr>
<td>Natural Finish</td>
<td>NF</td>
</tr>
<tr>
<td>Paint</td>
<td>P</td>
</tr>
<tr>
<td>Paver Tile</td>
<td>PVT</td>
</tr>
<tr>
<td>Perforated Metal Facing (Tile or Panels)</td>
<td>PMF</td>
</tr>
<tr>
<td>Plaster</td>
<td>PL</td>
</tr>
<tr>
<td>Plaster High Strength</td>
<td>HSPL</td>
</tr>
<tr>
<td>Plaster Keene Cement</td>
<td>KC</td>
</tr>
<tr>
<td>Plastic Laminate</td>
<td>HPDL</td>
</tr>
<tr>
<td>Polypropylene Fabric Wallcovering</td>
<td>PFW</td>
</tr>
<tr>
<td>Porcelain Paver Tile</td>
<td>PPT</td>
</tr>
<tr>
<td>Quarry Tile</td>
<td>QT</td>
</tr>
<tr>
<td>Radiant Ceiling Panel System</td>
<td>RCP</td>
</tr>
<tr>
<td>Resilient Stair Tread</td>
<td>RST</td>
</tr>
<tr>
<td>Rubber Base</td>
<td>RB</td>
</tr>
<tr>
<td>Rubber Tile Flooring</td>
<td>RT</td>
</tr>
<tr>
<td>Spandrel Glass</td>
<td>SLG</td>
</tr>
<tr>
<td>Stain</td>
<td>ST</td>
</tr>
<tr>
<td>Stone Flooring</td>
<td>SF</td>
</tr>
<tr>
<td>Structural Clay</td>
<td>SC</td>
</tr>
<tr>
<td>Suspension Decorative Grids</td>
<td>SDG</td>
</tr>
<tr>
<td>Terrazzo Portland Cement</td>
<td>PCT</td>
</tr>
<tr>
<td>Terrazzo Tile</td>
<td>TT</td>
</tr>
<tr>
<td>Terrazzo, Thin Set</td>
<td>TST</td>
</tr>
<tr>
<td>Textured Gypsum Ceiling Panel</td>
<td>TGC</td>
</tr>
<tr>
<td>Textured Metal Ceiling Panel</td>
<td>TMC</td>
</tr>
<tr>
<td>Thin set Terrazzo</td>
<td>TST</td>
</tr>
<tr>
<td>Veneer Plaster</td>
<td>VP</td>
</tr>
<tr>
<td>Vinyl Base</td>
<td>VB</td>
</tr>
<tr>
<td>Vinyl Coated Fabric Wallcovering</td>
<td>W</td>
</tr>
<tr>
<td>Vinyl Composition Tile</td>
<td>VCT</td>
</tr>
<tr>
<td>Vinyl Sheet Flooring</td>
<td>VSF</td>
</tr>
<tr>
<td>Vinyl Sheet Flooring (Welded Seams)</td>
<td>WSF</td>
</tr>
<tr>
<td>Wall Border</td>
<td>WB</td>
</tr>
<tr>
<td>Wood</td>
<td>WD</td>
</tr>
</tbody>
</table>

### 3.2 Finish Schedule Symbols

Symbol Definition:

- **Same finish as adjoining walls**
- *No color required*
- E Existing
- XX To match existing
- EFTR Existing finish to remain
- RM Remove

**END OF SECTION**
PART 1 - GENERAL

1.1 DESCRIPTION
This section specifies furred framing, wall furring, fasteners, and accessories for the screw attachment of gypsum board, plaster bases or other building boards.

1.2 RELATED WORK
A. Gypsum Board: Section 09 2900, GYPSUM BOARD.

1.3 TERMINOLOGY
A. Description of terms shall be in accordance with ASTM C754, ASTM C11, ASTM C841 and as specified.
B. Underside of Structure Overhead: In spaces where steel trusses or bar joists are shown, the underside of structure overhead shall be the underside of the floor or roof construction supported by beams, trusses, or bar joists. In interstitial spaces with walk-on floors the underside of the walk-on floor is the underside of structure overhead.
C. Thickness of steel specified is the minimum bare (uncoated) steel thickness.

1.4 SUBMITTALS
A. Submit in accordance with Section 01 3323, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
B. Manufacturer's Literature and Data:
   1. Studs, runners and accessories.
   2. Hanger inserts.
   3. Channels (Rolled steel).
   4. Furring channels.
   5. Screws, clips and other fasteners.
C. Shop Drawings:
   1. Typical metal stud and furring construction system including details around openings and corner details.

1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE
In accordance with the requirements of ASTM C754.

1.6 APPLICABLE PUBLICATIONS
A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
B. American Society For Testing And Materials (ASTM)
   A641-09..............................................Zinc-Coated (Galvanized) Carbon Steel Wire
   A653/653M-11.................................Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
PART 2 - PRODUCTS

2.1 PROTECTIVE COATING

Galvanize steel studs, runners (track), rigid (hat section) furring channels, "Z" shaped furring channels, and resilient furring channels, with coating designation of G-60 minimum, per ASTM 123.

2.2 STEEL STUDS AND RUNNERS (TRACK)

A. ASTM C645, modified for thickness specified and sizes as shown.
   1. Use ASTM A653/A653M steel, 0.8 mm (0.0329-inch) thick bare metal (33 mil).
   2. Runners same thickness as studs.
B. Provide not less than two cutouts in web of each stud, approximately 300 mm (12 inches) from each end, and intermediate cutouts on approximately 600 mm (24-inch) centers.
C. Doubled studs for openings and studs for supporting concrete backer-board.
D. Studs 3600 mm (12 feet) or less in length shall be in one piece.

2.3 FURRING CHANNELS

A. Rigid furring channels (hat shape): ASTM C645.
B. Resilient furring channels:
   1. Not less than 0.45 mm (0.0179-inch) thick bare metal.
   2. Semi-hat shape, only one flange for anchorage with channel web leg slotted on anchorage side, channel web leg on other side stiffens fastener surface but shall not contact anchorage surface other channel leg is attached to.
C. "Z" Furring Channels:
   1. Not less than 0.45 mm (0.0179-inch)-thick bare metal, with 32 mm (1-1/4 inch) and 19 mm (3/4-inch) flanges.
   2. Web furring depth to suit thickness of insulation with slotted perforations.
D. Rolled Steel Channels: ASTM C754, cold rolled; or, ASTM C841, cold rolled.

2.4 FASTENERS, CLIPS, AND OTHER METAL ACCESSORIES
A. ASTM C754, except as otherwise specified.
B. Fasteners for steel studs thicker than 0.84 mm (0.033-inch) thick. Use ASTM C954 steel drill screws of size and type recommended by the manufacturer of the material being fastened.
C. Clips: ASTM C841 (paragraph 6.11), manufacturer's standard items. Clips used in lieu of tie wire shall have holding power equivalent to that provided by the tie wire for the specific application.
D. Concrete ceiling hanger inserts (anchorage for hanger wire and hanger straps): Steel, zinc-coated (galvanized), manufacturers standard items, designed to support twice the hanger loads imposed and the type of hanger used.
E. Tie Wire and Hanger Wire:
   1. ASTM A641, soft temper, Class 1 coating.
   2. Gage (diameter) as specified in ASTM C754 or ASTM C841.
F. Attachments for Wall Furring:
   1. Manufacturers standard items fabricated from zinc-coated (galvanized) steel sheet.
   2. For concrete or masonry walls: Metal slots with adjustable inserts or adjustable wall furring brackets. Spacers may be fabricated from 1 mm (0.0396-inch) thick galvanized steel with corrugated edges.
G. Power Actuated Fasteners: Type and size as recommended by the manufacturer of the material being fastened.

PART 3 - EXECUTION

3.1 INSTALLATION CRITERIA
A. Where fire rated construction is required for walls, partitions, the construction shall be same as that used in fire rating test.
B. Construction requirements for fire rated assemblies and materials shall be as shown and specified, the provisions of the Scope paragraph (1.2) of ASTM C754 and ASTM C841 regarding details of construction shall not apply.

3.2 INSTALLING STUDS
A. Install studs in accordance with ASTM C754, except as otherwise shown or specified.
B. Space studs not more than 610 mm (24 inches) on center.
C. Cut studs 6 mm to 9 mm (1/4 to 3/8-inch) less than floor to underside of structure overhead when extended to underside of structure overhead.
D. Where studs are shown to terminate above suspended ceilings, provide bracing as shown or extend studs to underside of structure overhead.

E. Extend studs to underside of structure overhead for fire, rated partitions, smoke partitions, shafts, and sound rated partitions.

G. Openings:
   1. Frame jambs of openings in stud partitions and furring with two studs placed back to back or as shown.
   2. Fasten back to back studs together with 9 mm (3/8-inch) long Type S pan head screws at not less than 600 mm (two feet) on center, staggered along webs.
   3. Studs fastened flange to flange shall have splice plates on both sides approximately 50 X 75 mm (2 by 3 inches) screwed to each stud with two screws in each stud. Locate splice plates at 600 mm (24 inches) on center between runner tracks.

H. Fastening Studs:
   1. Fasten studs located adjacent to partition intersections, corners and studs at jambs of openings to flange of runner tracks with two screws through each end of each stud and flange of runner.
   2. Do not fasten studs to top runner track when studs extend to underside of structure overhead.

3.3 INSTALLING WALL FURRING FOR FINISH APPLIED TO ONE SIDE ONLY

A. In accordance with ASTM C754, or ASTM C841 except as otherwise specified or shown.

B. Wall furring-Stud System:
   1. Framed with 63 mm (2-1/2 inch) or narrower studs, 600 mm (24 inches) on center.
   2. Brace as specified in ASTM C754 for Wall Furring-Stud System or brace with sections or runners or studs placed horizontally at not less than three foot vertical intervals on side without finish.
   3. Securely fasten braces to each stud with two Type S pan head screws at each bearing.

C. Direct attachment to masonry or concrete; rigid channels or “Z” channels:
   1. Install rigid (hat section) furring channels at 600 mm (24 inches) on center, horizontally or vertically.
   2. Install “Z” furring channels vertically spaced not more than 600 mm (24 inches) on center.
   3. At corners where rigid furring channels are positioned horizontally, provide mitered joints in furring channels.
   4. Ends of spliced furring channels shall be nested not less than 200 mm (8 inches).
   5. Fasten furring channels to walls with power-actuated drive pins or hardened steel concrete nails. Where channels are spliced, provide two fasteners in each flange.
6. Locate furring channels at interior and exterior corners in accordance with wall finish material manufacturers printed erection instructions. Locate "Z" channels within 100 mm (4 inches) of corner.

D. Installing Wall Furring-Bracket System: Space furring channels not more than 400 mm (16 inches) on center.

3.4 INSTALLING SUPPORTS REQUIRED BY OTHER TRADES
   A. Provide for attachment and support of electrical outlets, access panel frames, and other items supported by stud construction.
   B. Provide additional studs where required. Install metal backing plates, or special metal shapes as required, securely fastened to metal studs.

3.5 TOLERANCES
   A. Fastening surface for application of subsequent materials shall not vary more than 3 mm (1/8-inch) from the layout line.
   B. Plumb and align vertical members within 3 mm (1/8-inch.)
   C. Level or align ceilings within 3 mm (1/8-inch.)

- - - E N D - - -
PART 1 - GENERAL

1.1 DESCRIPTION:
A. This section specifies metal and gypsum lathing and gypsum plaster.

1.2
A. Steel framing members for attachment of plaster bases:
   1. Section 09 2216, NON-STRUCTURAL METAL FRAMING.
B. Room finish schedule: Section 09 0600, SCHEDULE FOR FINISHES.
C. Cement plaster: Section 09 2400, PORTLAND CEMENT PLASTERING.
D. Veneer plaster: Section 09 2600, VENEER PLASTERING.

1.3 TERMINOLOGY:
A. Definitions and description of terms to be in accordance with ASTM C11, ASTM C841, and ASTM C842 and as specified.
B. Underside of Structure Overhead: In spaces where steel trusses or bar joists are shown, the underside of structure overhead is the underside of the floor or roof construction supported by beams, trusses, and bar joists.
C. Self-furring Lath: Metal plastering bases having dimples or crimps designed to hold the back plane of the lath 6 to 10 mm (1/4 to 3/8 inch) away from the plane of the solid backing.
D. Solid Backing or Solid Bases: Concrete, masonry, sheathing, rigid insulation, and similar materials to which plaster is directly applied.
E. Wet Areas: Areas of a building where cyclic or continuous exposure to very humid or wet conditions, or in which a dew point condition may occur in the plaster.

1.4 SUBMITTALS:
A. Submit in accordance with Section 01 3323, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
B. Shop Drawings:
   1. Details of floating interior angle unrestrained construction.
   2. Details of assembly and anchorage of lath and accessories.
C. Manufacturers' Literature and Data:
   1. Accessories for plaster, each type.
   2. Metal plaster bases, each type.
   3. Fasteners.
   4. Bonding compounds, including application instructions.
   5. Admixtures, including mixing and application instructions.
D. Manufacturers certificates:
   1. Gypsum plaster.
E. Samples: Accessories for plaster, each type, not less than 152 mm (6 inches) long.

Panel showing finish coat, 152 by 305 mm (6 by 12 inches) minimum.

G. Installer qualifications.

1.5 DELIVERY, STORAGE, AND PROTECTION:

A. Deliver manufactured materials in the manufacturers' original unbroken packages or containers which are labeled plainly with the manufacturers' names and brands. Keep cementitious materials dry and stored off the ground, under cover, and away from sweating walls and other damp surfaces until ready for use.

1.6 PROJECT CONDITIONS:

A. Comply with ASTM C842 requirements.

B. Maintain work areas at not less than 13 degrees C (55 degrees F) or greater than 27 degrees C (80 degrees F) for not less than one (1) week prior to application of plaster, continuously during application of plaster, and one (1) week after plaster has set or until plaster has dried.

1.7 QUALITY ASSURANCE:

A. Installers qualifications: Work to be performed by installer having a minimum of three (3) years’ experience for work relating to this Section.

//B. Mockup: Build 9.29 sq. m (100 sq. ft.) mockup of each substrate and finish texture indicated for gypsum plastering, including accessories. Simulate finished lighting conditions for review of mockups. Approved mockups may not become part of completed work.

1.8 PERFORMANCE REQUIREMENTS:

A. Where indicated on construction documents, provide gypsum plaster assemblies identical to those of assemblies tested for fire resistance according to ASTM E119 by a qualified testing agency.

B. Where indicated on construction documents provide gypsum plaster assemblies identical to those of assemblies tested for STC ratings according to ASTM E90 and classified according to ASTM E413 by a qualified testing agency.

1.9 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

B. ASTM International (ASTM):

A641/A641M-09a ....................... Zinc-Coated (Galvanized) Carbon Steel Wire A653/A653M-13
Steel Sheet, Zinc-Coated (Galvannealed) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
C28/C28M-10......................... Gypsum Plasters
C35-01(R2014)..........................Inorganic Aggregates For Use in Gypsum Plaster
C206-03(R2009)........................Finishing Hydrated Lime
C472-99(R2014)........................Physical Testing of Gypsum, Gypsum Plaster and Gypsum
Concrete
C631-09(R2014)........................Bonding Compounds for Interior Gypsum Plastering
C841-03(R2013)........................Installation of Interior Lathing and Furring
C842-05(R2010)........................Application of Interior Gypsum Plaster
C847-14a...............................Metal Lath
C1002-14...............................Steel Self-Piercing Tapping Screws for the Application of
Gypsum Panel Products or Metal Plaster Bases to Wood Studs
or Steel Studs
D3678-14...............................Rigid Poly (Vinyl Chloride) (PVC) Interior-Profile Extrusions
E413-10.................................Classification for Rating Sound Insulation
E90-09.................................Test Method for Laboratory Measurement of Airborne Sound
Transmission Loss of Building Partitions and Elements

C. Commercial Item Description (CID):
A-A-55615-95(R2006)...............Shield, Expansion; (Wood Screw and Log Bolt Self-Threading
Anchor)

PART 2 - PRODUCTS

2.1 PLASTERING BASES (LATH):
(Z180), hot-dip galvanized-zinc coating.
   1. Paper Backing: Kraft paper factory bonded to back of lath.
   2. Diamond-Mesh Lath:
      a. Type: Self-furring.
      b. Weight: 1.8 kg/sq. m (3.4 lb. sq. yd.).
   3. Flat-Rib Lath: Rib depth of not more than 3 mm (1/8 inch), 8 kg/sq. m (3.4 lb/sq. yd.).
   4. 10 mm (3/8-inch) Rib Lath: 2.2 kg/sq. m (4 lb/sq. yd.).
B. Gypsum Lath:
   1. Sheet; 610 mm x 2438 mm (2 ft. x 8 ft.).
   2. 10 mm (3/8 inch) thick.
   3. Type “X” for fire rated assemblies.

2.2 GYPSUM PLASTERS:
A. Base Coat: High strength gypsum plaster with a minimum average, dry compressive strength of
19 MPa (2800 psi) according to ASTM C472 for a mix of 45 kg (100 lb.) of plaster and .06 cu. m
(2 cu. ft.) of sand.
B. Finish Coat: High strength gypsum gauging plaster with a minimum average dry compressive strength of 34 MPa (5000 psi) according to ASTM C472.

2.3 LIME
A. ASTM C206, Type S.

2.4 AGGREGATES:
A. Natural sand, except grade aggregates in accordance with ASTM C35, "TABLE 1".
B. Vermiculite and perlite aggregates are not acceptable, except where required for fire rated assemblies.

2.5 BONDING COMPOUND (FOR INTERIOR WORK):
A. ASTM C631, except water re-emulsifiable compound is prohibited.

2.6 ACCESSORIES FOR GYPSUM PLASTER:
A. General: Coordinate depth of trim and accessories with thicknesses and number of plaster coats required as per ASTM C841.
D. Cornerbeads: Fabricated from zinc-coated (galvanized) steel.
   1. Smallnose cornerbead with expanded flanges; use unless otherwise indicated on construction documents.
   2. Smallnose cornerbead with perforated flanges; use on curved corners.
   3. Smallnose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.
   4. Bullnose cornerbead, radius 19 mm (3/4 inch) minimum, with expanded flanges; use at locations indicated on construction documents.
E. Casing Beads: Fabricated from zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
F. Control Joints: Fabricated from zinc-coated (galvanized) steel; one-piece type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.

2.7 FASTENERS:
A. Tie wire, screws, staples, clips, nails, and other fasteners ASTM C841, except as otherwise specified.
B. Provide fasteners for securing metal plastering bases having heads, or inserted through washers large enough to engage two strands (1 on each side of the washer) of the metal plastering base.
C. For fire rated construction type and size as used in fire rated test.
D. Screws: ASTM C1002.

PART 3 - EXECUTION

3.1 APPLYING LATH BASES:

A. Apply lath base in accordance with ASTM C841, except as otherwise specified or shown.

B. Provide metal plastering bases where plaster is required on partitions, ceilings and furring, where required for setting ceramic tile in adhesive on gypsum plaster and for light troughs, beams and other curved or irregular surfaces.
   1. Where plaster is required on solid bases, metal plastering bases are not required, unless shown on the construction documents.
   2. Form true surfaces, straight or in moderate curves where shown on construction documents, without sags or buckles and with long dimension of lath at right angles to direction of supports.
   3. Shape lathing to within 19 mm (3/4 inch) of finished profiles of irregular surfaces.
   4. Terminate lath for ceiling construction at casing bead (Floating Angle Construction) where butting into or penetrated by walls, columns, beams, and similar elements.

C. Gypsum lath may be used in lieu of expanded metal lath for gypsum plaster only on straight flat surfaces of partitions and walls, and on furring, except for lathing in wet areas and as a base for marble finishes.

D. Installing Metal Plastering Bases:
   1. Select type of expanded metal lath to conform to Table 2 of ASTM C841.
   2. Select type of fasteners based upon expanded metal lath type to be installed to conform to Table 1 of ASTM C841.
   3. Where metal plastering bases are required over solid backing, provide self-furring, diamond-mesh lath type.
   4. Attach self-furring diamond-mesh lath directly to masonry and concrete with hardened nails, power actuated drive pins. Locate fasteners at the dimples or crimps only.
   5. Where metal plastering bases are required over steel columns and studless solid plaster partitions supports by L-runners, provide rib lath.
   6. Provide rib lath above ceramic tile wainscots where the finish above the wainscot is required to finish flush with the tile face.
   7. Do not install continuous plastering bases through expansion and control joints. Terminate plastering base at each side of joint.

3.2 SURFACE PREPARATION OF SOLID BASES:

A. Prepare in accordance with ASTM C842, except as otherwise specified.

B. Terminate concrete form ties and other metal projections not less than 3.2 mm (1/8 inch) below the surface of concrete.
C. Remove projections and fill depressions, holes, cracks and similar voids flush with patching compound compatible with the substrate and plaster, within the tolerance, specified in ASTM C842.

D. Clean existing concrete surfaces specified to receive plaster to ensure bonding as specified in ASTM C842.

E. Condition new or existing concrete surfaces specified to receive plaster by applying bonding compound as specified in ASTM C842.

F. Condition existing, new, concrete, and masonry surfaces (solid backing) specified to receive plaster by applying metal plastering base as specified in ASTM C842.

### 3.3 INSTALLING PLASTERING ACCESSORIES:

**A.** Install accessories in accordance with ASTM C841, except as follows:

1. Set plastering accessories plumb, level and true to line, mitered at corners and intersections, and securely attach to supporting surfaces.
2. Install in one piece, within the limits of the longest commercially available lengths.
3. Wood plugs are not acceptable anchorage for fasteners.

**B.** Corner Beads: Install at external plaster corners.

**C.** Strip Lath:

1. Install centered over joints between dissimilar materials, such as clay tile, brick, concrete masonry units, concrete, and expanded metal and gypsum lath. Install where surfaces are required to be plastered and are in contact with each other in same plane, except where expansion joints and casing beads are required.
2. Wire tie, staple, screw, or nail strip lath to base along both edges at not over 152 mm (6 inches) on centers.
3. Reinforce gypsum lath at corners of openings, at internal corners, and at chases and similar breaks in continuity in accordance with ASTM C841.

**D.** Casing Beads:

1. Provide at locations where plaster terminates against other materials.
2. Provide where indicated in construction documents.
3. Provide where plaster terminates against trim of steel frames and trim of other materials and equipment, except where trim overlaps plaster.
4. Provide where plaster for new walls or furring (vertical or horizontal) terminates against existing construction.
5. Provide around perimeter of openings for recessed casework and equipment, except where edge is covered by flanges. Locate to conform to dimensions shown on approved shop drawings.
6. Both sides of expansion and control joints, unless shown otherwise.
7. Where ceilings butt into or are penetrated by walls, columns, beams, and similar elements so as to provide floating angle (unrestrained) construction in accordance with ASTM C841.

E. Cornerites:
1. Provide at interior corners of walls, partitions, and other vertical surfaces to be plastered, except where lath is carried around angle.
2. Fasten only as necessary to retain position during plastering.
3. Omit cornerites at junction of new plastered walls with existing plastered walls.
4. Provide where metal plastering bases are specified not to be carried around internal angles, and at locations where casing beads are specified and shown.

F. Control Joints:
1. Where control joints are placed parallel to framing members, install joints within 101 mm (4 inches) of framing member.
2. Install control joints only to the edges of abutting sheets of lath so that the lath is not continuous or tied across joint.
3. Extend control joints the full width and height of the wall or length of soffit/ceiling plaster membrane.

3.4 GYPSUM PLASTER APPLICATION:

A. Proportion, mix, and apply plaster in accordance with ASTM C842.

B. Thickness of Plaster: ASTM C842, except as follows:
1. Where greater thickness is indicated on construction documents.
2. Where thickness is required to match existing.
3. On metal plaster base 19 mm (3/4 inch), except where greater thickness is required for fire rated construction.
4. Apply finish coats to a uniform thickness of approximately 2 mm (1/16 inch) with not more than 3 mm (1/8 inch) thickness at any point.

C. Cut 2 mm (1/16 inch) deep V-joint in finish coat of plaster adjacent to metal door frames and wherever plaster finishes flush with other materials, except where casing beads are required. Omit 2 mm (1/16 inch) deep V-joint on walls and partitions where plaster is recessed back from face of door frames, or similar conditions.

D. Plaster to have a smooth-trowel finish unless specified or shown otherwise.

E. Apply gypsum plaster in three (3) coats except as follows: Gypsum plaster applied to masonry gypsum lath using the two-coat double back method.

F. Gypsum Plaster Base Coat: Apply base coats with sufficient pressure and ensure plaster is sufficiently plastic to provide a strong bond to bases. Work base coats into screeds at intervals from 1524 to 2438 mm (5 to 8 ft.). Plaster must not be continuous across expansion and control joints occurring in walls, partitions, and ceilings. Finish work level, plumb, square, and true, within a tolerance of 3 mm in 2438 mm (1/8 inch in 8 ft.) without waves, cracks, blisters, pits, crazing,
discoloration, projections, or other imperfections. Form plaster work carefully around angles and contours, and well up to screeds. Take special care to prevent sagging and consequent dropping of applications. There must be no visible junction marks in finish coat where one day’s work adjoins another.

1. Gypsum Two-Coat Base Coat: Apply the first coat to cover the base with sufficient material and pressure to form a good bond on the wall or ceiling base. Before the first coat has set and without scratching or cracking the surface, apply a second coat (double back) of the same material proportion as the base coat to the screeds. Straighten to a true surface without application of water, and cross rake or scratch to receive the finish coat.

2. Gypsum Three-Coat Base Coat: Apply scratch coat 5 to 6 mm (3/16 to 1/4 inch) thick to cover the base with sufficient material and pressure to form a good bond on the wall or ceiling base. Rake or scratch the surface and allow to set firm and hard. Apply the brown coat to bring the base coat out to the screeds, compact, and straighten to a true surface without the application of water, and cross rake or scratch to receive the finish coat.

G. Gypsum Plaster Finish Coats: Moderately moisten or fog spray base coat of plaster that has become dry before finish coat is applied. Accelerate plaster, if necessary, to provide a setting time of not more than four (4) hours from the time the plaster is mixed.

1. Lime-Putty and Gypsum Gauged Finish Coat: Apply lime-putty gypsum finish white coat over the base coat, scratch in thoroughly, lay on well, double back, and fill out to a true, even surface. Allow the finish to dry not more than five (5) minutes, then trowel well with water. Apply maximum pressure in order to compact the finish coat and provide a smooth finish free from blemishes and irregularities. Apply trowel finish coats of gypsum-gaged lime-putty over properly prepared base coats as thin as possible and 2 to 3 mm (1/16 to 1/8 inch) thick for conventional plaster system, except as necessary in spots to level out hollows in base coat.

H. Concealed Plaster:

1. Where plaster is concealed behind built in cabinets, furnishings, or equipment, apply finish coat.

2. Where plaster is concealed above ceilings, omit finish coat.

3. Where plaster is used as a base for adhesive application of tile and similar finishes, omit finish coat.

3.5 PATCHING:

A. After all work except painting is finished, point around trim, frames, and similar items.

B. Patch damaged plaster to match previously applied plaster in color and texture.

C. Sanding plaster is prohibited.

D. Patch, alter and replace existing plaster surfaces as required to complete work.

E. Patching of Rated Construction: Patch holes or openings 13 mm (1/2 inch) or less in diameter, or equivalent size, with patching plaster. Repair holes or openings over 13 mm (1/2 inch) diameter,
or equivalent size, with same materials used in construction so as to provide fire protection
equivalent to the fire rated construction, STC equivalent to the sound rated construction, and
construction that will not permit the passage of smoke.

3.6 CLEANING AND PROTECTION:
Remove temporary protection and enclosure of other work after plastering is complete. Remove
droppings or spatterings from other surfaces not indicated to be plastered. Leave clean and in a
condition to receive paint or other finish.

- - - E N D - - -
PORTLAND CEMENT PLASTERING

PART 1 - GENERAL
1.1 DESCRIPTION:
   A. This section specifies lathing and portland cement based plaster & stucco.

1.2 RELATED WORK:
   A. Room Finish Schedule and Color: Section 09 0600, SCHEDULE FOR FINISHES.
   B. Gypsum plaster: Section 09 2300, GYPSUM PLASTERING.
   C. Veneer plaster: Section 09 2600, VENEER PLASTERING.

1.3 TERMINOLOGY:
   A. Definitions and description of terms to be in accordance with ASTM C11, ASTM C926, ASTM C1063 and as specified.
   B. Underside of Structure Overhead: In spaces where steel trusses or bar joists are shown, the underside of structure overhead is defined as the underside of the floor or roof construction supported by beams, trusses, and bar joists.
   C. Self-furring Lath: Metal plastering bases having dimples or crimps designed to hold the back plane of the lath 6 to 10 mm (1/4 to 3/8 inch) away from the plane of the solid backing.
   D. Solid Backing or Solid Bases: Concrete, masonry, sheathing, rigid insulation, and similar materials to which plaster is directly applied.
   E. Wet Areas: Areas of a building where cyclic or continuous exposure to very humid or wet conditions, or in which a dew point condition may occur in the plaster.

1.4 SUBMITTALS:
   A. Submit in accordance with Section 01 3323, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
   B. Manufacturer's Literature and Data:
      1. Accessories for plaster, each type.
      2. Metal plastering bases, each type.
      3. Fasteners.
      4. Bonding compounds, including application instructions.
      5. Admixtures, including mixing and application instructions.
   C. Samples:
      1. Accessories for plaster, each type, not less than 152 mm (6 inches) long.
      2. Panel showing finish coat by mm 152 to 305 mm (6 by 12 inches) minimum.
   E. Installers qualifications.

1.5 DELIVERY, STORAGE AND PROTECTION:
   A. Deliver manufactured materials in the manufacturers’ original unbroken packages or containers which are labeled plainly with the manufacturers’ names and brands. Keep cementitious materials...
dry and stored off the ground, under cover, and away from sweating walls and other damp surfaces until ready for use.

1.6 PROJECT CONDITIONS:
A. Maintain work areas for interior work at a temperature of not less than 4 degrees C (40 degrees F) for not less than 48 hours prior to application of plaster, during application of plaster and 1 week after plaster has set or until plaster has dried.
B. Do not apply exterior plaster when the ambient temperature is less than 4 degrees C (40 degrees F), or when a drop in temperature below 4 degrees C (40 degrees F) is expected within 24 hours after application.
C. Do not apply plaster to frozen surfaces or surfaces containing frost.
D. Do not use frozen materials in the mix.
E. Protect plaster coats against freezing for a period of not less than 24 hours after application.

1.7 QUALITY ASSURANCE:
A. Installers Qualifications: Work is to be performed by installer having a minimum of three (3) years’ experience for work relating to this Section. Submit installer qualifications.
B. Mockup: Build 9.29 sq. m (100 sq. ft.) mockup for each substrate and finish texture indicated for cement plastering including accessories. For interior plaster work, simulate finished lighting for review of mockups. Approved mockups may not become part of completed work.

1.8 PERFORMANCE REQUIREMENTS:
A. Where indicated on construction documents, provide cement plaster assemblies identical to those of assemblies tested for fire resistance according to ASTM E119 by a qualified testing agency.
B. Where indicated on construction documents provide cement plaster assemblies identical to those of assemblies tested for STC ratings according to ASTM E90 and classified according to ASTM E413 by a qualified testing agency.

1.9 APPLICABLE PUBLICATIONS:
A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
B. ASTM International (ASTM):
   A653/A653M-13 ......................... Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
   A1064/A1064M-14 ..................... Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
   C91/C91M-12 ......................... Masonry Cement
   C150/C150M-12 ....................... Portland Cement
   C206-14 ................................. Finishing Hydrated Lime
C207-06(R2011) ......................... Hydrated Lime for Masonry Purposes
C260/C260M-10a ....................... Air Entraining Admixtures for Concrete.
C847-14a ............................... Metal Lath
C897-05(R2014) ....................... Aggregate for Job-Mixed Portland Cement Based Plasters
C926-14a ............................... Application of Portland Cement-Based Plaster
C932-06(R2013) ....................... Surface-Applied Bonding Compounds for Exterior Plastering
C933-14 ............................... Welded Wire Lath
C979/C979M-10 ....................... Pigments for Integrally Colored Concrete
C1002-14 ............................... Steel Self-Piercing Tapping Screws for the Application of
                                  Gypsum Panel Products or Metal Plaster Bases to Wood Studs
                                  or Steel Studs
C1063-14d ............................. Installation of Lathing and Furring to Receive Interior and
                                  Exterior Portland Cement-Based Plaster
E90-09 ................................. Test Method for Laboratory Measurement of Airborne Sound
                                  Transmission Loss of Building Partitions and Elements
E119-14 ................................. Test Methods for Fire Tests of Building Construction and
                                  Materials
E413-10 ................................. Classification for Rating Sound Insulation

C. Commercial Item Description (CID):
   A-A-55615-95(R2006) ............... Shield, Expansion (Wood Screw and Lag Bolt Self-Threading
                                  Anchors)

PART 2 - PRODUCTS

2.1 METAL PLASTERING BASES:

  A. Expanded Lath:
     1. ASTM C847, galvanized except as modified by ASTM C1063 and this specification. Self-
        furring where applied over solid backing.
     2. Flat diamond mesh weighing not less than 1.8 kg per square meter (3.4 pounds per square
        yard).

  B. Stucco Mesh: Flat expanded diamond mesh pattern, with openings approximately 38 by 75 mm
     (1-1/2 by 3 inches), weighing not less than 1.9 kg per square meter (3.6 pounds per square yard),
     with backing as specified.

  C. Wire Lath:
     1. Zinc coated (Galvanized).
     2. Welded Wire Lath: ASTM C933, with backing as specified.
     3. Self-furring where applied over solid backing.

  D. Building Paper Backing for Metal Plastering Bases:
     1. Backing attached to lath as specified in ASTM C933.
2. Vapor Permeable Backing: Fed. Spec. UU-B-790, Type I, Grade D.
3. Water Resistant Backing: Fed. Spec. UU-B-790, Type I, Grade B.

2.2 ACCESSORIES FOR CEMENT PLASTER:

A. Provide accessories that are roll formed galvanized steel, except that cornerite and strip lath that are formed from steel sheets with manufacturer’s standard galvanized coating.

B. Provide welded wire corner reinforcements of galvanized 1.4 mm (17 gauge) steel wire conforming to ASTM A1064/A1064M.

C. Provide furring, including hangers, bolts, inserts, clips, fastenings, and attachments of number, size, and design to develop the full strength of the members.

D. Control Joints: ASTM C1063, zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanged and removable protective tape on plaster face of control joint.


H. Cornerbeads: Fabricated from zinc-coated (galvanized) steel.
   1. Smallnose cornerbead with expanded flanges; use unless otherwise indicated on construction documents.
   2. Smallnose cornerbead with perforated flanges; use on curved corners.
   3. Smallnose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.
   4. Bullnose cornerbead, radius 19 mm (3/4 inch) minimum, with expanded flanges; use at locations indicated on construction documents.

I. Casing Beads: Fabricated from zinc-coated (galvanized) steel; square-edged style; with expanded flanges.

2.3 FASTENERS:

A. Tie, wire, screws, staples, clips, nails, and other fasteners ASTM C1063, except as otherwise specified.

B. Provide fasteners for securing metal plastering bases having heads, or inserted through washers large enough to engage two (2) strands (two (2) on each side of screw) of the metal plastering base.

C. For fire rated construction; provide fasteners of type and size as used in fire rated test.

D. Screws: ASTM C1002.

E. Expansion Shields: CID A-A-55615, of the Type and Class applicable.
2.4 CEMENT:
   A. Portland: ASTM C150/C150M, Type I.
   B. Masonry: ASTM C91/C91M, Type N.
   C. White where required for white finish coat.

2.5 LIME:
   A. ASTM C206, Type S; or ASTM C207, Type S.

2.6 AGGREGATES (SAND):
   A. ASTM C897, graded as required to suit texture of finish specified.
   B. White where white finish coat is specified.

2.7 BONDING AGENT:
   A. ASTM C932.

2.8 FACTORY PREPARED FINISH COAT FOR CEMENT PLASTER:
   A. Factory prepared dry blend of materials, integrally colored, designed for exterior finish coat application.
   C. Particle Size: Not more than 35 percent, by weight of all ingredients, including cement, aggregate, hydrated lime, admixture and coloring pigment is to pass a number 100 sieve.

2.9 ADMIXTURES:
   A. Air Entrainment: ASTM C260/C260M.

PART 3 - EXECUTION

3.1 METAL PLASTERING BASES (LATH) LOCATIONS:
   A. Where plaster is required on solid concrete or masonry bases, metal plastering bases are not required, unless shown on the construction documents. Where shown use wire lath or stucco mesh.
   B. On interior wall framing:
      1. Provide expanded lath.
      2. Provide welded wire lath with water resistant backing in wet areas.

3.2 APPLYING METAL PLASTERING BASES:
   A. In accordance with ASTM C1063, except as otherwise specified or indicated on construction documents.
   B. Form true surfaces, straight or in curves where shown on construction documents, without sags or buckles and with long dimension of lath at right angles to direction of supports.
   C. Terminate lath for ceiling or soffit construction at casing bead (floating angle construction) at perimeter angles between walls and ceilings or soffits.
   D. Lath with backing to be applied to produce a paper to paper and metal to metal lap at ends and sides of adjacent sheets, whether full sheets or less than full sheets are provided:
      1. Lap backing 50 mm (2 inches) for both horizontal and vertical laps.
2. Install horizontal laps in a ship lap fashion to conduct water to the outside and over flashing or waterproofing.

E. Do not install continuous metal plastering bases through expansion and control joints. Terminate at each side of joint.

F. Attach lath directly to masonry and concrete with hardened nails, power actuated drive pins or other approved fasteners. Install fasteners at dimples or crimps only.

G. Wood plugs are not acceptable.

3.3 INSTALLING PLASTERING ACCESSORIES:

A. Install accessories in accordance with ASTM C1063, except as otherwise specified.

1. Set plastering accessories plumb, level and true to line, neatly mitered at corners and intersections, and securely attach to supporting surfaces.

2. Install in one (1) piece, within the limits of the longest commercially available lengths.

B. Corner Beads: External-corner reinforcement corner bead at exterior corners, as required to establish grounds, and where shown on construction documents.

C. Strip Lath:

1. Install centered over joints between dissimilar materials, such as hollow tile, brick, concrete masonry units, concrete, and joints with expanded lath on framing or furring, where both such surfaces are required to be plastered and are in contact with each other in same plane, except where expansion joints and casing beads are required.

2. Wire tie or fasten strip lath to base along both edges at not over 152 mm (6 inches) on centers.

D. Casing Beads:

1. Provide at locations where shown on construction documents and at following locations where plaster terminates to provide finish trim:
   a. Against non-plastered surfaces such as masonry, concrete, and wood.
   b. Against trim of steel frames and trim of other materials and equipment, except where trim overlaps plaster.
   c. Around perimeter of openings except where edge is covered by flanges. Locate to conform to dimensions shown on shop drawings.
   d. Where plaster for new walls or furring (vertical or horizontal) terminates against existing construction.
   e. Both sides of expansion and control joints unless shown otherwise on construction documents.

2. Provide at perimeter angles between walls and ceilings so as to provide floating angle (unrestrained) construction in accordance with ASTM C1063.

E. Cornerites:
1. Provide at interior corners of walls, partitions, and other vertical surfaces to be plastered, except where lath is carried around angle.

2. Fasten only as necessary to retain position during plastering.

3. Omit cornerites at junction of new plastered walls with existing plastered walls at locations where casing beads are specified.

F. Control Joints:

1. Where control joints are placed parallel to framing members, install joints within 101 mm (4 inches) of the framing member.

2. Install control joints only to the edges of abutting sheets of lath so that the lath is not continuous or tied across the joint.

3. Extend joints the full width and height of the wall or length of soffit/ceiling plaster membrane.

3.4 SURFACE PREPARATION OF SOLID BASES:

A. Surfaces that are to receive plaster are to be prepared and conditioned in accordance with ASTM C926, except as otherwise specified.

B. New surfaces of masonry and concrete:
   1. Remove projections and clean concrete surface of form oil.
   2. Fill depressions, holes, cracks and similar voids flush with Portland cement plaster to provide substrate within the tolerance specified in ASTM C926.
   3. Use bonding agent.
   4. Cover with self-furring lath where required to keep the total plaster thickness as specified in Table 4 of ASTM C926.

C. Existing surfaces of concrete and masonry:
   1. Clean surface of dirt and other foreign matter which will prevent bond.
   2. Apply dash bond coat or bonding agent as specified therein.
   3. Where existing surfaces have a coating such as paint or bituminous waterproofing apply metal plastering base as indicated.

3.5 PORTLAND CEMENT BASED PLASTER:

A. Provide portland cement based plaster where cement plaster is shown and specified, and as follows:
   1. Three-Coat work is to be used over all metal plastering bases, with or without solid backing.
   2. Two-Coat work may only be used over solid bases conforming to requirements of Paragraph, SURFACE PREPARATION OF SOLID BASES.

B. Proportion, mix and apply plaster in accordance with ASTM C926, except as otherwise specified.
   1. Provide air entrained plaster for all exterior work.
   2. Provide coloring pigments for finish coat when integral color other than white is specified.
   3. Provide white cement with white sand when white finish coat is specified.
4. Factory prepared finish coat: Add water, mix, and apply as specified by manufacturer.

5. Color:
   a. Provide natural cement color when painted or other coating is specified.
   b. Other colors as specified in Section 09 0600, SCHEDULE FOR FINISHES.

6. Finish coat is to match existing finish.

- - - END - - -
VEENEER PLASTERING

PART 1 - GENERAL

1.1 DESCRIPTION:
A. This section specifies veneer plaster and veneer plaster base.

1.2 RELATED WORK:
A. Metal Framing: Section 09 2216, NON-STRUCTURAL METAL FRAMING.
B. Gypsum Backing Board on Multi-Layer Systems: Section 09 29 00, GYPSUM BOARD.
C. Gypsum Plaster: Section 09 2300, GYPSUM PLASTERING.
D. Cement Plaster: Section 09 2400, PORTLAND CEMENT PLASTERING.

1.3 TERMINOLOGY:
A. Definitions and description of terms in accordance with ASTM C11, ASTM C843, ASTM C844, and as specified.
B. Underside of Structure Overhead: Where steel trusses or bar joists are shown, the underside of structure overhead is the underside of the floor or roof construction supported by the trusses or bar joists.
C. Yoked: Gypsum Board cut out for opening with no joint at the opening corners.

1.4 SUBMITTALS:
A. Submit in accordance with Section 01 3323, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
B. Manufacturer's Literature and Data:
   1. Gypsum veneer plaster.
   2. Gypsum Base for Veneer Plaster.
   3. Accessories.
   5. Laminating adhesive.
C. Shop Drawings:
   1. Typical veneer plaster installation, showing corner details, casing details, control joint details, and other similar details.
D. Installers qualifications.

1.5 DELIVERY AND STORAGE:
A. Deliver and store plaster materials in the manufacturer’s original unopened containers.
B. Store materials off the ground within a completely enclosed structure or enclosed within a weathertight covering. Store gypsum base and gypsum backing board flat to prevent warping and protect from excessive exposure to sunlight.
1.6 SCHEDULING:
A. Commence application only after the area scheduled for veneer plaster work is completely weathertight.
B. The heating, ventilating, and air-conditioning systems should be complete and in operation prior to application of the plaster. If the mechanical system cannot be activated before veneer plastering is begun, the plastering may proceed in accordance with an approved plan to maintain the environmental conditions specified below.
C. Apply plaster prior to the installation of finish flooring and acoustic ceiling.

1.7 ENVIRONMENTAL REQUIREMENTS:
A. Do not expose the gypsum base to excessive sunlight prior to plaster application, as bond failure of the plaster may result.
B. Maintain a continuous uniform temperature of not less than 10 degrees C (50 degrees F) and not more than 27 degrees C (80 degrees F) for at least one (1) week prior to the application of veneer plaster, while the plastering is being done, and for at least one (1) week after the plaster is set.
C. Shield air supply and distribution devices to prevent any uneven flow of air across the plastered surfaces.
D. Provide ventilation to exhaust moist air to the outside during plaster application and set, and until plaster is dry.
E. In glazed areas, keep windows open top and bottom or side to side 76 to 101 mm (3 to 4 inches). Openings can be reduced by 50 percent when temperature is less than 4 degrees C (40 degrees F).
F. For enclosed areas lacking natural ventilation, provide temporary mechanical means for ventilation.
G. In unglazed areas subjected to hot, dry winds or temperature differentials from day to night of 10 degrees C (20 degrees F) or more, screen openings with cheesecloth or similar materials.
H. During periods of low indoor humidity, provide minimum air circulation following plastering operations and until plaster is dry.

1.8 QUALITY ASSURANCE:
A. Installers Qualifications: Work is to be performed by installer having a minimum of three (3) years’ experience for work relating to this Section. Submit installer qualifications.

1.9 PERFORMANCE REQUIREMENTS:
A. Where indicated on construction documents, provide veneer plaster assemblies identical to those of assemblies tested for fire resistance according to ASTM E119 by a qualified testing agency.
B. Where indicated on construction documents, provide veneer plaster assemblies identical to those of assemblies tested for STC ratings according to ASTM E90 and classified according to ASTM E413 by a qualified testing agency.
1.10 APPLICABLE PUBLICATIONS:
   A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
   B. ASTM International (ASTM):
      C11-13................................. Terminology Relating to Gypsum and Related Building Materials and Systems
      C472-99(R2014) ...................... Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete
      C475/C475M-12(R2014) .............. Joint Compound and Joint Tape for Finish Gypsum Board Construction
      C587-04(R2014) ...................... Gypsum Veneer Plaster
      C631-09(R2014) ...................... Bonding Compounds for Interior Plastering
      C840-13 ............................... Application and Finishing of Gypsum Board
      C843-99(R2012) ...................... Application of Gypsum Veneer Plaster
      C844-04(R2010) ...................... Application of Gypsum Base to Receive Gypsum Veneer Plaster
      C954-11 ............................... Steel Drill Screws for the Application of Gypsum Panel Products Board or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in thickness
      C1002-14 ............................. Steel Drill Screws for the Applications of Gypsum Panel Products Board or Metal Plaster Bases
      C1047-14a .......................... Accessories for Gypsum Wallboard and Gypsum Veneer Base
      C1396/C1396M-14a ................. Specification Gypsum Board
      D3678-14 ............................ Rigid Poly (Vinyl Chloride) (PVC) Interior-Profile Extrusions
      E90-09 ................................. Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
      E119-14 ............................... Test Methods for Fire Tests of Building Construction and Materials
      E413-10 ............................... Rating Sound Insulation
      40 CFR 59 ............................ Determination of Volatile Matter Content, Water Content, Density Volume Solids, and Weight Solids of Surface Coating

PART 2 - PRODUCTS
2.1 VENEER BASE:
   A. ASTM C1396/C1396M, plain, Type "X", 16 mm (5/8-inch) thick. Provide square edges, rounded, or tapered as recommended by the veneer plaster manufacturer.
2.2 GYPSUM VENEER PLASTER:
A. ASTM C587. Minimum compressive strength of finish coat plaster to be 17.2 MPa (2500 psi) in accordance with ASTM C472.

2.3 ACCESSORIES:
A. Corner Bead, Edge Trim and Control Joints: ASTM C1047 or ASTM D3678, except as specified.
B. Corner bead and edge trim (casings): Minimum 0.38 mm (0.015-inch) thick zinc-coated steel sheet or rigid PVC plaster.
C. Flanges not less than 22 mm (7/8-inch) wide with punch-outs or deformations as required to provide plaster bond.

2.4 JOINT REINFORCING TAPE:
A. ASTM C475/C475M, paper tape.

2.5 LAMINATING ADHESIVE:
A. ASTM C475/C475M joint compound chemical setting type or as recommended by veneer base manufacturer. VOC not to exceed 20 g/L; free of antifreeze and other deleterious impurities.
   1. Sealant adhesive shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, (EPA Method 24).

2.6 FASTENERS:
A. Screws: ASTM C1002 or ASTM C954.
B. Staples: Flattened zinc-coated steel wire, minimum 15 mm (9/16-inch) leg for securing corner beads or casing and minimum 9 mm (3/8-inch) leg for securing joint reinforcement.

2.7 BONDING COMPOUND:
A. ASTM C631.

PART 3 - EXECUTION

3.1 INSTALLATION CRITERIA:
A. Where fire rated construction is required for walls, partitions, columns, beams and floor-ceiling assemblies, construction to match that used in fire rating test and as shown on construction documents.
B. Sound Rated Assemblies and Materials: Construct as indicated on construction documents.
C. Ventilate unheated spaces above veneer plaster ceilings as per ASTM C844.

3.2 INSTALLATION OF VENEER BASE:
A. Steel Framing:
   1. Steel framing members to be installed as per ASTM C754.
   2. Space framing at 406 mm (16 inches) on center maximum. Provide partitions to support applied loads such as cabinets and counters without exceeding the permitted deflection.
   3. Partition Framing System:
a. Provide metal non-load bearing framing and furring system capable of carrying a transverse load of 24 ksm (5 psf) without exceeding either the allowable stress or a deflection of L/240.

b. Provide studs of 0.45 mm (0.0179 inch) maximum thickness for partitions having the same material and the same material thickness on both sides.

c. For partitions using 0.45 mm (0.0179 inch) thick studs, the surfacing material to cover the full height of the partition on both sides, or the stud flange to be otherwise supported to ensure rigidity.

d. Provide studs of 0.84 mm (0.0329 inch) minimum thickness for partitions having different materials or different material thickness on the two (2) sides.

e. At partition ends, corners, and intersections, and at jambs of openings, fasten studs to runners with screws.

4. Special Framing:

a. Build framing for beams, columns, soffits, and other special items to the sizes, shapes, or forms indicated on construction documents. Secure rigidly at each intersection with wallboard screws.

5. Wall Openings:

a. At wall openings the framing system to provide for the installation and anchorage of the required subframes or finish frames.

b. Attach steel frames securely through built-in anchors to the nearest stud on each side of the opening with wallboard screws.

c. Provide 0.84 mm (0.329 inch) minimum thickness double studs at both jambs of all doors openings.

d. For doors over 1219 mm (4 feet) wide, double doors, and for extra-heavy doors provide doubled studs.

e. Spot grout door frames at the jamb anchor locations with joint compound applied just prior to application of gypsum base.

8. Blocking:

a. Provide blocking when mounting equipment.

b. Cut metal blocking to fit in between the framing members.

c. Rigidly anchor blocking to the framing members.

d. Under no circumstances will accessories or other wall mount equipment be anchored directly to the veneer plaster system.

B. Veneer Base:

1. Apply gypsum base and backing board to framing and furring members in accordance with ASTM C844, as specified herein, and as indicated on construction documents.

2. Use veneer base of maximum practical length.
3. Install veneer base with long dimension direction as follows:
   a. On ceilings, at 90 degrees to framing to which it is applied.
   b. On partitions, horizontally or vertically, except when the partition is fire rated, apply base as designed in the fire rating test.

4. In vertical application of veneer base, use panels of length required to reach full height of vertical surfaces in one (1) continuous piece.

5. Erect veneer base so that the leading edge of the base is first attached to the open end of the metal stud flange.

6. Leave a space approximately 6 mm (1/4-inch) at bottom and top of veneer base for caulking or sealant.

7. Edge and End Joints:
   a. Locate edge joints over framing in fire rated partitions.
   b. Locate end joints over furring or framing in all cases.
   c. Stagger end joints of adjoining boards or multiple layer boards.

8. Control Joints:
   a. ASTM C844, Paragraph 7.4.
   b. Locate at both side of jambs of openings if gypsum board is not yoked. Use only one (1) system throughout.
   c. Not required for wall length less than 9144 mm (30 feet).
   d. Do not extend veneer base across control joints.
   e. Extend control joints the full height of the wall or length of soffit/ceiling veneer plaster membrane.

9. Two-Ply Construction:
   a. Apply in accordance with ASTM C844 with joints between layers staggered or offset and falling over framing member, except at control joints where they are to align.
   b. Use screws to hold veneer base in place.

10. Accessories:
    a. Set plastering accessories plumb, level and true to line, neatly mitered at corners and intersections, and securely attach to supporting surfaces with screws or staples.
    b. Install in one piece, within the limits of the longest commercially available lengths.
    c. Corner Beads:
       1) At all external corners.
       2) Where required as grounds.
       3) Where indicated on construction documents.
    d. Casings Beads:
       1) At both sides of expansion and control joints, except as otherwise shown on construction documents.
2) Where veneer plaster terminates against dissimilar materials and at perimeter of openings, except where covered by flanges, casings or permanently built-in equipment.

3) Where non-load bearing veneer plastered surfaces abuts load bearing members.

4) Where indicated on construction documents.

11. Concealed Surfaces: Do not omit veneer plaster behind cabinets, furniture, furnishings, or similar removable items. Omit veneer plaster above suspended ceilings and behind wood paneling unless required to maintain fire resistance or STC ratings.

3.3 SEALANT APPLICATION:

A. Apply sealants to veneer plaster base to cut outs, penetrations, and intersections with adjoining materials prior to application of veneer plaster for acoustical partitions.

B. Coordinate with Section 07 92 00, JOINT SEALANTS, for application of sealants.

3.4 VENEER PLASTER APPLICATION OVER GYPSUM BASE:

A. Apply gypsum veneer plaster in accordance with ASTM C843, and with the manufacturer’s approved installation instructions where such instructions are additional to or more restrictive than the requirements of ASTM C843. Apply plaster as a two-component system. Provide minimum plaster thickness as recommended by the manufacturer, but in no case less than 1.6 mm (1/16 inch) for one-component system. 1.6 mm (1/16 inch) for base coat and 0.8 mm (1/32 inch) for finish coat of a two-component system.

B. Joint Reinforcement: ASTM C843.

C. Apply smooth-trowel finish.

D. Extend finish to underside of structure overhead for fire partitions, smoke partitions, shafts, and sound rated partitions. Seal penetrations and edges for fire, smoke or acoustical requirements.

E. At new suspended ceilings, extend finish not less than 101 mm (4 inches) above suspended ceiling.

F. At existing ceilings, finish may terminate at ceiling except for fire, smoke, or sound rated partitions conditions stated above.

G. Seal and reinforce all joints and fastener heads above ceilings.

3.5 CLEANUP AND PATCHING:

A. Remove any plaster splashes from adjacent surfaces. Repair defects in veneer plaster. Plaster surfaces are to be smooth, clean, and in condition to receive the finishing materials that will be applied.

--- END ---
PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies installation and finishing of gypsum board.

1.2 RELATED WORK

A. Installation of steel framing members for walls, partitions, furring,: Section 09 2216, NON-STRUCTURAL METAL FRAMING.

1.3 TERMINOLOGY

A. Definitions and description of terms shall be in accordance with ASTM C11, C840, and as specified.

B. Underside of Structure Overhead: In spaces where steel trusses or bar joists are shown, the underside of structure overhead shall be the underside of the floor or roof construction supported by the trusses or bar joists.

C. "Yoked": Gypsum board cut out for opening with no joint at the opening (along door jamb or above the door).

1.4 SUBMITTALS

A. Submit in accordance with Section 01 3323, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:
   1. Cornerbead and edge trim.
   2. Finishing materials.
   3. Laminating adhesive.
   4. Gypsum board, each type.

C. Shop Drawings:
   1. Typical gypsum board installation, showing corner details, edge trim details and the like.

D. Samples:
   1. Cornerbead.
   2. Edge trim.
   3. Control joints.

E. Test Results:
   1. Fire rating test, each fire rating required for each assembly.
   2. Sound rating test.

F. Certificates: Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos material.

1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

In accordance with the requirements of ASTM C840.
1.6 ENVIRONMENTAL CONDITIONS
   In accordance with the requirements of ASTM C840.

1.7 APPLICABLE PUBLICATIONS
   A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
   B. American Society for Testing And Materials (ASTM):
      C11-08........................................ Terminology Relating to Gypsum and Related Building Materials and Systems
      C475-02 ..................................... Joint Compound and Joint Tape for Finishing Gypsum Board
      C840-08 ..................................... Application and Finishing of Gypsum Board
      C919-08 ..................................... Sealants in Acoustical Applications
      C954-07 ..................................... Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Stud from 0.033 in. (0.84mm) to 0.112 in. (2.84mm) in thickness
      C1002-07 ..................................... Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
      C1047-05 ..................................... Accessories for Gypsum Wallboard and Gypsum Veneer Base
      C1396-06 ..................................... Gypsum Board
      E84-08 ..................................... Surface Burning Characteristics of Building Materials
   C. Underwriters Laboratories Inc. (UL):
   D. Inchcape Testing Services (ITS):
      Latest Editions ............................ Certification Listings

PART 2 - PRODUCTS

2.1 GYPSUM BOARD
   A. Gypsum Board: ASTM C1396, Type X, 16 mm (5/8 inch) thick unless shown otherwise. Shall contain a minimum of 20 percent recycled gypsum.
   B. Coreboard or Shaft Wall Liner Panels.
      1. ASTM C1396, Type X.
      2. ASTM C1658: Glass Mat Gypsum Panels,
      3. Coreboard for shaft walls 300, 400, 600 mm (12, 16, or 24 inches) wide by required lengths 25 mm (one inch) thick with paper faces treated to resist moisture.
   C. Water Resistant Gypsum Backing Board: ASTM C620, Type X, 16 mm (5/8 inch) thick.
   D. Gypsum cores shall contain maximum percentage of post industrial recycled gypsum content available in the area (a minimum of 95 percent post industrial recycled gypsum content). Paper facings shall contain 100 percent post-consumer recycled paper content.
2.2 ACCESSORIES
A. ASTM C1047, except form of 0.39 mm (0.015 inch) thick zinc coated steel sheet or rigid PVC plastic.
B. Flanges not less than 22 mm (7/8 inch) wide with punchouts or deformations as required to provide compound bond.

2.3 FASTENERS
A. ASTM C1002 and ASTM C840, except as otherwise specified.
B. ASTM C954, for steel studs thicker than 0.04 mm (0.33 inch).
C. Select screws of size and type recommended by the manufacturer of the material being fastened.
D. For fire rated construction, type and size same as used in fire rating test.
E. Clips: Zinc-coated (galvanized) steel; gypsum board manufacturer’s standard items.

2.4 FINISHING MATERIALS AND LAMINATING ADHESIVE
ASTM C475 and ASTM C840. Free of antifreeze, vinyl adhesives, preservatives, biocides and other VOC. Adhesive shall contain a maximum VOC content of 50 g/l.

PART 3 - EXECUTION
3.1 GYPSUM BOARD HEIGHTS
A. Extend all layers of gypsum board from floor to underside of structure overhead on following partitions and furring:
   1. Two sides of partitions:
      a. Fire rated partitions.
      b. Smoke partitions.
      c. Sound rated partitions.
      d. Full height partitions shown (FHP).
      e. Corridor partitions.
   2. One side of partitions or furring:
      a. Inside of exterior wall furring or stud construction.
      b. Room side of room without suspended ceilings.
      c. Furring for pipes and duct shafts, except where fire rated shaft wall construction is shown.
   3. Extend all layers of gypsum board construction used for fireproofing of columns from floor to underside of structure overhead, unless shown otherwise.
B. In locations other than those specified, extend gypsum board from floor to heights as follows:
   1. Not less than 100 mm (4 inches) above suspended acoustical ceilings.
   2. At ceiling of suspended gypsum board ceilings.
   3. At existing ceilings.

3.2 INSTALLING GYPSUM BOARD
A. Coordinate installation of gypsum board with other trades and related work.
B. Install gypsum board in accordance with ASTM C840, except as otherwise specified.
C. Moisture and Mold–Resistant Assemblies: Provide and install moisture and mold-resistant glass mat gypsum wallboard products with moisture-resistant surfaces complying with ASTM C1658 where shown and in locations which might be subject to moisture exposure during construction.
D. Use gypsum boards in maximum practical lengths to minimize number of end joints.
E. Bring gypsum board into contact, but do not force into place.
F. Walls:
   1. When gypsum board is installed parallel to framing members, space fasteners 300 mm (12 inches) on center in field of the board, and 200 mm (8 inches) on center along edges.
   2. When gypsum board is installed perpendicular to framing members, space fasteners 300 mm (12 inches) on center in field and along edges.
   3. Stagger screws on abutting edges or ends.
   4. For single-ply construction, apply gypsum board with long dimension either parallel or perpendicular to framing members as required to minimize number of joints except gypsum board shall be applied vertically over "Z" furring channels.
   5. For two-ply gypsum board assemblies, apply base ply of gypsum board to assure minimum number of joints in face layer. Apply face ply of wallboard to base ply so that joints of face ply do not occur at joints of base ply with joints over framing members.
   6. For three-ply gypsum board assemblies, apply plies in same manner as for two-ply assemblies, except that heads of fasteners need only be driven flush with surface for first and second plies. Apply third ply of wallboard in same manner as second ply of two-ply assembly, except use fasteners of sufficient length enough to have the same penetration into framing members as required for two-ply assemblies.
   7. No offset in exposed face of walls and partitions will be permitted because of single-ply and two-ply or three-ply application requirements.
   8. Installing Two Layer Assembly Over Sound Deadening Board:
      a. Apply face layer of wallboard vertically with joints staggered from joints in sound deadening board over framing members.
      b. Fasten face layer with screw, of sufficient length to secure to framing, spaced 300 mm (12 inches) on center around perimeter, and 400 mm (16 inches) on center in the field.
      1. See ASTM C840 for design criteria.
   9. Control Joints ASTM C840 and as follows:
      a. Locate at both side jambs of openings if gypsum board is not "yoked". Use one system throughout.
      b. Not required for wall lengths less than 9000 mm (30 feet).
      c. Extend control joints the full height of the wall or length of soffit/ceiling membrane.
H. Fire and Smoke Partitions:
1. Cut gypsum board for a space approximately 3 mm to 6 mm (1/8 to 1/4 inch) wide around partition perimeter.
2. Coordinate for application of caulking or sealants to space prior to taping and finishing.
3. For sound rated partitions, use sealing compound (ASTM C919) to fill the annular spaces between all receptacle boxes and the partition finish material through which the boxes protrude to seal all holes and/or openings on the back and sides of the boxes. STC minimum values as shown.

I. Electrical and Telecommunications Boxes:
   1. Seal annular spaces between electrical and telecommunications receptacle boxes and gypsum board partitions.

J. Accessories:
   1. Set accessories plumb, level and true to line, neatly mitered at corners and intersections, and securely attach to supporting surfaces as specified.
   2. Install in one piece, without the limits of the longest commercially available lengths.
   3. Corner Beads:
      a. Install at all vertical and horizontal external corners and where shown.
      b. Use screws only. Do not use crimping tool.
   4. Edge Trim (casings Beads):
      a. At both sides of expansion and control joints unless shown otherwise.
      b. Where gypsum board terminates against dissimilar materials and at perimeter of openings, except where covered by flanges, casings or permanently built-in equipment.
      c. Where gypsum board surfaces of non-load bearing assemblies abut load bearing members.
      d. Where shown.

3.3 FINISHING OF GYPSUM BOARD

A. Finish joints, edges, corners, and fastener heads in accordance with ASTM C840. Use Level 4 finish for all finished areas open to public view.

B. Before proceeding with installation of finishing materials, assure the following:
   1. Gypsum board is fastened and held close to framing or furring.
   2. Fastening heads in gypsum board are slightly below surface in dimple formed by driving tool.

C. Finish joints, fasteners, and all openings, including openings around penetrations, on that part of the gypsum board extending above suspended ceilings to seal surface of non-decorated smoke barrier, fire rated gypsum board construction. After the installation of hanger rods, hanger wires, supports, equipment, conduits, piping and similar work, seal remaining openings and maintain the integrity of the smoke barrier, fire rated and sound rated construction. Sanding is not required of non-decorated surfaces.
3.4 REPAIRS

A. After taping and finishing has been completed, and before decoration, repair all damaged and defective work, including non decorated surfaces.

B. Patch holes or openings 13 mm (1/2 inch) or less in diameter, or equivalent size, with a setting type finishing compound or patching plaster.

C. Repair holes or openings over 13 mm (1/2 inch) diameter, or equivalent size, with 16 mm (5/8 inch) thick gypsum board secured in such a manner as to provide solid substrate equivalent to undamaged surface.

D. Tape and refinish scratched, abraded or damaged finish surfaces including cracks and joints in non decorated surface to provide fire protection equivalent to the fire rated construction and STC equivalent to the sound rated construction.

- - - E N D - - -
PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION:
A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the painting and finishing as shown on the construction documents and/or specified herein, including, but not limited to, the following:
11. Painting gypsum drywall exposed to view.
2. Painting pipes, pipe coverings, conduit, ducts, supports and other electrical items and equipment exposed to view.
3. Incidental painting and touching up as required to produce proper finish for painted surfaces, including touching up of factory finished items.
4. Painting of any surface not specifically mentioned to be painted herein or on construction documents, but for which painting is obviously necessary to complete the job, or work which comes within the intent of these specifications, is to be included as though specified.

1.2 RELATED WORK:
A. Activity Hazard Analysis: Section 01 3526, SAFETY REQUIREMENTS.
B. Type of Finish, Color, and Gloss Level of Finish Coat: Section 09 0600, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS:
A. Submit in accordance with Section 01 3323, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
B. Painter qualifications.
C. Manufacturer's Literature and Data:
1. Before work is started, or sample panels are prepared, submit manufacturer's literature and technical data, the current Master Painters Institute (MPI) "Approved Product List" indicating brand label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use subsequent MPI "Approved Product List", however, only one (1) list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI "Approved Product List" where applicable is acceptable.
D. Sample Panels:
1. After painters’ materials have been approved and before work is started submit sample panels showing each type of finish and color specified.
2. Panels to Show Color: Composition board, 100 x 250 mm (4 x 10 inch).
3. Panel to Show Transparent Finishes: Wood of same species and grain pattern as wood approved for use, 100 x 250 mm (4 x 10 inch face) minimum, and where both flat and edge grain
will be exposed, 250 mm (10 inches) long by sufficient size, 50 x 50 mm (2 x 2 inch) minimum or actual wood member to show complete finish.

4. Attach labels to panel stating the following:
   a. Federal Specification Number or manufacturers name and product number of paints used.
   b. Specification code number specified in Section 09 0600, SCHEDULE FOR FINISHES.
   c. Product type and color.
   d. Name of project.

5. Strips showing not less than 50 mm (2 inch) wide strips of undercoats and 100 mm (4 inch) wide strip of finish coat.

E. Sample of identity markers if used.

F. Manufacturers' Certificates indicating compliance with specified requirements:
   1. Manufacturer’s paint substituted for Federal Specification paints meets or exceeds performance of paint specified.

1.4 DELIVERY AND STORAGE:

A. Deliver materials to site in manufacturer's sealed container marked to show following:
   1. Name of manufacturer.
   2. Product type.
   3. Batch number.
   4. Instructions for use.
   5. Safety precautions.

B. In addition to manufacturer's label, provide a label legibly printed as following:
   1. Federal Specification Number, where applicable, and name of material.
   2. Surface upon which material is to be applied.
   3. Specify Coat Types: Prime; body; finish; etc.

C. Maintain space for storage, and handling of painting materials and equipment in a ventilated, neat and orderly condition to prevent spontaneous combustion from occurring or igniting adjacent items.

D. Store materials at site at least 24 hours before using, at a temperature between 7 and 30 degrees C (45 and 85 degrees F).

1.5 QUALITY ASSURANCE:

A. Qualification of Painters: Use only qualified journeyman painters for the mixing and application of paint on exposed surfaces. Submit evidence that key personnel have successfully performed surface preparation and application of coating on a minimum of three (3) similar projects within the past three (3) years.

B. Paint Coordination: Provide finish coats which are compatible with the prime paints used. Review other Sections of these specifications in which prime paints are to be provided to ensure compatibility of the total coatings system for the various substrates. Upon request from other subcontractors, furnish information on the characteristics of the finish materials proposed to be used,
to ensure that compatible prime coats are used. Provide barrier coats over incompatible primers or remove and re-prime as required. Notify the Contracting Officer’s Technical Representative (COTR) in writing of any anticipated problems using the coating systems as specified with substrates primed by others.

1.6 MOCK-UP PANEL:

A. In addition to the samples specified herein to be submitted for approval, apply in the field, at their final location, each type and color of approved paint materials, applied 3.05 m (10 feet) wide, floor to ceiling of wall surfaces, before proceeding with the remainder of the work, for approval by the COTR. Paint mock-ups to include one (1) door and frame assembly.

B. Finish and texture approved by COTR will be used as a standard of quality and workmanship for remainder of work.

C. Repaint individual areas which are not approved, as determined by the COTR, until approval is received.

1.7 REGULATORY REQUIREMENTS:

A. Paint materials are to conform to the restrictions of the local Environmental and Toxic Control jurisdiction.

1. Volatile Organic Compounds (VOC) Emissions Requirements: Field-applied paints and coatings that are inside the waterproofing system to not exceed limits of authorities having jurisdiction.

2. Lead-Base Paint:
   a. Comply with Section 410 of the Lead-Based Paint Poisoning Prevention Act, as amended, and with implementing regulations promulgated by Secretary of Housing and Urban Development.
   b. Regulations concerning prohibition against use of lead-based paint in federal and federally assisted construction, or rehabilitation of residential structures are set forth in Subpart F, Title 24, Code of Federal Regulations, Department of Housing and Urban Development.
   c. Do not use coatings having a lead content over 0.06 percent by weight of non-volatile content.
   d. For lead-paint removal, see Section 02 8333, LEAD-BASED PAINT REMOVAL AND DISPOSAL.

3. Asbestos: Provide materials that do not contain asbestos.

4. Chromate, Cadmium, Mercury, and Silica: Provide materials that do not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.

5. Human Carcinogens: Provide materials that do not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.

6. Use high performance acrylic paints in place of alkyd paints.

1.8 SAFETY AND HEALTH

A. Apply paint materials using safety methods and equipment in accordance with the following:
1. Comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis (AHA) as specified in Section 01 3526, SAFETY REQUIREMENTS. The AHA is to include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

B. Safety Methods Used During Paint Application: Comply with the requirements of SSPC PA Guide 10.

C. Toxic Materials: To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:
   1. The applicable manufacturer’s Material Safety Data Sheets (MSDS) or local regulation.
   2. 29 CFR 1910.1000.
   3. ACHIH-BKLT and ACGHI-DOC, threshold limit values.

1.9 APPLICABLE PUBLICATIONS:
   A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
   B. American Conference of Governmental Industrial Hygienists (ACGIH):
      ACGIH TLV-BKLT-2012..............Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)
      ACGIH TLV-DOC-2012..............Documentation of Threshold Limit Values and Biological Exposure Indices, (Seventh Edition)
   C. ASME International (ASME):
      A13.1-07(R2013)..........................Scheme for the Identification of Piping Systems
      40 CFR 59..............................Determination of Volatile Matter Content, Water Content, Density Volume Solids, and Weight Solids of Surface Coating
   E. Commercial Item Description (CID):
      A-A-1272A..............................Plaster Gypsum (Spackling Compound)
   F. Federal Specifications (Fed Spec):
      TT-P-1411A..............................Paint, Copolymer-Resin, Cementitious (For Waterproofing Concrete and Masonry Walls) (CEP)
   G. Master Painters Institute (MPI):
      8 ...........................................Exterior Alkyd, Flat MPI Gloss Level 1
      9 ...........................................Exterior Alkyd Enamel MPI Gloss Level 6
      10 ..........................................Exterior Latex, Flat
      11 ..........................................Exterior Latex, Semi-Gloss
      18 ...........................................Organic Zinc Rich Primer
      114 ............................................Interior Latex, Gloss
      138 ............................................Interior High Performance Latex, MPI Gloss Level 2
PART 2 - PRODUCTS

2.1 MATERIALS:
   A. Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer’s technical data sheets for specified coatings and solvents.

2.2 PAINT PROPERTIES:
   A. Use ready-mixed (including colors), except two component epoxies, polyurethanes, polyesters, paints having metallic powders packaged separately and paints requiring specified additives.
   B. Where no requirements are given in the referenced specifications for primers, use primers with pigment and vehicle, compatible with substrate and finish coats specified.
   C. Provide undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer, and use only to recommended limits.
   D. VOC Content: For field applications that are inside the weatherproofing system, paints and coating to comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
      1. Flat Paints and Coatings: 50 g/L.
      2. Non-flat Paints and Coatings: 150 g/L.
   E. VOC test method for paints and coatings is to be in accordance with 40 CFR 59 (EPA Method 24). Part 60, Appendix A with the exempt compounds’ content determined by Method 303 (Determination of Exempt Compounds) in the South Coast Air Quality Management District’s (SCAQMD) “Laboratory Methods of Analysis for Enforcement Samples” manual.
2.3 PLASTIC TAPE:
A. Pigmented vinyl plastic film in colors as specified in Section 09 0600, SCHEDULE FOR FINISHES or specified.
B. Pressure sensitive adhesive back.
C. Snap on coil plastic markers.
D. Widths as shown on construction documents.

2.4 BIOBASED CONTENT
A. Paint products shall comply with following bio-based standards for biobased materials:

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Percent by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior Paint</td>
<td>20 percent biobased material</td>
</tr>
<tr>
<td>Exterior Paint</td>
<td>20 percent biobased material</td>
</tr>
<tr>
<td></td>
<td>79</td>
</tr>
</tbody>
</table>

B. The minimum-content standards are based on the weight (not the volume) of the material.

PART 3 - EXECUTION
3.1 JOB CONDITIONS:
A. Safety: Observe required safety regulations and manufacturer's warning and instructions for storage, handling and application of painting materials.
   1. Take necessary precautions to protect personnel and property from hazards due to falls, injuries, toxic fumes, fire, explosion, or other harm.
   2. Deposit soiled cleaning rags and waste materials in metal containers approved for that purpose. Dispose of such items off the site at end of each day's work.
B. Atmospheric and Surface Conditions:
   1. Do not apply coating when air or substrate conditions are:
      a. Less than 3 degrees C (5 degrees F) above dew point.
      b. Below 10 degrees C (50 degrees F) or over 35 degrees C (95 degrees F), unless specifically pre-approved by the COTR and the product manufacturer. Under no circumstances are application conditions to exceed manufacturer recommendations.
3. When the relative humidity exceeds 85 percent; or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer's printed instructions.

2. Maintain interior temperatures until paint dries hard.

3. Do no exterior painting when it is windy and dusty.

4. Do not paint in direct sunlight or on surfaces that the sun will warm.

5. Apply only on clean, dry and frost free surfaces except as follows:
   a. Apply water thinned acrylic and cementitious paints to damp (not wet) surfaces only when allowed by manufacturer's printed instructions.
   b. Concrete and masonry when permitted by manufacturer's recommendations, dampen surfaces to which water thinned acrylic and cementitious paints are applied with a fine mist of water on hot dry days to prevent excessive suction and to cool surface.

3.2 INSPECTION:
   A. Examine the areas and conditions where painting and finishing are to be applied and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.3 GENERAL WORKMANSHIP REQUIREMENTS:
   A. Application may be by brush or roller. Spray application only upon acceptance from the COTR in writing.
   B. Furnish to the COTR a painting schedule indicating when the respective coats of paint for the various areas and surfaces will be completed. This schedule is to be kept current as the job progresses.
   C. Protect work at all times. Protect all adjacent work and materials by suitable covering or other method during progress of work. Upon completion of the work, remove all paint and varnish spots from floors, glass and other surfaces. Remove from the premises all rubbish and accumulated materials of whatever nature not caused by others and leave work in a clean condition.
   D. Remove and protect hardware, accessories, device plates, lighting fixtures, and factory finished work, and similar items, or provide in place protection. Upon completion of each space, carefully replace all removed items by workmen skilled in the trades involved.
   E. When indicated to be painted, remove electrical panel box covers and doors before painting walls. Paint separately and re-install after all paint is dry.
   F. Materials are to be applied under adequate illumination, evenly spread and flowed on smoothly to avoid runs, sags, holidays, brush marks, air bubbles and excessive roller stipple.
   G. Apply materials with a coverage to hide substrate completely. When color, stain, dirt or undercoats show through final coat of paint, the surface is to be covered by additional coats until the paint film is of uniform finish, color, appearance and coverage, at no additional cost to the Government.
   H. All coats are to be dry to manufacturer’s recommendations before applying succeeding coats.
   I. All suction spots or “hot spots” in plaster after the application of the first coat are to be touched up before applying the second coat.
3.4 SURFACE PREPARATION:

A. General:

1. The Contractor shall be held wholly responsible for the finished appearance and satisfactory completion of painting work. Properly prepare all surfaces to receive paint, which includes cleaning, sanding, and touching-up of all prime coats applied under other Sections of the work. Broom clean all spaces before painting is started. All surfaces to be painted or finished are to be completely dry, clean and smooth.

2. See other sections of specifications for specified surface conditions and prime coat.

3. Perform preparation and cleaning procedures in strict accordance with the paint manufacturer’s instructions and as herein specified, for each particular substrate condition.

4. Clean surfaces before applying paint or surface treatments with materials and methods compatible with substrate and specified finish. Remove any residue remaining from cleaning agents used. Do not use solvents, acid, or steam on concrete and masonry. Schedule the cleaning and painting so that dust and other contaminants from the cleaning process will not fall in wet, newly painted surfaces.

5. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   a. Concrete: 12 percent.
   b. Fiber-Cement Board: 12 percent.
   c. Masonry (Clay and CMU’s): 12 percent.
   e. Gypsum Board: 12 percent.
   f. Plaster: 12 percent.

B. Ferrous Metals:

1. Remove oil, grease, soil, drawing and cutting compounds, flux and other detrimental foreign matter in accordance with SSPC-SP 1 (Solvent Cleaning).

2. Remove loose mill scale, rust, and paint, by hand or power tool cleaning, as defined in SSPC-SP 2 (Hand Tool Cleaning) and SSPC-SP 3 (Power Tool Cleaning).

3. Fill dents, holes and similar voids and depressions in flat exposed surfaces of hollow steel doors and frames, access panels, roll-up steel doors and similar items specified to have semi-gloss or gloss finish with TT-F-322D (Filler, Two-Component Type, For Dents, Small Holes and Blow-Holes). Finish flush with adjacent surfaces.
   a. Fill flat head countersunk screws used for permanent anchors.
   b. Do not fill screws of item intended for removal such as glazing beads.

4. Spot prime abraded and damaged areas in shop prime coat which expose bare metal with same type of paint used for prime coat. Feather edge of spot prime to produce smooth finish coat.

5. Spot prime abraded and damaged areas which expose bare metal of factory finished items with paint as recommended by manufacturer of item.
D. Masonry, Concrete, Cement Board, Cement Plaster and Stucco:
1. Clean and remove dust, dirt, oil, grease efflorescence, form release agents, laitance, and other deterrents to paint adhesion.
2. Use emulsion type cleaning agents to remove oil, grease, paint and similar products. Use of solvents, acid, or steam is not permitted.
3. Remove loose mortar in masonry work.
4. Replace mortar and fill open joints, holes, cracks and depressions with new mortar. Do not fill weep holes. Finish to match adjacent surfaces.
5. Neutralize Concrete floors to be painted by washing with a solution of 1.4 Kg (3 pounds) of zinc sulfate crystals to 3.8 L (1 gallon) of water, allow to dry three (3) days and brush thoroughly free of crystals.
6. Repair broken and spalled concrete edges with concrete patching compound to match adjacent surfaces as specified in Division 03, CONCRETE Sections. Remove projections to level of adjacent surface by grinding or similar methods.

F. Gypsum Plaster and Gypsum Board:
1. Remove efflorescence, loose and chalking plaster or finishing materials.
2. Remove dust, dirt, and other deterrents to paint adhesion.
3. Fill holes, cracks, and other depressions with CID-A-A-1272A finished flush with adjacent surface, with texture to match texture of adjacent surface. Patch holes over 25 mm (1-inch) in diameter as specified in Section for plaster or gypsum board.

3.5 PAINT PREPARATION:
A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of pigment and uniform composition.
B. Do not thin unless necessary for application and when finish paint is used for body and prime coats. Use materials and quantities for thinning as specified in manufacturer's printed instructions.
C. Remove paint skins, then strain paint through commercial paint strainer to remove lumps and other particles.
D. Mix two (2) component and two (2) part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise.
E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

3.6 APPLICATION:
A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.
B. Unless otherwise specified, apply paint in three (3) coats; prime, body, and finish. When two (2) coats applied to prime coat are the same, first coat applied over primer is body coat and second coat is finish coat.
C. Apply each coat evenly and cover substrate completely.

D. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions, and approved by COTR.

E. Apply by brush or roller. Spray application for new or existing occupied spaces only upon approval by acceptance from COTR in writing.
   1. Apply painting materials specifically required by manufacturer to be applied by spraying.
   2. In new construction and in existing occupied spaces, where paint is applied by spray, mask or enclose with polyethylene, or similar air tight material with edges and seams continuously sealed including items specified in "Building and Structural Work Field Painting"; "Work not Painted"; motors, controls, telephone, and electrical equipment, fronts of sterilizes and other recessed equipment and similar prefinished items.

F. Do not paint in closed position operable items such as access doors and panels, window sashes, overhead doors, and similar items except overhead roll-up doors and shutters.

3.7 PRIME PAINTING:
   A. After surface preparation, prime surfaces before application of body and finish coats, except as otherwise specified.
   B. Spot prime and apply body coat to damaged and abraded painted surfaces before applying succeeding coats.
   C. Additional field applied prime coats over shop or factory applied prime coats are not required except for exterior exposed steel apply an additional prime coat.

F. Metals:
   1. Steel and iron: MPI 79 (Marine Alkyd Metal Primer) or MPI 95 (Fast Drying Metal Primer). Use MPI 101 (Cold Curing Epoxy Primer) where MPI 77 (Epoxy Cold Cured, Gloss or MPI 98 (High Build Epoxy Coating)or MPI 108 (High Build Epoxy Marine Coating) finish is specified.
   2. Zinc-coated steel and iron: MPI 134 (Waterborne Galvanized Primer) or MPI 135 (Non-Cementitious Galvanized Primer).
   3. Aluminum scheduled to be painted: MPI 95 (Fast Drying Metal Primer).
   4. Terne Metal: MPI 79 (Marine Alkyd Metal Primer) or MPI 95 (Fast Drying Metal Primer)
   5. Copper and copper alloys scheduled to be painted: MPI 95 (Fast Drying Metal Primer).
   8. Metal over 94 degrees C (201 degrees F), Boilers, Incinerator Stacks, and Engine Exhaust Pipes: MPI 22 (High Heat Resistant Coating).

G. Gypsum Board:
   1. Surfaces scheduled to have MPI 10 (Exterior Latex, Flat) or MPI 11 (Exterior Latex, Semi-Gloss) or MPI 119 (Exterior Latex, High Gloss (acrylic)) or MPI 53 (Interior Latex, Flat),
MPI Gloss Level 1 or MPI 52 (Interior Latex, MPI Gloss Level 3) or MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5) or MPI 114 (Interior Latex, Gloss) finish: Use or MPI 10 (Exterior Latex, Flat) or MPI 11 (Exterior Latex, Semi-Gloss) or MPI 119 (Exterior Latex, High Gloss (acrylic)) or MPI 53 (Interior Latex, MPI Gloss Level 3) or MPI 52 (Interior Latex, MPI Gloss Level 3) or MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5) or MPI 114 (Interior Latex, Gloss) respectively.

H. Gypsum Plaster and Veneer Plaster:
2. MPI 45 (Interior Primer Sealer), except use MPI 50 (Interior Latex Primer Sealer) when an alkyd flat finish is specified.
3. Surfaces scheduled to have MPI 10 (Exterior Latex, Flat) or MPI 11 (Exterior Latex, Semi-Gloss) or MPI 119 (Exterior Latex, High Gloss (acrylic)) or MPI 53 (Interior Latex, Flat, MPI Gloss Level 1) or MPI 52 (Interior Latex, MPI Gloss Level 3) or MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5) or MPI 114 (Interior Latex, Gloss) or finish: Use MPI 10 (Exterior Latex, Flat) or MPI 11 (Exterior Latex, Semi-Gloss) or MPI 119 (Exterior Latex, High Gloss (acrylic)) or MPI 53 (Interior Latex, Flat, MPI Gloss Level 1) or MPI 52 Latex, MPI Gloss Level 3) or MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5) or MPI 114 (Interior Latex, Gloss) respectively.
4. Use MPI 101 (Cold Curing Epoxy Primer) for surfaces scheduled to receive or MPI 77 (Epoxy Cold Cured, Gloss) or MPI 108 (High Build Epoxy Marine Coating) or finish.

Concrete Masonry Units except glazed or integrally colored and decorative units:
- MPI 4 (Block Filler) on interior surfaces.
- Prime exterior surface as specified for exterior finishes.

J. Cement Plaster Interior Surfaces Walls:
1. MPI 53 (Interior Latex, Flat, MPI Gloss Level 1) except use two (2) coats where substrate has aged less than six (6) months.

3.8 INTERIOR FINISHES:
A. Apply following finish coats over prime coats in spaces or on surfaces specified in Section 09 0600, SCHEDULE FOR FINISHES.
B. Gypsum Board:
1. One (1) coat of MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) plus one (1) coat of MPI 139 (Interior High Performance Latex, MPI Gloss level 3).
2. Two (2) coats of MPI 138 (Interior High Performance Latex, MPI Gloss Level 2).
3. One (1) coat of MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) plus one (1) coat of MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5) or MPI 114 (Interior Latex, Gloss).
4. One (1) coat of MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) plus one (1) coat of MPI 48 (Interior Alkyd Gloss).

C. Plaster:
1. One (1) coat of MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) or MPI 50 (Interior Latex Primer Sealer) plus one (1) coat of MPI 139 (Interior High Performance Latex, MPI Gloss level 3).
2. Two (2) coats of MPI 51 (Interior Alkyd, Eggshell).
3. One (1) coat of MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) or MPI 50 (Interior Latex Primer Sealer) plus one (1) coat of 139 (Interior High Performance Latex, MPI Gloss level 3).
4. One (1) coat MPI 101 (Cold Curing Epoxy Prime).

E. Masonry and Concrete Walls:
1. Over MPI 4 (Interior/Exterior Latex Block Filler) on CMU surfaces.
2. Two (2) coats of MPI 53 (Interior Latex, Flat, MPI Gloss Level 1) or MPI 52 (Interior Latex, MPI Gloss Level 3) or MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5) or MPI 114 (Interior Latex, Gloss).
3. Two (2) coats of MPI 138 (Interior High Performance Latex, MPI Gloss Level 2) or MPI 139 (Interior High Performance Latex, MPI Gloss Level 3) or MPI 140 (Interior High Performance Latex MPI Gloss Level 4) or MPI 141 (Interior High Performance Latex MPI Gloss Level 5) or MPI 114 (Interior Latex, Gloss).

Sealers:
a. MPI 31 (gloss) or MPI 71 (flat) thinned as recommended by manufacturer at rate of one (1) part of thinner to four (4) parts of varnish.
b. Apply sealers specified except sealer may be omitted where pigmented, penetrating, or wiping stains containing resins are used.
c. Allow manufacturer’s recommended drying time before sanding, but not less than 24 hours or 36 hours in damp or muggy weather.
d. Sand as specified.

Paint Finish:
a. One (1) coat of MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) plus one (1) coat of MPI 47 (Interior Alkyd, Semi-Gloss).
b. One (1) coat MPI 66 (Interior Alkyd Fire retardant, Clear Top-Coat (UL Approved) or MPI 67 (Interior Latex Fire Retardant, Top-Coat (UL Approved), intumescent type, on exposed wood or in attics with floors used for mechanical equipment and above ceilings where shown.
c. One (1) coat of MPI 45 Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat) plus one (1) coat of MPI 48 (Interior Alkyd Gloss).
d. Two (2) coats of MPI 51 (Interior Alkyd, Eggshell).
3.9 REFINISHING EXISTING PAINTED SURFACES:
A. Clean, patch and repair existing surfaces as specified under “Surface Preparation”. No “telegraphing” of lines, ridges, flakes, etc., through new surfacing is permitted. Where this occurs, sand smooth and re-finish until surface meets with COTR’s approval.
B. Remove and reinstall items as specified under “General Workmanship Requirements”.
C. Remove existing finishes or apply separation coats to prevent non compatible coatings from having contact.
D. Patched or Replaced Areas in Surfaces and Components: Apply spot prime and body coats as specified for new work to repaired areas or replaced components.
E. Except where scheduled for complete painting apply finish coat over plane surface to nearest break in plane, such as corner, reveal, or frame.
F. In existing rooms and areas where alterations occur, clean existing stained and natural finished wood retouch abraded surfaces and then give entire surface one (1) coat of MPI 31 (Polyurethane, Moisture Cured, Clear Gloss) or MPI 71 (Polyurethane, Moisture Cured, Clear Flat).
G. Refinish areas as specified for new work to match adjoining work unless specified or scheduled otherwise.
H. Coat knots and pitch streaks showing through old finish with MPI 36 (Knot Sealer) before refinishing.
I. Sand or dull glossy surfaces prior to painting.
J. Sand existing coatings to a feather edge so that transition between new and existing finish will not show in finished work.

3.10 PAINT COLOR:
A. Color and gloss of finish coats is specified in Section 09 0600, SCHEDULE FOR FINISHES.
B. For additional requirements regarding color see Articles, “REFINISHING EXISTING PAINTED SURFACE” and “MECHANICAL AND ELECTRICAL FIELD PAINTING SCHEDULE”.
C. Coat Colors:
   1. Color of priming coat: Lighter than body coat.
   2. Color of body coat: Lighter than finish coat.
   3. Color prime and body coats to not show through the finish coat and to mask surface imperfections or contrasts.

3.11 ELECTRICAL WORK FIELD PAINTING SCHEDULE:
A. Field painting of mechanical and electrical consists of cleaning, touching-up abraded shop prime coats, and applying prime, body and finish coats to materials and equipment if not factory finished in space scheduled to be finished.
B. In spaces not scheduled to be finish painted in Section 09 0600, SCHEDULE FOR FINISHES paint as specified below.
C. Paint various systems specified in ELECTRICAL, Division 27 - COMMUNICATIONS, and Division 28 – ELECTRONIC SAFETY AND SECURITY.
D. Paint after tests have been completed.
E. Omit prime coat from factory prime-coated items.
F. Finish painting of mechanical and electrical equipment is not required when located in interstitial spaces, above suspended ceilings, in concealed areas such as pipe and electric closets, pipe basements, pipe tunnels, trenches, attics, roof spaces, shafts and furred spaces except on electrical conduit containing feeders 600 volts or more.
G. Omit field painting of items specified in “BUILDING AND STRUCTURAL WORK FIELD PAINTING”; “Building and Structural Work not Painted”.
H. Color:
   1. Paint items having no color specified in Section 09 06 00, SCHEDULE FOR FINISHES to match surrounding surfaces.
   2. Paint colors as specified in Section 09 06 00, SCHEDULE FOR FINISHES except for following:
      b. Gray: Heating, ventilating, air conditioning and refrigeration equipment (except as required to match surrounding surfaces), and water and sewage treatment equipment and sewage ejection equipment.
      c. Aluminum Color: Ferrous metal on outside of boilers and in connection with boiler settings including supporting doors and door frames and fuel oil burning equipment, and steam generation system (bare piping, fittings, hangers, supports, valves, traps and miscellaneous iron work in contact with pipe).
      d. Federal Safety Red: Exposed fire protection piping hydrants, post indicators, electrical conducts containing fire alarm control wiring, and fire alarm equipment.
      e. Federal Safety Orange: Entire lengths of electrical conduits containing feeders 600 volts or more.
      f. Color to match brickwork sheet metal covering on breeching outside of exterior wall of boiler house.
I. Apply paint systems on properly prepared and primed surface as follows:
   1.
   2. Interior Locations:
      a. Apply two (2) coats of MPI 47 (Interior Alkyd, Semi-Gloss) to following items:
         1) Metal under 94 degrees C (201 degrees F) of items such as bare piping, fittings, hangers and supports.
         2) Equipment and systems such as hinged covers and frames for control cabinets and boxes, cast-iron radiators, electric conduits and panel boards.
3) Heating, ventilating, air conditioning, plumbing equipment, and machinery having shop
prime coat and not factory finished.
   b.
   e. Paint electrical conduits containing cables rated 600 volts or more using two (2) coats of
MPI 9 (Exterior Alkyd Enamel) or MPI 8 (Exterior Alkyd, Flat) or MPI 94 (Exterior Alkyd,
Semi-gloss) in the Federal Safety Orange color in exposed and concealed spaces full length
of conduit.

3. Other exposed locations:
   a. Metal surfaces, except aluminum, of cooling towers exposed to view, including connected
pipes, rails, and ladders: Two (2) coats of MPI 1 (Aluminum Paint).
   b. Cloth jackets of insulation of ducts and pipes in connection with plumbing, air conditioning,
ventilating refrigeration and heating systems: One (1) coat of MPI 50 (Interior Latex Primer
Sealer) and one (1) coat of MPI 10 (Exterior Latex, Flat) or MPI 11 (Exterior Latex Semi-
Gloss) or MPI 119 (Exterior Latex, High Gloss (acrylic)).

3.12 BUILDING AND STRUCTURAL WORK FIELD PAINTING:
A. Painting and finishing of interior except as specified here-in-after.
   1. Painting and finishing of new and existing work including colors and gloss of finish selected is
specified in Finish Schedule, Section 09 06 00, SCHEDULE FOR FINISHES.
   2. Painting of disturbed, damaged and repaired or patched surfaces when entire space is not
scheduled for complete repainting or refinishing.
   3. Painting of ferrous metal and galvanized metal.
   4. Painting of wood with fire retardant paint exposed in attics, when used as mechanical equipment
space (except shingles).
   5. Identity painting and safety painting.
B. Building and Structural Work not Painted:
   1. Prefinished items:
      a. Specified factory finished under other sections.
      b. Factory finished equipment and pre-engineered metal building components such as metal
roof and wall panels.
   2. Finished surfaces:
      a. Hardware except ferrous metal.
      b. Anodized aluminum, stainless steel, chromium plating, copper, and brass, except as
otherwise specified.
      c. Signs, fixtures, and other similar items integrally finished.
   3. Concealed surfaces:
      a. Inside dumbwaiter, elevator and duct shafts, interstitial spaces, pipe basements, crawl
spaces, pipe tunnels, above ceilings, attics, except as otherwise specified.
b. Inside walls or other spaces behind access doors or panels.
c. Surfaces concealed behind permanently installed casework and equipment.

4. Moving and operating parts:
   a. Shafts, chains, gears, mechanical and electrical operators, linkages, and sprinkler heads, and sensing devices.
   b. Tracks for overhead or coiling doors, shutters, and grilles.

5. Labels:
   a. Code required label, such as Underwriters Laboratories Inc., Intertek Testing Service or Factory Mutual Research Corporation.
   b. Identification plates, instruction plates, performance rating, and nomenclature.

3.13 IDENTITY PAINTING SCHEDULE:

A. Identify designated service in new buildings or projects with extensive remodeling in accordance with ASME A13.1, unless specified otherwise, on exposed piping, piping above removable ceilings, piping in accessible pipe spaces, interstitial spaces, and piping behind access panels. For existing spaces where work is minor match existing.

1. Legend may be identified using snap-on coil plastic markers or by paint stencil applications.

2. Apply legends adjacent to changes in direction, on branches, where pipes pass through walls or floors, adjacent to operating accessories such as valves, regulators, strainers and cleanouts a minimum of 12.2 M (40 feet) apart on straight runs of piping. Identification next to plumbing fixtures is not required.

3. Locate Legends clearly visible from operating position.

4. Use arrow to indicate direction of flow using black stencil paint.

5. Identify pipe contents with sufficient additional details such as temperature, pressure, and contents to identify possible hazard. Insert working pressure shown on construction documents where asterisk appears for High, Medium, and Low Pressure designations as follows:
   a. High Pressure - 414 kPa (60 psig) and above.
   b. Medium Pressure - 104 to 413 kPa (15 to 59 psig).
   c. Low Pressure - 103 kPa (14 psig) and below.
   d. Add Fuel oil grade numbers.

6. Legend name in full or in abbreviated form as follows:

   | COLOR OF PIPING | COLOR OF EXPOSED PIPING | COLOR OF BACKGROUND LETTERS | LEGEND ABBREVIATIONS |

7. Electrical Conduits containing feeders over 600 volts, paint legends using 50 mm (2 inch) high black numbers and letters, showing the voltage class rating. Provide legends where conduits pass through walls and floors and at maximum 6096 mm (20 foot) intervals in between. Use
labels with yellow background with black border and words Danger High Voltage Class, as indicated in the electrical documents.

a. Conduits containing high voltage feeders over 600 volts: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS / Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS / Section 28 05 33, RACEWAYS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY.

B. Fire and Smoke Partitions:
   1. Identify partitions above ceilings on both sides of partitions except within shafts in letters not less than 64 mm (2 1/2 inches) high.
   2. Stenciled message: "SMOKE BARRIER" or, "FIRE BARRIER" as applicable.
   3. Locate not more than 6096 mm (20 feet) on center on corridor sides of partitions, and with at least one (1) message per room on room side of partition.
   4. Use semi-gloss paint of color that contrasts with color of substrate.

C. Identify columns in pipe basements and interstitial space:
   1. Apply stenciled number and letters to correspond with grid numbering and lettering indicated on construction documents.
   2. Paint numbers and letters 101 mm (4 inches) high, locate 45 mm (18 inches) below overhead structural slab.
   3. Apply on four (4) sides of interior columns and on inside face only of exterior wall columns.
   4. Color:
      a. Use black on concrete columns.
      b. Use white or contrasting color on steel columns.

3.14 PROTECTION CLEAN UP, AND TOUCH-UP:

A. Protect work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.

B. Upon completion, clean paint from hardware, glass and other surfaces and items not required to be painted of paint drops or smears.

C. Before final inspection, touch-up or refinshed in a manner to produce solid even color and finish texture, free from defects in work which was damaged or discolored.

--- END ---
SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS

PART 1 - GENERAL

1.1 DESCRIPTION:
A. Provide seismic restraint in accordance with the requirements of this section in order to maintain the integrity of nonstructural components of the building so that they remain safe and functional in case of seismic event.
C. Definitions: Non-structural building components are components or systems that are not part of the building’s structural system whether inside or outside, above or below grade. Non-structural components of buildings include:
   1. Architectural Elements: Facades that are not part of the structural system and its shear resistant elements; cornices and other architectural projections and parapets that do not function structurally; glazing; nonbearing partitions; suspended ceilings; stairs isolated from the basic structure; cabinets; bookshelves; medical equipment; and storage racks.
   2. Electrical Elements: Power and lighting systems; substations; switchgear and switchboards; auxiliary engine-generator sets; transfer switches; motor control centers; motor generators; selector and controller panels; fire protection and alarm systems; special life support systems; and telephone and communication systems.
   3. Mechanical Elements: Heating, ventilating, and air-conditioning systems; medical gas systems; plumbing systems; sprinkler systems; pneumatic systems; boiler equipment and components.

1.2 QUALITY CONTROL:
A. Shop-Drawing Preparation:
   1. Have seismic-force-restraint shop drawings and calculations prepared by a professional structural engineer experienced in the area of seismic force restraints. The professional structural engineer shall be registered in the state where the project is located.
   2. Submit design tables and information used for the design-force levels, stamped and signed by a professional structural engineer registered in the State where project is located.
B. Coordination:
   1. Do not install seismic restraints until seismic restraint submittals are approved by the Resident Engineer.
   2. Coordinate and install trapezes or other multi-pipe hanger systems prior to pipe installation.
C. Seismic Certification:
   1. In structures assigned to IBC Seismic Design Category C, D, E, or F, permanent equipments and components are to have Special Seismic Certification in accordance with requirements of section 13.2.2 of ASCE 7 except for equipment that are considered rugged as listed in section 2.2 OSHPD code application notice CAN No. 2-1708A.5, and shall comply with section 13.2.6 of ASCE 7.

1.3 SUBMITTALS:
A. Submit a coordinated set of equipment anchorage drawings prior to installation including:
   1. Description, layout, and location of items to be anchored or braced with anchorage or brace points noted and dimensioned.
   2. Details of anchorage or bracing at large scale with all members, parts brackets shown, together with all connections, bolts, welds etc. clearly identified and specified.
   3. Numerical value of design seismic brace loads.
   4. For expansion bolts, include design load and capacity if different from those specified.
B. Submit prior to installation, a coordinated set of bracing drawings for seismic protection of piping, with data identifying the various support-to-structure connections and seismic bracing structural connections, include:
   1. Single-line piping diagrams on a floor-by-floor basis. Show all suspended piping for a given floor on the same plain.
   2. Type of pipe (Copper, steel, cast iron, insulated, non-insulated, etc.).
   3. Pipe contents.
   4. Structural framing.
   5. Location of all gravity load pipe supports and spacing requirements.
   7. Location of all seismic bracing.
   9. Type of connection (Vertical support, vertical support with seismic brace etc.).
   10. Seismic brace reaction type (tension or compression): Details illustrating all support and bracing components, methods of connections, and specific anchors to be used.

C. Submit prior to installation, bracing drawings for seismic protection of suspended ductwork and suspended electrical and communication cables, include:
   1. Details illustrating all support and bracing components, methods of connection, and specific anchors to be used.
   2. Numerical value of applied gravity and seismic loads and seismic loads acting on support and bracing components.
   3. Maximum spacing of hangers and bracing.
   4. Seal of registered structural engineer responsible for design.

D. Submit design calculations prepared and sealed by the registered structural engineer specified above in paragraph 1.3A.

E. Submit for concrete anchors, the appropriate ICBC evaluation reports, OSHPD pre-approvals, or lab test reports verifying compliance with OSHPD Interpretation of Regulations 28-6.

1.4 APPLICABLE PUBLICATIONS:
A. The Publications listed below (including amendments, addenda revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only.

B. American Concrete Institute (ACI):
   1. 355.2-07 Qualification for Post-Installed Mechanical Anchors in Concrete and Commentary

C. American Institute of Steel Construction (AISC):

D. Load and Resistance Factor Design, Volume 1, Second Edition

E. American Society for Testing and Materials (ASTM):
   1. A36/A36M-08 Standard Specification for Carbon Structural Steel
   2. A53/A53M-10 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
   3. A307-10 Standard Specification for Carbon Steel Bolts and Studs; 60,000 PSI Tensile Strength.
   5. A325M-09 Standard Specification for High-Strength Bolts for Structural Steel Joints [Metric]
   6. A490-10 Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
   7. A490M-10 Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints [Metric]
   8. A500/A500M-10 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
9. A501-07 Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
10. A615/A615M-09 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
11. A992/A992M-06 Standard Specification for Steel for Structural Shapes for Use in Building Framing
12. A996/A996M-09 Standard Specification for Rail-Steel and Axel-Steel Deformed Bars for Concrete Reinforcement

F. American Society of Civil Engineers (ASCE 7) Latest Edition.
H. VA Seismic Design Requirements, H-18-8, August 2013
I. National Uniform Seismic Installation Guidelines (NUSIG)

1.5 REGULATORY REQUIREMENT:
B. Exceptions: The seismic restraint of the following items may be omitted:
   1. Equipment weighing less than 400 pounds, which is supported directly on the floor or roof.
   2. Equipment weighing less than 20 pounds, which is suspended from the roof or floor or hung from a wall.
   3. All other piping less than 2 ½ inches inside diameter, except for automatic fire suppression systems.
   4. All piping suspended by individual hangers, 12 inches or less in length from the top of pipe to the bottom of the support for the hanger.
   5. All electrical conduits, less than 2 ½ inches inside diameter.

PART 2 - PRODUCTS
2.1 STEEL:
A. Structural Steel: ASTM A36, ASTM A36M, or ASTM A992.
B. Structural Tubing: ASTM A500, Grade B.
D. Steel Pipe: ASTM A53/A53M, Grade B.
E. Bolts & Nuts: ASTM A307, A325, A325M, A490, or A490M.

2.2 CAST-IN-PLACE CONCRETE:
A. Concrete: 28 day strength, f'c = 25 MPa (3,000 psi)
B. Reinforcing Steel: ASTM A615/615M or ASTM A996/A996M deformed.

PART 3 - EXECUTION
3.1 CONSTRUCTION, GENERAL:
A. Provide equipment supports and anchoring devices to withstand the seismic design forces, so that when seismic design forces are applied, the equipment cannot displace, overturn, or become inoperable.
B. Provide anchorages in conformance with recommendations of the equipment manufacturer and as shown on approved shop drawings and calculations.
C. Construct seismic restraints and anchorage to allow for thermal expansion.
D. Testing Before Final Inspection:
SECTION 13 0541 - SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS

1. Test 10-percent of anchors in masonry and concrete per ASTM E488, and ACI 355.2 to determine that they meet the required load capacity. If any anchor fails to meet the required load, test the next 20 consecutive anchors, which are required to have zero failure, before resuming the 10-percent testing frequency.

2. Before scheduling Final Inspection, submit a report on this testing indicating the number and location of testing, and what anchor-loads were obtained.

3.2 EQUIPMENT RESTRAINT AND BRACING:

A. Split system air conditioning system, indoor wall-mounted units.

3.3 MECHANICAL DUCTWORK AND PIPING; BOILER PLANT STACKS AND BREACHING; ELECTRICAL BUSWAYS, CONDUITS, AND CABLE TRAYS; AND TELECOMMUNICATION WIRES AND CABLE TRAYS

A. Support and brace mechanical ductwork and piping; electrical busways, conduits and cable trays; and telecommunication wires and cable trays including boiler plant stacks and breeching to resist directional forces (lateral, longitudinal and vertical).

B. Brace duct and breeching branches with a minimum of 1 brace per branch.

C. Provide supports and anchoring so that, upon application of seismic forces, piping remains fully connected as operable systems which will not displace sufficiently to damage adjacent or connecting equipment, or building members.

D. Seismic Restraint of Piping:

1. Design criteria:
   a. Piping resiliently supported: Restrain to support 120% of the weight of the systems and components and contents.
   b. Piping not resiliently supported: Restrain to support 60% of the weight of the system components and contents.
   c. Provide seismic restraints according to one of the following options:

E. Piping Connections: Provide flexible connections where pipes connect to equipment. Make the connections capable of accommodating relative differential movements between the pipe and equipment under conditions of earthquake shaking.

- - - END - - -
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 23.

B. Definitions:
   1. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.
   2. Option or optional: Contractor's choice of an alternate material or method.
   3. RE: Resident Engineer
   4. COTR: Contracting Officer's Technical Representative.

1.2 QUALITY ASSURANCE

A. Mechanical, electrical and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems shall be comprised of high quality institutional-class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All construction firms and personnel shall be experienced and qualified specialists in industrial and institutional HVAC

B. Equipment Vibration Tolerance:
   1. Refer to Section 23 0541, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT. Equipment shall be factory-balanced to this tolerance and re-balanced on site, as necessary.

C. Products Criteria:
   1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years (or longer as specified elsewhere). The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions and/or additional requirements.
   2. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
   3. Conform to codes and standards as required by the specifications. Conform to local codes, if required by local authorities such as the natural gas supplier, if the local codes are more stringent then those specified. Refer any conflicts to the Resident Engineer.
   4. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
   5. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
   6. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
   7. Asbestos products or equipment or materials containing asbestos shall not be used.

D. Equipment Service Organizations:
   1. HVAC: Products and systems shall be supported by service organizations that maintain a complete inventory of repair parts and are located within 100 miles to the site.

E. HVAC Mechanical Systems Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
   1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
   2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.

F. Execution (Installation, Construction) Quality:
1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to the Resident Engineer for resolution. Provide written hard copies or computer files of manufacturer's installation instructions to the Resident Engineer at least two weeks prior to commencing installation of any item. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations is a cause for rejection of the material.
2. Provide complete layout drawings required by Paragraph, SUBMITTALS. Do not commence construction work on any system until the layout drawings have been approved.

G. Upon request by Government, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with telephone numbers and e-mail addresses.

1.3 SUBMITTALS
A. Submit in accordance with Section 01 3323, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and with requirements in the individual specification sections.
B. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements.
C. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
D. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
E. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient.
F. Layout Drawings:
1. Submit complete consolidated and coordinated layout drawings for all new systems, and for existing systems that are in the same areas.
2. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8-inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show locations and adequate clearance for all equipment, piping, valves, control panels and other items. Show the access means for all items requiring access for operations and maintenance. Provide detailed layout drawings of all piping and duct systems.
3. Do not install equipment foundations, equipment or piping until layout drawings have been approved.
4. In addition, for HVAC systems, provide details of the following:
   a. Hangers, inserts, supports, and bracing.
   b. Pipe sleeves.
   c. Duct or equipment penetrations of floors, walls, ceilings, or roofs.
G. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.
1. Submit belt drive with the driven equipment. Submit selection data for specific drives when requested by the Resident Engineer.
2. Submit electric motor data and variable speed drive data with the driven equipment.
3. Equipment and materials identification.
5. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
6. Wall, floor, and ceiling plates.

H. HVAC Maintenance Data and Operating Instructions:
1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
2. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

I. Provide copies of approved HVAC equipment submittals to the Testing, Adjusting and Balancing Subcontractor.

1.4 APPLICABLE PUBLICATIONS
A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

1.5 DELIVERY, STORAGE AND HANDLING
A. Protection of Equipment:
1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
2. Place damaged equipment in first class, new operating condition; or, replace same as determined and directed by the Resident Engineer. Such repair or replacement shall be at no additional cost to the Government.
3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:
1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. Clean interior of all tanks prior to delivery for beneficial use by the Government.
4. Boilers shall be left clean following final internal inspection by Government insurance representative or inspector.
5. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.6 JOB CONDITIONS – WORK IN EXISTING BUILDING
A. Building Operation: Government employees will be continuously operating and managing all facilities, including temporary facilities, that serve the medical center.
B. Maintenance of Service: Schedule all work to permit continuous service as required by the medical center.
C. Phasing of Work: Comply with all requirements shown on drawings or specified.
D. Building Working Environment: Maintain the architectural and structural integrity of the building and the working environment at all times. Maintain the interior of building at 18 degrees C (65 degrees F) minimum. Limit the opening of doors, windows or other access openings to brief periods as necessary for rigging purposes. No storm water or ground water leakage permitted.
Provide daily clean-up of construction and demolition debris on all floor surfaces and on all equipment being operated by VA.

E. Acceptance of Work for Government Operation: As new facilities are made available for operation and these facilities are of beneficial use to the Government, inspections will be made and tests will be performed. Based on the inspections, a list of contract deficiencies will be issued to the Contractor. After correction of deficiencies as necessary for beneficial use, the Contracting Officer will process necessary acceptance and the equipment will then be under the control and operation of Government personnel.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

A. Provide maximum standardization of components to reduce spare part requirements.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
   1. All components of an assembled unit need not be products of same manufacturer.
   2. Constituent parts that are alike shall be products of a single manufacturer.
   3. Components shall be compatible with each other and with the total assembly for intended service.
   4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment, which serve the same function, must be the same make and model. Exceptions will be permitted if performance requirements cannot be met.

2.2 COMPATIBILITY OF RELATED EQUIPMENT

Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational plant that conforms to contract requirements.

2.3 DRIVE GUARDS

A. For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulley, sheaves, shafts, gears and other moving parts regardless of height above the floor to prevent damage to equipment and injury to personnel. Drive guards may be excluded where motors and drives are inside factory fabricated air handling unit casings.

B. V-belt and sheave assemblies shall be totally enclosed, firmly mounted, non-resonant. Guard shall be an assembly of minimum 22-gage sheet steel and expanded or perforated metal to permit observation of belts. 25 mm (one-inch) diameter hole shall be provided at each shaft centerline to permit speed measurement.

C. Materials: Sheet steel, cast iron, expanded metal or wire mesh rigidly secured so as to be removable without disassembling pipe, duct, or electrical connections to equipment.

D. Access for Speed Measurement: 25 mm (One inch) diameter hole at each shaft center.

2.4 LIFTING ATTACHMENTS

Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.
2.5 ELECTRIC MOTORS
   A. All material and equipment furnished and installation methods shall conform to the requirements of Section 23 0512, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT and Section 26 0521, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide special energy efficient premium efficiency type motors as scheduled.

2.6 EQUIPMENT AND MATERIALS IDENTIFICATION
   A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and shown in the maintenance manuals. Identification for piping is specified in Section 09 91 00, PAINTING.
   B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 48 mm (3/16-inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 9100, PAINTING permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.
   C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 48 mm (3/16-inch) high riveted or bolted to the equipment.

2.7 GALVANIZED REPAIR COMPOUND
   Mil. Spec. DOD-P-21035B, paint form.

2.8 HVAC PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS
   A. Vibration Isolators: Refer to Section 23 0541, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
   B. Pipe Supports: Comply with MSS SP-58. Type Numbers specified refer to this standard. For selection and application comply with MSS SP-69. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting requirements.
   C. Attachment to Steel Building Construction:
      1. Welded attachment: MSS SP-58, Type 22.
      2. Beam clamps: MSS SP-58, Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23mm (7/8-inch) outside diameter.
   D. Attachment to existing structure: Support from existing floor/roof frame.
   E. Hanger Rods: Hot-rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 38 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
   F. Hangers Supporting Multiple Pipes (Trapeze Hangers): Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 mm by 41 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts. Not permitted for steam supply and condensate piping.
      1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
      2. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4-inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 13mm (1/2-inch) galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.
   G. Supports for Piping Systems:
      1. Select hangers sized to encircle insulation on insulated piping. Refer to Section 23 0711, HVAC, PLUMBING, AND BOILER PLANT INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or preinsulated calcium silicate shields. Provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.
2. Piping Systems except High and Medium Pressure Steam (MSS SP-58):
   a. Standard clevis hanger: Type 1; provide locknut.
   b. Riser clamps: Type 8.
   c. Wall brackets: Types 31, 32 or 33.
   d. Roller supports: Type 41, 43, 44 and 46.
   e. Saddle support: Type 36, 37 or 38.
   f. Turnbuckle: Types 13 or 15. Preinsulate.
   g. U-bolt clamp: Type 24.
   h. Copper Tube:
      1) Hangers, clamps and other support material in contact with tubing shall be
         painted with copper colored epoxy paint, plastic coated or taped with non
         adhesive isolation tape to prevent electrolysis.
      2) For vertical runs use epoxy painted or plastic coated riser clamps.
      3) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube
         or plastic inserted vibration isolation clamps.
      4) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper
         tube.
   i. Supports for plastic or glass piping: As recommended by the pipe manufacturer with
      black rubber tape extending one inch beyond steel support or clamp.

3. Convertor and Expansion Tank Hangers: May be Type 1 sized for the shell diameter.
   Insulation where required will cover the hangers.

H. Pre-insulated Calcium Silicate Shields:
   1. Provide 360 degree water resistant high density 965 kPa (140 psi) compressive strength
      calcium silicate shields encased in galvanized metal.
   2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.
   3. Shield thickness shall match the pipe insulation.
   4. The type of shield is selected by the temperature of the pipe, the load it must carry, and
      the type of support it will be used with.
      a. Shields for supporting chilled or cold water shall have insulation that extends a
         minimum of 1 inch past the sheet metal. Provide for an adequate vapor barrier in
         chilled lines.
      b. The pre-insulated calcium silicate shield shall support the maximum allowable water
         filled span as indicated in MSS-SP 69. To support the load, the shields may have one
         or more of the following features: structural inserts 4138 kPa (600 psi) compressive
         strength, an extra bottom metal shield, or formed structural steel (ASTM A36) wear
         plates welded to the bottom sheet metal jacket.
   5. Shields may be used on steel clevis hanger type supports, roller supports or flat surfaces.

2.9 PIPE PENETRATIONS
   A. Install sleeves during construction for other than blocked out floor openings for risers in
      mechanical bays.
   B. Sheet Metal, Plastic, or Moisture-resistant Fiber Sleeves: Provide for pipe passing through
      floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for
      below.
   C. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch
      greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large
      enough to accommodate the insulation. Interior openings shall be caulked tight with fire
      stopping material and sealant to prevent the spread of fire, smoke, and gases.
   D. Sealant and Adhesives: Shall be as specified in Section 07 9200, JOINT SEALANTS.

2.10 SPECIAL TOOLS AND LUBRICANTS
   A. Furnish, and turn over to the Resident Engineer, tools not readily available commercially, that
      are required for disassembly or adjustment of equipment and machinery furnished.
B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.

C. Refrigerant Tools: Provide system charging/Evacuation equipment, gauges, fittings, and tools required for maintenance of furnished equipment.

D. Lubricants: A minimum of 0.95 L (one quart) of oil, and 0.45 kg (one pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

2.11 ASBESTOS

Materials containing asbestos are not permitted.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

A. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Prepare equipment layout drawings to coordinate proper location and personnel access of all facilities. Submit the drawings for review as required by Part 1. Follow manufacturer's published recommendations for installation methods not otherwise specified.

B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.

C. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.

D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.

E. Cutting Holes:
   1. Locate holes to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by Resident Engineer. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to Resident Engineer for approval.
   2. Do not penetrate membrane waterproofing.

F. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but must be provided.

G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.

H. Electrical and Pneumatic Interconnection of Controls and Instruments: This generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.

I. Protection and Cleaning:
   1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the Resident Engineer. Damaged or defective items in the opinion of the Resident Engineer, shall be replaced.
   2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and
equipment against dirt, water chemical, or mechanical injury. At completion of all work
thoroughly clean fixtures, exposed materials and equipment.

J. Concrete and Grout: Use concrete and shrink compensating grout 25 MPa (3000 psi) minimum,
specified in Section 03 3053, CAST-IN-PLACE CONCRETE.

K. Install gages, thermometers, valves and other devices with due regard for ease in reading or
operating and maintaining said devices. Locate and position thermometers and gages to be
easily read by operator or staff standing on floor or walkway provided. Servicing shall not
require dismantling adjacent equipment or pipe work.

L. Install steam piping expansion joints as per manufacturer’s recommendations.

M. Work in Existing Building:
   1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article,
ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL
REQUIREMENTS for relocation of existing equipment, alterations and restoration of
existing building(s).
   2. As specified in Section 01 0000, GENERAL REQUIREMENTS, Article, OPERATIONS
AND STORAGE AREAS, make alterations to existing service piping at times that will least
interfere with normal operation of the facility.
   3. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to the
Resident Engineer for determination of proper design for openings through structural
sections and opening layouts approval, prior to cutting or drilling into structure. After
Resident Engineer's approval, carefully cut opening through construction no larger than
absolutely necessary for the required installation.

N. Switchgear/Electrical Equipment Drip Protection: Every effort shall be made to eliminate the
installation of pipe above electrical and telephone switchgear. If this is not possible, encase
pipe in a second pipe with a minimum of joints. Installation of piping, ductwork, leak protection
apparatus or other installations foreign to the electrical installation shall be located in the space
equal to the width and depth of the equipment and extending from to a height of 1.8 m (6 ft.)
above the equipment of to ceiling structure, whichever is lower (NFPA 70).

O. Inaccessible Equipment:
   1. Where the Government determines that the Contractor has installed equipment not
conveniently accessible for operation and maintenance, equipment shall be removed and
reinstalled or remedial action performed as directed at no additional cost to the
Government.
   2. The term "conveniently accessible" is defined as capable of being reached without the use
of ladders, or without climbing or crawling under or over obstacles such as motors, fans,
pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 TEMPORARY PIPING AND EQUIPMENT

A. Continuity of operation of existing facilities will generally require temporary installation or
relocation of equipment and piping.

B. The Contractor shall provide all required facilities in accordance with the requirements of
phased construction and maintenance of service. All piping and equipment shall be properly
supported, sloped to drain, operate without excessive stress, and shall be insulated where
injury can occur to personnel by contact with operating facilities. The requirements of
Paragraph 3.1 apply.

C. Temporary facilities and piping shall be completely removed and any openings in structures
sealed. Provide necessary blind flanges and caps to seal open piping remaining in service.

3.3 RIGGING

A. Design is based on application of available equipment. Openings in building structures are
planned to accommodate design scheme.
B. Alternative methods of equipment delivery may be offered by Contractor and will be considered by Government under specified restrictions of phasing and maintenance of service as well as structural integrity of the building.

C. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for Government operation and maintenance of service.

D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility. Upon request, the Government will check structure adequacy and advise Contractor of recommended restrictions.

E. Contractor shall check all clearances, weight limitations and shall offer a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.

F. Rigging plan and methods shall be referred to Resident Engineer for evaluation prior to actual work.

G. Restore building to original condition upon completion of rigging work.

3.4 PIPE AND EQUIPMENT SUPPORTS

A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the Resident Engineer.

B. Use of chain, wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above will not be permitted. Replace or thoroughly clean rusty products and paint with zinc primer.

C. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 15 mm (1/2-inch) clearance between pipe or piping covering and adjacent work.

D. HVAC Horizontal Pipe Support Spacing: Refer to MSS SP-69. Provide additional supports at valves, strainers, in-line pumps and other heavy components. Provide a support within one foot of each elbow.

E. HVAC Vertical Pipe Supports:
   1. Up to 150 mm (6-inch pipe), 9 m (30 feet) long, bolt riser clamps to the pipe below couplings, or welded to the pipe and rests supports securely on the building structure.
   2. Vertical pipe larger than the foregoing, support on base elbows or tees, or substantial pipe legs extending to the building structure.

F. Overhead Supports:
   1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
   2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
   3. Tubing and capillary systems shall be supported in channel troughs.

3.5 CLEANING AND PAINTING

A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment and systems shall be thoroughly cleaned and painted. Refer to Section 09 9100, PAINTING.

B. In addition, the following special conditions apply:
   1. Cleaning shall be thorough. Use solvents, cleaning materials and methods recommended by the manufacturers for the specific tasks. Remove all rust prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.
2. Material And Equipment Not To Be Painted Includes:
   a. Motors, controllers, control switches, and safety switches.
   b. Control and interlock devices.
   c. Lubrication devices and grease fittings.
   d. Copper, brass, aluminum, stainless steel and bronze surfaces.
   e. Pressure gauges and thermometers.
   f. Glass.
   g. Name plates.
3. Control and instrument panels shall be cleaned, damaged surfaces repaired, and shall be touched-up with matching paint obtained from panel manufacturer.
4. Paint shall withstand the following temperatures without peeling or discoloration:
   a. Condensate and feedwater -- 38 degrees C (100 degrees F) on insulation jacket surface and 120 degrees C (250 degrees F) on metal pipe surface.
   b. Steam -- 52 degrees C (125 degrees F) on insulation jacket surface and 190 degrees C (375 degrees F) on metal pipe surface.
5. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary to achieve this.

3.6 IDENTIFICATION SIGNS
   A. Provide laminated plastic signs, with engraved lettering not less than 5 mm (3/16-inch) high, designating functions, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.
   B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance.
   C. Pipe Identification: Refer to Section 09 9100, PAINTING.

3.7 MOTOR AND DRIVE ALIGNMENT
   A. Belt Drive: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane.
   B. Direct-connect Drive: Securely mount motor in accurate alignment so that shafts are free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

3.8 LUBRICATION
   A. Lubricate all devices requiring lubrication prior to initial operation. Field-check all devices for proper lubrication.
   B. Equip all devices with required lubrication fittings or devices. Provide a minimum of one liter (one quart) of oil and 0.5 kg (one pound) of grease of manufacturer's recommended grade and type for each different application; also provide 12 grease sticks for lubricated plug valves. Deliver all materials to Resident Engineer in unopened containers that are properly identified as to application.
   C. Provide a separate grease gun with attachments for applicable fittings for each type of grease applied.
   D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

3.9 STARTUP AND TEMPORARY OPERATION
   Start up equipment as described in equipment specifications. Verify that vibration is within specified tolerance prior to extended operation. Temporary use of equipment is specified in Section 01 0000, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.
3.10 OPERATING AND PERFORMANCE TESTS
   A. Prior to the final inspection, provide functional testing for all equipment installed. Functional testing shall include all modes of system operation for the equipment being tested. Provide reports and test records to the COTR.
   B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.
   C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

3.11 INSTRUCTIONS TO VA PERSONNEL
   Provide in accordance with Article, INSTRUCTIONS, of Section 01 0000, GENERAL REQUIREMENTS.

END OF SECTION
GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION:
This section specifies the furnishing, installation and connection of motors for HVAC and steam generation equipment.

1.2 SUBMITTALS:
A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA and SAMPLES, and Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. Shop Drawings:
1. Provide documentation to demonstrate compliance with drawings and specifications.
2. Include electrical ratings, efficiency, bearing data, power factor, frame size, dimensions, mounting details, materials, horsepower, voltage, phase, speed (RPM), enclosure, starting characteristics, torque characteristics, code letter, full load and locked rotor current, service factor, and lubrication method.

C. Manuals:
1. Submit simultaneously with the shop drawings, companion copies of complete installation, maintenance and operating manuals, including technical data sheets and application data.

D. Certification: Two weeks prior to final inspection, unless otherwise noted, submit four copies of the following certification to the Resident Engineer:
1. Certification that the motors have been applied, installed, adjusted, lubricated, and tested according to manufacturer published recommendations.

E. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

1.3 APPLICABLE PUBLICATIONS:
A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

PART 2 - PRODUCTS

2.1 MOTORS:
A. For alternating current, fractional and integral horsepower motors, NEMA Publications MG 1 and MG 2 shall apply.

B. All material and equipment furnished and installation methods shall conform to the requirements of Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS; and Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide premium efficiency type motors as scheduled. Unless otherwise specified for a particular application, use electric motors with the following requirements.

C. Single-phase Motors: Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC) type. Provide capacitor-start type for hard starting applications.
1. Contractor’s Option - Electrically Commutated motor (EC Type): Motor shall be brushless DC type specifically designed for applications with heavy duty ball bearings and electronic commutation. The motor shall be speed controllable down to 20% of full speed and 85% efficient at all speeds.

1. Two Speed Motors: Each two-speed motor shall have two separate windings. Provide a time- delay (20 seconds minimum) relay for switching from high to low speed.

E. Voltage ratings shall be as follows:
1. Single phase:
   a. Motors connected to 120-volt systems: 115 volts.
   b. Motors connected to 208-volt systems: 200 volts.
2. Three phase:
   a. Motors connected to 208-volt systems: 200 volts.

F. Number of phases shall be as follows:
1. Motors, less than 373 W (1/2 HP): Single phase.
2. Motors, 373 W (1/2 HP) and larger: 3 phase.
3. Exceptions:
   a. Hermetically sealed motors.
   b. Motors for equipment assemblies, less than 746 W (one HP), may be single phase
      provided the manufacturer of the proposed assemblies cannot supply the assemblies
      with three phase motors.

G. Motors shall be designed for operating the connected loads continuously in a 40°C (104°F)
environment, where the motors are installed, without exceeding the NEMA standard
temperature rises for the motor insulation. If the motors exceed 40°C (104°F), the motors shall
be rated for the actual ambient temperatures.

H. Motor designs, as indicated by the NEMA code letters, shall be coordinated with the connected
loads to assure adequate starting and running torque.

I. Motor Enclosures:
1. Shall be the NEMA types as specified and/or shown on the drawings.
2. Where the types of motor enclosures are not shown on the drawings, they shall be the
   NEMA types, which are most suitable for the environmental conditions where the motors
   are being installed.
3. Enclosures shall be primed and finish coated at the factory with manufacturer’s prime coat
   and standard finish.

J. Special Requirements:
1. Where motor power requirements of equipment furnished deviate from power shown on
   plans, provide electrical service designed under the requirements of NFPA 70 without
   additional time or cost to the Government.
2. Assemblies of motors, starters, controls and interlocks on factory assembled and wired
   devices shall be in accordance with the requirements of this specification.
3. Wire and cable materials specified in the electrical division of the specifications shall be
   modified as follows:
   a. Wiring material located where temperatures can exceed 71 degrees C (160 degrees
      F) shall be stranded copper with Teflon FEP insulation with jacket. This includes
      wiring on the boilers.
   b. Other wiring at boilers and to control panels shall be NFPA 70 designation THWN.
   c. Provide shielded conductors or wiring in separate conduits for all instrumentation and
      control systems where recommended by manufacturer of equipment.
4. Select motor sizes so that the motors do not operate into the service factor at maximum
   required loads on the driven equipment. Motors on pumps shall be sized for
   non-overloading at all points on the pump performance curves.
5. Motors utilized with variable frequency drives shall be rated “inverter-duty” per NEMA
   Standard, MG1, Part 31.4.4.2. Provide motor shaft grounding apparatus that will protect
   bearings from damage from stray currents.

K. Energy-Efficient Motors (Motor Efficiencies): All permanently wired polyphase motors of 746
Watts (1 HP) or more shall meet the minimum full-load efficiencies as indicated in the following
table. Motors of 746 Watts or more with open, drip-proof or totally enclosed fan-cooled
enclosures shall be NEMA premium efficiency type, unless otherwise indicated. Motors
provided as an integral part of motor driven equipment are excluded from this requirement if a
minimum seasonal or overall efficiency requirement is indicated for that equipment by the

<table>
<thead>
<tr>
<th>Rating (kW (HP))</th>
<th>1200 RPM</th>
<th>1800 RPM</th>
<th>3600 RPM</th>
<th>Rating (kW)</th>
<th>1200 RPM</th>
<th>1800 RPM</th>
<th>3600 RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.746 (1)</td>
<td>82.5%</td>
<td>85.5%</td>
<td>77.0%</td>
<td>0.746 (1)</td>
<td>82.5%</td>
<td>85.5%</td>
<td>77.0%</td>
</tr>
<tr>
<td>1.12 (1.5)</td>
<td>86.5%</td>
<td>86.5%</td>
<td>84.0%</td>
<td>1.12 (1.5)</td>
<td>87.5%</td>
<td>86.5%</td>
<td>84.0%</td>
</tr>
<tr>
<td>1.49 (2)</td>
<td>87.5%</td>
<td>86.5%</td>
<td>85.5%</td>
<td>1.49 (2)</td>
<td>88.5%</td>
<td>86.5%</td>
<td>85.5%</td>
</tr>
<tr>
<td>2.24 (3)</td>
<td>88.5%</td>
<td>89.5%</td>
<td>85.5%</td>
<td>2.24 (3)</td>
<td>89.5%</td>
<td>89.5%</td>
<td>86.5%</td>
</tr>
<tr>
<td>3.73 (5)</td>
<td>89.5%</td>
<td>89.5%</td>
<td>86.5%</td>
<td>3.73 (5)</td>
<td>89.5%</td>
<td>89.5%</td>
<td>88.5%</td>
</tr>
</tbody>
</table>

L. Minimum Power Factor at Full Load and Rated Voltage: 90 percent at 1200 RPM, 1800 RPM and 3600 RPM.

PART 3 - EXECUTION

3.1 INSTALLATION:
   A. Install motors in accordance with manufacturer’s recommendations, the NEC, NEMA, as shown on the drawings and/or as required by other sections of these specifications.

3.2 FIELD TESTS
   A. Perform an electric insulation resistance Test using a megohmmeter on all motors after installation, before start-up. All shall test free from grounds.
   B. Perform Load test in accordance with ANSI/IEEE 112, Test Method B, to determine freedom from electrical or mechanical defects and compliance with performance data.
   C. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.
   D. All test data shall be complied into a report form for each motor and provided to the contracting officer or their representative.

3.3 STARTUP AND TESTING
   A. The Commissioning Agent will observe startup and contractor testing of all equipment. Coordinate the startup and contractor testing schedules with Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.

3.4 DEMONSTRATION AND TRAINING
   A. Provide services of manufacturer’s technical representative for two hours to instruct VA personnel in operation and maintenance of units.

- - - E N D - - -
NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION
A. Noise criteria and seismic restraints for equipment for HVAC and plumbing work.

1.2 QUALITY ASSURANCE
A. Refer to article, QUALITY ASSURANCE in specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
B. Noise Criteria:
1. Noise levels in all 8 octave bands due to equipment and duct systems shall not exceed following NC levels:

<table>
<thead>
<tr>
<th>TYPE OF ROOM</th>
<th>NC LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shops</td>
<td>50</td>
</tr>
</tbody>
</table>

2. For equipment which has no sound power ratings scheduled on the plans, the contractor shall select equipment such that the fore-going noise criteria, local ordinance noise levels, and OSHA re-quirements are not exceeded. Selection procedure shall be in accordance with ASHRAE Fundamentals Handbook, Chapter 7, Sound and Vibration.

3. An allowance, not to exceed 5db, may be added to the measured value to compensate for the variation of the room attenuating effect between room test condition prior to occupancy and design condition after occupancy which may include the addition of sound absorbing material, such as, furniture. This allowance may not be taken after occupancy. The room attenuating effect is defined as the difference between sound power level emitted to room and sound pressure level in room.

4. In absence of specified measurement requirements, measure equipment noise levels three feet from equipment and at an elevation of maxi-mum noise generation.

C. Seismic Restraint Requirements:
1. Equipment:
   a. All mechanical equipment not supported with isolators external to the unit shall be securely anchored to the structure. Such mechanical equipment shall be properly supported to resist a horizontal force of 50 percent of the weight of the equipment furnished.
      1) All mechanical equipment mounted on vibration isolators shall be provided with seismic restraints capable of resisting a horizontal force of 50 percent of the weight of the equipment furnished.
   b. Piping: Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.

1.3 SUBMITTALS
A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
B. Manufacturer's Literature and Data:
   1. Vibration isolators:
      a. Floor mountings
      b. Hangers
      c. Snubbers
   2. Seismic Requirements: Submittals are required for all equipment anchors, supports and seismic restraints. Submittals shall include weights, dimensions, standard connections, and manufacturer's certification that all specified equipment will withstand seismic Lateral Force requirements as shown on drawings.

1.4 APPLICABLE PUBLICATIONS
A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
B. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
   1. Fundamentals Handbook, Chapter 7, Sound and Vibration
         1) A123/A123M-09 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
            (a) A307-07b Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
      2) Manufacturers Standardization (MSS):
         (a) SP-58-2009 Pipe Hangers and Supports-Materials, Design and Manufacture
      3) Occupational Safety and Health Administration (OSHA):
         (a) 29 CFR 1910.95 Occupational Noise Exposure
      4) American Society of Civil Engineers (ASCE):
         (a) ASCE 7-10 Minimum Design Loads for Buildings and Other Structures.
      5) American National Standards Institute / Sheet Metal and Air Conditioning Contractor's National Association (ANSI/SMACNA):
      6) International Code Council (ICC):
         (a) 2009 IBC International Building Code.
      7) Department of Veterans Affairs (VA):
         (a) H-18-8 2010 Seismic Design Requirements.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS
A. Type of isolator, base, and minimum static deflection shall be as required for each specific equipment application as recommended by isolator or equipment manufacturer but subject to minimum requirements indicated herein and in the schedule on the drawings.
B. Elastometric Isolators shall comply with ASTM D2240 and be oil resistant neoprene with a maximum stiffness of 60 durometer and have a straight-line deflection curve.
C. Exposure to weather: Isolator housings to be either hot dipped galvanized or powder coated to ASTM B117 salt spray testing standards. Springs to be powder coated or electro galvanized. All hardware to be electro galvanized. In addition provide limit stops to resist wind velocity. Velocity pressure established by wind shall be calculated in accordance with section 1609 of the International Building Code. A minimum wind velocity of 75 mph shall be employed.
D. Uniform Loading: Select and locate isolators to produce uniform loading and deflection even when equipment weight is not evenly distributed.
E. Color code isolators by type and size for easy identification of capacity.

2.2 SEISMIC RESTRAINT REQUIREMENTS FOR EQUIPMENT
A. Bolt pad mounted equipment, without vibration isolators, to the floor or other support using ASTM A307 standard bolting material.
B. Floor mounted equipment, with vibration Isolators: Type SS. Where Type N isolators are used provide channel frame base horizontal restraints bolted to the floor, or other support, on all sides of the equipment. Size and material required for the base shall be as recommended by the isolator manufacturer.
C. On all sides of suspended equipment, provide bracing for rigid supports and provide restraints for resiliently supported equipment.
2.3 VIBRATION ISOLATORS

A. Floor Mountings:
   1. Seismic Pad (Type DS): Pads shall be natural rubber / neoprene waffle with steel top plate and drilled for an anchor bolt. Washers and bushings shall be reinforced duck and neoprene. Size pads for a maximum load of 345 kPa (50 pounds per square inch).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Vibration Isolation:
   1. No metal-to-metal contact will be permitted between fixed and floating parts.
   2. Connections to Equipment: Allow for deflections equal to or greater than equipment deflections. Electrical, drain, piping connections, and other items made to rotating or reciprocating equipment (pumps, compressors, etc.) which rests on vibration isolators, shall be isolated from building structure for first three hangers or supports with a deflection equal to that used on the corresponding equipment.
   3. Common Foundation: Mount each electric motor on same foundation as driven machine. Hold driving motor and driven machine in positive rigid alignment with provision for adjusting motor alignment and belt tension. Bases shall be level throughout length and width. Provide shims to facilitate pipe connections, leveling, and bolting.
   4. Provide heat shields where elastomers are subject to temperatures over 38 degrees C (100 degrees F).
   5. Extend bases for pipe elbow supports at discharge and suction connections at pumps. Pipe elbow supports shall not short circuit pump vibration to structure.
   6. Non-rotating equipment such as heat exchangers and convertors shall be mounted on isolation units having the same static deflection as the isolation hangers or support of the pipe connected to the equipment.

B. Inspection and Adjustments: Check for vibration and noise transmission through connections, piping, ductwork, foundations, and walls. Adjust, repair, or replace isolators as required to reduce vibration and noise transmissions to specified levels.

3.2 ADJUSTING

A. Adjust vibration isolators after piping systems are filled and equipment is at operating weight.
B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4inch (6-mm) movement during start and stop.
D. Adjust active height of spring isolators.
E. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.
F. Torque anchor bolts according to equipment manufacturer’s recommendations to resist seismic forces.

3.3 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.
HVAC AND BOILER PLANT INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Field applied insulation for thermal efficiency and condensation control for
   1. HVAC piping and equipment.

B. Definitions
   1. ASJ: All service jacket, white finish facing or jacket.
   2. Air conditioned space: Space having air temperature and/or humidity controlled by
      mechanical equipment.
   3. Cold: Equipment, ductwork or piping handling media at design temperature of 16 degrees
      C (60 degrees F) or below.100 - 121 Degrees C (200-500 Degrees F)(HPR, MPR, LPS,
      Vent piping from PRV Safety Valves, Condensate receivers, and flash tanks)100 - 121
      Degrees C(200-500 Degrees F)(HPR, MPR, LPS, Vent piping from PRV Safety Valves,
      Condensate receivers, and flash tanks)
   4. Concealed: Ductwork and piping above ceilings and in chases, and pipe spaces.
   5. Exposed: Piping, ductwork, and equipment exposed to view in finished areas including
      mechanical, and electrical equipment rooms or exposed to outdoor weather. Attics and
      crawl spaces where air handling units are located are considered to be mechanical
      rooms. Shafts, chases, unfinished attics, crawl spaces and pipe basements are not
      considered finished areas.
   6. FSK: Foil-scrim-kraft facing.
   7. Hot: HVAC Ductwork handling air at design temperature above 16 degrees C (60 degrees
      F);HVAC equipment or piping handling media above 41 degrees C (105 degrees F).
   8. Density: kg/m3 - kilograms per cubic meter (Pcf - pounds per cubic foot).
      a. Flat surface: Watt per square meter (BTU per hour per square foot).
      b. Pipe or Cylinder: Watt per square meter (BTU per hour per linear foot).
   10. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour,
        per square foot, per degree F temperature difference).
   11. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of
       water vapor. Performance of the vapor retarder is rated in terms of permeance (perms).
       For the purpose of this specification, vapor retarders shall have a maximum published
       permeance of 0.1 perms and vapor barriers shall have a maximum published permeance
       of 0.001 perms.
   12. RS: Refrigerant suction.
   13. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

1.2 QUALITY ASSURANCE

A. Refer to article QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS
   FOR HVAC.

B. Criteria:
   1. Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through 4.3.3.6, 4.3.10.2.6, and
      5.4.6.4, parts of which are quoted as follows:
      4.3.3.1 Pipe insulation and coverings, duct coverings, duct linings, vapor retarder
         facings, adhesives, fasteners, tapes, and supplementary materials added to air ducts,
         plenums, panels, and duct silencers used in duct systems, unless otherwise provided
         for in 4.3.3.1.1 or 4.3.3.1.2., shall have, in the form in which they are used, a
         maximum flame spread index of 25 without evidence of continued progressive
         combustion and a maximum smoke developed index of 50 when tested in
         accordance with NFPA 255, Standard Method of Test of Surface Burning
         Characteristics of Building Materials.
      4.3.3.1.1 Where these products are to be applied with adhesives, they shall be tested
         with such adhesives applied, or the adhesives used shall have a maximum flame
spread index of 25 and a maximum smoke developed index of 50 when in the final dry state. (See 4.2.4.2)

4.3.3.1.2 The flame spread and smoke developed index requirements of 4.3.3.1 shall not apply to air duct weatherproof coverings where they are located entirely outside of a building, do not penetrate a wall or roof, and do not create an exposure hazard.

4.3.3.2 Closure systems for use with rigid and flexible air ducts tested in accordance with UL 181, Standard for Safety Factory-Made Air Ducts and Air Connectors, shall have been tested, listed, and used in accordance with the conditions of their listings, in accordance with one of the following:

UL 181A, Standard for Safety Closure Systems for Use with Rigid Air Ducts and Air Connectors
UL 181B, Standard for Safety Closure Systems for Use with Flexible Air Ducts and Air Connectors

4.3.3.3 Air duct, panel, and plenum coverings and linings, and pipe insulation and coverings shall not flame, glow, smolder, or smoke when tested in accordance with a similar test for pipe covering, ASTM C 411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation, at the temperature to which they are exposed in service.

4.3.3.3.1 In no case shall the test temperature be below 121°C (250°F).

4.3.3.4 Air duct coverings shall not extend through walls or floors that are required to be fire stopped or required to have a fire resistance rating, unless such coverings meet the requirements of 5.4.6.4.

4.3.3.5* Air duct linings shall be interrupted at fire dampers to prevent interference with the operation of devices.

4.3.3.6 Air duct coverings shall not be installed so as to conceal or prevent the use of any service opening.

4.3.10.2.6 Materials exposed to the airflow shall be noncombustible or limited combustible and have a maximum smoke developed index of 50 or comply with the following.

4.3.10.2.6.1 Electrical wires and cables and optical fiber cables shall be listed as noncombustible or limited combustible and have a maximum smoke developed index of 50 or shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

4.3.10.2.6.4 Optical-fiber and communication raceways shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 2024, Standard for Safety Optical-Fiber Cable Raceway.

4.3.10.2.6.6 Supplementary materials for air distribution systems shall be permitted when complying with the provisions of 4.3.3.

5.4.6.4 Where air ducts pass through walls, floors, or partitions that are required to have a fire resistance rating and where fire dampers are not required, the opening in the construction around the air duct shall be as follows:

1. Not exceeding a 25.4 mm (1 in.) average clearance on all sides
2. Filled solid with an approved material capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste when subjected to the time-temperature fire conditions required for fire barrier penetration as specified in NFPA 251, Standard Methods of Tests of Fire Endurance of Building Construction and Materials

2. Test methods: ASTM E84, UL 723, or NFPA 255.
3. Specified k factors are at 24 degrees C (75 degrees F) mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.

4. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

C. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

1.3 SUBMITTALS
A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

1.4 STORAGE AND HANDLING OF MATERIAL
Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

1.5 APPLICABLE PUBLICATIONS
A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

B. Military Specifications (Mil. Spec.):
   MIL-A-3316C (2)-90 Adhesives, Fire-Resistant, Thermal Insulation
   MIL-C-19565C (1)-88 Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier

C. National Fire Protection Association (NFPA):
   90A-09 Standard for the Installation of Air Conditioning and Ventilating Systems
   251-06 Standard methods of Tests of Fire Endurance of Building Construction Materials
   255-06 Standard Method of tests of Surface Burning Characteristics of Building Materials
   262 Standard method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces

PART 2 - PRODUCTS
2.1 FLEXIBLE ELASTOMERIC CELLULAR THERMAL
   ASTM C177, C518, k = 0.039 (0.27) at 24 degrees C (75 degrees F), flame spread not over 25, smoke developed not over 50, for temperatures from minus 4 degrees C (40 degrees F) to 93 degrees C (200 degrees F). No jacket required.

2.2 INSULATION FACINGS AND JACKETS
A. Pipe fitting insulation covering (jackets) for piping exposed inside buildings: Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) conforming to Fed Spec L-P-335, composition A, Type II Grade GU, and Type III, minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape.

B. Aluminum Jacket-Piping systems: ASTM B209, 3003 alloy, H-14 temper, 0.6 mm (0.023 inch) minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated to match shape of fitting and of 0.6 mm (0.024) inch minimum thickness aluminum. Fittings shall be of same construction as straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands shall be installed on all circumferential joints. Bands shall be 13 mm (0.5 inch) wide on 450 mm (18 inch) centers. System shall be weatherproof if utilized for outside service.
2.3 PIPE COVERING PROTECTION SADDLES
   A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass or high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m³ (3.0 pcf).

   **Nominal Pipe Size and Accessories Material (Insert Blocks)**

<table>
<thead>
<tr>
<th>Nominal Pipe Size mm (inches)</th>
<th>Insert Blocks mm (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up through 125 (5)</td>
<td>150 (6) long</td>
</tr>
<tr>
<td>150 (6)</td>
<td>150 (6) long</td>
</tr>
<tr>
<td>200 (8), 250 (10), 300 (12)</td>
<td>225 (9) long</td>
</tr>
<tr>
<td>350 (14), 400 (16)</td>
<td>300 (12) long</td>
</tr>
<tr>
<td>450 through 600 (18 through 24)</td>
<td>350 (14) long</td>
</tr>
</tbody>
</table>

   B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high density Polyisocyanurate (for temperatures up to 149 degrees C [300 degrees F]), cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m³ (3.0 pcf).

2.4 ADHESIVE, MASTIC, CEMENT
   C. Mil. Spec. MIL-A-24179, Type II Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.
   D. Mil. Spec. MIL-C-19565, Type I: Protective finish for outdoor use.
   E. Mil. Spec. MIL-C-19565, Type I or Type II: Vapor barrier compound for indoor use.
   F. ASTM C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement.
   G. Other: Insulation manufacturers' published recommendations.

2.5 REINFORCEMENT AND FINISHES
   A. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.
   B. PVC fitting cover: Fed. Spec L-P-535, Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 4 degrees C (40 degrees F) to 121 degrees C (250 degrees F). Below 4 degrees C (40 degrees F) and above 121 degrees C (250 degrees F). Provide double layer insert. Provide color matching vapor barrier pressure sensitive tape.

2.6 FLAME AND SMOKE
   Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM, NFPA and UL standards and specifications. See paragraph 1.2 "Quality Assurance".

PART 3 - EXECUTION
3.1 GENERAL REQUIREMENTS
   A. Required pressure tests of duct and piping joints and connections shall be completed and the work approved by the Resident Engineer for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.
B. Except for specific exceptions, insulate entire specified equipment, piping (pipe, fittings, valves, accessories). Insulate each pipe and duct individually. Do not use scrap pieces of insulation where a full length section will fit.

C. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16 degrees C (60 degrees F) and below. Lap and seal vapor retarder over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).

D. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.

E. Protect all insulation outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.

F. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.

G. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow/fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/fitting. Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.

H. Firestop Pipe and Duct insulation:
   1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed.
   2. Pipe and duct penetrations requiring fire stop insulation including, but not limited to the following:
      a. Pipe risers through floors
      b. Pipe or duct chase walls and floors
      c. Smoke partitions
      d. Fire partitions

I. Provide vapor barrier jackets over insulation as follows:
   1. All piping exposed to outdoor weather.
   2. All interior refrigerant piping.

J. Provide metal jackets over insulation as follows:
   1. All piping exposed to outdoor weather.

K. A 50 mm (2 inch) overlap is required at longitudinal and circumferential joints.

3.2 INSULATION INSTALLATION

A. Flexible Elastomeric Cellular Thermal Insulation:
   1. Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions and finish with two coats of weather resistant finish as recommended by the insulation manufacturer.
   2. Pipe and tubing insulation:
      a. Use proper size material. Do not stretch or strain insulation.
      b. To avoid undue compression of insulation, provide cork stoppers or wood inserts at supports as recommended by the insulation manufacturer. Insulation shields are specified under Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
      c. Where possible, slip insulation over the pipe or tubing prior to connection, and seal the butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and apply it to the pipe sealing the seam and joints with contact adhesive. Optional tape sealing, as recommended by the manufacturer, may be employed.
Make changes from mineral fiber insulation in a straight run of pipe, not at a fitting.
Seal joint with tape.
3. Apply sheet insulation to flat or large curved surfaces with 100 percent adhesive coverage. For fittings and large pipe, apply adhesive to seams only.

3.3 PIPE INSULATION SCHEDULE

A. Provide insulation for piping systems as scheduled below:
1. Refrigerant piping systems (gas & liquid lines, unless specifically prohibited by equipment manufacturer) - 1" flexible elastomeric.

--- END ---
SECTION 23 2300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Field installed refrigerant piping for direct expansion HVAC systems.

B. Refrigerant piping shall be sized, selected, and designed either by the equipment manufacturer or in strict accordance with the manufacturer's published instructions. The schematic piping diagram shall show all accessories such as, stop valves, level indicators, liquid receivers, oil separator, gauges, thermostatic expansion valves, solenoid valves, moisture separators and driers to make a complete installation.

C. Definitions:

1. Refrigerating system: Combination of interconnected refrigerant-containing parts constituting one closed refrigeration circuit in which a refrigerant is circulated for the purpose of extracting heat.
   a. Low side means the parts of a refrigerating system subjected to evaporator pressure.
   b. High side means the parts of a refrigerating system subjected to condenser pressure.

2. Brazed joint: A gas-tight joint obtained by the joining of metal parts with alloys which melt at temperatures higher than 449 degrees C (840 degrees F) but less than the melting temperatures of the joined parts.

1.2 QUALITY ASSURANCE

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.

B. Comply with ASHRAE Standard 15, Safety Code for Mechanical Refrigeration. The application of this Code is intended to assure the safe design, construction, installation, operation, and inspection of every refrigerating system employing a fluid which normally is vaporized and liquefied in its refrigerating cycle.

C. Comply with ASME B31.5: Refrigerant Piping and Heat Transfer Components.

D. Products shall comply with UL 207 "Refrigerant—Containing Components and Accessories, "Nonelectrical"; or UL 429 "Electrical Operated Valves."

1.3 SUBMITTALS

A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Certification: Copies of certificates for welding procedure, performance qualification record and list of welders' names and symbols.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Welding Society, Inc. (AWS):

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

A. Refrigerant Piping: For piping up to 100 mm (4 inch) use Copper refrigerant tube, ASTM B280, cleaned, dehydrated and sealed, marked ACR on hard temper straight lengths. Coils shall be tagged ASTM B280 by the manufacturer. For piping over 100 mm (4 inch) use A53 Black SML steel.

B. Water and Drain Piping: Copper water tube, ASTM B88M, Type B or C (ASTM B88, Type M or L).

C. Fittings, Valves and Accessories:

SECTION 23 2300 - REFRIGERANT PIPING

2. Brazed Joints, refrigerant tubing: Cadmium free, AWS A5.8/A5.8M, 45 percent silver brazing alloy, Class BAg-5.
2. Steel fittings: ASTM wrought steel fittings.
4. Refrigeration Valves:
   a. Stop Valves: Brass or bronze alloy, packless, or packed type with gas tight cap, frost proof, back seating.
5. Flexible Metal Hose: Seamless bronze corrugated hose, covered with bronze wire braid, with standard copper tube ends. Provide in suction and discharge piping of each compressor.

2.2 GAGES
   A. Temperature Gages: Comply with ASME B40.200. Industrial-duty type and in required temperature range for service in which installed. Gages shall have Celsius scale in 1-degree (Fahrenheit scale in 2-degree) graduations and with black number on a white face. The pointer shall be adjustable. Rigid stem temperature gages shall be provided in thermal wells located within 1525 mm (5 feet) of the finished floor. Universal adjustable angle type or remote element type temperature gages shall be provided in thermal wells located 1525 to 2135 mm (5 to 7 feet) above the finished floor. Remote element type temperature gages shall be provided in thermal wells located 2135 mm (7 feet) above the finished floor.
   B. Vacuum and Pressure Gages: Comply with ASME B40.100 and provide with throttling type needle valve or a pulsation dampener and shut-off valve. Gage shall be a minimum of 90 mm (3-1/2 inches) in diameter with a range from 0 kPa (0 psig) to approximately 1.5 times the maximum system working pressure. Each gage range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.
      1. Suction: 101 kPa (30 inches Hg) vacuum to 1723 kPa (gage) (250 psig).
      2. Discharge: 0 to 3445 kPa (gage) (0 to 500 psig).

2.3 THERMOMETERS AND WELLS
   A. Refer to specification Section 23 21 13, HYDRONIC PIPING.

2.4 PIPE SUPPORTS
   A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.

2.5 REFRIGERANTS AND OIL
   A. Provide EPA approved refrigerant and oil for proper system operation.

2.6 PIPE/CONDUIT ROOF PENETRATION COVER
   A. Penetration Cover: Galvanized sheet metal with flanged removable top. Provide 38 mm (1-1/2 inch) thick mineral fiber board insulation.
   B. Flashing Sleeves: Provide sheet metal sleeves for conduit and pipe penetrations of the penetration cover. Seal watertight penetrations.

2.7 PIPE INSULATION FOR DX HVAC SYSTEMS
   A. Refer to specification Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Install refrigerant piping and refrigerant containing parts in accordance with ASHRAE Standard 15 and ASME B31.5
      1. Install piping as short as possible, with a minimum number of joints, elbow and fittings.
2. Install piping with adequate clearance between pipe and adjacent walls and hangers to allow for service and inspection. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping or other surface. Use pipe sleeves through walls, floors, and ceilings, sized to permit installation of pipes with full thickness insulation.

3. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing.

4. Use copper tubing in protective conduit when installed below ground.

5. Install hangers and supports per ASME B31.5 and the refrigerant piping manufacturer’s recommendations.

B. Joint Construction:
1. Brazed Joints: Comply with AWS "Brazing Handbook" and with filler materials complying with AWS A5.8/A5.8M.
   a. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper tubing.
   b. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
   c. Swab fittings and valves with manufacturer’s recommended cleaning fluid to remove oil and other compounds prior to installation.
   d. Pass nitrogen gas through the pipe or tubing to prevent oxidation as each joint is brazed. Cap the system with a reusable plug after each brazing operation to retain the nitrogen and prevent entrance of air and moisture.

C. Protect refrigerant system during construction against entrance of foreign matter, dirt and moisture; have open ends of piping and connections to compressors, condensers, evaporators and other equipment tightly capped until assembly.

D. Pipe relief valve discharge to outdoors for systems containing more than 45 kg (100 lbs) of refrigerant.

E. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 0711, HVAC AND BOILER PLANT INSULATION.

F. Seismic Bracing: Refer to specification Section 13 0541, SEISMIC RESTRAINTS REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS, for bracing of piping & equipment in seismic areas.

3.2 PIPE AND TUBING INSULATION
A. Refer to Section 23 0711, HVAC AND BOILER PLANT INSULATION.

3.3 SIGNS AND IDENTIFICATION
A. Each refrigerating system erected on the premises shall be provided with an easily legible permanent sign securely attached and easily accessible, indicating thereon the name and address of the installer, the kind and total number of pounds of refrigerant required in the system for normal operations, and the field test pressure applied.

3.4 FIELD QUALITY CONTROL
Prior to initial operation examine and inspect piping system for conformance to plans and specifications and ASME B31.5. Correct equipment, material, or work rejected because of defects or nonconformance with plans and specifications, and ANSI codes for pressure piping.

A. After completion of piping installation and prior to initial operation, conduct test on piping system according to ASME B31.5. Furnish materials and equipment required for tests. Perform tests in the presence of Resident Engineer. If the test fails, correct defects and perform the test again until it is satisfactorily done and all joints are proved tight.
1. Every refrigerant-containing parts of the system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gages, control
mechanisms and systems that are factory tested, shall be tested and proved tight after complete installation, and before operation.

2. The high and low side of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high or low side of the system, respectively, except systems erected on the premises using non-toxic and non-flammable Group A1 refrigerants with copper tubing not exceeding DN 18 (NPS 5/8). This may be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 20 degrees C (68 degrees F) minimum.

B. Test Medium: A suitable dry gas such as nitrogen or shall be used for pressure testing. The means used to build up test pressure shall have either a pressure-limiting device or pressure-reducing device with a pressure-relief device and a gage on the outlet side. The pressure relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system components.

3.5 SYSTEM TEST AND CHARGING

A. System Test and Charging: As recommended by the equipment manufacturer or as follows:

1. Connect a drum of refrigerant to charging connection and introduce enough refrigerant into system to raise the pressure to 70 kPa (10 psi) gage. Close valves and disconnect refrigerant drum. Test system for leaks with halide test torch or other approved method suitable for the test gas used. Repair all leaking joints and retest.

2. Connect a drum of dry nitrogen to charging valve and bring test pressure to design pressure for low side and for high side. Test entire system again for leaks.

3. Evacuate the entire refrigerant system by the triplicate evacuation method with a vacuum pump equipped with an electronic gage reading in mPa (microns). Pull the system down to 665 mPa (500 microns) 665 mPa (2245.6 inches of mercury at 60 degrees F) and hold for four hours then break the vacuum with dry nitrogen (or refrigerant). Repeat the evacuation two more times breaking the third vacuum with the refrigeration to be charged and charge with the proper volume of refrigerant.

--- END ---
PART 1 - GENERAL

1.1 DESCRIPTION
A. This section specifies split-systems.
B. Definitions:
   1. Energy Efficiency Ratio (EER): The ratio of net cooling capacity is Btu/h to total rate of electricity input in watts under designated operating conditions (Btu hour/Watt).
   2. Seasonal Energy Efficiency Ratio (EER): The ratio of the total cooling output of an air conditioner during its normal annual usage period for cooling in Btu/h divided by total electric energy input in watts during the same period (Btu hour/Watt).
   3. Unitary: A Unitary Air Conditioner consists of one or more factory-made assemblies which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function as well.
   4. Where such equipment is provided in more than one assembly the separated assemblies are to be designed to be used together and the requirements of rating are based upon use of matched assemblies.

1.2 QUALITY ASSURANCE
A. Refer to specification Section 23 0511, COMMON WORK RESULTS FOR HVAC.

1.3 SUBMITTALS
A. Submit in accordance with specification Section 01 3323, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES
B. Manufacturer’s literature and data:
   1. Sufficient information, including capacities, pressure drops and piping connections clearly presented, shall be included to determine compliance with drawings and specifications for units noted below:
      a. Unitary air conditioners:
         1) Self-contained units
         2) Split systems
         3) Rooftop units
      b. Window air conditioners
      c. Through-the-wall packaged terminal air conditioning units
      d. Gas-Fired Furnaces
   2. Unit Dimensions required clearances, operating weights accessories and start-up instructions.
   3. Electrical requirements, wiring diagrams, interlocking and control wiring showing factory installed and portions to be field installed.
   4. Mounting and flashing of the roof curb to the roofing structure with coordinating requirements for the roof membrane system.
C. Certification: Submit proof of specified ARI Certification.
D. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required sensible-to-heat-ratio, energy efficiency ratio (EER), and coefficient of performance (COP).
E. Operating and Maintenance Manual: Submit three copies of Operating and Maintenance manual to Resident Engineer three weeks prior to final inspection.

1.4 APPLICABLE PUBLICATIONS
A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
PART 2 - PRODUCTS

2.1 UNITARY AIR CONDITIONERS - GENERAL

A. APPLICABLE ARI STANDARDS:
   1. Cooling Capacity 39.6 kW (135,000 Btu/h) and More: AHRI 340/ 360.
   2. Cooling Capacity Less Than 39.6 kW (135,000 Btu/h): AHRI 210/240. Units shall be listed
      in the ARI Directory of Certified Unitary Air-Conditioners.

B. Performance Rating: Cooling capacity of units shall meet the sensible heat and total heat
   requirements shown in the contract documents. In selecting unit size, make true allowance for
   “sensible to total heat ratio” to satisfy required sensible cooling capacity.

C. Machinery Guards: Provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys,
   sheaves, shafts, gears and other moving parts regardless of height above the floor. Drive
   guards may be excluded where motors and drives are inside factory fabricated casings.

D. Corrosion Prevention: Unless specified otherwise, equipment fabricated from ferrous metals
   that do not have a zinc coating or a duplex coating of zinc and paint shall be treated for
   prevention of rust with a factory coating or paint system that will withstand 125 hours in a
   salt-spray fog test, except that equipment located outdoors shall be tested for 500 hours. The
   salt-spray fog test shall be in accordance with ASTM B117 using a 20 percent sodium chloride
   solution. Immediately after completion of the test, the coating shall show no signs of blistering,
   wrinkling or cracking, no loss of adhesion, and the specimen shall show no signs of rust
   beyond 3 mm (1/8-inch) on both sides from the scratch mark.

2.2 SPLIT-SYSTEM AIR CONDITIONERS

A. Description: Factory assembled and tested, wall-mounted unit, with an air-cooled remote
   condensing unit, and field-installed refrigeration piping.

B. Wall-Mounting, Evaporator-Fan Components:
   1. Cabinet: Enameled steel with removable panels on front and ends in color selected by
      Architect, and discharge drain pans with drain connection.
   2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with
   4. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with
      AHRI 210/240, and with thermal-expansion valve.
   5. Electric-Resistance Heating Coil: Helical, nickel-chrome, resistance-wire heating
      elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in
      magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time
      fuses in terminal box for overcurrent protection.
   7. Fan Motors: Comply with requirements in Section 23 0512, GENERAL MOTOR
      REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT for multi-tapped,
      multi-speed motors with internal thermal protection and permanent lubrication.
   8. Filters: Disposable, with MERV rating of 7 or higher according to ASHRAE 52.2.

C. Air-Cooled, Compressor-Condenser Components:
   1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable
      panels for access to controls, weep holes for water drainage, and mounting holes in base.
      Service valves, fittings, and gage ports shall be brass and located outside of the casing.
   2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration
      isolation. Compressor motor shall have thermal- and current-sensitive overload devices,
      start capacitor, relay, and contactor.
   3. Compressor motor with manual-reset, high-pressure switch and automatic-reset,
      low-pressure switch.
   4. Refrigerant: R-410A unless otherwise indicated.
5. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with liquid subcooler.
6. Fan: Aluminum, propeller type, directly connected to motor.
7. Motor: Permanently lubricated, with integral thermal-overload protection.
8. Low Ambient Kit: Permit operation down to minus 18 deg C (0 deg F).

PART 3 EXECUTION

3.1 INSTALLATION
A. Install refrigerant piping per Section 23 2300, REFRIGERANT PIPING.
B. Install seismic restraints according to manufacturer's written instructions.
C. Install units level and plumb maintaining manufacturer's recommended clearances and tolerances.
D. Install water-cooled units with thermometer and pressure gage at the water supply and return connection.
E. Install vibration spring isolators under base of self contained unit, with minimum static deflection of 25 mm (1 inch) unless otherwise indicated. Refer to Section 23 0541, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.
F. Install ground-mounting, compressor-condenser components on 100 mm (4-inch) thick, reinforced concrete base; 100 mm (4 inches) larger on each side than unit. Concrete, reinforcement, and formwork are specified in Section 03 3000, CAST-IN-PLACE CONCRETE. Coordinate anchor installation with concrete base.
G. Install ground-mounting, compressor-condenser components on polyethylene mounting base.
H. Install roof-mounting compressor-condenser components on equipment supports specified in Section 07 7200, ROOF ACCESSORIES. Anchor units to supports with removable, cadmium-plated fasteners.
I. Install seismic restraints.
J. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 25 mm (1 inch) unless otherwise indicated. Refer to Section 23 0541, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.
K. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
L. Install wall sleeves in finished wall assembly and weatherproof. Install and anchor wall sleeves to withstand, without damage seismic forces as required by code.

3.2 CONNECTIONS
A. Verify condensate drainage requirements.
B. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.
C. Install piping adjacent to units to allow service and maintenance.
D. Install normal-weight, 20.7-MPa (3000-psi), compressive strength (28-day) concrete mix inside roof curb, 100 mm (4 inches) thick.
E. Ground equipment and install power wiring, switches, and controls for self contained and split systems.
F. Connect refrigerant piping to coils with shutoff valves on the suction and liquid lines at the coil and a union or flange at each connection at the coil and condenser.
G. Install ducts to the units with flexible duct connections.
H. Connect piping with shutoff duty valves on the supply and return side of the coil and unions at all connections and with a throttling valve on the return piping near the coil.
I. Connect piping with shutoff duty valves on the supply and return side of the water cooled condenser and unions at all connections and with a throttling valve on the return piping near the condenser.
J. Connect piping with shutoff duty valves and unions on the steam supply and condensate side of the steam coil. On the condensate line near the coil provide a strainer, trap and shutoff valve.

3.3 FIELD QUALITY CONTROL
A. Perform tests and inspections and prepare test reports.
B. Tests and Inspections: After installing units and after electrical circuitry has been energized, test units for compliance with requirements. Inspect for and remove shipping bolts, blocks, and tie-down straps. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Remove and replace malfunctioning units and retest as specified above.

3.4 INSTRUCTIONS
Provide services of manufacturer’s technical representative for four hours to instruct VA personnel in operation and maintenance of units.

3.5 STARTUP AND TESTING
Equipment startup and functional testing of installed equipment and systems shall be performed by factory-authorized personnel. Startup and testing shall be performed in accordance with manufacturer's requirements.

3.6 DEMONSTRATION AND TRAINING
A. Provide services of manufacturer’s technical representative for four hours to instruct VA personnel in operation and maintenance of units.

- - - END - - -
PART 1 - GENERAL

1.1 DESCRIPTION

A. This section applies to all sections of Division 26.
B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, conductors and cable, switchboards, switchgear, panelboards, motor control centers, generators, automatic transfer switches, and other items and arrangements for the specified items are shown on the drawings.
C. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company’s system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company’s system, and obtain electric utility company approval for sizes and settings of these devices.
D. Conductor ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways sized per NEC. Aluminum conductors are prohibited.
E. Execute electrical work in strict accordance with the latest edition of the National Electrical Code and governing local ordinances, codes, and regulations. Assure the strict conformity of electrical equipment, materials, construction methods, tests, and definitions with the established standards of the following in their latest adopted revision: UL (Underwriter’s Laboratories, Inc.), and NEMA (National Electrical Manufacturers Association).
F. Purchase permits, licenses, and approvals required for execution of work.

1.2 MINIMUM REQUIREMENTS

A. The International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), and National Fire Protection Association (NFPA) codes and standards are the minimum requirements for materials and installation.
B. All electrical installations shall comply with the current code requirements of NFPA 70 (NEC), NFPA 99, NFPA 101, OESC (Oregon Electrical Specialty Code), OARs (Oregon Administrative Rules), ORSs (Oregon Revised Statutes), and all local codes and ordinances.
C. The drawings and specifications shall govern in those instances where requirements are greater than those stated in the above codes and standards.

1.3 TEST STANDARDS

A. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety requirements of a NRTL. Materials and equipment which no NRTL accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, and NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.
B. Definitions:
1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed materials and equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled materials and equipment, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
3. Certified: Materials and equipment which:
a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
   b. Are periodically inspected by a NRTL.
   c. Bear a label, tag, or other record of certification.
4. Nationally Recognized Testing Laboratory: Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)
A. Manufacturer’s Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.
B. Product Qualification:
   1. Manufacturer's materials and equipment shall have been in satisfactory operation, on three installations of similar size and type as this project, for at least three years.
   2. The Government reserves the right to require the Contractor to submit a list of installations where the materials and equipment have been in operation before approval.
C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 CONTRACTOR QUALIFICATIONS
A. Contractor Qualifications: Contractors must provide five (5) projects in the last 5-years demonstrating a successful installation of medium voltage upgrades in active occupied facilities. Additional qualification requirements are as follows:
   1. Minimum of two (2) projects must be Federal projects with primary medium voltage upgrades in active occupied facilities. These projects must include:
      a. Medical facilities.
      b. Serving as Prime Contractor.
      c. Overall project value of five (5) million dollars or more.
      d. Located in the State of Oregon.
   2. Contractor must also have a current work history of successfully working in occupied Veterans Affairs Facilities.
   3. Contractor must be S.A.M. (System for Award Management) certified.
   4. Contractor must have a current E.M.R. (Experience Modification Rate) in the State of Oregon equal to or less than 0.60 and a 3-year average of equal to or less than 0.60.
   5. Contractor must currently participate in an Apprentice Training Program with a graduation rate equal to or greater than 80%.

1.6 APPLICABLE PUBLICATIONS
A. Applicable publications listed in all Sections of Division 26 are the latest issue, unless otherwise noted.
B. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.

1.7 MANUFACTURED PRODUCTS
A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available.
B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.
C. Equipment Assemblies and Components:
   1. Components of an assembled unit need not be products of the same manufacturer.
   2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
   3. Components shall be compatible with each other and with the total assembly for the intended service.
   4. Constituent parts which are similar shall be the product of a single manufacturer.
D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Testing Is Specified:
   1. The Government shall have the option of witnessing factory tests. The Contractor shall notify the Government through the COTR a minimum of 15 working days prior to the manufacturer's performing the factory tests.
   2. Four copies of certified test reports shall be furnished to the COTR two weeks prior to final inspection and not more than 90 days after completion of the tests.
   3. When materials and equipment fail factory tests, and re-testing and re-inspection is required, the Contractor shall be liable for all additional expenses for the Government to witness re-testing.

1.8 VARIATIONS FROM CONTRACT REQUIREMENTS
   A. Where the Government or the Contractor requests variations from the contract requirements, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.9 MATERIALS AND EQUIPMENT PROTECTION
   A. Materials and equipment shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
      1. Store materials and equipment indoors in clean dry space with uniform temperature to prevent condensation.
      2. During installation, equipment shall be protected against entry of foreign matter, and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
      3. Damaged equipment shall be repaired or replaced, as determined by the COTR.
      4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
      5. Damaged paint on equipment shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.10 WORK PERFORMANCE
   A. All electrical work shall comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J – General Environmental Controls, OSHA Part 1910 subpart K – Medical and First Aid, and OSHA Part 1910 subpart S – Electrical, in addition to other references required by contract.
   B. Job site safety and worker safety is the responsibility of the Contractor.
   C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:
      1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.
      2. Before initiating any work, a job specific work plan must be developed by the Contractor with a peer review conducted and documented by the COTR and Medical Center staff. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used, and exit pathways.
      3. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the COTR.
   D. For work that affects existing electrical systems, arrange, phase and perform work to assure minimal interference with normal functioning of the facility. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
   E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
   F. Coordinate location of equipment and conduit with other trades to minimize interference.
1.11 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. Equipment location shall be as close as practical to locations shown on the drawings.

B. Working clearances shall not be less than specified in the NEC.

C. Inaccessible Equipment:
   1. Where the Government determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
   2. “Readily accessible” is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

D. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company’s system shall conform to the electric utility company’s requirements. Coordinate fuses, circuit breakers and relays with the electric utility company’s system, and obtain electric utility company approval for sizes and settings of these devices.

1.12 EQUIPMENT IDENTIFICATION

A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards and switchgear, panelboards, cabinets, motor controllers, fused and non-fused safety switches, generators, automatic transfer switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.

B. Identification signs for Normal Power System equipment, including Medium-Voltage Transformers, shall be laminated black phenolic resin with a white core with engraved lettering. Identification signs for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering for Life Safety branch equipment, laminated orange phenolic resin with a black core with engraved lettering for Critical branch equipment, and yellow phenolic resin with a black core with engraved lettering for Equipment branch equipment. Lettering shall be a minimum of 12 mm (1/2 inch) high. Identification signs shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws. Unless noted otherwise within the drawings.

C. Install adhesive arc flash warning labels on all equipment as required by NFPA 70E. Label shall indicate the arc hazard boundary (inches), working distance (inches), arc flash incident energy at the working distance (calories/cm²), required PPE category and description including the glove rating, voltage rating of the equipment, limited approach distance (inches), restricted approach distance (inches), prohibited approach distance (inches), equipment/bus name, date prepared, and manufacturer name and address.

1. Contractor shall be responsible for providing complete Arc-Flash Hazards Calculation report and label all equipment required per NFPA 70E to properly identify arc-flash hazards. Contractor is required to pay for and submit Arc-Flash Hazards Calculation report to Owner’s Representative and Engineer for review and approval prior to commencing work.

D. Overcurrent Protective Device Coordination Study:
   1. Basis of Design Equipment: Eaton Cutler-Hammer. Refer to drawings for basis of design overcurrent protective device coordination study equipment ratings, settings, and time-current curves. All calculations have been performed and adjusted for Selective Coordination based on Eaton Cutler-Hammer equipment. Any equipment submitted that does not correspond with the basis of design, must be re-performed by the Contractor and the Contractor shall be responsible for all costs incurred.
   2. Other reviewed and approved Manufacturers: Contractor shall be responsible for providing a complete Overcurrent Protective Device Coordination Study report and install all devices per settings contained in the Coordination Study report. Contractor is required to pay for and submit Coordination Study report to Owner’s Representative and Engineer 10-days prior to Bid for review and prior-approval for substitution request. Substitution requests must also comply with Division 01 requirements.
   3. Refer to Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY, for additional requirements.
1.13 SUBMITTALS
A. Submit to the COTR in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
B. The Government’s approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.
C. All submittals shall include six copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Government to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.
D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
   1. Mark the submittals, "SUBMITTED UNDER SECTION__________________".
   2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
   3. Submit each section separately.
E. The submittals shall include the following:
   1. Information that confirms compliance with contract requirements. Include the manufacturer’s name, model or catalog numbers, catalog information, technical data sheets, shop drawings, manuals, pictures, nameplate data, and test reports as required.
   2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer’s recommendations and behavior problems (e.g., vibration, thermal expansion, etc.) associated with equipment or piping so that the proposed installation can be properly reviewed. Include sufficient fabrication information so that appropriate mounting and securing provisions may be designed and attached to the equipment.
   3. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
   4. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.
F. Maintenance and Operation Manuals:
   1. Submit as required for systems and equipment specified in the technical sections. Furnish in hardcover binders or an approved equivalent.
   2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, building, name of Contractor, and contract name and number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.
   3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
   4. The manuals shall include:
      a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
      b. A control sequence describing start-up, operation, and shutdown.
      c. Description of the function of each principal item of equipment.
      d. Installation instructions.
      e. Safety precautions for operation and maintenance.
      f. Diagrams and illustrations.
      g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.
      h. Performance data.
i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.

j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

G. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.

H. After approval and prior to installation, furnish the COTR with one sample of each of the following:
   1. A minimum 300 mm (12 inches) length of each type and size of wire and cable along with the tag from the coils or reels from which the sample was taken. The length of the sample shall be sufficient to show all markings provided by the manufacturer.
   2. Each type of conduit coupling, bushing, and termination fitting.
   3. Conduit hangers, clamps, and supports.
   4. Duct sealing compound.
   5. Each type of receptacle, toggle switch, lighting control sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

1.14 SINGULAR NUMBER
   A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., “the switch”), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.15 POLYCHLORINATED BIPHENYL (PCB) EQUIPMENT
   A. This project requires the removal, transport, and disposal of electrical equipment containing Polychlorinated Biphenyls (PCB) in accordance with the Federal Toxic Substances Control Act (TSCA).
   B. The equipment to be removed is shown on the drawings.
   C. The selective demolition shall be in accordance with Section 02 41 00, DEMOLITION.

1.16 ACCEPTANCE CHECKS AND TESTS
   A. The Contractor shall furnish the instruments, materials, and labor for tests.
   B. Where systems are comprised of components specified in more than one section of Division 26, the Contractor shall coordinate the installation, testing, and adjustment of all components between various manufacturer’s representatives and technicians so that a complete, functional, and operational system is delivered to the Government.
   C. When test results indicate any defects, the Contractor shall repair or replace the defective materials or equipment, and repeat the tests. Repair, replacement, and retesting shall be accomplished at no additional cost to the Government.

1.17 WARRANTY
   A. All work performed and all equipment and material furnished under this Division shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer for the Government.

1.18 INSTRUCTION
   A. Instruction to designated Government personnel shall be provided for the particular equipment or system as required in each associated technical specification section.
   B. Furnish the services of competent instructors to give full instruction in the adjustment, operation, and maintenance of the specified equipment and system, including pertinent safety requirements. Instructors shall be thoroughly familiar with all aspects of the installation, and shall be trained in operating theory as well as practical operation and maintenance procedures.
   C. A training schedule shall be developed and submitted by the Contractor and approved by the COTR at least 30 days prior to the planned training.
PART 1 - GENERAL

1.1 DESCRIPTION

A. There are no new medium voltage cables required for this Project.
B. Existing medium voltage cables in this Project will be disconnected and reconnected. This Section describes code, safety, testing, and good practice requirements when working with medium voltage cables.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
B. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for medium-voltage cables.
D. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Manholes and ducts for medium-voltage cables.
E. Section 26 12 19, PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS: Medium-voltage cable terminations for use in pad-mounted, liquid-filled, medium-voltage transformers.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

A. Medium-voltage cables shall be thoroughly tested at the factory per NEMA WC 74 to ensure that there are no electrical defects. Factory tests shall be certified.

1.5 QUALIFICATIONS

A. Qualified Worker Approval:
   1. Qualified workers who install and test cables, splices, and terminations shall have not fewer than five years of experience splicing and terminating cables equivalent to those being spliced and terminated, including experience with the materials in the approved splices and terminations.
   2. Furnish satisfactory proof of such experience for each qualified worker who splices or terminates the cables.
B. Electric Utility Company Approval:
   1. Prior to construction, obtain written approval from the supplying electric utility company for the following items:
      a. Service entrance cables, splices, and terminations.
      b. A list of qualified workers who will install, splice, and terminate the service entrance cables.
   2. Furnish satisfactory proof of such experience for each qualified worker who splices or terminates the cables.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
B. American Society for Testing and Materials (ASTM):
   B3-01 (2007) .......Standard Specification for Soft or Annealed Copper Wire
C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   48-09 .................Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV
   386-95 .................Separable Insulated Connector Systems for Power Distribution Systems above 600 V
400-01 .................Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems
400.2-04 .................Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)
400.3-06 .................Guide for Partial Discharge Testing of Shielded Power Cable Systems in a Field Environment
400-00 ..................Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500,000 V

D. National Electrical Manufacturers Association (NEMA):
   WC 71-99 ............Non-Shielded Cables Rated 2001-5000 Volts for Use in the Distribution of Electric Energy
   WC 74-06 ............5-46 KV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy

E. National Fire Protection Association (NFPA):
   70-11 ..................National Electrical Code (NEC)

F. Underwriters Laboratories (UL):
   1072-06 ...............Medium-Voltage Power Cables

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL
   A. Installation shall be in accordance with the NEC, as shown on the drawings, and per manufacturer’s instructions.
   B. Ground shields in accordance with Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
   C. Cable maximum pull length, maximum pulling tension, and minimum bend radius shall conform with the recommendations of the manufacturer.

3.2 PROTECTION DURING SPlicing OPERATIONS
   A. Blowers shall be provided to force fresh air into manholes where free movement or circulation of air is obstructed. Waterproof protective coverings shall be available on the work site to provide protection against moisture while a splice is being made. Pumps shall be used to keep manholes dry during splicing operations. Under no conditions shall a splice or termination be made that exposes the interior of a cable to moisture. A manhole ring at least 150 mm (6 inches) above ground shall be used around the manhole entrance to keep surface water from entering the manhole. Unused ducts shall be plugged and water seepage through ducts in use shall be stopped before splicing.

3.3 SPLICES AND TERMINATIONS
   A. Install the materials as recommended by the manufacturer, including precautions pertaining to air temperature and humidity during installation.
   B. Installation shall be accomplished by qualified workers trained to perform medium-voltage equipment installations. Use tools as recommended or provided by the manufacturer. All manufacturer’s instructions shall be followed.
   C. Splices in manholes shall be located midway between cable racks on walls of manholes, and supported with cable arms at approximately the same elevation as the enclosing duct.
   D. Where the Government determines that unsatisfactory splices and terminations have been installed, the Contractor shall replace the unsatisfactory splices and terminations with approved material at no additional cost to the Government.

3.4 FIREPROOFING
   A. Cover all cable segments exposed in manholes and pullboxes with fireproofing tape.
   B. Apply the tape in a single layer, wrapped in a half-lap manner, or as recommended by the manufacturer. Extend the tape not less than 25 mm (1 inch) into each duct.
   C. At each end of a taped cable section, secure the fireproof tape in place with glass cloth tape.

3.5 CIRCUIT IDENTIFICATION OF FEEDERS
A. In each manhole and pullbox, install permanent identification tags on each circuit’s cables to clearly designate the circuit identification and voltage. The tags shall be the embossed brass type, 40 mm (1.5 inches) in diameter and 40 mils thick. Attach tags with plastic ties. Position the tags so they will be easy to read after the fireproofing tape is installed.

3.6 ACCEPTANCE CHECKS AND TESTS

A. Perform tests in accordance with the manufacturer’s recommendations. Include the following visual and electrical inspections.

B. Test equipment, labor, and technical personnel shall be provided as necessary to perform the acceptance tests. Arrangements shall be made to have tests witnessed by the COTR.

C. Visual Inspection:
   1. Inspect exposed sections of cables for physical damage.
   2. Inspect shield grounding, cable supports, splices, and terminations.
   3. Verify that visible cable bends meet manufacturer’s minimum bending radius requirement.
   4. Verify installation of fireproofing tape and identification tags.

D. Electrical Tests:
   1. Acceptance tests shall be performed on new and service-aged cables as specified herein.
   2. Test new cable after installation, splices, and terminations have been made, but before connection to equipment and existing cable.

E. Service-Aged Cable Tests:
   1. Maintenance tests shall be performed on service-aged cable interconnected to new cable.
   2. After new cable test and connection to an existing cable, test the interconnected cable. Disconnect cable from all equipment that could be damaged by the test.

F. Insulation-Resistance Test: Test all new and service-aged cables with respect to ground and adjacent conductors.
   1. Test data shall include megohm readings and leakage current readings. Cables shall not be energized until insulation-resistance test results have been approved by the COTR. Test voltages and minimum acceptable resistance values shall be:

<table>
<thead>
<tr>
<th>Voltage Class</th>
<th>Test Voltage</th>
<th>Min. Insulation Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>5kV</td>
<td>2,500 VDC</td>
<td>1,000 megohms</td>
</tr>
<tr>
<td>15kV</td>
<td>2,500 VDC</td>
<td>5,000 megohms</td>
</tr>
<tr>
<td>25kV</td>
<td>5,000 VDC</td>
<td>20,000 megohms</td>
</tr>
<tr>
<td>35kV</td>
<td>15,000 VDC</td>
<td>100,000 megohms</td>
</tr>
</tbody>
</table>

   2. Submit a field test report to the COTR that describes the identification and location of cables tested, the test equipment used, and the date tests were performed; identifies the persons who performed the tests; and identifies the insulation resistance and leakage current results for each cable section tested. The report shall provide conclusions and recommendations for corrective action.

G. Online Partial Discharge Test: Comply with IEEE 400 and 400.3. Test all new and service-aged cables. Perform tests after cables have passed the insulation-resistance test, and after successful energization.
   1. Testing shall use a time or frequency domain detection process, incorporating radio frequency current transformer sensors with a partial discharge detection range of 10 kHz to 300 MHz.
   2. Submit a field test report to the COTR that describes the identification and location of cables tested, the test equipment used, and the date tests were performed; identifies the persons who performed the tests; and numerically and graphically identifies the magnitude of partial discharge detected for each cable section tested. The report shall provide conclusions and recommendations for corrective action.

H. Final Acceptance: Final acceptance shall depend upon the satisfactory performance of the cables under test. No cable shall be put into service until all tests are successfully passed, and field test reports have been approved by the COTR.

END OF SECTION
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 DESCRIPTION
A. This section applies to all sections of Division 26.
B. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below, indicated as cable(s), conductor(s), wire, or wiring in this section.

1.2 RELATED WORK
A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
B. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

1.3 QUALITY ASSURANCE
A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS
A. Conductors and cables shall be thoroughly tested at the factory per NEMA to ensure that there are no electrical defects. Factory tests shall be certified.

1.5 SUBMITTALS
A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
   1. Shop Drawings:
      a. Submit sufficient information to demonstrate compliance with drawings and specifications.
      b. Submit the following data for approval:
         1) Electrical ratings and insulation type for each conductor and cable.
         2) Splicing materials and pulling lubricant.
   2. Certifications:
      a. Certification by the manufacturer that the conductors and cables conform to the requirements of the drawings and specifications.
      b. Certification by the Contractor that the conductors and cables have been properly installed, adjusted, and tested.

1.6 APPLICABLE PUBLICATIONS
A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by designation only.
B. American Society of Testing Material (ASTM):
   D2301-10................................. Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
   D2304-10................................. Test Method for Thermal Endurance of Rigid Electrical Insulating Materials
   D3005-10................................. Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
C. National Electrical Manufacturers Association (NEMA):
   WC 70-09 ......................... Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy
D. National Fire Protection Association (NFPA):
   70-11 ................................. National Electrical Code (NEC)
E. Underwriters Laboratories, Inc. (UL):
   44-10 ................................. Thermoset-Insulated Wires and Cables
   83-08 ................................. Thermoplastic-Insulated Wires and Cables
PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Conductors and cables shall be in accordance with NEMA, UL, as specified herein, and as shown on the drawings.
B. All conductors shall be copper.
C. Single Conductor and Cable:
   1. No. 12 AWG: Minimum size, except where smaller sizes are specified herein or shown on the drawings.
   2. No. 8 AWG and larger: Stranded.
   3. No. 10 AWG and smaller: Solid; except shall be stranded for final connection to motors, transformers, and vibrating equipment.
   4. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.
D. Color Code:
   1. No. 10 AWG and smaller: Solid color insulation or solid color coating.
   2. No. 8 AWG and larger: Color-coded using one of the following methods:
      a. Solid color insulation or solid color coating.
      b. Stripes, bands, or hash marks of color specified.
      c. Color using 19 mm (0.75 inches) wide tape.
   3. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
   4. Conductors shall be color-coded as follows:

<table>
<thead>
<tr>
<th>208/120 V</th>
<th>Phase</th>
<th>480/277 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>A</td>
<td>Brown</td>
</tr>
<tr>
<td>Red</td>
<td>B</td>
<td>Orange</td>
</tr>
<tr>
<td>Blue</td>
<td>C</td>
<td>Yellow</td>
</tr>
<tr>
<td>White</td>
<td>Neutral</td>
<td>Gray *</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* or white with colored (other than green) tracer.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Color code for isolated power system wiring shall be in accordance with the NEC.

2.2 SPLICES

A. Splices shall be in accordance with NEC and UL.
B. Above Ground Splices for No. 10 AWG and Smaller:
   1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
   2. The integral insulator shall have a skirt to completely cover the stripped conductors.
   3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:
   1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
3. Splice and insulation shall be product of the same manufacturer.
4. All bolts, nuts, and washers used with splices shall be zinc-plated.

D. Above Ground Splices for 250 kcmil and Larger:
1. Long barrel “butt-splice” or “sleeve” type compression connectors, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
3. Splice and insulation shall be product of the same manufacturer.

E. Underground Splices for No. 10 AWG and Smaller:
1. Solderless, screw-on, reusable pressure cable type, with integral insulation. Listed for wet locations, and approved for copper and aluminum conductors.
2. The integral insulator shall have a skirt to completely cover the stripped conductors.
3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer’s packaging, shall be strictly followed.

F. Underground Splices for No. 8 AWG and Larger:
1. Mechanical type, of high conductivity and corrosion-resistant material. Listed for wet locations, and approved for copper and aluminum conductors.
2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
3. Splice and insulation shall be product of the same manufacturer.

G. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

2.3 CONNECTORS AND TERMINATIONS
A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be zinc-plated.

2.4 CONTROL WIRING
A. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified herein, except that the minimum size shall be not less than No. 14 AWG.
B. Control wiring shall be sized such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.

2.5 WIRE LUBRICATING COMPOUND
A. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive.
B. Shall not be used on conductors for isolated power systems.

PART 3 - EXECUTION
3.1 GENERAL
A. Install conductors in accordance with the NEC, as specified, and as shown on the drawings.
B. Install all conductors in raceway systems.
C. Splice conductors only in outlet boxes, junction boxes, pullboxes, manholes, or handholes.
D. Conductors of different systems (e.g., 120 V and 277 V) shall not be installed in the same raceway.
E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
F. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with non-metallic ties.

G. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.

H. Use expanding foam or non-hardening duct-seal to seal conduits entering a building, after installation of conductors.

I. Conductor and Cable Pulling:
   1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.
   2. Use nonmetallic pull ropes.
   3. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.
   4. All conductors in a single conduit shall be pulled simultaneously.
   5. Do not exceed manufacturer’s recommended maximum pulling tensions and sidewall pressure values.

J. No more than three branch circuits shall be installed in any one conduit.

K. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

3.2 INSTALLATION IN MANHOLES

A. Train the cables around the manhole walls, but do not bend to a radius less than six times the overall cable diameter.

B. Fireproofing:
   1. Install fireproofing on low-voltage conductors where the low-voltage conductors are installed in the same manholes with medium-voltage conductors.
   2. Use fireproofing tape as specified in Section 26 05 13, MEDIUM-VOLTAGE CABLES, and apply the tape in a single layer, half-lapped, or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than 25 mm (1 inch) into each duct.
   3. Secure the fireproofing tape in place by a random wrap of glass cloth tape.

3.3 SPLICE AND TERMINATION INSTALLATION

A. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer’s published torque values using a torque screwdriver or wrench.

B. Where the Government determines that unsatisfactory splices or terminations have been installed, replace the splices or terminations at no additional cost to the Government.

3.4 CONDUCTOR IDENTIFICATION

A. When using colored tape to identify phase, neutral, and ground conductors larger than No. 8 AWG, apply tape in half-overlapping turns for a minimum of 75 mm (3 inches) from terminal points, and in junction boxes, pullboxes, and manholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.

3.5 FEEDER CONDUCTOR IDENTIFICATION

A. In each interior pullbox and each underground manhole and handhole, install brass tags on all feeder conductors to clearly designate their circuit identification and voltage. The tags shall be the embossed type, 40 mm (1-1/2 inches) in diameter and 40 mils thick. Attach tags with plastic ties.

3.6 EXISTING CONDUCTORS

A. Unless specifically indicated on the plans, existing conductors shall not be reused.

3.7 CONTROL WIRING INSTALLATION

A. Unless otherwise specified in other sections, install control wiring and connect to equipment to perform the required functions as specified or as shown on the drawings.

B. Install a separate power supply circuit for each system, except where otherwise shown on the drawings.

3.8 CONTROL WIRING IDENTIFICATION
A. Install a permanent wire marker on each wire at each termination.
B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
C. Wire markers shall retain their markings after cleaning.
D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

3.9 ACCEPTANCE CHECKS AND TESTS
A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
   2. Electrical tests:
      a. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phase-to-phase and phase-to-ground resistance with an insulation resistance tester. Existing conductors to be reused shall also be tested.
      b. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 V DC for 600 V rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megaohms for 300 V rated cable and 100 megaohms for 600 V rated cable.
      c. Perform phase rotation test on all three-phase circuits.

END OF SECTION
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION
A. This section specifies the furnishing, installation, connection, and testing of grounding and bonding equipment, indicated as grounding equipment in this section.
B. “Grounding electrode system” refers to grounding electrode conductors and all electrodes required or allowed by NEC, as well as made, supplementary, and lightning protection system grounding electrodes.
C. The terms “connect” and “bond” are used interchangeably in this section and have the same meaning.

1.2 RELATED WORK
A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
C. Section 26 12 19, PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS: pad-mounted, liquid-filled, medium-voltage transformers.
D. Section 26 23 00, LOW-VOLTAGE SWITCHGEAR: Low-voltage switchgear.
E. Section 26 24 16, PANELBOARD: Low-voltage panelboards.
F. Section 26 29 21, ENCLOSED SWITCHES AND CIRCUIT BREAKERS: Enclosed Switches and Circuit Breakers.

1.3 QUALITY ASSURANCE
A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS
A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
   1. Shop Drawings:
      a. Submit sufficient information to demonstrate compliance with drawings and specifications.
      b. Submit plans showing the location of system grounding electrodes and connections, and the routing of aboveground and underground grounding electrode conductors.
   2. Test Reports:
      a. Two weeks prior to the final inspection, submit ground resistance field test reports to the COTR.
   3. Certifications:
      a. Certification by the Contractor that the grounding equipment has been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS
A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
B. American Society for Testing and Materials (ASTM):
   B1-07................................. Standard Specification for Hard-Drawn Copper Wire
   B3-07................................. Standard Specification for Soft or Annealed Copper Wire
   B8-11................................. Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
D. National Fire Protection Association (NFPA):
   70-11 ............................... National Electrical Code (NEC)
   70E-12 ............................... National Electrical Safety Code
PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS
A. Equipment grounding conductors shall be insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.
B. Bonding conductors shall be bare stranded copper, except that sizes No. 10 AWG and smaller shall be bare solid copper. Bonding conductors shall be stranded for final connection to motors, transformers, and vibrating equipment.
C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.
D. Insulation: THHN-THHN and XHHW-2. XHHW-2 shall be used for isolated power systems.

2.2 GROUND RODS
A. Steel or copper clad steel, 19 mm (0.75 inch) diameter by 3 M (10 feet) long.
B. Quantity of rods shall be as shown on the drawings, and as required to obtain the specified ground resistance.

2.3 CONCRETE ENCASED ELECTRODE
A. Concrete encased electrode shall be No. 4 AWG bare copper wire, installed per NEC.

2.4 GROUND CONNECTIONS
A. Below Grade and Inaccessible Locations: Exothermic-welded type connectors.
B. Above Grade:
   1. Bonding Jumpers: Listed for use with aluminum and copper conductors. For wire sizes No. 8 AWG and larger, use compression-type connectors. For wire sizes smaller than No. 8 AWG, use mechanical type lugs. Connectors or lugs shall use zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
   2. Connection to Building Steel: Exothermic-welded type connectors.
   3. Connection to Grounding Bus Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
   4. Connection to Equipment Rack and Cabinet Ground Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.5 GROUND TERMINAL BLOCKS
A. At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.6 GROUNDING BUS BAR
A. Pre-drilled rectangular copper bar with stand-off insulators, minimum 6.3 mm (0.25 inch) thick x 100 mm (4 inches) high in cross-section, length as shown on the drawings, with hole size, quantity, and spacing per detail shown on the drawings. Provide insulators and mounting brackets.

PART 3 - EXECUTION

3.1 GENERAL
A. Install grounding equipment in accordance with the NEC, as shown on the drawings, and as specified herein.
B. System Grounding:
   1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformer.
   2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
C. Equipment Grounding: Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.
D. For patient care area electrical power system grounding, conform to NFPA 99 and NEC.

3.2 INACCESSIBLE GROUNDING CONNECTIONS
A. Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.

3.3 MEDIUM-VOLTAGE EQUIPMENT AND CIRCUITS
A. Switchgear: Provide a bare grounding electrode conductor from the switchgear ground bus to the grounding electrode system.
B. Duct Banks and Manholes: Provide an insulated equipment grounding conductor in each duct containing medium-voltage conductors, sized per NEC except that minimum size shall be No. 2 AWG. Bond the equipment grounding conductors to the switchgear ground bus, to all manhole grounding provisions and hardware, to the cable shield grounding provisions of medium-voltage cable splices and terminations, and to equipment enclosures.
C. Pad-Mounted Transformers:
   1. Provide a driven ground rod and bond with a grounding electrode conductor to the transformer grounding pad.
   2. Ground the secondary neutral.
D. Lightning Arresters: Connect lightning arresters to the equipment ground bus or ground rods as applicable.

3.4 SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS
A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
B. Metallic Piping, Building Structural Steel, and Supplemental Electrode(s):
   1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water pipe systems, building structural steel, and supplemental or made electrodes. Provide jumpers across insulating joints in the metallic piping.
   2. Provide a supplemental ground electrode as shown on the drawings and bond to the grounding electrode system.
C. Switchgear, Switchboards, Unit Substations, Panelboards, Motor Control Centers, Engine-Generators, Automatic Transfer Switches, and other electrical equipment:
   1. Connect the equipment grounding conductors to the ground bus.
   2. Connect metallic conduits by grounding bushings and equipment grounding conductor to the equipment ground bus.
D. Transformers:
   1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
   2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the nearest component of the grounding electrode system.

3.5 OUTDOOR METALLIC FENCES AROUND ELECTRICAL EQUIPMENT
A. Fences shall be grounded with a ground rod at each fixed gate post and at each corner post.
B. Drive ground rods until the top is 300 mm (12 inches) below grade. Attach a No. 4 AWG copper conductor by exothermic weld to the ground rods, and extend underground to the immediate vicinity of fence post. Lace the conductor vertically into 300 mm (12 inches) of fence mesh and fasten by two approved bronze compression fittings, one to bond the wire to post and the other to bond the wire to fence. Each gate section shall be bonded to its gatepost by a 3 mm x 25 mm (0.375 inch x 1 inch) flexible, braided copper strap and...
3.6 CORROSION INHIBITORS
   A. When making grounding and bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.7 GROUND RESISTANCE
   A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.
   B. Grounding system resistance shall comply with the electric utility company ground resistance requirements.

3.8 GROUND ROD INSTALLATION
   A. For outdoor installations, drive each rod vertically in the earth, until top of rod is 610 mm (24 inches) below final grade.
   B. For indoor installations, leave 100 mm (4 inches) of each rod exposed.
   C. Where buried or permanently concealed ground connections are required, make the connections by the exothermic process, to form solid metal joints. Make accessible ground connections with mechanical pressure-type ground connectors.
   D. Where rock or impenetrable soil prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified ground resistance.

3.9 ACCEPTANCE CHECKS AND TESTS
   A. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized or connected to the electric utility company ground system, and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall.
   B. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.
   C. Below-grade connections shall be visually inspected by the COTR prior to backfilling. The Contractor shall notify the COTR 24 hours before the connections are ready for inspection.

END OF SECTION
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION
A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes, to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.
B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK
A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
B. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

1.3 QUALITY ASSURANCE
A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS
A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
   1. Shop Drawings:
      a. Size and location of main feeders.
      b. Size and location of panels and pull-boxes.
      c. Layout of required conduit penetrations through structural elements.
      d. Submit the following data for approval:
         1) Raceway types and sizes.
         2) Conduit bodies, connectors and fittings.
         3) Junction and pull boxes, types and sizes.
   2. Certifications: Two weeks prior to final inspection, submit the following:
      a. Certification by the manufacturer that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment conform to the requirements of the drawings and specifications.
      b. Certification by the Contractor that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment have been properly installed.

1.5 APPLICABLE PUBLICATIONS
A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
B. American National Standards Institute (ANSI):
   C80.1-05  Electrical Rigid Steel Conduit
   C80.3-05  Steel Electrical Metal Tubing
   C80.6-05  Electrical Intermediate Metal Conduit
C. National Fire Protection Association (NFPA):
   70-11    National Electrical Code (NEC)
D. Underwriters Laboratories, Inc. (UL):
   1-05     Flexible Metal Conduit
   5-11     Surface Metal Raceway and Fittings
   6-07     Electrical Rigid Metal Conduit - Steel
   50-95    Enclosures for Electrical Equipment
   360-13   Liquid-Tight Flexible Steel Conduit
   467-13   Grounding and Bonding Equipment
   514A-13  Metallic Outlet Boxes
514B-12 Conduit, Tubing, and Cable Fittings
514C-07 Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
651-11 Schedule 40 and 80 Rigid PVC Conduit and Fittings
651A-11 Type EB and A Rigid PVC Conduit and HDPE Conduit
797-07 Electrical Metallic Tubing
1242-06 Electrical Intermediate Metal Conduit - Steel

E. National Electrical Manufacturers Association (NEMA):
   TC-2-13 Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
   TC-3-13 PVC Fittings for Use with Rigid PVC Conduit and Tubing
   FB1-12 Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
   FB2.10-13 Selection and Installation Guidelines for Fittings for use with Non-Flexible Conduit or Tubing (Rigid Metal Conduit, Intermediate Metallic Conduit, and Electrical Metallic Tubing)
   FB2.20-12 Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable

F. American Iron and Steel Institute (AISI):
   S100-2007 North American Specification for the Design of Cold-Formed Steel Structural Members

PART 2 - PRODUCTS

2.1 MATERIAL

A. Conduit Size: In accordance with the NEC, but not less than 13 mm (0.5-inch) unless otherwise shown. Where permitted by the NEC, 13 mm (0.5-inch) flexible conduit may be used for tap connections to recessed lighting fixtures.

B. Conduit:
   1. Size: In accordance with the NEC, but not less than 13 mm (0.5-inch).
   2. Rigid Steel Conduit (RMC): Shall conform to UL 6 and ANSI C80.1.
   4. Electrical Metallic Tubing (EMT): Shall conform to UL 797 and ANSI C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 V or less.
   5. Flexible Metal Conduit: Shall conform to UL 1.
   7. Direct Burial Plastic Conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
   8. Surface Metal Raceway: Shall conform to UL 5.

C. Conduit Fittings:
   1. Rigid Steel and Intermediate Metallic Conduit Fittings:
      a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
      b. Standard threaded couplings, locknuts, bushings, conduit bodies, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
      c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
      d. Bushings: Metallic insulating type, consisting of an insulating insert, molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
      e. Erickson (Union-Type) and Set Screw Type Couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case-hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
      f. Sealing Fittings: Threaded cast iron type. Use continuous drain-type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
2. Electrical Metallic Tubing Fittings:
   a. Fittings and conduit bodies shall meet the requirements of UL 514B, ANSI C80.3, and NEMA FB1.
   b. Only steel or malleable iron materials are acceptable.
   c. Compression Couplings and Connectors: Concrete-tight and rain-tight, with connectors having insulated throats.
   d. Indent-type connectors or couplings are prohibited.
   e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
3. Flexible Metal Conduit Fittings:
   a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
   b. Clamp-type, with insulated throat.
4. Liquid-tight Flexible Metal Conduit Fittings:
   a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
   b. Only steel or malleable iron materials are acceptable.
   c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
5. Direct Burial Plastic Conduit Fittings: Fittings shall meet the requirements of UL 514C and NEMA TC3.
6. Surface Metal Raceway Fittings: As recommended by the raceway manufacturer. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, conduit entry fittings, accessories, and other fittings as required for complete system.
7. Expansion and Deflection Couplings:
   a. Conform to UL 467 and UL 514B.
   b. Accommodate a 19 mm (0.75-inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
   c. Include internal flexible metal braid, sized to guarantee conduit ground continuity and a low-impedance path for fault currents, in accordance with UL 467 and the NEC tables for equipment grounding conductors.
   d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat-resistant molded rubber material with stainless steel jacket clamps.
D. Conduit Supports:
   1. Parts and Hardware: Zinc-coat or provide equivalent corrosion protection.
   2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
   3. Multiple Conduit (Trapeze) Hangers: Not less than 38 mm x 38 mm (1.5 x 1.5 inches), 12-gauge steel, cold-formed, lipped channels; with not less than 9 mm (0.375-inch) diameter steel hanger rods.
   4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
E. Outlet, Junction, and Pull Boxes:
   1. UL-50 and UL-514A.
   2. Rustproof cast metal where required by the NEC or shown on drawings.
   3. Sheet Metal Boxes: Galvanized steel, except where shown on drawings.
F. Metal Wireways: Equip with hinged covers, except as shown on drawings. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.

PART 3 - EXECUTION

3.1 PENETRATIONS
A. Cutting or Holes:
   1. Cut holes in advance where they should be placed in the structural elements, such as ribs or beams. Obtain the approval of the COTR prior to drilling through structural elements.
   2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammers, impact electric, hand, or manual hammer-type drills are not allowed, except when permitted by the COTR where working space is limited.
B. Firestop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.
C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal the gap around conduit to render it watertight, as specified in Section 07 92 00, JOINT SEALANTS.

3.2 INSTALLATION, GENERAL
A. In accordance with UL, NEC, NEMA, as shown on drawings, and as specified herein.
B. Raceway systems used for Essential Electrical Systems (EES) shall be entirely independent of other raceway systems.
C. Install conduit as follows:
   1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
   2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.
   3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new conduits.
   4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
   5. Cut conduits square, ream, remove burrs, and draw up tight.
   6. Independently support conduit at 2.4 M (8 feet) on centers with specified materials and as shown on drawings.
   7. Do not use suspended ceilings, suspended ceiling supporting members, lighting fixtures, other conduits, cable tray, boxes, piping, or ducts to support conduits and conduit runs.
   8. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
   9. Close ends of empty conduits with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
   10. Conduit installations under fume and vent hoods are prohibited.
   11. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid steel and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
   12. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.
   13. Conduit bodies shall only be used for changes in direction, and shall not contain splices.

D. Conduit Bends:
   1. Make bends with standard conduit bending machines.
   2. Conduit hickey may be used for slight offsets and for straightening stubbed out conduits.
   3. Bending of conduits with a pipe tee or vise is prohibited.

E. Layout and Homeruns:
   1. Install conduit with wiring, including homeruns, as shown on drawings.
   2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted and approved by the COTR.

3.3 CONCEALED WORK INSTALLATION
A. In Concrete:
   1. Conduit: Rigid steel, IMC, or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel, or vapor barriers.
   2. Align and run conduit in direct lines.
   3. Install conduit through concrete beams only:
      a. Where shown on the structural drawings.
      b. As approved by the COTR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
   4. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
      a. Conduit outside diameter larger than one-third of the slab thickness is prohibited.
      b. Space between conduits in slabs: Approximately six conduit diameters apart, and one conduit
diameter at conduit crossings.

- Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (0.75-inch) of concrete around the conduits.

5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to ensure low resistance ground continuity through the conduits. Tightening setscrews with pliers is prohibited.

B. Above Furred or Suspended Ceilings and in Walls:

1. Conduit for Conductors Above 600 V: Rigid steel. Mixing different types of conduits in the same system is prohibited.
2. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits in the same system is prohibited.
3. Align and run conduit parallel or perpendicular to the building lines.
4. Connect recessed lighting fixtures to conduit runs with maximum 1.8 M (6 feet) of flexible metal conduit extending from a junction box to the fixture.
5. Tightening set screws with pliers is prohibited.
6. For conduits running through metal studs, limit field cut holes to no more than 70% of web depth. Spacing between holes shall be at least 457 mm (18 inches). Cuts or notches in flanges or return lips shall not be permitted.

3.4 EXPOSED WORK INSTALLATION

A. Unless otherwise indicated on drawings, exposed conduit is only permitted in mechanical and electrical rooms.
B. Conduit for Conductors Above 600 V: Rigid steel. Mixing different types of conduits in the system is prohibited.
C. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits in the system is prohibited.
D. Align and run conduit parallel or perpendicular to the building lines.
E. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
F. Support horizontal or vertical runs at not over 2.4 M (8 feet) intervals.
G. Surface Metal Raceways: Use only where shown on drawings.

H. Painting:
   1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
   2. Paint all conduits containing cables rated over 600 V safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (2 inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6 M (20 feet) intervals in between.

3.5 HAZARDOUS LOCATIONS

A. Use rigid steel conduit only.
B. Install UL approved sealing fittings that prevent passage of explosive vapors in hazardous areas equipped with explosion-proof lighting fixtures, switches, and receptacles, as required by the NEC.

3.6 WET OR DAMP LOCATIONS

A. Use rigid steel or IMC conduits unless as shown on drawings.
B. Provide sealing fittings to prevent passage of water vapor where conduits pass from warm to cold locations, i.e., refrigerated spaces, constant-temperature rooms, air-conditioned spaces, building exterior walls, roofs, or similar spaces.
C. Use rigid steel or IMC conduit within 1.5 M (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers, unless as shown on drawings. Conduit shall be half-lapped with 10 mil PVC tape before installation. After installation, completely recoat or retape any damaged areas of coating.
D. Conduits run on roof shall be supported with integral galvanized lipped steel channel, attached to UV-inhibited polycarbonate or polypropylene blocks every 2.4 M (8 feet) with 9 mm (3/8-inch) galvanized threaded rods, square washer and locknut. Conduits shall be attached to steel channel with conduit clamps.
3.7 MOTORS AND VIBRATING EQUIPMENT
A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
B. Use liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside airstream of HVAC units, and locations subject to seepage or dripping of oil, grease, or water.
C. Provide a green equipment grounding conductor with flexible and liquid-tight flexible metal conduit.

3.8 EXPANSION JOINTS
A. Conduits 75 mm (3 inch) and larger that are secured to the building structure on opposite sides of a building expansion joint require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
B. Provide conduits smaller than 75 mm (3 inch) with junction boxes on both sides of the expansion joint. Connect flexible metal conduits to junction boxes with sufficient slack to produce a 125 mm (5 inch) vertical drop midway between the ends of the flexible metal conduit. Flexible metal conduit shall have a green insulated copper bonding jumper installed. In lieu of this flexible metal conduit, expansion and deflection couplings as specified above are acceptable.
C. Install expansion and deflection couplings where shown.
D. Seismic Areas: In seismic areas, provide conduits rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 375 mm (15 inches) of slack flexible conduit. Flexible conduit shall have a copper bonding jumper installed.

3.9 CONDUIT SUPPORTS
A. Safe working load shall not exceed one-quarter of proof test load of fastening devices.
B. Use pipe straps or individual conduit hangers for supporting individual conduits.
C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and an additional 90 kg (200 lbs). Attach each conduit with U-bolts or other approved fasteners.
D. Support conduit independently of junction boxes, pull-boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
E. Fasteners and Supports in Solid Masonry and Concrete:
   1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
   2. Existing Construction:
      a. Steel expansion anchors not less than 6 mm (0.25-inch) bolt size and not less than 28 mm (1.125 inch) in embedment.
      b. Power set fasteners not less than 6 mm (0.25-inch) diameter with depth of penetration not less than 75 mm (3 inch).
      c. Use vibration and shock-resistant anchors and fasteners for attaching to concrete ceilings.
F. Hollow Masonry: Toggle bolts.
G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
K. Spring steel type supports or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.
L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.10 BOX INSTALLATION
A. Boxes for Concealed Conduits:
   1. Flush-mounted.
2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.

B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations or where more than the equivalent of 4-90 degree bends are necessary.

C. Locate pullboxes so that covers are accessible and easily removed. Coordinate locations with piping and ductwork where installed above ceilings.

D. Remove only knockouts as required. Plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.

E. Outlet boxes mounted back-to-back in the same wall are prohibited. A minimum 600 mm (24 inch) center-to-center lateral spacing shall be maintained between boxes.

F. Flush-mounted wall or ceiling boxes shall be installed with raised covers so that the front face of raised cover is flush with the wall. Surface-mounted wall or ceiling boxes shall be installed with surface-style flat or raised covers.

G. Minimum size of outlet boxes for ground fault circuit interrupter (GFCI) receptacles is 100 mm (4 inches) square x 55 mm (2.125 inches) deep, with device covers for the wall material and thickness involved.

H. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1."

I. On all branch circuit junction box covers, identify the circuits with black marker.

END OF SECTION
OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 DESCRIPTION
A. The Engineer performed the overcurrent protective device coordination study, and the results are included in the drawings, based on the basis of design manufacturer: Eaton Cutler-Hammer.
B. This section specifies the overcurrent protective device coordination study, indicated as the study in this section, required by the Contractor for any substitution request equipment and shall be the sole responsibility of the Contractor.
C. A short-circuit and selective coordination study shall be prepared for the electrical overcurrent devices to be installed under this project. The coordination study shall include existing overcurrent devices not to be replaced in this project for complete system coordination.
D. The study shall present a well-coordinated time-current analysis of each overcurrent protective device from the individual device up to the utility source and the on-site generator sources.

1.2 RELATED WORK
A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.
B. Section 26 23 00, LOW-VOLTAGE SWITCHGEAR: Low-voltage switchgear.
C. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.

1.3 QUALITY ASSURANCE
A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
B. The study shall be prepared by the equipment manufacturer.

1.4 SUBMITTALS
A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
   1. Product data on the software program to be used for the study. Software shall be in mainstream use in the industry, shall provide device settings and ratings, and shall show selective coordination by time-current drawings.
   2. Complete study as described in paragraph 1.6. Submittal of the study shall be well-coordinated with submittals of the shop drawings for equipment in related specification sections.
   3. Certifications: Two weeks prior to final inspection, submit the following.
      a. Certification by the Contractor that the overcurrent protective devices have been set in accordance with the approved study.

1.5 APPLICABLE PUBLICATIONS
A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
B. Institute of Electrical and Electronics Engineers (IEEE):
   242-01 .................................... Protection and Coordination of Industrial and Commercial Power Systems
   399-97 .................................... Industrial and Commercial Power Systems Analysis
   1584a-04 ................................. Guide for Performing Arc-Flash Hazard Calculations

1.6 STUDY REQUIREMENTS
A. The study shall include one line diagram, short-circuit and ground fault analysis, and protective coordination plots for all overcurrent protective devices.
B. One Line Diagram:
   1. Show all electrical equipment and wiring to be protected by the overcurrent devices.
   2. Show the following specific information:
      a. Calculated fault impedance, X/R ratios, and short-circuit values at each feeder and branch circuit bus.
b. Relay, circuit breaker, and fuse ratings.
c. Generator kW/kVA and transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
d. Voltage at each bus.
e. Identification of each bus, matching the identification on the drawings.
f. Conduit, conductor, and busway material, size, length, and X/R ratios.

C. Short-Circuit Study:
1. The study shall be performed using computer software designed for this purpose. Pertinent data and the rationale employed in developing the calculations shall be described in the introductory remarks of the study.
2. Calculate the fault impedance to determine the available short-circuit and ground fault currents at each bus. Incorporate applicable motor and/or generator contribution in determining the momentary and interrupting ratings of the overcurrent protective devices.
3. Present the results of the short-circuit study in a table. Include the following:
   a. Device identification.
   b. Operating voltage.
   c. Overcurrent protective device type and rating.
   d. Calculated short-circuit current.

D. Coordination Curves:
1. Prepare the coordination curves to determine the required settings of overcurrent protective devices to demonstrate selective coordination. Graphically illustrate on log-log paper that adequate time separation exists between devices, including the utility company upstream device if applicable. Plot the specific time-current characteristics of each overcurrent protective device in such a manner that all devices are clearly depicted.
2. The following specific information shall also be shown on the coordination curves:
   a. Device identification.
   b. Potential transformer and current transformer ratios.
   c. Three-phase and single-phase ANSI damage points or curves for each cable, transformer, or generator.
   d. Applicable circuit breaker or protective relay characteristic curves.
   e. No-damage, melting, and clearing curves for fuses.
   f. Transformer in-rush points.
3. Develop a table to summarize the settings selected for the overcurrent protective devices. Include the following in the table:
   a. Device identification.
   b. Protective relay or circuit breaker potential and current transformer ratios, sensor rating, and available and suggested pickup and delay settings for each available trip characteristic.
   c. Fuse rating and type.

1.7 ANALYSIS
A. Analyze the short-circuit calculations, and highlight any equipment determined to be underrated as specified. Propose solutions to effectively protect the underrated equipment.

1.8 ADJUSTMENTS, SETTINGS, AND MODIFICATIONS
A. Final field settings and minor modifications of the overcurrent protective devices shall be made to conform with the study, without additional cost to the Government.

PART 2 - PRODUCTS (NOT USED)
PART 3 - EXECUTION (NOT USED)

END OF SECTION
COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 26.

B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

1.2 RELATED WORK

A. Section 01 00 00 GENERAL REQUIREMENTS.

B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 SUMMARY

A. This Section includes requirements for commissioning the Facility electrical systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.

B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Division 26 is part of the construction process. Documentation and testing of these systems, as well as training of the VA’s Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 26, is required in cooperation with the VA and the Commissioning Agent.

B. The Facility electrical systems commissioning will include the systems listed in Section 01 19 00 General Commissioning Requirements:

1.6 SUBMITTALS

A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS

A. Commissioning of Electrical systems will require inspection of individual elements of the electrical systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 19 00 and the Commissioning plan to schedule electrical systems inspections as required to support the Commissioning Process.

3.2 PRE-FUNCTIONAL CHECKLISTS

A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The
Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

### 3.3 CONTRACTORS TESTS

A. Contractor tests as required by other sections of Division 26 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days’ notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

### 3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

### 3.5 TRAINING OF VA PERSONNEL

A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 19 00. The instruction shall be scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 26 Sections for additional Contractor training requirements.
PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 DESCRIPTION
A. This section specifies the furnishing, installation, connection, and testing of the pad-mounted, liquid-filled, medium-voltage transformers, indicated as transformers in this section.
B. Refer to drawings for existing transformers to be replaced. New transformers shall be located on existing pads and pad-vaults upon removal of existing transformers.

1.2 RELATED WORK
A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
B. Section 26 05 13, MEDIUM-VOLTAGE CABLES: Medium-voltage cables.
C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground currents.
D. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.

1.3 QUALITY ASSURANCE
A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS
A. Transformers shall be thoroughly tested at the factory to ensure that there are no electrical or mechanical defects. Tests shall be conducted as per IEEE Standards. Factory tests shall be certified. The following tests shall be performed:
   1. Perform insulation-resistance tests, winding-to-winding and each winding-to-ground.
   2. Perform turns-ratio tests at all tap positions.
B. Furnish four (4) copies of certified manufacturer's factory test reports to the COTR prior to shipment of the transformers to ensure that the transformers have been successfully tested as specified.

1.5 SUBMITTALS
A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
   1. Shop Drawings:
      a. Submit sufficient information to demonstrate compliance with drawings and specifications.
      b. Include electrical ratings, nameplate data, impedance, outline drawing with dimensions and front, top, and side views, weight, mounting details, decibel rating, termination information, temperature rise, no-load and full-load losses, regulation, overcurrent protection, connection diagrams, and accessories.
      c. Complete nameplate data, including manufacturer’s name and catalog number.
      d. Certification from the manufacturer that representative transformers have been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.
   2. Manuals:
      a. When submitting the shop drawings, submit companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
         1) Identify terminals on wiring diagrams to facilitate installation, maintenance, and operation.
         2) Indicate on wiring diagrams the internal wiring for each piece of equipment and interconnections between the pieces of equipment.
         3) Approvals will be based on complete submissions of manuals, together with shop drawings.
      b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
1) Update the manual to include any information necessitated by shop drawing approval.
2) Show all terminal identification.
3) Include information for testing, repair, troubleshooting, assembly, disassembly, and recommended maintenance intervals.
4) Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.

B. Certifications:
   1. Two weeks prior to the final inspection, submit the following certifications.
      a. Certification by the manufacturer that the transformers conform to the requirements of the drawings and specifications.
      b. Certification by the Contractor that the transformers have been properly installed, connected, and tested.

1.6 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
D. Provide Seismic tested equipment as follows:
   1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the 2012 International Building Code (IBC) Site Classification D. The spectral response accelerations of $S_s = 0.803g$ and $S_l = 0.409g$ are used. The test response spectrum shall be based upon a 5% damping factor, and a peak S$D_s$ of at least 0.631g's (3-12 Hz) applied at the base of the equipment in the horizontal direction. The tests shall cover a frequency range from 1 to 100 Hz. Guidelines for the installation consistent with these requirements shall be provided by the equipment manufacturer and based upon testing of representative equipment. Equipment certification acceptance criteria shall be based upon the ability of the equipment to be returned to service immediately after a seismic event within the above requirements without the need for repairs.
   2. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards:
      a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed Civil Engineer in the State of Oregon. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
      b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
      c. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered when the capability of the equipment, meets or exceeds the specified response spectra.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at the time of shipment.

1.8 FIELD MEASUREMENTS

A. Measure primary and secondary voltages and make appropriate tap adjustments.

1.9 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
B. American National Standards Institute (ANSI):
C37.47-00............................... High Voltage Current-Limiting Type Distribution Class Fuses and Fuse Disconnecting Switches
C57.12.00-00 ..................... Liquid-Immersed Distribution, Power and Regulating Transformers
C57.12.25-90 ....................... Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution-Transformers with Separable Insulated High Voltage Connectors; High Voltage, 34500 Grd Y/19920 Volts and Below; Low-Voltage 240/120 Volts; 167 kVA and Smaller Requirements
C57.12.26-92 ....................... Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors (34500 Grd Y/19920 V and Below, 2500 kVA and Smaller)
C57.12.28-05 ....................... Pad-Mounted Equipment - Enclosure Integrity
C57.12.29-05 ....................... Pad-Mounted Equipment – Enclosure Integrity for Coastal Environments
C57.12.34-10 ....................... Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 5 MVA and Smaller; High Voltage, 34.5 kV Nominal System Voltage and Below; Low Voltage, 15kV Nominal System Voltage and Below

C. American Society for Testing and Materials (ASTM):
   D3487-08........................ Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus

D. Institute of Electrical and Electronic Engineers (IEEE):
   C2-07.................................. National Electrical Safety Code
   C57.12.10-11 ......................... Liquid-Immersed Power Transformers
   C57.12.90-10 ......................... Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
   C62.11-06............................... Metal-Oxide Surge Arresters for AC Power Circuits
   48-09 .................................. Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5kV Through 765kV or Extruded Insulation Rated 2.5kV Through 500kV
   386-06 .................................. Separable Insulated Connector Systems for Power Distribution Systems Above 600 V
   592-07 .................................. Exposed Semiconducting Shields on High-Voltage Cable Joints and Separable Connectors

E. International Code Council (ICC):
   IBC-12 ............................... International Building Code

F. National Electrical Manufacturers Association (NEMA):
   LA 1-09............................... Surge Arresters
   TP 1-02............................... Guide for Determining Energy Efficiency for Distribution Transformers
   TR 1-00 ............................... Transformers, Regulators, and Reactors

G. National Fire Protection Association (NFPA):
   70-11 ............................... National Electrical Code (NEC)

H. Underwriters Laboratories Inc. (UL):
   467-07 ............................... Grounding and Bonding Equipment

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Transformers shall be in accordance with ANSI, ASTM, IEEE, NEMA, NFPA, UL, as shown on the drawings, and as specified herein. Each transformer shall be assembled as an integral unit by a single manufacturer.
B. Transformers shall be complete, outdoor type, continuous duty, integral assembly, grounded, tamper-resistant, and with liquid-immersed windings.
C. Ratings shall not be less than shown on the drawings.
D. Completely fabricate transformers at the factory so that only the external cable connections are required at the project site.
E. Thoroughly clean, phosphatize, and finish all the metal surfaces at the factory with a rust-resistant primer and dark green enamel finish coat, except where a different color is specified in Section 09 06 00, SCHEDULE FOR FINISHES. All surfaces of the transformer that will be in contact with the concrete pad shall be treated with corrosion-resistant compounds and epoxy resin or a rubberized sealing compound.

   1. Refer to Division 01 for Substitution Requests.
   2. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.2 CONSTRUCTION

A. The unit shall be biodegradable electrical insulating fluid from high oleic vegetable oil sources filled and shall be in accordance with the latest edition of the NEC. High fire point fluids shall be Factory Mutual and UL approved.

B. The transformer shall carry its continuous rating with average winding or temperature rise by resistance that shall not exceed 65-degrees C rise, based on an average ambient of 30-degrees C over 24-hours with a maximum of 40-degrees C.

C. The transformer shall be designed to meet the sound level standards for liquid transformers as defined in NEMA and ANSI.

D. High-voltage and low-voltage windings shall be copper. Insulation between layers of the windings shall be by thermally set insulating paper or equal.

E. The main transformer tank and attached components shall be designed to withstand pressures greater than the required operating design value without permanent deformation. Construction shall consist of carbon steel reinforced with external, internal or sidewall braces. All seams and joints shall be continuously welded.

F. The assembly shall be individually welded and receive a quality control pressurized check for leaks. The entire tank assembly shall receive a similar leak test before tanking. A final six-hour leak test shall be performed.

G. The transformer(s) shall be compartmental-type, self-cooled and tamper-resistant for mounting on a pad. The unit shall restrict the entry of water (other than flood water) into the compartments so as not to impair its operation. There shall be no exposed screws, bolts or other fastening devices which are externally removable.

H. The transformer(s) shall consist of a transformer tank and full-height, bolt-on high- and low-voltage cable terminating compartments located side-by-side separated by a rigid metal barrier. Each compartment shall have separate doors, designed to provide access to the high-voltage compartment only after the low-voltage has been opened. There shall be at least one additional fastening device accessible only after the low-voltage door has been opened, which must be removed to open the high-voltage door. Doors shall be mounted flush with the cabinet frame. The low-voltage door shall have a handle-operated, three-point latching mechanism designed to be secured with a single padlock. A hex-head or penta-head bolt shall be incorporated into the low-voltage door latching mechanism. Both high and low-voltage doors shall be incorporated into the low-voltage door latching mechanism. Both high and low-voltage doors shall be equipped with stainless steel hinges and door stops to secure them in the open position.

I. Compartment sills, doors and covers shall be removable to facilitate cable pulling and installation. The high-voltage door shall be on the left with the low-voltage door on the right. Compartments shall be designed for cable entry from below.

J. Transformer(s) shall be supplied with a welded or bolted main tank cover and be of a sealed-tank construction designed to withstand a pressure of 7 psig without permanent distortion. The tank cover shall be designed to shed water and be supplied with a tamper-resistant access handhole sized to allow access to internal bushing and switch connections. Transformers supplied with “less flammable” fluids shall be manufactured to withstand 12 psig without rupture. The transformer shall remain effectively sealed for a top-oil temperature of -5 degrees C to 105 degrees C. When necessary to meet the temperature rise rating specified, cooling panels shall be provided.

K. The transformer manufacturer shall certify that the transformer is non-PCB containing less than 1 part per million detectable PCBs. Nonflammable transformer liquids including askarel and insulating liquids
containing tetrachloroethylene, perchloroethylene, chlorine compounds, or halogenated compounds are not acceptable and shall not be provided.

L. When high-voltage taps are specified above, full-capacity taps shall be provided with a tap changing mechanism designed for de-energized operation. The tap changer operator shall be located within one of the compartments.

M. The coil windings shall be designed to reduce losses and manufactured with the conductor material as specified above. All insulating materials shall be rated for 120 degrees C class.

N. The core material shall be high-grade, grain-oriented, non-aging silicon core steel with high magnetic permeability, low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below saturation to allow for a minimum of 10 percent overvoltage excitation. The cores shall be properly annealed to reduce stresses induced during the manufacturing processes and reduce core losses.

O. The core frame shall be designed to provide maximum support of the core and coil assembly. The core frame shall be welded or bolted to ensure maximum short-circuit strength.

P. The core and coil assembly shall be designed and manufactured to meet the short-circuit requirements of ANSI C57.12.90. The core and coil assembly shall be baked in an oven prior to tanking to “set” the epoxy coating on the insulating paper and remove moisture from the insulation prior to vacuum filling.

Q. Transformer shall be vacuum-filled with the appropriate fluid as indicated above. The process shall be of sufficient vacuum and duration to ensure that the core and coil assembly is free of moisture prior to filling the tank.

R. Transformer units shall include suitable outdoor paint finish. The paint shall be applied using an electrostatically dry powder system to a minimum of three (3) mils average thickness. Units shall be painted padmount green, Munsell No. 7GY3.29/1.5.

2.3 COMPARTMENTS

A. Construction:
   1. Enclosures shall be weatherproof and in accordance with ANSI C57.12.28.
   2. The medium- and low-voltage compartments shall be separated with a steel barrier that extends the full height and depth of the compartments.
   3. The compartments shall be constructed of sheet steel (gauge to meet ANSI requirements) with bracing and with reinforcing gussets using jig welds to assure rectangular rigidity.
   4. All bolts, nuts, and washers shall be zinc-plated steel.
   5. Sufficient space shall be provided for equipment, cabling, and terminations within the compartments.
   6. Affix transformer nameplate permanently within the low-voltage compartment. Voltage and kVA rating, connection configuration, impedance, date of manufacture, and serial number shall be shown on the nameplate.

B. Doors:
   1. Provide a separate door for each compartment with provisions for a single padlock to secure all doors. Provide each compartment door with open-position doorstops and corrosion-resistant tamperproof hinges welded in place. The medium-voltage compartment door shall be mechanically prevented from opening unless the low-voltage compartment door is open.
   2. The secondary compartment door shall have a one-piece steel handle and incorporate three-point locking mechanisms.
   3. Provide a 50 mm (2 inches) size padlock for each assembly, as approved by the COTR. Padlocks shall be keyed to the COTR’s established key set. Firmly attach the padlock to the door assembly by a chain.

2.4 ACCESSORIES

A. Transformer features and accessories shall include:
   1. Dial-type thermometer.
   2. Liquid level gauge.
   3. Pressure-vacuum gauge.
   4. Drain valve with sample valve.
   5. Pressure relief valve.
7. Upper fill/filter press connection or valve.
8. Additional accessories:
   a. Alarm contacts.
   b. Rapid pressure rise relay.
   c. Winding temperature relay.
   d. Gas sampling valve.

2.5 BIL RATING
A. 15 kV class equipment shall have a minimum 95 kV BIL rating.
B. 25 kV class equipment shall have a minimum 125 kV BIL rating.

2.6 TRANSFORMERS
A. Transformer ratings shall be as shown on drawings. kVA ratings shown on the drawings are for continuous duty without the use of cooling fans.
B. Temperature rises shall not exceed the NEMA TR 1 standards of 65˚ C (149˚ F) by resistance.
C. Transformer insulating material shall be less flammable, edible-seed-oil based, and UL listed as complying with NFPA 70 requirements for fire point of not less than 300˚ C (600˚ F) when tested according to ASTM D 92. Liquid shall be biodegradable and nontoxic.
D. Transformer impedance shall be not less than 4-1/2% for sizes 150 kVA and larger. Impedance shall be as shown on the drawings.
E. Sound levels shall conform to NEMA TR 1 standards.
F. Primary and Secondary Windings for Three-Phase Transformers:
   1. Primary windings shall be delta-connected.
   2. Secondary windings shall be wye-connected, except where otherwise indicated on the drawings. Provide isolated neutral bushings for secondary wye-connected transformers.
   3. Secondary leads shall be brought out through pressure-tight epoxy bushings.
G. Primary windings shall have four 2-1/2% full-capacity voltage taps; two taps above and two taps below rated voltage.
H. Core and Coil Assemblies:
   1. Cores shall be grain-oriented, non-aging, silicon steel to minimize losses.
   2. Core and coil assemblies shall be rigidly braced to withstand the stresses caused by rough handling during shipment, and stresses caused by any possible short-circuit currents.
   3. Coils shall be continuous-winding type without splices except for taps. Material shall be copper.
   4. Coil and core losses shall be optimum for efficient operation.
   5. Primary, secondary, and tap connections shall be brazed or pressure type.
   6. Provide end fillers or tiedowns for coil windings.
I. The transformer tank, cover, and radiator gauge thickness shall not be less than that required by ANSI.
J. Accessories:
   1. Provide standard NEMA features, accessories, and the following:
      a. No-load tap changer. Provide warning sign.
      b. Lifting, pulling, and jacking facilities.
      c. Globe-type valve for oil filtering and draining, including sampling device.
      d. Pressure relief valve.
      e. Liquid level gauge and filling plug.
      f. A grounding pad in the medium- and low-voltage compartments.
      g. A diagrammatic nameplate.
      h. Dial-type liquid thermometer with a maximum reading pointer and an external reset.
      i. Hot stick. Securely fasten hot stick within low-voltage compartment.
   2. The accessories shall be made accessible within the compartments without disassembling trims and covers.
K. Transformers shall meet the minimum energy efficiency values per NEMA TP 1:
<table>
<thead>
<tr>
<th>KVA</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
<td>98.7</td>
</tr>
<tr>
<td>112.5</td>
<td>98.8</td>
</tr>
<tr>
<td>150</td>
<td>98.9</td>
</tr>
<tr>
<td>225</td>
<td>99.0</td>
</tr>
<tr>
<td>300</td>
<td>99.0</td>
</tr>
<tr>
<td>500</td>
<td>99.1</td>
</tr>
<tr>
<td>750</td>
<td>99.2</td>
</tr>
<tr>
<td>1000</td>
<td>99.2</td>
</tr>
<tr>
<td>1500</td>
<td>99.3</td>
</tr>
<tr>
<td>2000</td>
<td>99.4</td>
</tr>
<tr>
<td>2500</td>
<td>99.4</td>
</tr>
</tbody>
</table>

2.7 TRANSFORMER FUSE ASSEMBLY
A. The primary fuse assembly shall be a combination of externally replaceable Bay-O-Net liquid-immersed fuses in series with liquid-immersed current-limiting fuses.

2.8 PRIMARY CONNECTIONS
A. Primary connections shall be 200 A dead-front loadbreak wells and inserts for cable sizes shown on the drawings.

2.9 PRIMARY FUSING
A. Provide oil-immersed, loadbreak bay-o-net overload sensing fuses in series with under oil partial range current limiting fuses.

2.10 MEDIUM-VOLTAGE SWITCH
A. The transformer primary disconnect switch shall be an oil-immersed, internal, gang-operated, load-interrupter type, rated at ampacity and system voltage as shown on the drawings, with a minimum momentary withstand rating of not less than the calculated available fault current shown on the drawings.
B. For loop feeds, switch shall be a four-position, V-blade manual switch located in the medium-voltage compartment and hot-stick-operated.

2.11 MEDIUM-VOLTAGE TERMINATIONS
A. Terminate the medium-voltage cables in the primary compartment with 200 A loadbreak premolded rubber elbow connectors, suitable for submersible applications. Elbow connectors shall have a semi-conductive shield material covering the housing. The separable connector system shall include the loadbreak elbow, the bushing insert, and the bushing well. Separable connectors shall comply with the requirements of IEEE 386, and shall be interchangeable between suppliers. Allow sufficient slack in medium-voltage cable, ground, and drain wires to permit elbow connectors to be moved to their respective parking stands.
B. Ground metallic cable shield with a cable shield grounding adapter, consisting of a solderless connector enclosed in watertight rubber housing covering the entire assembly, bleeder wire, and ground braid.

2.12 LOW-VOLTAGE EQUIPMENT
A. Mount the low-voltage bushings, and hot stick in the low-voltage compartment.
B. The low-voltage leads shall be brought out of the tank by epoxy pressure tight bushings, and shall be standard arrangement.
C. Tin-plate the low-voltage neutral terminal and isolate from the transformer tank. Provide a removable ground strap sized in accordance with the NEC and connect between the secondary neutral and ground pad.
2.13 CABLE FAULT INDICATORS (LOOP SYSTEMS ONLY):

A. Provide each incoming and outgoing cable within the medium-voltage compartment with a single-phase cable fault indicator with in-rush restraint. Mount the indicator on the cable support member.
   1. The sensor assembly shall have a split-core for easy installation over the incoming and outgoing cable. The core shall be laminated, grain-oriented silicon steel, and encapsulated. Provide a clamp to secure the two coil halves around the cable.
   2. Select the coil to the pick-up at the current setting shown on the drawings.
      a. The coil setting shall be accurate to within 10% of the pick-up.
      b. The coil current-time curve shall coordinate with the primary current-limiting fuse.

B. Upon restoration of the system to normal operating conditions, the cable fault indicator shall automatically reset to normal and be ready to operate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install transformers outdoors, as shown on the drawings, in accordance with the NEC, and as recommended by the manufacturer.
B. Anchor transformers with rustproof bolts, nuts, and washers not less than 12 mm (1/2 inch) diameter, in accordance with manufacturer’s instructions, and as shown on drawings.
C. In seismic areas, transformers shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.
D. Mount transformers on concrete slab. Unless otherwise indicated, the slab shall be at least 200 mm (8 inches) thick, reinforced with a 150 by 150 mm (6 by 6 inches) No. 6 mesh placed uniformly 100 mm (4 inches) from the top of the slab. Slab shall be placed on a 150 mm (6 inches) thick, well-compacted gravel base. The top of the concrete slab shall be approximately 100 mm (4 inches) above the finished grade. Edges above grade shall have 12-1/2 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 200 mm (8 inches) beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface.
E. Grounding:
   1. Ground each transformer in accordance with the requirements of the NEC. Install ground rods per the requirements of Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS, to maintain a maximum resistance of 5 ohms to ground.
   2. Connect the ground rod to the ground pads in the medium- and low-voltage compartments.
   3. Install and connect the cable shield grounding adapter per the manufacturer’s instructions. Connect the bleeder wire of the cable shield grounding adapter to the loadbreak or deadbreak elbow grounding point with minimum No. 14 AWG wire, and connect the ground braid to the grounding system with minimum No. 6 AWG bare copper wire. Use soldered or mechanical grounding connectors listed for this purpose.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform manufacturer’s required field tests in accordance with the manufacturer’s recommendations. In addition, include the following:
   1. Visual Inspection and Tests:
      a. Compare equipment nameplate data with specifications and approved shop drawings.
      b. Inspect physical and mechanical condition. Check for damaged or cracked bushings and liquid leaks.
      c. Verify that control and alarm settings on temperature indicators are as specified.
      d. Inspect all field-installed bolted electrical connections, using the calibrated torque-wrench method to verify tightness of accessible bolted electrical connections, and perform thermographic survey after energization under load.
      e. Vacuum-clean transformer interior. Clean transformer enclosure exterior.
      f. Verify correct liquid level in transformer tank.
      g. Verify correct equipment grounding per the requirements of Section 26 05 26, GROUNDING AND
BONDING FOR ELECTRICAL SYSTEMS.

h. Verify the presence and connection of transformer surge arresters, if provided.

i. Verify that the tap-changer is set at rated system voltage.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the Contractor shall demonstrate that the transformers are in good operating condition and properly performing the intended function.

3.4 SPARE PARTS

A. Deliver the following spare parts for the project to the COTR two weeks prior to final inspection:

1. Six insulated protective caps.
2. One spare set of medium-voltage fuses for each size and type of fuse used in the project.
3. One spare set of three cable fault indicators.

3.5 INSTRUCTION

A. The Contractor shall instruct maintenance personnel, for not less than one 2-hour period, on the maintenance and operation of the equipment on the date requested by the COTR.

END OF SECTION
LOW-VOLTAGE SWITCHGEAR

PART 1 - GENERAL

1.1 DESCRIPTION
   A. This section specifies the furnishing, installation, connection, and testing of low-voltage switchgear, indicated as switchgear in this section.

1.2 RELATED WORK
   A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
   B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
   C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible fault currents.
   D. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.

1.3 QUALITY ASSURANCE
   A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS
   A. Switchgear shall be thoroughly tested at the factory, with the circuit breakers in the connected position in their compartments. Tests shall be in accordance with IEEE C37.20.1 and NEMA C37.51. Factory tests shall be certified, and shall include the following tests:
      1. Design tests.
      2. Production tests.
      3. Conformance tests.
   B. The following additional tests shall be performed:
      1. Verify that circuit breaker sizes and types correspond to drawings, and the Overcurrent Protective Device Coordination Study.
      2. Verify tightness of bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer’s published data.
      3. Confirm correct operation and sequencing of key-type mechanical interlock systems for multiple circuit breakers by attempting closure on locked-open devices, and attempting to open locked-closed devices, and making key exchange with devices operated in off-normal positions.
      4. Verify correct barrier and shutter installation and operation.
      5. Exercise all active components.
      6. Inspect indicating devices for correct operation.
      7. Perform an insulation-resistance test, phase to ground, on each bus section, with phases not under test grounded, in accordance with manufacturer’s published data.
      8. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 V DC for 300-volt rated cable and 1000 V DC for 600-volt rated cable, or as required if solid-state components or control devices cannot tolerate the applied voltage.
      9. If applicable, verify correct function of control transfer relays located in the switchgear with multiple control power sources.
     10. Perform phasing checks on double-ended or dual-source switchgear to insure correct bus phasing from each source.
   C. Furnish four (4) copies of certified manufacturer’s factory test reports prior to shipment of the switchgear to ensure that the switchgear has been successfully tested as specified.
   D. The Government shall have an option to witness the factory tests. All expenses of the Government Representative’s trips to witness the testing will be paid by the Government. Notify the COTR not less than 30 days prior to making tests at the factory.
1.5 SUBMITTALS

A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1. Shop Drawings:
   a. Switchgear shop drawings shall be submitted simultaneously with or after the Overcurrent Protective Device Coordination Study.
   b. Submit sufficient information to demonstrate compliance with drawings and specifications.
   c. Prior to fabrication of switchgear, submit the following data for approval:
      1) Complete electrical ratings.
      2) Circuit breaker sizes.
      3) Interrupting ratings.
      4) Safety features.
      5) Accessories and nameplate data.
      6) Switchgear one line diagram, showing ampere rating, number of bars per phase and neutral in each bus run (horizontal and vertical), bus spacing, equipment ground bus, and bus material.
      7) Elementary and interconnection wiring diagrams.
      8) Technical data for each component.
      9) Dimensioned exterior views of the switchgear.
     10) Dimensioned section views of the switchgear.
     11) Floor plan of the switchgear.
     12) Foundation plan for the switchgear.
     13) Provisions and required locations for external conduit and wiring entrances.
     14) Approximate design weights.
   d. Certification from the manufacturer that representative switchgear has been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.

2. Manuals:
   a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
      1) Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the switchgear.
      2) Include information for testing, repair, trouble shooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
      3) Provide a replacement and spare parts list. Include a list of tools and instruments for testing and maintenance purposes.
   b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Certifications: Two weeks prior to final inspection, submit the following.
   a. Certification by the manufacturer that switchgear conforms to the requirements of the drawings and specifications.
   b. Certification by the Contractor that switchgear has been properly installed, adjusted, and tested.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata), form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

B. Institute of Engineering and Electronic Engineers (IEEE):
   C37.13-08.................................. Low-voltage AC Power Circuit Breakers Used in Enclosures
   C37.20.1-07.................................. Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
   C57.13-08.................................. Instrument Transformers
   C62.41.1-03.................................. Surge Environment in Low-voltage (1000V and less) AC Power Circuits
   C62.45-92.................................. Surge Testing for Equipment connected to Low-Voltage AC Power Circuits
C. International Code Council (ICC):
   IBC-12 ..................................... International Building Code

D. National Electrical Manufacturers Association (NEMA):
   C37.51-10............................... Metal-Enclosed Low Voltage AC Power Circuit Breaker Switchgear Assemblies — Conformance Test Procedures

E. National Fire Protection Association (NFPA):
   70-11 ..................................... National Electrical Code (NEC).

F. Underwriters Laboratories, Inc. (UL):
   891-05 ................................... Switchboards
   977-07 .................................... Safety Fused Power-Circuit Devices
   1053-99 .................................. Ground Fault Sensing and Relaying Equipment
   1558-99 .................................. Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear

PART 2 - PRODUCTS

2.1 GENERAL

A. Shall be in accordance with ANSI, IEEE, NEMA, NFPA, UL, as shown on the drawings, and have the following features:
   1. Switchgear shall be a complete, grounded, continuous-duty, integral assembly, metal clad, dead-front, dead-rear, self-supporting, indoor type switchgear assembly. Incorporate devices shown on the drawings and all related components required to fulfill operational and functional requirements.
   2. Switchgear shall be Type 1 front accessible, unless noted otherwise as shown on the drawings.
   3. Ratings shall not be less than shown on the drawings. Short circuit ratings shall not be less than 100 kA.
   4. Switchgear shall conform to the arrangements and details shown on the drawings.
   5. Switchgear shall be assembled, connected, and wired at the factory so that only external circuit connections are required at the construction site. Split the structure only as required for shipping and installation. Packaging shall provide adequate protection against rough handling during shipment.
   6. All non-current-carrying parts shall be grounded per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS for additional requirements.


2.2 HOUSING

A. Shall have the following features:
   1. Frames and enclosures:
      a. The assembly shall be braced with reinforcing gussets using bolted connections to assure rectangular rigidity.
      b. The enclosure shall be steel, leveled, and not less than the gauge required by applicable publications.
      c. Die-pierce the holes for connecting adjacent structures to insure proper alignment, and to allow for future additions.
      d. All bolts, nuts, and washers shall be zinc-plated/ steel.
   2. Circuit breaker compartments:
      a. An individual compartment shall be supplied for each circuit breaker and each future circuit breaker as shown on the drawings. Compartments shall be provided with isolated wireways for control wiring between devices.
         1) Separate each compartment so that the circuit breaker, buses, and cable terminations are in separate compartments with steel partitions or barriers of approved and properly installed insulation.
         2) Each compartment furnished with a circuit breaker (active or spare) shall be fully equipped as noted on drawings and specified below.
         3) Each compartment noted as space for future circuit breaker, as shown on drawings, shall be fully equipped for positioning and connecting the breaker. Provide all equipment required to implement the future breaker installation.
   3. Auxiliary compartments:
a. Compartments shall be provided for auxiliaries, metering, and transition or termination sections as required by the manufacturer, and as shown on drawings. Compartments shall be provided with isolated wireways for control wiring between devices.

4. Compartment doors:
   a. The doors shall permit convenient removal and interchanging of circuit breakers between compartments. The doors shall be capable of a swing approaching 180 degrees.
   b. Concealed or semi-concealed hinges shall be provided to attach the doors. Weld the hinges to the equipment structure and to the compartment doors.

B. Finish:
   1. All metal surfaces shall be thoroughly cleaned, phosphatized and factory primed prior to applying baked enamel or lacquer finish.
   2. Provide a light gray finish for indoor switchgear.

2.3 BUSES

A. Bus Bars and Interconnections:
   1. Provide copper phase and neutral buses, fully rated for the amperage as shown on the drawings for the entire length of the switchgear. Bus laminations shall have a minimum of 6 mm (1/4 inch) spacing.
   2. Mount the buses on appropriately spaced insulators and brace to withstand the available short circuit currents.
   3. The bus and bus compartment shall be designed so that the acceptable NEMA standard temperature rises are not exceeded.
   4. Install a copper ground bus the full length of the switchgear assembly.
   5. Main Bonding Jumper: An un-insulated copper bus, size as shown on drawings, shall interconnect the neutral and ground buses, when the switchgear is used to establish the system common ground point.
   6. All bolts, nuts, and washers shall be zinc-plated steel. Bolts shall be torqued to the values recommended by the manufacturer.
   7. Make provisions for future bus extensions by means of bolt holes or other approved method.

2.4 LOW-VOLTAGE POWER CIRCUIT BREAKERS

A. General: Circuit breakers shall be dead front, drawout, stored energy type with solid state trip devices. Arcing contacts shall be renewable.

B. Rating: Circuit breakers shall be 3 pole, 600 volts AC and below, 60 cycle with frame size, trip rating and functions, and system voltage as shown on drawings. Breakers shall have 30 cycle short time current ratings.

C. Drawout Mounting: Provide a racking mechanism to position and hold the breaker in the connected, test, or disconnected position. Provide an interlock to prevent movement of the breaker into or out of the connected position unless the breaker is tripped open.

D. Trip Devices: Breakers shall be electrically and mechanically trip free and shall have trip devices in each pole. Unless otherwise indicated on drawings, each breaker shall have overcurrent and short-circuit trip devices. Trip devices shall be of the solid state type with adjustable pick-up settings, with both long time and short time elements, and integral trip unit testing provisions. Devices shall have time-delay band adjustment. Long-time delay element shall have inverse time characteristics. Main circuit breakers shall not have instantaneous trip function.

E. Position Indicator: Provide a mechanical indicator visible from the front of the unit to indicate whether the breaker is open or closed.

F. Trip Button: Equip each breaker with a mechanical trip button accessible from the front of the door.

G. Padlocking: Provisions shall be included for padlocking the breaker in the open position.

H. Operation: Unless otherwise indicated herein or on the drawings, breakers 1600 ampere frame size and less shall be manually operated. Breakers larger than 1600 ampere frame size shall be electrically operated.

I. Fused Circuit Breakers: The fuses used with combination fused breakers shall be high-interrupting capacity current-limiting type and coordinated with the circuit breaker. Fuses shall be on the line side of the breaker on a common drawout carriage (except 3000 and 4000 ampere breakers). Circuit breakers of 3000 and
4000 ampere frame size may have their fuses in a separate compartment with drawout mounting. A feature shall be included which trips the breaker when any fuse blows. An interlock shall prevent the reclosure of the breaker until the blown fuse is replaced. A blown fuse indicator shall be provided on the front of the breaker. In the case of fuses in a separate compartment, an interlock shall be provided to require the breaker to be open before it is possible to open the fuse compartment door.

2.5 OTHER EQUIPMENT
A. Furnish tools and accessories required for circuit breaker and switchgear test, inspection, maintenance, and proper operation.
B. Panelboards: Requirements for panelboards shown to be installed in the switchgear shall be as shown on the drawings and in Section 26 24 16, PANELBOARDS.

2.6 CONTROL WIRING
A. Switchgear control wires shall not be less than No. 14 AWG copper 600 V rated. Install wiring complete at the factory, adequately bundled and protected. Provide separate control circuit fuses in each breaker compartment and locate for ease of access and maintenance.

2.7 NAMEPLATES AND MIMIC BUS
A. Nameplates: Provide nameplates as required in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
B. Mimic Bus: Provide an approved mimic bus on front of each switchgear assembly. Color shall be black for the Normal Power system and red for the Essential Electrical System, either factory-painted plastic or metal strips. Plastic tape shall not be used. Use symbols similar to one line diagram shown on drawings. Plastic or metal strips shall be mounted with plated screws.

PART 2 - EXECUTION
3.1 INSTALLATION
A. Install switchgear in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.
B. Anchor switchgear with rustproof bolts, nuts, and washers not less than 13 mm (1/2 inch) diameter, in accordance with manufacturer’s instructions, and as shown on drawings.
C. In seismic areas, switchgear shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.
D. Interior Location. Mount switchgear on concrete slab. Unless otherwise indicated, the slab shall be at least 100 mm (4 inches) thick. The top of the concrete slab shall be approximately 100 mm (4 inches) above finished floor. Edges above floor shall have 15 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 100 mm (8 inches) beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface.

3.2 ACCEPTANCE CHECKS AND TESTS
A. Perform in accordance with the manufacturer’s recommendations. In addition, include the following:
   1. Visual Inspection and Tests:
      a. Compare equipment nameplate data with specifications and approved shop drawings.
      b. Inspect physical, electrical, and mechanical condition.
      c. Confirm correct application of manufacturer’s recommended lubricants.
      d. Verify appropriate anchorage, required area clearances, and correct alignment.
      e. Verify that circuit breaker sizes and types correspond to approved shop drawings.
      f. Verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energizing.
      g. Confirm correct operation and sequencing of key-type mechanical interlock systems.
      h. Vacuum-clean switchgear enclosure interior. Clean switchgear enclosure exterior.
      i. Inspect insulators for evidence of physical damage or contaminated surfaces.
j. Verify correct shutter installation and operation.
k. Exercise all active components.
l. Verify the correct operation of all sensing devices, alarms, and indicating devices.
m. Verify that vents are clear.

2. Electrical tests:
a. Perform insulation-resistance tests on each bus section.
b. Perform insulation-resistance test on control wiring; do not perform this test on wiring connected to solid-state components.
c. Perform phasing check on double-ended switchgear to ensure correct bus phasing from each source.

3.3 FOLLOW-UP VERIFICATION
A. Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the switchgear is in good operating condition and properly performing the intended function.

3.4 TEMPORARY HEATING
A. Apply temporary heat to switchgear, according to manufacturer's written instructions, throughout periods when switchgear environment is not controlled for temperature and humidity within manufacturer's stipulated service conditions.

3.5 WARNING SIGN
A. Mount on each entrance door of the switchgear room, approximately 1500 mm (5 feet) above grade or floor, a clearly lettered warning sign for warning personnel. The sign shall be attached with rustproof metal screws.

3.6 ONE LINE DIAGRAM AND SEQUENCE OF OPERATION
A. At final inspection, an as-built one line diagram shall be laminated or mounted under acrylic glass, and installed in a frame mounted in the switchgear room or in the outdoor switchgear enclosure.
B. Furnish a written sequence of operation for the switchgear and connected line side/load side electrical distribution equipment. The sequence of operation shall be laminated or mounted under acrylic glass, and installed in a frame mounted in the switchgear room or in the outdoor switchgear enclosure.
C. Deliver an additional four copies of the as-built one line diagram and sequence of operation to the COTR.

3.7 AS-LEFT TRIP UNIT SETTINGS
A. The trip unit settings shall be set in the field by an authorized representative of the switchgear manufacturer per the approved Overcurrent Protective Device Coordination Study in accordance with Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY.
B. Post a durable copy of the "as-left" trip unit settings in a convenient location in the switchgear room. Deliver four additional copies of the settings to the COTR. Furnish this information prior to the activation of the switchgear.

3.8 INSTRUCTION
A. Furnish the services of a factory-trained technician for two, 4-hour training periods for instructing personnel in the maintenance and operation of the switchgear, on the dates requested by the COTR.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION
A. This section specifies the furnishing, installation, connection, and testing of indoor control components for medium- and low-voltage paralleling Standby and Essential Electrical System generators.

B. The generator paralleling controls shall be compatible and functional with the switchgear, engine generators, automatic transfer switches, remote annunciators, and all related components.

1.2 RELATED WORK
A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint of nonstructural components.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible fault currents.

D. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.

E. Section 26 23 00, LOW-VOLTAGE SWITCHGEAR: Low-voltage enclosures, busing, and circuit breakers for generator paralleling switchgear.

F. Section 26 36 23, AUTOMATIC TRANSFER SWITCHES: Automatic transfer switches.

1.3 QUALITY ASSURANCE
A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS and as listed below.

B. The paralleling equipment manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

C. Source Limitations: The paralleling switchgear shall be designed, manufactured, and warranted by the generator set manufacturer to provide a single source of responsibility for all the products provided. Warranty documents shall be provided verifying compliance to this requirement. Supplier shall directly employ service technicians specifically trained and qualified on the diagnosis and repair of engines, alternators, power transfer equipment, and paralleling equipment. The technicians shall be trained in the installation and commissioning of complex generator systems, including line voltage generator paralleling equipment.

D. The paralleling system, including generator sets and paralleling equipment, shall be serviced by a single local service organization that is trained and factory certified in both generator set and paralleling equipment service. The technicians serving the site shall be specifically trained and certified by the manufacturer in the diagnosis and repair of the synchronizing, paralleling, and load sharing equipment provided. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

E. The manufacturer shall maintain model and serial number records for the paralleling equipment for at least 20 years.

1.4 FACTORY TESTS
A. Factory Tests shall be required.

B. Factory Tests shall be in accordance with Paragraph, MANUFACTURED PRODUCTS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirement:
   1. Generator paralleling controls shall be tested to assure that there are no electrical or mechanical defects. Tests shall be conducted in accordance with UL and ANSI standards.
1.5 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:
   a. Per the requirements of Section 26 23 00, LOW-VOLTAGE SWITCHGEAR.
   b. Include sequences of operation and interconnecting controls diagrams, showing connections to switchgear, generators, automatic transfer switches, and remote annunciators.
   c. Certification from the manufacturer that representative generator paralleling controls have been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.
   d. Elevation and other Drawings: Describing physical dimensions, weights, mounting provisions and requirements, mechanical and wiring access points.
   e. Design Calculations: Provide seismic calculations along with certifications noted above.
   f. Submit names, qualifications, and locations of individuals who will service and support the equipment.

2. Manuals:
   a. When submitting the shop drawings, submit companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
   1) The terminals of wiring diagrams shall be identified to facilitate installation, maintenance, and operation.
   2) Wiring diagrams shall indicate internal wiring for each piece of equipment and the interconnection between the pieces of equipment, including related equipment specified in other sections.
   3) Provide a clear and concise description of operation, including detailed information required to properly operate the equipment.
   4) Approvals shall be based on complete submissions of manuals together with shop drawings.
   b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Test Reports:
   a. Two weeks prior to the final inspection, submit certified field test reports and data sheets.

4. Certifications: Two weeks prior to the final inspection, submit the following.
   a. Certification by the manufacturer that the generator paralleling controls conform to the requirements of the drawings and specifications.
   b. Certification by the Contractor that the generator paralleling controls have been properly installed, connected, and tested.

5. Product Data: Provide the noted technical data for the controls, switchgear, and transfer equipment described in this section. Materials required include:
   a. Technical data fully describing the critical design features of the equipment proposed, and substantiating compliance to the requirements of this specification. This material shall include 3rd party certifications and listing details for all equipment provided, including seismic certifications described herein.
   b. Data shall include a complete description of the features and function of the proposed equipment, described on the manufacturer's published literature or manufacturer's letterhead with a manufacturer's employee signature validating its accuracy.
   c. Include a listing of all setting ranges and factory default settings.
   d. Include a detailed sequence of operation for the specific equipment provided.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. International Code Council (ICC):

653-10-531 VA Roseburg Correct Electrical Deficiencies
100% Design Submittal 2017/03/10
1.7 EXTRA MATERIALS

A. Provide additional items to support the paralleling system equipment, completely programmed and tested, packaged and labeled consistently with designations in system drawings.
   1. One set of fuses of each type used in the system
   2. Submit one racking handle(s) with equipment. A charging handle shall be furnished on each breaker mechanism.
   3. For all switchgear with circuit breakers in upper compartments, provide one circuit breaker lifting device.

B. Maintenance tools: Furnish tools and miscellaneous items required for system inspection, monitoring, maintenance, and operation. Tools shall be provided for the system shall include:
   1. Any non-standard tools for mechanical maintenance on the system. This includes items such as circuit breaker racking wrenches and special engine tools.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Only approved bidders shall supply equipment provided under this contract. Equipment specifications for this project are based on microprocessor-based paralleling equipment manufactured by Cummins Power Generation. Digital Paralleling Equipment by other suppliers that meets the requirements of this specification is acceptable, if approved not less than 2 weeks before scheduled bid date. Proposals must include a line by line compliance statement based on this specification.

2.2 GENERATOR PARALLELING MONITOR AND CONTROL SYSTEM

A. Acceptable Manufacturers
2.3 **RATINGS**

A. The low voltage switchgear shall consist of an indoor enclosure containing circuit breakers and the necessary accessory components all factory assembled (except for necessary shipping splits) and operationally checked.

B. The assembly shall be a self-supporting and floor mounted on a level concrete pad.

C. The integrated switchgear assembly shall withstand the effects of closing, carrying and interrupting currents up to the assigned maximum short circuit rating.

D. Voltage rating shall be as indicated on the drawings. The entire assembly shall be suitable for 600 volts maximum AC service. System voltage will be 480Y/277 volt 3 phase 4 wire with ground.

E. The ampacity of the Low Voltage Switchgear shall be determined by the loading of the feeder circuits. The main bus rating shall be 3000A, 4000A, 5000A, 6000A, 7000A, 8000A) (for UL 1558 listed equipment choose from the following 1600A, 2000A, 3200A, 4000A, 5000A.) UPDATE BUS RATINGS

F. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current of for UL 891 listed gear choose from the following (65,000), (100,000), or (150,000) amperes symmetrical at rated voltage for UL 1558 listed gear choose from the following (42,000), (65,000), (85,000), or (200,000) amperes symmetrical at rated voltage or as shown on the drawings.

G. All circuit interruption shall be accomplished by the circuit breaker and without the aid of limiter fuses. The circuit breaker short-time ratings shall as specified on the drawings.

H. The assembly is designed for use on 60 Hz electrical systems up to 600 Vac. The assembly shall be properly braced to the ratings of the circuit breaker installed within the assembly.

I. Any items not specifically mentioned but which are obviously necessary for proper operation are implied in this specification.

2.4 **CONSTRUCTION**

A. General

1. Each steel section shall contain one or more individual circuit breakers, or instrumentation compartments, and a rear compartment for the buses and outgoing cable connections.

2. Rigid removable steel base channel shall be provided at the front and rear of each section.

3. The finish shall be medium gray ANSI #49 or ANSI #61.

B. Dimensions

1. Section widths should be 22, 30, or 36” wide dependent on the size of the circuit breakers being installed.

2. The lineup shall provide adequate wire bending space for mains and feeders breakers using up to 750 kcmil wires.

3. Section depth shall be 54” minimum when using 800A feeders. Additional depth to the lineup shall be for the sole purpose of additional wire bending and conduit space.

4. Adequate conduit space shall be provided to allow all conductors to exit the structure at the same end.

C. Moving and Handling

1. The Lineup shall be divided into shipping splits not to exceed 88” wide and shall be capable of being lifted overhead or by a forklift.

2. Each shipping split shall be provided with removable lifting straps.

3. Removable Base Channels shall be provided with prying slots for ease of final positioning at the job-site.

4. For circuit breakers, an overhead or floor mounted lifter shall be provided to ease the installation or removal of circuit breakers in excess of 75 pounds.
2.5 BREAKER COMPARTMENT

A. Circuit Breakers
   1. Each circuit breaker shall be mounted in its own barriered compartment.
   2. Feeder circuit breakers rated 2000A or less shall be capable of being mounted in the uppermost compartment without de-rating.
   3. Operational buttons on the circuit breaker as well as the trip unit and the display shall be accessible without opening the breaker compartment door.
   4. All mains and feeders shall be two-step stored energy circuit breakers and shall allow for closed door racking.
   5. All circuit breakers shall be drawout-style construction.
   6. Circuit breakers of like sizes and rated 1600A or less shall be interchangeable as standard. Circuit breakers of lower interruption ratings shall be mechanically prohibited from being placed in the cell.
   7. Circuit Breaker and prepared space compartments shall be “keyed” such that a breaker cannot be incorrectly installed with respect to Interrupting Rating, Frame Size, or secondary connections.
   8. Prepared spaces shall be totally complete, include the racking mechanism, bussing, and secondary contacts as necessary, so that a circuit breaker of the correct frame size can be installed with no modifications required.

B. Secondary Connections
   1. All customer secondary control and communications connections shall be made from the front of the switchgear lineup.
   2. A dedicated wiring area accessible from the front shall allow easy access to all control or communications terminations
   3. Control Connections shall be cage clamp terminals. All control wire shall be 14 gauge SIS.
   4. Dedicated conduit entry for control wires shall be provided at the top and bottom of each section, capable of landing up to 3 each 1 ½” conduits and accessible from the front.
   5. All interconnections between sections at shipping splits shall use locking-pull apart terminal blocks.
   6. All secondary and communication wiring shall be securely fastened to the switchgear without the use of adhesive backed wire anchors.

C. Instrumentation
   1. Where additional space is required for instrumentation, CPT’s, metering, etc., a barriered instrumentation compartment shall be used.
   2. The instrumentation compartment shall not inhibit the routing of control or communication wires.
   3. Individual component mounting surfaces and pans in the instrument compartments shall be painted white as standard.

2.6 BUSING AND CABLE COMPARTMENT

A. Busing
   1. All vertical and horizontal distribution bussing shall be rated for the full ampacity of the lineup.
   2. All bus joints shall consist of Grade 5 hardware and conical spring (e.g. Belleville) washers to withstand mechanical forces exerted during short circuits. All joints shall consist of a minimum of 2 bolts.
   3. Busing shall be plated along it entire length.
   4. Busing shall be braced to withstand the instantaneous interrupting rating of the main breaker(s) or 65kA minimum.
   5. Optional barriers shall be available to separate the busing and cable compartment.

B. Cable Compartment
   1. All incoming or outgoing power conductors shall be routed through this area.
   2. Feeder Breakers shall have adequate wire bending space regardless of the interrupting rating. See table below for additional information.
   3. Conduit area for each section shall be a minimum of 17” wide and provide adequate depth for all section conduits. Select depth based on the tables below:

2.7 CIRCUIT BREAKERS AND TRIP UNITS

A. Circuit Breakers
   1. The circuit breaker shall be listed to (for UL 891 listed gear choose UL 489 for UL 1558 listed gear
choose UL 1066).

2. Circuit breakers shall be suitable for the required instantaneous rating without the use of current limiting fuses.

3. All circuit breakers shall have field interchangeable electrical accessories including shunt trip, spring release, electrical operator, auxiliary contacts, and Trip Unit.

4. All secondary connections shall be made directly to the front of the circuit breaker cradle.

5. Each Circuit breaker shall have built in contact temperature and contact wear sensors.

6. Circuit breaker must be equipped with an interlock to discharge the stored energy spring before the circuit breaker can be withdrawn from its cell. Circuit breaker must provide a positive ground contact check between the circuit breaker and cell when the accessory cover is removed while the circuit breaker is in the connected, test or disconnected positions.

B. Padlocking provisions shall be furnished to receive up to three padlocks when circuit breaker is in the disconnected position, positively preventing unauthorized closing of the circuit breaker contacts.

C. Provisions for up to two key locks shall be furnished allowing locking in the disconnected position. Provisions for locking in the connected, test and disconnected positions by padlock or key lock shall be available as an option.

D. Located on the face of the circuit breaker shall be buttons, with optional lockable clear cover, to open and close the circuit breaker and indicators to show the position of the circuit breaker contacts, status of the closing springs, and circuit breaker position in the cell. An indicator shall show "charged--not OK to close" if closing springs are charged but circuit breaker is not ready to close. Circuit breaker racking system must have positive stops at the connected, test, disconnected and withdrawn positions.

E. Circuit breaker must be equipped with an interlock to discharge the stored energy spring before the circuit breaker can be withdrawn from its cell. Circuit breaker must provide a positive ground contact check between the circuit breaker and cell when the accessory cover is removed while the circuit breaker is in the connected, test or disconnected positions.

F. Circuit breaker shall provide long service life. The 3200 A circuit breaker frame and those of lower ratings must be certified to perform a minimum of 10,000 operations without maintenance. The 4000 A and 5000 A frames must be certified to 5,000 operations without maintenance.

G. Trip Units
1. All trip units shall be removable to allow for field upgrades.
2. Trip Units shall incorporate "True RMS Sensing", and have LED long-time pickup indications.
3. All trip units shall have the option of turning instantaneously to the off position.
4. Electronic trip unit functions shall consist of adjustable long-time pickup and delay, optional short-time pickup and delay, instantaneous, OR optional neutral protection and optional ground-fault pickup and delay.
5. Adjustable long-time pickup (Ir) and delay shall be available in an adjustable rating plug that is UL Listed as field-replaceable. Adjustable rating plug shall allow for nine long-time pickup settings from 0.4 to 1 times the sensor plug (In). Other adjustable rating plugs shall be available for more precise settings to match the application. Long-time delay settings shall be in nine bands from 0.5–24 seconds at six times Ir.
6. Short-time pickup shall allow for nine settings from 1.5 to 10 times Ir. Short-time delay shall be in nine bands from 0.1–0.4 I2t ON and 0–0.4 I2t OFF.
7. Instantaneous settings on the trip units with LSI protection shall be available in nine bands from 2 to 15 times In.
8. All trip units shall have the capability for the adjustments to be set and read locally by rotating a switch. Optional: trip units shall have the capability to electronically adjust the settings locally and remotely to fine increments below the switch settings. Fine increments for pickup adjustments are to be one ampere. Fine increments for delay adjustments are to be one second.
9. Trip unit shall provide local trip indication and capability to indicate local and remote reason for trip, i.e., overload, short circuit or ground fault.
10. Ground-fault protection shall be available for solidly grounded three-phase, three-wire or three-phase, four-wire systems. Trip unit shall be capable of the following types of ground-fault protection: residual, source ground return, and modified differential. Ground-fault sensing systems may be changed in the
11. Ground-fault settings for circuit breaker sensor sizes 1200 A or below shall be in nine bands from 0.2 to 1.0 times In. The ground-fault settings for circuit breakers above 1200 A shall be nine bands from 500 to 1200 A.
12. Neutral current transformers shall be available for four-wire systems.
13. Trip units shall be capable of communicating on MODBUS® networks.
14. Trip units shall be available to provide additional protection by offering adjustable inverse definite minimum time lag (IDMTL). IDMTL provides optimized coordination by the adjustment of the slope of the long-time delay protection.
15. Trip units shall be available to provide real-time metering. Metering functions include current, voltage, power, and frequency.
16. Trip units shall be available to provide harmonic analysis and waveform capture.

H. ARC FLASH LIMITING FEEDER BREAKERS - Optional: Arc flashes limiting feeder breakers are to be used to reduce incident energy on equipment downstream of the switchgear. This equipment could be MCC’s, switchboards, panelboards, control panels, or busway, etc. They shall not be used to reduce arc flash incident energy (cal/cm2) inside the switchgear or while racking feeder breakers in and out of energized switchgear.
1. Feeder breakers shall be Low Voltage Power Circuit Breaker and listed to UL 1066.
2. Circuit breakers shall be suitable for 200kA short circuit rating without the use of current limiting fuses.
3. Circuit breaker shall have published testing data and IEEE 1584 equations to support the reduction of arc flash incident energy and flash protection boundary (mm).

2.8 DIFFERENTIAL GROUND FAULT PROTECTION
A. 480Y/277V or 600Y/347V, 4-wire, connected equipment having multiple sources shall have a modified differential ground fault system (MDGF). The manufacturer shall complete the MDGF design prior to building equipment to insure that the proper main or tie breaker(s) operate properly during the following occurrences on the main bus.
1. Ensure the system will trip with the occurrence of a ground fault at any location in the switchgear.
2. Ensure system will not trip without ground fault and with normal current flow.
3. Ensure system will not trip due to large single-phase currents.
4. Ensure system will trip with combination of normal current flow and ground fault current flowing together.
5. Ensure system will not trip with circulating currents through the neutral due to multiple grounds and sources external to the immediate low voltage power sources.
6. The manufacturer shall be required to include additional CT’s, ground fault relays, interlocks, wiring, components etc. to insure the ground fault systems operates without nuisance tripping on the main bus of the switchgear.

2.9 OPTIONAL ACCESSORIES
A. Provide a floor running portable circuit breaker transfer truck with manual lifting mechanism.
B. Alternate Maintenance Setting (AMS) switch Design for the temporary arc-flash incident energy reduction during maintenance activities.
1. For each feeder circuit breaker, provide a manual switch on the compartment door to switch the circuit breaker short time tripping characteristics to instantaneous with minimum pick-up setting, in order to reduce the danger from potential arc-flash at downstream equipment.
2. Provide a lock feature for the AMS switch so that it may be locked in either the Off or On maintenance mode position.
3. Provide a blue LED indicating light to indicate AMS switch is in the maintenance mode.
4. Wire contacts on all AMS switches to a common alarm input to plant control system.
5. Provide for remote AMS switches or indication, as needed.
6. If circuit breaker integral trip unit cannot be controlled as specified, provide discrete relay with shunt-trip or equivalent to provide specified performance.

2.10 TRANSIENT VOLTAGE SURGE SUPPRESSION
A. Provide transient voltage surge suppression as shown in Drawings.
2.11 INDIVIDUAL GENERATOR MONITORING AND CONTROL PANEL

A. Provide a paralleling control panel for each generator set in the emergency/standby power system. The paralleling control functions shall be integrated with the generator set control functions, and provided in a single, dedicated purpose microprocessor-based control designed and manufactured by the generator set manufacturer. Each paralleling control panel shall contain the functions as described in this section. No PLC-based control shall be used to provide these functions. Each paralleling control shall be independent and autonomous, requiring no interaction with other controls for proper operation, except load sharing and paralleling breaker status functions. Failure of the system master control shall have no impact on the functions described in this section for the generator sets.

1. The control shall be designed for proper operation without recalibration in ambient temperatures from -40 °C (-40 °F) to +70 °C (158 °F), and for storage from -55 °C (-67 °F) to +80 °C (176 °F). Control will operate with humidity up to 95%, non-condensing.

2. The HMI shall be designed for proper operation in ambient temperatures from -20 °C (-4 °F) to +70 °C (158 °F), and for storage from -30 °C (-22 °F) to +80 °C (176 °F). The control board shall be fully encapsulated to provide superior resistance to dust and moisture. Display panel shall have a single membrane surface, which is impervious to effects of dust, moisture, oil and exhaust fumes. The panel shall use a sealed membrane to provide long reliable service life in harsh environments. The control system shall be specifically designed and tested for resistance to RFI/EMI and to resist effects of vibration to provide a long reliable life when mounted on a genset. The control shall include transient voltage surge suppression to provide compliance to referenced standards.

3. Each paralleling control shall be provided with an operator panel to allow the operator to view the status and control operation of the specific generator set being paralleled. The operator panel shall be provided with the following features and capabilities.

   a. The control shall include an option to provide both a local and remote operation panel.
   b. The control shall provide comprehensive three phase AC metering functions for the generator set and an additional source, including: 3-phase voltage (L-L and L-N) and current, frequency, phase rotation, individual phase and totalized values of kW, kVAR, kVA and Power Factor; totalized positive and negative kW-hours, kVAR-hours, and kVA-hours. Three wire or four wire voltage connection with direct sensing of voltages to 600V, and up to 45kV with external transformers. Current sensing is accomplished with either 5 amp or 1 amp CT secondaries and with up to 10,000 amp primary.
   c. Running Time Meter, Start Counter,
   d. Four tactile feel membrane switches shall be included to control auto mode, stop/off, manual mode, and manual start.
   e. Two tactile feel membrane switches dedicated to control of circuit breaker shall be included.
   f. One tactile feel membrane switch shall be provided for fault reset.
   g. One tactile feel membrane switch shall be provided to test panel lamps. Operation of this switch shall cause all lamps on the panel to be simultaneously tested.
   h. The control panel shall be provided with a set of DC-powered lamps with a switch to allow viewing of all functions on the front panel when normal lighting systems are not available.
   i. Emergency Stop switch. The emergency stop switch shall be a red, mushroom head switch which maintains its position until manually reset.
   j. Precision voltage and frequency adjust raise/lower switches. Switches shall allow the generator set frequency and voltage to be adjusted plus or minus 5% when the generator set is operating independently of the system bus. The switches shall be disabled when the paralleling breaker is closed. Voltage and frequency adjustments while the paralleling breaker is open shall not impact on the load sharing when the paralleling breaker is closed.
   k. The control shall support the following languages: English, Spanish, French, German, Italian, Greek, Portuguese, Finnish, Norwegian, Danish, Russian (Cyrillic), Chinese, Hungarian, Japanese, Polish, and Czech.
   l. Alarm and status indicating panel to indicate the following conditions (alarm horn shall be located on master control):

<table>
<thead>
<tr>
<th>Function</th>
<th>Lamp Color</th>
<th>Alarm Horn</th>
<th>Shutdown Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition</td>
<td>Light Color</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low DC Voltage</td>
<td>Amber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High DC Voltage</td>
<td>Amber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weak Battery</td>
<td>Amber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fail to Sync</td>
<td>Amber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Oil Pressure Alarm</td>
<td>Amber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Fuel – day tank</td>
<td>Amber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Engine Temp Alarm</td>
<td>Amber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground Fault</td>
<td>Amber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overcurrent Alarm</td>
<td>Amber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breaker Failure</td>
<td>Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breaker Tripped</td>
<td>Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not in Auto</td>
<td>Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Engine Temp</td>
<td>Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Oil Pressure</td>
<td>Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overcurrent</td>
<td>Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short Circuit</td>
<td>Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of Excitation</td>
<td>Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse Power</td>
<td>Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overcrank</td>
<td>Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overspeed</td>
<td>Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under Frequency</td>
<td>Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under Voltage</td>
<td>Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over Voltage</td>
<td>Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase Rotation</td>
<td>Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Coolant Level</td>
<td>Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automatic</td>
<td>Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generator Running</td>
<td>Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breaker Open</td>
<td>Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breaker Closed</td>
<td>Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demand Mode Standby</td>
<td>Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timing for Start</td>
<td>Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timing for Shutdown</td>
<td>Green</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**B. Internal Controls.** The following internal control functions shall be provided for each generator set control in the system.

1. The control shall include a synchronizer to electronically adjust the engine governor to match the voltage, frequency and phase angle of another source such as another generator set(s) or the utility grid. Synchronizer shall maintain the engine generator voltage within 0.5 - 10% (adjustable) of bus voltage and phase angle within 0.1 – 20 electrical degrees (adjustable) of the bus for 0.5 - 5 seconds (adjustable) before circuit breaker closing. The synchronizer shall include provisions to provide proper operation even with highly distorted bus voltage waveforms. The synchronizer can match other sources over a range of 60-110% of nominal voltage and -24 to +6 hertz. The system shall be provided with a fail to synchronize time delay that is adjustable from 10-900 seconds. Control logic for fail to synchronize function shall allow field adjustment of function for either alarm or shutdown of the generator set on failure condition. Each unit shall have its own synchronizer; systems using a switching scheme to utilize a single system synchronizer will not be approved. Synchronizers
systems which utilize a motor driven pot for control of AC voltage during the synchronizing process will not be accepted.

2. Controls shall include a sync check function to prevent accidental closure of the paralleling breaker with the generator set out of phase with the bus. Provisions to allow closure of the first generator set to a de-energized bus shall be included. Adjustable criteria are for the sync check function shall be: phase difference from 0.1-20 degrees, frequency difference from 0.001-1.0 Hz, voltage difference from 0.5-10%, and a dwell time from 0.5-5.0 seconds. The sync check function should ensure that generator set phase rotation matches bus phase rotation. Internally the sync check shall be used to confirm synchronization prior to performing closed transition operations. An external sync check output is also available. The sync check function shall operate in both the automatic and manual mode of the generator set control.

3. Electronic isochronous kW load sharing control to operate the engine governors during synchronizing and to provide isochronous load sharing when paralleled. The control system shall allow sharing of real kW load between all generator sets in the system to within 1% of equal levels, without introduction of frequency droop into the system. The control system shall include all equipment required for kW load sharing with an isolated bus. Electronic kVAR load sharing control shall operate the alternator excitation system while the generator set is paralleled. The control system shall allow sharing of reactive load between all generator sets in the system to within 1% of equal levels, without introduction of voltage droop into the system. The isochronous load sharing module shall be integral function of the generator control.

4. When the generator set control receives a signal indicating that the genset is paralleled with an infinite source such as a utility (mains) service, the genset shall operate in load govern mode. Control shall be adjustable for kW values from 0-100% of standby rating, and 0.7-1.0 power factor (lagging). The control shall include inputs to allow independent control of kW and kVar load level by a remote device while in the load govern mode. The rate of load increase and decrease shall also be adjustable in the control.

5. Load demand governing controls shall be provided to cause the generator set to ramp down to zero load when signaled to shut down in a load demand mode. On a signal to re-start, the load demand governing controls shall cause the generator set to synchronize to the system bus, close, and ramp up to its proportional share of the total bus load. The ramp rate of the generator set shall be operator-adjustable.

6. The control shall include a first start function to monitor all of the generator sets as they are starting to positively prevent out of phase paralleling if two or more engine generator sets reach operating conditions simultaneously. The control shall provide a lockout signal to disable breaker closure for generator set(s) in the system which have not been selected to be the first units to close to the bus. The control shall verify that the generator set has reached at least 90% of nominal voltage and frequency before closing to the bus. Controls shall recognize a failure of the first breaker signaled to close and allow system operation to proceed in spite of this failure. The first start function shall be integral to each generator set control and failure of any generator set control shall not affect the first start functionality of the other controls in the system. Systems using dead bus relay schemes without a disable signal to positively prevent out of phase paralleling shall not be acceptable under this specification. Systems that provide an independent PLC to perform this function shall not be acceptable. System shall include an independent backup to automatically operate in the event that the primary system fails.

7. The control shall include an integrated three phase line-to-line sensing voltage regulation system that is compatible with shunt or PMG excitation systems. The voltage regulation system shall be three phase full wave rectified and have a FET output for good motor starting capability. Major system features shall include: Digital output voltage regulation - Capable of regulating output voltage to within +/-1.0% for any loads between no load and full load. Voltage drift shall not exceed +/-1.5% for a 40 °C (104 °F) change in temperature in an eight hour period. On engine starting or sudden load acceptance, voltage shall be controlled to a maximum of 5% overshoot over nominal level.

8. The control shall include an integrated isochronous governing system capable of controlling engine speed within +/-0.25% for any steady state load from no load to full load. Frequency drift shall not exceed +/-0.5% for a 33 °C (60 °F) change in ambient temperature over an 8 hour period. The control shall include temperature dependent governing dynamics that will modify the engine governing control parameters as a function of engine temperature.

9. Masterless Load Demand: The control shall offer the capability for generator sets to share essential
information regarding the current systems load and available system capacity in isolated bus paralleling topology. All generator sets in this mode shall be capable of autonomously starting and stopping based on dynamic analysis of real power (kW) system load versus demand, such that in the event that total capacity is above the specified load set point then generator sets can be shutdown to avoid unnecessarily providing surplus capacity, whereas by contrast in the event that total capacity is below the specified load set point then generator set can be started to provide the required additional capacity per load needs. The priority for generator set starting and shutdown can be set either by the operator or be based upon the number of generator set run hours. Integrated on-board system logic provides the MLD topology control without the need for any additional system.

10. The control shall include a derate function to reduce output power of the genset in response to a fault condition. If a derate command occurs while operating on an isolated bus, the control shall issue commands to reduce the load on the genset via contact closures or Modbus. If a derate command occurs while in utility parallel mode, the control shall actively reduce power by lowering the base load kW to the derated target kW.

11. The control shall provide a load shed signal when the generator set overloaded or in an under frequency condition. The overload parameters shall be adjustable from 80%–140% of generator kW rating for more than 0-120 seconds. The frequency parameters shall be adjustable from 0.1-10Hz under nominal frequency for more than 0-20 seconds.

12. The control shall accept up to four alarm or status inputs to indicate a configurable (customer-specified) condition. The inputs shall be programmable for warning, derate, shutdown, shutdown with cooldown or status indication and for labeling the input.

13. The control in conjunction with InPower software, shall accept commands to allow a technician to verify the proper operation of the control and its interface by simulating failure modes or by forcing the control to operate outside of its normal operating ranges.

14. The control shall include provisions for utility and genset breaker interfaces including separate relays for opening and closing the respective breaker, as well as inputs for both 'a' and 'b' breaker position contacts and tripped status. Breaker diagnostics shall include contact Failure, fail to close, fail to open, fail to disconnect, and tripped. Upon breaker failure, appropriate control action shall be taken to maintain system integrity.

15. The control shall provide adjustable start delay from 0-300sec, stop delay from 0-800sec, transfer delay from 0-120sec, retransfer delay from 0-1800sec, programmed transition delay from 0-60sec, and maximum parallel time from 0-1800sec.

16. Cooldown time delay, adjustable: 0-600 seconds. The control panel shall indicate the time remaining in the time delay period when the generator set is timing for shutdown.

17. Control equipment shall contain a system of diagnostic LED’s to assist in analyzing proper system function.

C. Generator Set Protection – The control shall include the protective functions listed below. On operation of a protective function the control shall indicate a fault by illuminating the appropriate status LED on the HMI, as well as display the fault code and fault description on the HMI display screen. The nature of the fault and time of occurrence shall be logged in the control.

1. The control shall include a Maintenance Mode that will provide the capability to instantaneously shutdown the generator set in order to reduce the risk of Arc Flash due to thermal overload or electrical faults by inverse time protection.

2. Reverse power shutdown (32) - Controls shall be provided to sense reverse power conditions on the engine while paralleled to the system bus. Reverse power protection shall be set to operate at not more than 20% of the kW rating of the generator set at standby conditions. Adjustment range: 5-20% of standby kW rating, delay 1-15 seconds. Default: 10%, 3 seconds.

3. Reverse Var shutdown - Controls shall be provided to sense reverse var conditions on the alternator while paralleled to the system bus. Reverse Var protection shall be set to operate at not less than 15% of the kVAR rating of the alternator at standby conditions. A reactive capability curve shall be provided to allow proper setting of this protection. Shutdown level is adjustable: 15-50% of rated Var output, delay 10-60 seconds.

4. Overcurrent warning/shutdown (51) - Electronic alternator overcurrent alarm and shutdown protection. This protection shall be required in addition to the overcurrent trip on the paralleling breaker, and shall sense current flow at the generator set output terminals. The overcurrent alarm shall be indicated
when the load current on the generator set is more than 110% of rated current for more than 60 seconds. The overcurrent shutdown shall be matched to the thermal damage curve of the generator set, and shall not have an instantaneous function.

5. Short circuit protection - This protection is in addition to the overcurrent trip on the paralleling breaker. The short circuit shall occur when the load current on the generator set is more than 175% of rated current and an aggregate time/current calculation indicates that the system is approaching the thermal damage point of the alternator. The equipment used shall not have an instantaneous function and shall be selectively coordinated with the feeder circuit breakers. Control shall include algorithms to protect alternator from repeated over current conditions over a short period of time.

6. Current Regulation - A UL-listed comprehensive monitoring and control system shall be integral to the generator set control that guards the electrical integrity of the alternator and power system by providing protection against a wide array of fault conditions in the genset or in the load. The current regulation control system shall provide single and three phase fault current regulation so that downstream protective devices have the maximum current available to quickly clear fault conditions without subjecting the alternator to potentially catastrophic failure conditions. The control shall provide overcurrent and short circuit protection for the conductors connecting the generator set to the paralleling switchgear. This protection may be integrated with alternator protection but must be positively coordinated to prevent tripping of the paralleling breaker prior to the operation of the alternator protective equipment.

7. Controls shall be provided to regulate output current on any phase to a maximum of 3 times rated current under fault conditions for both single phase and three phase faults. In conjunction with a permanent magnet generator, it shall provide 3 times rated current on all phases for motor starting and short circuit coordination purposes.

8. High AC voltage shutdown (59) - Controls shall be provided to shut down generator set and initiate alarm when the generator set output voltage on any phase exceeds preset values. Time to trip is inversely proportional to amount above threshold. Values adjustable from 105-125% of nominal voltage, with time delay adjustable from 0.1-10 seconds.

9. Low AC voltage shutdown (27) - Controls shall be provided to shut down generator set and initiate alarm when the generator set voltage on any phase has dropped below a preset value. Adjustable over a range of 50-95% of reference voltage, time delay 2-20 seconds. Function tracks reference voltage. Control does not nuisance trip when voltage varies due to the control directing voltage to drop, such as during a V/Hz roll-off or synchronizing.

10. Under frequency shutdown (81 u) - Controls shall be provided to shut down generator set and initiate alarm when the generator set output frequency cannot be maintained. Settings are adjustable from 2-10 Hz below reference governor set point, for a 1-20 second time delay. Under frequency protection is disabled when excitation is switched off, such as when engine is operating in idle speed mode.

11. Over frequency shutdown/warning (81o) - Controls shall be provided to shut down generator set and initiate alarm when the generator set is operating at a potentially damaging frequency level. Settings are adjustable from 2-10 Hz above nominal governor set point for a 1-20 second time delay.

12. Low and high battery voltage warning – The control shall indicate status of battery charging system (failure) by continuously monitoring battery voltage.

13. Weak battery voltage warning - The control shall test the battery each time the genset is signaled to start and indicate a warning if the battery indicates impending failure.

2.12 MASTER CONTROL SYSTEM AND MONITORING EQUIPMENT

A. A Master Control System and Monitoring Equipment: Provide an independent system master control to monitor and control the operation of the entire paralleling system. Each panel shall contain the components and devices as described in this section.

B. Construction

1. The Master Control should be housed either fully incorporated into the switchgear or housed separately in a standalone enclosure.

2. The enclosure frame shall be welded and constructed of a minimum of 12 gauge steel. Covers shall be constructed of a minimum of 16 gauge steel.

3. The enclosure shall be painted smooth ANSI 61 Gray and the interior subpanels shall be full height of the enclosure, constructed of a minimum 12 gauge unpainted galvanized conductive steel. The
ENCLOSURE should allow for baying as necessary to house all the necessary components for the Master Control.

4. All doors and covers shall have foam-in-place urethane gaskets.
5. The enclosure shall be a design to allow top lifting with lifting eyes
6. The enclosure shall include a lockable door handle which operates a three-point latching system, with a minimum of two keys provided.
7. The enclosure shall be NEMA 1.
8. All interior panels and doors shall be bonded to the grounding bar.
9. The master control system shall be listed and labeled under the requirements of UL 891, including all covers, barriers, and supports. Individual control sections shall be isolated from each other by metal or insulating barriers.
10. All wiring shall be UL listed 105 degree C, 600 volt rated, and sized as required. Each wire, device or function shall be suitably identified by silk screen or similar permanent identification.
11. AC control circuits in the switchboard shall be protected with properly sized miniature circuit breakers. Potential transformers shall be protected on line and load side.
12. All CT installations shall include shorting type terminal blocks.
13. All field control interconnecting wiring shall be sized as specified by system manufacturer (wiring not designated by the system manufacturer shall be minimum 14 AWG copper). All control interconnect wiring shall be stranded.
14. All active control system components in the system shall be suitable for operation in ambient temperatures ranging from 0 to +60 degrees C. The active control electronics shall be environmentally protected from dust, dirt, and humidity. The controls shall be suitable for operation in an ambient ranging from 5-95% relative humidity, and shall be protected from the effects of equipment vibration.
15. The touchscreen and other non-LED displays specified shall be suitable for operation from 0- +50 degrees C. The controls shall be suitable for operation in an ambient ranging from 10-90% relative humidity.

C. Additional Components Required
1. A door operated 24VDC LED light connected to the best battery system shall be provided to allow for troubleshooting when normal lighting systems are not available.
2. Service ports that allows a PC, mouse, keyboard, and mass storage media connection to the interior control components without needing to open the enclosure door during regular operation, maintenance and service.
3. An alarm horn with a red flashing LED light shall be provided with sound level at least 90 db at 10cm pulsing.

D. Main Controller
1. The Main controller of the Master Control shall be: Cummins DMC-8000.
2. The PLC shall use a non-volatile memory to store the program, constants, symbols, comments, and data and shall not require a battery that requires regular maintenance. (Remove for Redundancy option)
3. The PLC and associated I/O components shall have the following minimum specifications:
   a. 0-60 degree C operating temperature
   b. -40 to 85 degree C storage temperature
   c. 19Vdc to 30Vdc operating voltage
   d. LED diagnostics for troubleshooting.
1. The PLC shall use primarily a distributed I/O configuration to reduce the amount of interconnect wiring.
2. PLC languages used shall comply with IEC 61131. The Primary code language for the sequence of operation shall be Sequential Function Chart.
3. The PLC programming software shall automatically keep track of each change by recording the build version. This version shall be available on the diagnostics screen in the HMI.
4. The PLC programming software vendor shall maintain additional tools to allow for the ability to automatically and graphically display the differences between two program versions.
5. The PLC I/O shall be primarily of a distributed I/O architecture with the I/O placed as close as possible to the device being controlled to limit the amount of interconnect wiring and reduce field wiring mistakes. Typically this would consist of the I/O being mounted on a din rail in the switchgear.
enclosure.

6. The PLC I/O network shall be a self-healing Ethernet ring network, where any cable break will not interrupt communications between the PLC and the I/O communication module. Diagnostic information shall be located on the diagnostics screen in the HMI to graphically indicate where any cable breaks and communication failures have occurred.

E. Operator Panel
1. The Operator Panel shall be constructed of two parts, a Touchscreen and an Industrial PC.
   a. Both the Touchscreen and Industrial PC shall have separate isolated 24VDC power supplies.
   b. The touchscreen shall be constructed so that it can be replaced without any program modifications, licensing, or software tools.
   c. The touchscreen shall have an aluminum bezel and be a resistive touch 19 inch SXGA TFT LCD LED backlight with 1280x1024 resolution.
   d. The Industrial PC shall be of a panel mount construction.
   e. The Industrial PC shall have the following specifications and shall not have any moving parts such as fans or spinning media drives:
      1) 32GB Solid State Hard Disk Drive
      2) Windows 7 embedded
      3) 2 10/100/1000 Base T RJ45 ports
      4) 6 USB 2.0 Ports
      5) 9-35VDC power supply
2. One of the Ethernet ports on the Industrial PC shall be dedicated for customer interface to the web server and building management system interface.

2.13 OPERATOR SCREENS

A. The Operator Screens shall be constructed so that every main screen is within one click of each other. A common navigation bar should be available so that any screen can be accessed from another screen without the need to return to a main menu. The Screen Navigation buttons shall be graphical in nature and indicate visually whether the screen is available to be selected, is unselected, or is selected.

B. The operator screens shall have visual indication of new and active alarms as well as the number of active alarms on every screen. The active alarm log screen shall be within one click from any other screen.

C. Operator Help Screens shall be available on every screen with screen specific content.

D. The Security Log-in/Log out screens shall be available from every screen.

E. The current System Operating Mode shall be displayed on every screen.

F. Online Diagram: The Online Diagram shall display graphical indication of all Power System components monitored by the Master Control, including:
   1. Generator State (Running, Not Running)
   2. Generator Mode (Auto, Manual, Start Pending, Running, Cooldown, Load Demand Stop)
   3. Generator Fault (Warning, De-rate, Shutdown)
   4. Breaker States (Open, Closed, Racked Out, Failed, Unknown, Manual)
   5. Breaker Type (Fixed Mount, Drawout).
   6. All Loads assigned to the Load/Add shed sequence shall display the levels to which the load is assigned
   7. Bus Status (Hot, Cold, Unknown)
   8. Feeder Breakers shall have the ability to open and close by pressing the breaker symbol to open a control window for operator initiated open and close.
   9. Automatic Transfer Switches shall show status of the switch as well as the source status when available.
   10. The Power System device names shall be field editable to suit customer specific device names and shall not require programming software to do so.
   11. Average Voltage and Power for each source shall be displayed.

G. The Generator Summary Screen shall display generator state, status, and all engine and alternator parameters including at a minimum the following:
   1. Generator Control Switch Position
2. Generator State
   a. Stopped
   b. Start Pending
   c. Warmup at Idle
   d. Running
   e. Cool down at rated
   f. Cool down at idle

1. Generator Common Warning
2. Generator Shutdown
3. Load Demand Stop
4. Circuit Breaker Position
   a. Open, Closed, disconnected, Unknown, Failed

5. Engine Data
   a. Engine Speed
   b. Oil Pressure
   c. Coolant Temperature
   d. Battery Voltage
   e. Engine Runtime
   f. Number of Starts
   g. Kilowatt Hours
   h. Fuel Rate
   i. Total Fuel Used

6. Alternator Data
   a. Line to Line Voltage
   b. Line to Neutral Voltage
   c. Current
   d. Frequency
   e. Power Factor
   f. Total kW
   g. Percent kW
   h. Total kVA
   i. Total kVAR

7. Paralleling Bus Data
   a. Line to Neutral Voltage
   b. Line to Line Voltage
   c. Frequency

8. Annunciator Points
   a. Common Alarm
   b. Genset Supplying Load
   c. Genset Running
   d. Not in Auto
   e. High Battery Voltage
   f. Low Battery Voltage
   g. Charger AC Failure
   h. Failed to Start
   i. Low Coolant Temperature
   j. Pre High Engine Temperature
   k. High Engine Temperature
   l. Pre Low Oil Pressure
   m. Over Speed
   n. Low Coolant Level
   o. Low Fuel Level

9. Analog Gauges shall be available and the gauge range shall be field adjustable without additional
programming software with the following features:
a. Power
b. Average Voltage Line to Line
c. Average Current
d. Frequency
e. Oil Pressure
f. Coolant Temperature
g. Engine Speed
h. Battery Voltage
10. Manual Generator Control
   a. Start
   b. Stop
   c. Fault Reset
11. Paralleling Breaker Control
   a. Open
   b. Close
H. Metering Screen
   1. The metering screen shall display system metering data at a minimum for all source breakers. The metering shall be a minimum of 1% accurate for voltage and current measurements.
   2. The following data shall be displayed.
      a. Voltage Line to Line (Phase)
      b. Voltage Line to Line (Average)
      c. Voltage Line to Neutral (Phase)
      d. Voltage Line to Neutral (Average)
      e. Current (Phase)
      f. Current (Average)
      g. Frequency
      h. Real Power (Phase)
      i. Real Power (Average)
      j. Reactive Power (Phase)
      k. Reactive Power (Average)
      l. Apparent Power (Phase)
      m. Apparent Power (Average)
      n. Power Factor (Average)
      o. KW Hours Import (Total)
      p. KW Hours Export (Total)
      q. KVAR Hours Import (Total)
      r. KVAR Hours Export (Total)
   3. Analog Gauges should be available for the following parameters. The range shall be field adjustable for min and max. The gauges shall be available in two sizes.
      a. Real Power (kW)
      b. Average Voltage Line to Line
      c. Average Current
      d. Frequency
I. Trending Screen
   1. The Trending Screen shall display the historical data log information from the database. The data log rate shall log parameter data as it changes and should not exceed a 2 second log rate.
   2. The trending graph shall be able to display up to 8 simultaneous pens.
   3. The trending graph shall allow for each parameter being logged to be displayed at any one time and not be limited to trend “groups”, or limited to a single simultaneous device.
   4. The graph scale shall be adjustable for time as well as for each parameter’s y axis.
   5. The Trend shall be able to be paused and then re-started without any loss of data.
   6. The available trend information shall be for the previous 90 days at a minimum in a FIFO format.
   7. The Trend data shall be available for export to a USB media drive in a .CSV file format.
8. The following Parameters shall be available for Trending:
   a. Generator Data
      1) i. Average Voltage Line to Line
      2) ii. Average Voltage Line to Neutral
      3) iii. Average Current
      4) iv. Percent kW
      5) v. Total kW
      6) vi. Total kVAR
      7) vii. Total KVA
      8) viii. Frequency
      9) ix. Power Factor
      10) x. Battery Voltage
      11) xi. Oil Pressure
      12) xii. Oil Temperature
      13) xiii. Coolant Temperature
      14) xiv. Engine RPM
      15) xv. Fuel Rate
   b. Meter Data
      1) i. Average Voltage Line to Line
      2) ii. Average Voltage Line to Neutral
      3) iii. Average Current
      4) iv. Total kW
      5) v. Total kVAR
      6) vi. Total KVA
      7) vii. Frequency
      8) viii. Power Factor
   c. ATS Load Data (Optional)
      1) i. Line to Neutral Voltage
      2) ii. Line to Line Voltage
      3) iii. Current
      4) iv. Frequency
      5) v. Power Factor
      6) vi. Total kW
      7) vii. Total kVA
      8) viii. Total kVAR

J. System Control Screen
   1. The System Control Screen shall be the screen where all operator initiated functions are started and stopped.
   2. The System Control functions include:
      a. Transition Type Selection
      b. Time Delay Adjustments
      c. System Mode Adjustments

K. Load Control Screen
   1. The Load Control Screen shall allow for load level configuration for each load. Each load should be able to be assigned to a configurable load add and load shed level.
   2. The Shed levels should be allowed to be automatically assigned according to the order of the assigned add level, or if desired be operator customized.
   3. Each Load shall be able to have a field configurable name that corresponds to the name on the one line diagram. Programming software should not be required to change the load name.
   4. The Load Control Screen shall show the status of each Load Level as follows:
      a. Added
      b. Shed
      c. Restored
5. Generator Bus Metering Shall be displayed on the Load Control Screen.
6. Manual Add/Shed control of each load level shall be available.

L. Load Demand Screen
   1. The Load Demand Screen Shall allow for enabling the Load Demand Function.
   2. Functionality for Load Demand shall be field adjustable for the following engine shutdown sequences.
      a. Operator Entered Sequence
      b. Engine Run Hour Optimization Sequence
         1) Rotate the Generator Shutdown Sequence automatically based on a field adjustable engine hour difference set point.
      a. Engine Rotation Sequence
         1) Rotate the shutdown sequence each time the generators are called to start.
   1. The load demand function shall automatically adjust the load demand sequence to remove a generator that is shutdown on a fault, and to move a generator with an active warning to be the first generator to shut down in the sequence
   2. The Load demand shutdown algorithm shall be field adjustable for the following methods:
      a. Generator Operating Percentage
         1) Adjusts the number of generators online based upon a shutdown and pickup loading percentage.
      a. Absolute kW
         1) Adjusts the number of generators online based upon the online kW reserve capacity.
         2) Allow for N+1 Redundancy to ensure at least N+1 generators are always available to the load.
   1. The following Load Demand set points shall be available for adjustment:
      a. Initial Time Delay
      b. Shutdown Time Delay
      c. Restart Time Delay
      d. Spare Capacity Pickup KW
      1. A table shall be available to display the next generator to start, stop, and the respective kilowatt values for when each generator will start and stop based on the current Load Demand setup parameters.
         a. Additionally the table shall show the availability of each generator in the system.
   1. The Load Demand settings and sequence shall be verified by the control for accuracy and validity prior to implementing any changes.

M. Event Log Screen
   2. The Event Log Screen shall log all events in the system. In general this should be any change in the system that does not require operator intervention or acknowledgement.
   3. The Event Log shall log all state changes for Security Log, System Events, Breakers, Generators, and ATS as follows:
      a. Generator
         1) The generator has been given a start command
         2) The generator is warming up at idle
         3) The generator is running
         4) The generator is cooling down at rated speed
         5) The generator is cooling down at idle
         6) The generator has stopped
      b. Breaker
         1) The circuit breaker is closed
         2) The circuit breaker is open
         3) The circuit breaker has been racked out (optional)
      c. ATS
         1) The ATS is connected to Normal
         2) The ATS is connected to Emergency
         3) The ATS is in the Neutral position
4) The ATS is connected to both the Normal and Emergency source (Closed transition ATS only)

d. System
1) Changes in the system mode (Manual, Open Transition, Soft Closed Transition, Hard Closed Transition)
2) System Test Mode (Test with Load, Test without Load, Extended parallel)
3) Load Bus Selected
4) Remote Commands Enable/Disable
5) Audible Alarm Silence
6) Load Demand Mode

e. Security
1) User logon
2) User log off
3) iii. User changed their password
4) iv. A user was added to the system
5) v. A user was removed from the system

1. The Event Log shall have the ability to filter events based on the event type or the date that an even occurred.
2. The Event log shall be able to show up to 1000 events.
3. The Event log shall be able to be printed.
4. The Event log shall be able to be cleared.

N. Current Alarm Screen
5. The Current Alarm Screen shall display all currently active or unacknowledged alarms
6. The alarm shall be time and date stamped.
7. The alarms shall be color coded by status of the alarm
   a. Active Alarms should appear in Red
   b. Active Alarms that have been acknowledged should appear in green
   c. Inactive Alarms yet to be acknowledged should appear in blue

1. The current alarm list shall be able to be printed.
2. The current alarms shall be available to be emailed as they become active.
3. The DMC shall log at a minimum the following alarms:
   a. Generator Alarms
      1) Shutdown with Breaker Fail to Open
      2) Fail to Come Online
      3) Communication Failure
      4) Common Alarm
      5) Not in Auto
      6) High Battery Voltage
      7) Low Battery Voltage
      8) Charger AC Failure
      9) Fail to Start
     10) Low Coolant Temp
     11) PreHigh Engine Temp
     12) High Engine Temp
     13) PreLow Oil Pressure
     14) Low Oil Pressure
     15) Over speed
     16) Low Coolant Level
     17) Low Fuel Level
     18) Ground Fault (optional)
     19) High AC Voltage
     20) Low AC Voltage
     21) Under Frequency
22) Overload
23) Overcurrent
24) Short Circuit
25) Reverse KW
26) Reverse KVAR
27) Fail to Sync
28) Emergency Stop
29) NEC Fail to Open (optional)
30) NEC Fail to Close (optional)

b. Generator Breaker Alarms
1) In Manual (optional)
2) Fail to Open
3) Fail to Close
4) Ground Fault (optional)
5) Lockout Trip
6) Protective Relay Failure (optional)
7) Unexpected Out of Cell (optional)

c. Main Circuit Breaker Alarms
1) Fail to Open
2) Fail to Close
3) Fail to Sync
4) Aux Failure
5) Ground Fault (optional)
6) Lockout Trip
7) Protective Relay Failure (optional)
8) Unexpected CB Open
9) Unexpected CB Close
10) Unexpected Change to Manual (optional)
11) Unexpected Out of Cell (optional)
12) In Manual (optional)

d. Power Transfer Alarms
1) Transfer Pair Ramp Load Up Failure (optional)
2) Transfer Pair Ramp Load Down Failure (optional)
3) Transfer Pair Minimum Capacity Not Met (optional)
4) Transfer Pair Fail to Disconnect (optional)

e. Feeder Breaker Alarms
1) Fail To Open (optional)
2) Fail To Close (optional)
3) Ground Fault
4) Lockout Trip
5) Protective Relay Fail (optional)
6) In Manual (optional)

f. Load Control Alarms
1) Overload Alarm
2) Load Shed Level (one alarm per shed level)
3) Quick Shed
4) Invalid Load Dump Signal

g. Communication Alarms
1) IO Link 1 Failure
2) IO Link 2 Failure
3) IO Device Warning
4) IO Device Failure
5) IO Communication Alarm
6) PLC to Touchscreen Communication Failure
h. System Alarms
   1) Low Fuel Main Tank
   2) Remote Genset E-Stop Active
   3) System in Manual
   4) Master Synchronizer Hardware Failure
   5) Station Power UPS Alarm
   6) Station Power From Batteries
   7) PLC Communication Failure
   8) PLC Memory Card Failure
   9) PLC Failure
   10) HMI Low Disk Space
   11) Neutral Ground Resistor Fault (optional)
   12) NEC Failure (optional)

O. Alarm History Screen
   1. The Alarm History database shall hold all recorded alarms for 365 days and shall be able to display up to 1000 alarms simultaneously.
   2. The Alarm History Screen shall allow an operator to filter the displayed alarms by the following filter types
      a. Date
      b. Message (User entered text string)
   1. The displayed alarm history screen shall be able to be printed.

P. ATS Summary Screen (Optional)
   1. The ATS Summary screen shall display all AC metering data and ATS position for each networked ATS in the system.
   2. The data displayed shall be at a minimum the following:
      a. Line to Line Voltage
      b. Line to Neutral Voltage
      c. Current
      d. Frequency
      e. Power Factor
      f. Total kW
      g. Total kVA
      h. Total kVAR
   3. The following annunciation points should be available:
      a. Source 1 available
      b. Source 1 connected
      c. Source 2 available
      d. Source 2 connected
      e. Common Alarm
      f. Not in Auto
      g. Test / Exercise Mode
      h. Load Shed
      i. Transfer Inhibit
      j. Retransfer Inhibit
      k. Fail to Close
      l. Fail to Disconnect
      m. Bypass to Emergency (Option)
      n. Bypass to Normal (Option)
   4. A control option shall be available to allow for a remote test of each ATS in the system. The test function shall allow for a group of ATS to be selected and tested simultaneously.

Q. Scheduler Screen
   1. The master control shall have the ability to run scheduled events based on a set Calendar and event type.
2. The Scheduler Screen shall allow for all setup and configuration of the Schedules including the following:
   a. Repeat Intervals
      1) Every Week
      2) Every 2 Weeks
      3) Every 4 Weeks
      4) First week of the month
      5) Second week of the month
      6) Third week of the month
      7) Fourth week of the month
      8) Last week of the month
   b. The day of the week for which the scheduled event will occur
   c. The start time and duration of the event.
   d. The mode of operation during the event
      1) Test with load
      2) Test without load
      3) Extended Parallel
   e. Up to 6 Schedule Exceptions
      1) Exception day
      2) Exception repeat interval
      3) Start time and duration of exception

R. Reports
   1. All Reports shall be available for view on the operator screen, saved to a USB media drive, printed, viewed through the web server interface and available to be emailed.
   2. Generator Report
      a. The generator report shall allow for a facility to record the necessary data to ensure compliance with NFPA 110.
      b. The Generator report function shall allow for simultaneous reporting of all generators in the system.
      c. Each generator shall be assigned a file with its respective reports.
      d. The report shall allow for the following setup parameters
         4) i. Minimum generator loading (adjustable from 0-100% of rated)
         5) ii. Runtime
         6) iii. Report Sample Rate (adjustable from 1 minute to 60 minutes)
      e. The report shall record the following Generator parameters at a rate set by the Report Sample rate:
         1) i. Oil Pressure
         2) ii. Coolant Temp
         3) iii. Battery Voltage
         4) iv. Total kW
         5) v. Percent kW
         6) vi. Total KVAR
         7) vii. Frequency
         8) viii. Current Line (Phase)
         9) ix. Voltage Line to Line (Phase)
      f. The total time that the generator was above the minimum loading requirement shall be recorded.
      g. The report shall have a field to enter operator comments.
   3. Automatic Transfer Switch Report (Optional)
      a. The ATS report shall record any changes in switch position for each ATS in the system.
      b. Upon the start of a new Calendar year, a new report shall be created for each ATS and the previous year’s report shall be archived.
      c. Each ATS in the system will have a separate report.
      d. Run Report
      e. The Run report shall record all events that occur during a system operation such as a utility outage
or test.
f. The Report shall contain the following data and the time at which it occurred:
   1) Utility Failure or Test Start Time
   2) Each generator command to start
   3) Each generator reaching rated frequency and voltage
   4) Each generator closing its circuit breaker
   5) Transfer of ATS
   6) Operation of circuit breakers
   7) Each generator opening its circuit breaker
   8) Each generator has stopped

4. Operator Settings Report
   a. The Operator Settings Report shall contain a list of all settings and parameters that can be changed by the operator.
   b. The Operator Settings Report should include the following project information:
      1) Project Name
      2) Model Number
      3) Order Number
      4) Serial Number
      5) Distributor Contact Information

5. Factory Settings Report
   a. The Factory Settings Report shall contain a list of all settings that are available in the factory (technician) setup screens.
   b. These include at a minimum the following:
      1) Project Information
      2) Generator Settings
      3) Meter Settings
      4) System Settings
      5) Field adjustable device names
      6) Load types and Load Add Shed Setup

S. Security
   1. The Security of the Operator Screen should have levels of security that allow different access for:
      a. View only
      b. Operators and Managers
      c. Technicians
      d. The Security should be setup so a user can be assigned to a level of access and have a unique log-in name and password.
      e. The manager user level and above shall be allowed to add and remove unique users.
      f. Each unique user’s log in activity shall be recorded in the event log.
      g. When multiple user interfaces are used (including the web interface) only one operator or above user shall be allowed to be logged in simultaneously for security purposes.
      h. The security system should ensure that a strong password is used. The password rules should be a minimum of 8 characters and contain at least one alpha and one numeric.
      i. The security system should have an auto logout period when there is no activity. This time delay should be field adjustable.

T. Integrity Checks
   1. All operator and factory settings shall have integrity bounds checks built in to ensure that an only a valid entry is allowed.

U. Alarm and Report Notification
   1. The Operator Interface shall have the capability for alarms and reports to be sent via an email notification service.
   2. The notification system should send an email for each alarm as soon as it becomes active.
   3. Reports should be capable of being sent via email as soon as they are generated, or manually emailed per user discretion.
4. The notification service shall be capable of interfacing with encrypted and unencrypted email servers.
5. The notification service shall be capable of sending emails to multiple users simultaneously.

V. Web Interface
1. The Operator Interface shall have the capability of serving web pages that are essentially identical to the main operator interface.
2. The web pages shall be available by using Microsoft Internet Explorer 6 or higher.
3. The web pages shall allow for monitoring of control and should use the same security settings as the main operator interface.
4. All reports, alarms, historical trending, and display screens shall be available on the web.

W. Building Management Interface
1. The building management interface shall be Modbus TCP/IP or Modbus Serial EIA485.
2. When accessing the master control, the building management interface shall be restricted from direct access to the PLC so that there is no inadvertent security lapses.

X. Single Point of Control
1. The Operator Interface must have the provisions to ensure that only one operator is in control of the system at any access point to the master control. This includes all redundant, secondary, or web screen interfaces.
2. When the system has the control mode to “operator” the Scheduler shall not override the operator commands, but shall be paused until the Scheduler is again placed into control of the system.

Y. Help screens
1. Each screen in the system shall contain a detailed graphical help screen to allow an operator to understand the basic screen functions on each screen.
2. The help screens shall be available from the web interface screens.

Z. Time Synchronization
1. The operator interface real time clock shall be synchronized at all times to the PLC real time clock.
2. The master control real time clock shall have the capability of synchronizing with a NTP time server.

AA. Printing
1. The Operator Interface shall be capable of connecting to either a local or corporate network printer to allow printing of alarms, events, reports, trends, etc.

2.14 INTERNAL CONTROLS FOR THE MASTER CONTROL

A. Expected Monitoring I/O
1. The Master Control shall monitor the following breaker status at a minimum.
   a. Aux A contact.
   b. Aux B contact (optional)
   c. Cell position (if applicable)
   d. Tripped Status
   e. Auto or Manual control mode status
   f. Protective Relay Failure (if applicable)
2. The Master Control shall monitor the following generator status points through hard wired inputs at a minimum.
   a. Ready to Load (90% rated voltage and frequency)
   b. Shutdown
   c. Load Dump/Load Shed

B. The Master Control shall use circuit protection for control circuitry that indicates when the protective device needs to be reset or replaced.

C. The Master Control shall allow for all field wiring to be landed on dedicated terminal blocks. The terminal blocks shall be rated to be capable of the largest required wire gauge that may be required for field wiring.

D. All Control Relays in the Master Control shall have LED indicators.

E. The Master Control 24VDC bus for control power shall be derived from a “best battery”. The “best battery” shall combine the 24VDC battery supplies from each generator, as well as the station battery power supply. Provisions must be available for an additional customer supplied 24VDC source to be added to the best
battery bus.

F. The station battery included in the Master Control shall be capable of supplying the entire cabinet's power requirements during starter dip of the engine generators, as well as be able to fully supply the power requirements in the case of a failure of all generator batteries. The station battery system shall consist of a 24VDC power supply, a UPS, and a set of batteries capable of supplying the Master Control power indefinitely during normal conditions, and for at least 30 minutes during an entire facility outage before additional charging is required.

G. When paralleling with the Utility, a Master Synchronizer and kW/KVar controller shall be used to ensure the generators are synchronized with the Utility prior to paralleling. The master synchronizer shall be designed and manufactured by the generator control and master control manufacturer to ensure compatibility and optimized algorithms for synchronizing.

H. When paralleling with the Utility, the Master Control shall use a kW and kVAR controller to control the output of the generator. The controller shall be a separate controller from the main Master Control PLC and shall be manufactured and designed by the generator control manufacturer to ensure compatibility and optimized algorithms.

I. The Master Control shall be able to actively control kW and kVAR output of the generator in multiple modes:
   1. Closed Loop PI Control to control Utility kW and KVAR import.
      a. Open Loop control to control Generator kW and KVAR outputs, with an option to constrain the utility export/import value.
      b. Close Loop PI control to hold the Generator % kW and kVAR outputs constant.
      c. Close Loop PI control to hold the Generator power factor constant.
      d. Close Loop PI control to hold the Utility power factor constant.
   2. The controller shall calculate the amount of power to be produced by the generators at a minimum of 50 times per second.

2.15 PARALLELING OPERATION

J. Emergency Mode:
   1. Upon initiation of the automatic start sequence, all engine generators shall start. The first engine generator to achieve 90% of nominal voltage and frequency shall be connected to the bus. All first priority loads shall be transferred to the bus upon sensing availability of power on the bus. As the remaining engine generators start, their respective synchronizers shall initiate control of voltage and frequency of the oncoming set with the bus. Upon synchronizing with the bus, the oncoming engine generator shall be paralleled on the bus. Each time an additional engine generator is added to the bus, the remaining loads shall be transferred in priority sequence, until all loads are connected to the bus. The generator paralleling controls shall prevent the automatic transfer of loads to the bus until there is sufficient capacity to carry these loads. Provision shall be made to manually override the load addition circuits for supervised operation.
   2. Load management sensing shall be furnished to ensure that sufficient generating capacity is connected to the bus to carry the load. The load management sensing shall also ensure that not more than the required capacity plus a limited reserve is connected to the bus at any time. The system in conjunction with the load management shall ensure maximum efficiency in the utilization of engine generators to ensure maximum fuel economy.
   3. Load management sensing shall ensure that the on-line reserve capacity does not fall to less than 10% or exceed more than 110% of a single engine generator. Upon sensing if the connected load exceeds the present limit for an established period of time, the next engine generator will be started and paralleled. If upon sensing, the connected load is determined to be less than the preset limit for an established period of time, the last engine generator to be paralleled will be disconnected and shut down. Its controls will be automatically reset so that the engine generator will be ready for next operation.
   4. While one engine generator is connected to the bus, and if the connected load exceeds the capacity of the bus, resulting in a decrease in system frequency to 58 Hz or less, load dumping will be initiated to reduce the connected load within the capacity of the bus. Similarly, with increased loading, the remaining engine generator will be signaled to start and be paralleled to the engine generator already connected to the bus, and the load dump signal will be automatically cancelled. Upon restoration of the
normal source of power supply, as defined in the generator paralleling controls for an adjustable period of 0 to 30 minutes, the loads shall be transferred back to the normal power source. Subsequently, the engine generator shall be disconnected from the bus, run for an adjustable period of time up to 15 minutes maximum for cool down, and then shut down. All controls associated with operation of the engine generator shall automatically reset for the next automatic operation.

K. Manual Mode: The engine generators and automatic transfer switch(es) can be operated manually.

L. Exercising Mode: Incorporate controls so as to allow automatic and manual testing of each engine generator and remotely located transfer switch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be as shown on the drawings, manufacturer’s instructions, and per Section 26 23 00, LOW-VOLTAGE SWITCHGEAR.

B. Mount generator paralleling controls on concrete slab. Unless otherwise indicated, the slab shall be at least 100 mm (4 inches) thick. The top of the concrete slab shall be approximately 100 mm (4 inches) above finished floor. Edges above floor shall have 12.5 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 100 mm (8 inches) beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface. Concrete work shall be as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

3.2 EXAMINATION

A. The installer shall be responsible for inspection of the site and verification that the equipment can be installed and operated as required by the manufacturer.

3.3 CONNECTIONS

A. Ground each piece of equipment according to the requirements elsewhere in Division 26 “Grounding and Bonding for Electrical Systems”, and in compliance with instructions in the drawings.

B. Connect power conductors in compliance to appropriate instructions based on voltage class, elsewhere in Division 26.

C. Provide control interconnection wiring and connect all control interconnections in strict compliance to the equipment manufacturers’ instructions.

3.4 ACCEPTANCE CHECKS AND TESTS

A. An authorized representative of the generator paralleling controls manufacturer shall technically supervise and participate during all of the field adjustments and tests. Major adjustments and field tests shall be witnessed by the COTR. The manufacturer’s representative shall certify in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer’s recommendations.

B. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:
   a. Compare equipment nameplate data with specifications and approved shop drawings.
   b. Inspect physical, electrical, and mechanical condition.
   d. Verify appropriate equipment grounding.
   e. Verify appropriate anchorage and required area clearances.

2. Systems Tests:
   a. Verify proper operation of all control, monitoring, trending, and alarm functions.
   b. Verify undisrupted operation of the system under conditions of loss of the generator paralleling controls.
   c. Test and verify continuity of all interconnecting copper and fiber optic control media.

C. Perform all acceptance checks and tests specified in Section 26 23 00, LOW-VOLTAGE SWITCHGEAR, and Section 26 36 23, AUTOMATIC TRANSFER SWITCHES.
3.5 FIELD QUALITY CONTROL
   A. Prior to acceptance testing, test insulation resistance of each switchgear bus, component, connecting supply, feeder, and control circuit (in compliance and under supervision of equipment manufacturer(s).) Test continuity of each circuit. Retain permanent records of this testing.
   B. A factory-authorized and certified service technician shall inspect all control wiring for type of wiring material and installation practice, verify that the wiring is properly installed by point to point testing, and complete installation and startup checks as required by the equipment manufacturer.

3.6 CLEANING
   A. All equipment is to be thoroughly cleaned, with any shipping or installation damage repaired, prior to equipment commissioning and final test.

3.7 PROTECTION
   A. Equipment shall be protected from the environment in compliance to manufacturer’s recommendations. As a minimum, equipment shall be protected from moisture, dirt, and condensation.

3.8 INSTRUCTION
   A. Furnish the services of a factory-trained technician for two 4-hour periods to instruct personnel in the operation and maintenance of the generator paralleling controls and related equipment on the date requested by the COR.

END OF SECTION
PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION
A. This section specifies the furnishing, installation, and connection of panelboards.

1.2 RELATED WORK
A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
D. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.

1.3 QUALITY ASSURANCE
A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS
A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, circuit breakers, wiring and connection diagrams, accessories, and nameplate data.
   c. Certification from the manufacturer that a representative panelboard has been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.
2. Manuals:
   a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering circuit breakers and replacement parts.
      1) Include schematic diagrams, with all terminals identified, matching terminal identification in the panelboards.
      2) Include information for testing, repair, troubleshooting, assembly, and disassembly.
   b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
   a. Certification by the manufacturer that the panelboards conform to the requirements of the drawings and specifications.
   b. Certification by the Contractor that the panelboards have been properly installed, adjusted, and tested.

1.5 QUALIFICATIONS
A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. Provide Seismic tested equipment as follows:
   1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the latest International Building Code (IBC).
   2. The Contractor shall be responsible to hire a project structural engineer to provide site specific ground motion criteria for use by the manufacturer to establish SDS values required.
   3. The IP rating of the equipment shall be 1.5.
   4. The Contractor’s structural engineer for the Site shall evaluate the SDS values published on the manufacturer’s website to ascertain that they are "equal to" or "greater than" those required for the Project Site.
   5. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards:
      a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed Civil Engineer in the State of Oregon. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
      b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
      c. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered when the capability of the equipment, meets or exceeds the specified response spectra.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Equipment shall be handled and stored in accordance with manufacturer’s instructions. One (1) copy of these instructions shall be included with the equipment at the time of shipment.

1.7 APPLICABLE PUBLICATIONS
   A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
   B. International Code Council (ICC):
      IBC-12 ..................................... International Building Code
   C. National Electrical Manufacturers Association (NEMA):
      PB 1-11 .................................. Panelboards
      250-08 .................................. Enclosures for Electrical Equipment (1,000V Maximum)
   D. National Fire Protection Association (NFPA):
      70-11 .................................. National Electrical Code (NEC)
      70E-12 .................................. Standard for Electrical Safety in the Workplace
   E. Underwriters Laboratories, Inc. (UL):
      50-95 .................................. Enclosures for Electrical Equipment
      67-09 .................................. Panelboards
      489-09 .................................. Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS
   A. Panelboards shall be in accordance with NEC, NEMA, UL, as specified, and as shown on the drawings.
B. Panelboards shall have main breaker or main lugs, bus size, voltage, phases, number of circuit breaker mounting spaces, top or bottom feed, flush or surface mounting, branch circuit breakers, and accessories as shown on the drawings.

C. Panelboards shall be completely factory-assembled with molded case circuit breakers and integral accessories as shown on the drawings or specified herein.

D. Non-reduced size copper bus bars, rigidly supported on molded insulators, and fabricated for bolt-on type circuit breakers.

E. Bus bar connections to the branch circuit breakers shall be the “distributed phase” or “phase sequence” type.

F. Mechanical lugs furnished with panelboards shall be cast, stamped, or machined metal alloys listed for use with the conductors to which they will be connected.

G. Neutral bus shall be 100% rated, mounted on insulated supports.

H. Grounding bus bar shall be equipped with screws or lugs for the connection of equipment grounding conductors.

I. Bus bars shall be braced for the available short-circuit current as shown on the drawings, but not be less than 22,000 A symmetrical for 120/208 V and 120/240 V panelboards, and 25,000 A symmetrical for 277/480 V panelboards.

J. In two-section panelboards, the main bus in each section shall be full size. The first section shall be furnished with subfeed lugs on the line side of main lugs only, or through-feed lugs for main breaker type panelboards, and have field-installed cable connections to the second section as shown on the drawings. Panelboard sections with tapped bus or crossover bus are not acceptable.

K. Series-rated panelboards are not permitted.

L. Finishes: surfaces of the trim assembly shall be properly cleaned, primed, and a finish coat of gray ANSI 61 paint applied.

M. Basis of design is Eaton Cutler-Hammer.
   1. Refer to Division 01 for Substitution Requests.
   2. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.2 ENCLOSURE AND TRIMS

A. Enclosures:
   1. Reuse existing panel box enclosures throughout this Project, unless noted otherwise on drawings. Provide new interiors for each and every panelboard within scope of work as shown in drawings.
   2. For new panelboards, with new enclosures, provide galvanized steel enclosures, with NEMA rating as shown on the drawings or as required for the environmental conditions in which installed.
   3. Enclosures shall not have ventilating openings.
   4. Enclosures may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.
   5. Provide manufacturer’s standard option for prepunched knockouts on top and bottom endwalls.
   6. Include removable inner dead front cover, independent of the panelboard cover.

B. Trims:
   2. Interior hinged door with hand-operated latch or latches, as required to provide access only to circuit breaker operating handles, not to energized parts.
   3. Outer hinged door shall be securely mounted to the panelboard enclosure with factory bolts, screws, clips, or other fasteners, requiring a key or tool for entry. Hand-operated latches are not acceptable.
4. Inner and outer doors shall open left to right.
5. Trims shall be flush or surface type as shown on the drawings.

2.3 BRANCH CIRCUIT PANELBOARDS
A. The minimum short-circuit rating for branch circuit panelboards shall be 22,000 amperes symmetrical at 240 volts, and 25,000 amperes symmetrical at 480 volts, or as indicated on the drawings. Panelboards shall be fully rated. Basis of design panelboards are Eaton type Pow-R-Line 1a, Pow-R-Line 2a or Pow-R-Line 3a.
B. Bolt-on, heavy-duty, quick-make, quick-break, single- and multi-pole circuit breakers of the types specified herein, shall be provided for each circuit with toggle handles that indicate when unit has tripped.
C. All circuit breakers shall be thermal-magnetic type with common handle for all multiple pole circuit breakers. Circuit breakers shall be minimum 100-ampere frame. Ratings through 100-ampere trip shall take up the same pole spacing. Circuit breakers shall be UL listed as type SWD for lighting circuits.
   1. Circuit breaker handle locks (ON position) shall be provided for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.

2.4 DISTRIBUTION PANELBOARDS
A. Distribution panelboards equipped with bolt-on devices shall have interrupting ratings as indicated on the drawings. Panelboards shall be fully rated. Basis of design panelboards are Eaton type Pow-R-Line 3a or Pow-R-Line 4B. Panelboards shall have molded case circuit breakers as indicated below.
B. Where indicated, provide circuit breakers UL listed for application at 100% of their continuous ampere rating in their intended enclosure.
C. Main breakers, if furnished, shall be equipped with microprocessor based trip units that have integral Arc Flash Reduction trip feature. The use of zone selective interlocking to emulate this function does not meet the intent of this specification and will not be allowed.
D. Distribution circuit breakers shall be fixed mounted type and equipped with either microprocessor based trip units or thermal magnetic trip units as scheduled on the contract drawings.
E. Provide shunt trips, bell alarms, and auxiliary switches as shown on the contract drawings.

2.5 MOLDED CASE CIRCUIT BREAKERS
A. Circuit breakers shall be per UL, NEC, as shown on the drawings, and as specified.
B. Circuit breakers shall be bolt-on type.
C. Circuit breakers shall have minimum interrupting rating as required to withstand the available fault current, but not less than:
   1. 120/208 V Panelboard: 22,000 A symmetrical.
   2. 120/240 V Panelboard: 22,000 A symmetrical.
   3. 277/480 V Panelboard: 25,000 A symmetrical.
D. Circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for less than 400 A frame. Circuit breakers with 400 A frames and above shall have magnetic trip, adjustable from 5x to 10x. Breaker trip setting shall be set in the field, based on the approved protective device study as specified in Section 26 05 71, ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY.
E. Circuit breaker features shall be as follows:
   1. A rugged, integral housing of molded insulating material.
   2. Silver alloy contacts.
   3. Arc quenchers and phase barriers for each pole.
   4. Quick-make, quick-break, operating mechanisms.
   5. A trip element for each pole, thermal magnetic type with long time delay and
6. Electrically and mechanically trip free.
7. An operating handle which indicates closed, tripped, and open positions.
8. An overload on one pole of a multi-pole breaker shall automatically cause all the poles of the breaker to open.
9. Ground fault current interrupting breakers, shunt trip breakers, lighting control breakers (including accessories to switch line currents), or other accessory devices or functions shall be provided where shown on the drawings.

2.6 NAMEPLATES
A. Provide nameplates as required in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

PART 3 - EXECUTION
3.1 INSTALLATION
A. Installation shall be in accordance with the manufacturer’s instructions, the NEC, as shown on the drawings, and as specified.
B. Locate panelboards so that the present and future conduits can be conveniently connected.
C. In seismic areas, panelboards shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.
D. Install a printed schedule of circuits in each panelboard after approval by the COTR. Schedules shall reflect final load descriptions, room numbers, and room names connected to each circuit breaker. Schedules shall be printed on the panelboard directory cards and be installed in the appropriate panelboards.
E. Mount panelboards such that the maximum height of the top circuit breaker above the finished floor shall not exceed 1980 mm (78 inches).
F. Provide blank cover for each unused circuit breaker mounting space.
G. Rust and scale shall be removed from the inside of existing enclosures where new interior components are to be installed. Paint inside of enclosures with rust-preventive paint before the new interior components are installed. Provide new trim. Trim shall fit tight to the enclosure.
H. Panelboard enclosures shall not be used for conductors feeding through, spliced, or tapping off to other enclosures or devices.

3.2 ACCEPTANCE CHECKS AND TESTS
A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
   1. Visual Inspection and Tests:
      a. Compare equipment nameplate data with specifications and approved shop drawings.
      b. Inspect physical, electrical, and mechanical condition.
      c. Verify appropriate anchorage and required area clearances.
      d. Verify that circuit breaker sizes and types correspond to approved shop drawings.
      e. To verify tightness of accessible bolted electrical connections, use the calibrated torque-wrench method or perform thermographic survey after energization.

3.3 FOLLOW-UP VERIFICATION
A. Upon completion of acceptance checks, settings, and tests, the Contractor shall demonstrate that the panelboards are in good operating condition and properly performing the intended function.

END OF SECTION
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 DESCRIPTION
A. This section specifies the furnishing, installation, and connection of fused and unfused disconnect switches (indicated as switches in this section), and separately-enclosed circuit breakers for use in electrical systems rated 600 V and below.

1.2 RELATED WORK
A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground faults.
D. Section 26 24 16, PANELBOARDS: Molded-case circuit breakers.

1.3 QUALITY ASSURANCE
A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS
A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
   1. Shop Drawings:
      a. Submit sufficient information to demonstrate compliance with drawings and specifications.
      b. Submit the following data for approval:
         1) Electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, fuses, circuit breakers, wiring and connection diagrams, accessories, and device nameplate data.
      c. Certification from the manufacturer that representative enclosed switches and circuit breakers have been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.
   2. Manuals:
      a. Submit complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering fuses, circuit breakers, and replacement parts.
         1) Include schematic diagrams, with all terminals identified, matching terminal identification in the enclosed switches and circuit breakers.
         2) Include information for testing, repair, troubleshooting, assembly, and disassembly.
      b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
   3. Certifications: Two weeks prior to final inspection, submit the following.
      a. Certification by the manufacturer that the enclosed switches and circuit breakers conform to the requirements of the drawings and specifications.
      b. Certification by the Contractor that the enclosed switches and circuit breakers have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS
A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
B. International Code Council (ICC):
   IBC-12 ........................................ International Building Code
C. National Electrical Manufacturers Association (NEMA):
SECTION 26 29 21 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

FU l-07................................. Low Voltage Cartridge Fuses
KS l-06................................. Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

D. National Fire Protection Association (NFPA):
   70-11 ............................... National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):
   98-07 ............................... Enclosed and Dead-Front Switches
   248-00 ............................... Low Voltage Fuses
   489-09 ............................... Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

2.1 FUSED SWITCHES RATED 600 AMPERES AND LESS
   A. Switches shall be in accordance with NEMA, NEC, UL, as specified, and as shown on the drawings.
   B. Shall be NEMA classified General Duty (GD) for 240 V switches, and NEMA classified Heavy Duty (HD) for
      480 V switches.
   C. Shall be horsepower (HP) rated.
   D. Shall have the following features:
      1. Switch mechanism shall be the quick-make, quick-break type.
      2. Copper blades, visible in the open position.
      3. An arc chute for each pole.
      4. External operating handle shall indicate open and closed positions, and have lock-open padlocking
         provisions.
      5. Mechanical interlock shall permit opening of the door only when the switch is in the open position,
         defeatable to permit inspection.
      6. Fuse holders for the sizes and types of fuses specified.
      7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
      8. Ground lugs for each ground conductor.
      9. Enclosures:
         a. Shall be the NEMA types shown on the drawings.
         b. Where the types of switch enclosures are not shown, they shall be the NEMA types most suitable
            for the ambient environmental conditions.
         c. Shall be finished with manufacturer’s standard gray baked enamel paint over pretreated steel.

2.2 UNFUSED SWITCHES RATED 600 AMPERES AND LESS
   A. Shall be the same as fused switches, but without provisions for fuses.

2.3 FUSED SWITCHES RATED OVER 600 AMPERES TO 1200 AMPERES
   B. Shall be the same as fused switches, and shall be NEMA classified Heavy Duty (HD).

2.4 MOTOR RATED TOGGLE SWITCHES
   A. Type 1, general purpose for single-phase motors rated up to 1 horsepower.
   B. Quick-make, quick-break toggle switch with external reset button and thermal overload protection matched
      to nameplate full-load current of actual protected motor.

2.5 CARTRIDGE FUSES
   A. Shall be in accordance with NEMA FU 1.
   B. Service Entrance: Class L, Class RK1, or Class J.
   C. Feeders: Class L, Class RK1, or Class RK5, time delay

2.6 SEPARATELY-ENCLOSED CIRCUIT BREAKERS
   A. Provide circuit breakers in accordance with the applicable requirements in Section 26 24 16, PANELBOARDS.
   B. Enclosures shall be the NEMA types shown on the drawings. Where the types are not shown, they shall be
the NEMA type most suitable for the ambient environmental conditions.

PART 2 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the manufacturer’s instructions, the NEC, as shown on the drawings, and as specified.

B. In seismic areas, enclosed switches and circuit breakers shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.

C. Fused switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuses.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer’s recommendations. In addition, include the following:

1. Visual Inspection and Tests:
   a. Compare equipment nameplate data with specifications and approved shop drawings.
   b. Inspect physical, electrical, and mechanical condition.
   c. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

3.3 SPARE PARTS

A. Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fused disconnect switch installed on the project. Deliver the spare fuses to the COTR.

END OF SECTION
GENERATOR CONTROL PANEL REPLACEMENT AND CLOUD REMOTE MONITORING AND CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. This Section includes packaged engine-generator panel control replacement of the seven (7) generators with the features as specified and indicated. Engine generators will be used as the Standby power source for the systems.
B. Provide a cloud based remote monitoring system that provides information and sends notifications to ensure generator is available when needed. With easy-to-use mobile and web interfaces, send notifications and give instant access to the genset controls and ATSs enabling real-time monitoring and control.

1.3 ACTION SUBMITTALS
A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, and location and size of each field connection.
   1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
   2. Wiring Diagrams: Control interconnection, Customer connections.
   3. A meeting shall be scheduled with supplier, end user, end user’s technical representative and installing contractor to go over the features prior to final submittals. At this first meeting the remote control shall be explained and a preliminary submittal shall be provided.
   4. At this first meeting if the proposed generator set replacement controls are other than Cummins Command 3.3 and the Cummins Power Command 500/550. A complete live internet demonstration of the proposed equipment capabilities will be required.
   5. If proposed product does not meet the specification and the live demonstration is not accomplished, then Cummins Power Command shall be provided.

1.4 QUALITY ASSURANCE
A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

1.5 WARRANTY
A. Base Warranty: Manufacturer shall provide base warranty coverage on the NEW material and workmanship of the NEW equipment provided. The existing engine, alternator, cooling system, block heater, fuel system, battery charger or batteries are not covered. Prior to all upfit of the new controllers and data acquisition equipment, each generator set shall be inspected and possible deficiencies shall be detailed for possible additional required work not provided for in this specification.
B. All new work shall be warrantied for minimum of twelve (12) months from registered commissioning and start-up.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
1. Manufacturers: The basis for this specification is Cummins Power Generation equipment.
2. Confirm under ACTION SUBMITTALS 1.3.A. 3, 4 & 5 are met if alternate product, other than Cummins is to be proposed.
2.2 CONTROLS

A. Engine generator control shall be microprocessor based and provide automatic starting, monitoring, protection and control functions for the unit. They will need to be installed on all 7 generator sets.

B. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. (Switches with different configurations but equal functions are acceptable.) When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.

C. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.

D. Configuration: Operating and safety indications, protective devices, system controls, engine gages and associated equipment shall be grouped in a common control and monitoring panel. Mounting method shall isolate the control panel from generator-set vibration. AC output power circuit breakers and other output power equipment shall not be mounted in the control enclosure.

E. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:

1. AC voltmeter (3-phase, line to line and line to neutral values).
2. AC ammeter (3-phases).
3. AC frequency meter.
4. Ammeter-voltmeter displays shall simultaneously display conditions for all three phases.
5. Emergency Stop Switch: Switch shall be a red “mushroom head” pushbutton device complete with lock-out/tag-out provisions. Depressing switch shall cause the generator set to immediately stop the generator set and prevent it from operating.
6. Fault Reset Switch: Supply a dedicated control switch to reset/clear fault conditions.
7. DC voltmeter (alternator battery charging).
8. Engine-coolant temperature gauge.
9. Engine lubricating-oil pressure gauge.
10. Running-time meter.
11. Generator-voltage and frequency digital raise/lower switches. Rheostats for these functions are not acceptable. The control shall adjustment of these parameters in a range of plus or minus 5% of the voltage and frequency operating set point (not nominal voltage and frequency values.) The voltage and frequency adjustment functions shall be disabled when the paralleling breaker is closed.
12. Fuel tank derangement alarm.
13. Fuel tank high-level shutdown of fuel supply alarm, as provided for by the existing fuel system.
14. AC Protective Equipment: The control system shall include over/under voltage, over current, loss of voltage reference, and over excitation shut down protection. There shall be a ground fault alarm for generator sets rated over 1000 amps, overload warning, and overcurrent warning alarm.
15. Status LED indicating lamps to indicate remote start signal present at the control, existing shutdown condition, existing alarm condition, not in auto, and generator set running.
16. A graphical display panel with appropriate navigation devices shall be provided to view all information noted above, as well as all engine status and alarm/shutdown conditions (including those from an integrated engine emission control system). The display shall also include integrated provisions for adjustment of the gain and stability settings for the governing and voltage regulation systems.
17. Panel lighting system to allow viewing and operation of the control when the generator room or enclosure is not lighted.
18. Data Logging: The control system shall log the latest 20 different alarm and shut down conditions, the
total number of times each alarm or shutdown has occurred, and the date and time the latest of these shutdown and fault conditions occurred.

19. **DC control Power Monitoring:** The control system shall continuously monitor DC power supply to the control, and annunciate low or high voltage conditions. It shall also provide an alarm indicating imminent failure of the battery bank based on degraded voltage recover on loading (engine cranking).

**F. Control Heater:** Generator sets that are installed in outdoor enclosures, or are in tropical or coastal environments shall be provided with control heaters for anti-condensation protection.

**G. Common Remote Audible Alarm:** Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
   1. Overcrank shutdown.
   2. Coolant low-temperature alarm.
   3. Control switch not in auto position.
   4. Battery-charger malfunction alarm.
   5. Battery low-voltage alarm.

### 2.3 CLOUD BASED REMOTE MONITORING AND CONTROLS

**A.** Provide a remote monitoring system that provides information and send notifications to ensure the 7 generators and 21 ATSs are available when needed. With easy-to-use mobile and web interfaces, send notifications and give instant access to the genset controls and ATSs enabling real-time monitoring and control.

**1. Requirements**
   a. Site and asset status at a glance
   b. Notifications, of possible problems
   c. Real-time Remote Monitoring through PowerCommand Cloud™
   d. Asset Control, of generator set and ATS
   e. Convenient access through web UI and mobile app
   f. Multiple sites and equipment management
   g. Secure data transmission and storage
   h. Data Trending
   i. Supported by a worldwide network of independent distributors who provide parts, service and warranty support

**2. Features**
   a. Cloud Link to communicate to the asset controls and communicate telemetry data to the end user.
   b. Monitoring: The Web and Mobile app monitor customer account and site information along with monitoring asset data (generator, transfer switch and sensors).
   c. Asset Control: The Web and Mobile app can control the system with start, stop, and fault reset commands.
   d. Notification: The have the capability to notify users through email to users when an event becomes active.
   e. Account/Fleet Management: Make available a Web app to offer fleet management capability.
   f. User Interface: The have a user interface for setup purposes and the web and mobile app monitoring purposes.
   g. Event Storage and Export: Store an event log to enable the user to monitor the event logs.
   h. Data Storage and Export: Store the data and enable data export and graphing of data trends.
   i. On Device Diagnostics: Provide via Cloud Link on device diagnostics.
   j. Software Update: Offers local software update capability, while enabling execution of the remote software updates
3. The Dashboard shall provide an overall system status at a glance that will include multiple sites and devices connected to the cloud. User to have the flexibility to filter assets by status and location and then access information about specific sites and equipment, shall provide.
   a. Annunciator Data: This section displays the key status, warning and fault events where color coding is used (green, amber, red) depending on the event severity according to NFPA 110.
   b. Alternator Data: User can access vital electrical genset information.
   c. Engine Data: Engine information is available in this section.
   d. The genset status and telemetry information is available via both the mobile app and web app.
   e. Data Trending: The user can create graphs for a particular device by selecting a parameter and duration. In addition, asset data can be exported to .csv files.
   f. Asset Details: Easy access to Generator’s details such as model, serial number, and control model.
   g. ATS status and telemetry information is available on the ATS page.
      i. The user can also create data trend graphs for a particular device by selecting a parameter and duration.
      ii. Asset Details: Easy access to ATS’s details such as model, serial number, and control model.
      iii. Sources Data: User can access vital electrical source information including status
      iv. ATS Load Data: Load information is available in this section.
   h. Send notifications to give instant access to equipment enabling real-time monitoring and control to make decisions, right away minimizing downtime and maximizing power system performance.

B. Owner end user required product to enable the PowerCommand 500/550 to operate.
   1. Cellular service provider SIM cards. Quantity as required.
   2. Cellular service provider contract.

PART 3 - EXECUTION

3.1 INSTALLATION

A. New genset control shall be installed on generator sets by providing supplier, all interconnection wiring between controls, paralleling gear and remote monitor and remote start via Cummins 550/550 under section 2.3 will be by installing contactor.
B. Equipment shall be installed by the contractor in accordance with final submittals and contract documents Install equipment in accordance with manufacturer’s instructions and instructions.
C. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.
D. Equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as instructed by the Engineer of Record.
E. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.
F. Prior to work installing new genset controls at each site and a meeting between on site staff and contractor shall be scheduled. To discuss the portable genset provided by the contractor and planned down time for connection and testing.

3.2 ON-SITE ACCEPTANCE TEST

A. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by owner. The Engineer of Record shall be notified in advance and shall have the option to witness the tests. The generator set manufacturer shall provide a site test specification covering the entire system. Tests shall include:

B. Prior to start of active testing, all existing field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque, by the electrical contractor.
C. Installation acceptance tests to be conducted on site shall include a "cold start" test, a 30 minute full load (resistive) test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.

D. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 30 minutes. Coordinate timing and obtain approval for start of test with site personnel.

E. Shortcomings of the existing engine, alternator, cooling system, block heater, fuel system, battery charger or batteries are not covered. Possible deficiencies shall be detailed for possible required repair work.

3.3 TRAINING
A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

3.4 FIELD QUALITY CONTROL
A. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

3.5 SERVICE AND SUPPORT
A. The new controller up fitted generator sets shall be serviced by the local service organization that provided the controller and data logging system. Beginning at Substantial Completion, provide 12 months’ full maintenance by skilled employees of manufacturer's designated service organization. The service organization shall be on call 24 hours per day, 365 days per year. The service organization shall be physically located within 100 of the site. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation.

END OF SECTION
AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION
A. This section specifies the furnishing, installation, connection, and testing of programmed open-transition automatic transfer switches (center off) with bypass isolation, indicated as automatic transfer switches or ATS in this section.

1.2 RELATED WORK
A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personal safety and to provide a low impedance path for possible ground fault currents.
D. Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
E. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.
F. Section 26 23 13, GENERATOR PARALLELING CONTROLS: Paralleling controls for multiple engine-generators.
G. Section 26 32 13, GENERATOR CONTROL PANEL REPLACEMENT AND CLOUD REMOTE MONITORING AND CONTROL: Requirements for normal and emergency power generation.

1.3 QUALITY ASSURANCE
A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
B. A factory-authorized representative shall be capable of providing emergency maintenance and repairs at the project site within 4-hours maximum of notification.
C. Automatic transfer switch, bypass/isolation switch, and annunciation control panels shall be products of the same manufacturer.
D. Source Limitations: All transfer switches are to be obtained through one source from a single manufacturer. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for products provided.
E. 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 as suitable for use in emergency, legally required or optional standby use as appropriate for the connected load.

1.4 FACTORY TESTS
A. ATS shall be thoroughly tested at the factory to assure that there are no electrical or mechanical defects.
B. Factory Tests shall be in accordance with Paragraph, MANUFACTURED PRODUCTS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
   1. Perform visual inspection to verify that each ATS is as specified.
   2. Perform mechanical test to verify that ATS sections are free of mechanical defects.
   3. Perform insulation resistance test to ensure electrical integrity and continuity of entire system.
   4. Perform main switch contact resistance test.
   5. Perform electrical tests to verify complete system electrical operation.

1.5 SUBMITTALS
A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
   1. Shop Drawings:
a. Submit sufficient information to demonstrate compliance with drawings and specifications.
b. Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
c. Include voltage rating, continuous current rating, number of phases, withstand and closing rating, dimensions, weights, mounting details, conduit entry provisions, front view, side view, equipment and device arrangement, elementary and interconnection wiring diagrams, factory relay settings, and accessories.
d. Installation and mounting instructions, including information for proper installation of equipment to meet seismic requirements.
e. For automatic transfer switches that are networked together to a common means of annunciation and/or control, submit interconnection diagrams as well as site and building plans, showing connections for normal and emergency sources of power, load, control and annunciation components, and interconnecting communications paths. Equipment locations on the diagrams and plans shall match the site, building, and room designations on the drawings.
f. Complete nameplate data, including manufacturer's name and catalog number.
g. A copy of the markings that are to appear on the automatic transfer switches when installed.
h. Certification from the manufacturer that representative ATS have been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.

2. Manuals:
a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
   1) Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the automatic transfer switches.
   2) Include information for testing, repair, troubleshooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
   3) Provide a replacement and spare parts list. Include a list of tools and instruments for testing and maintenance purposes.
b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
   1) Include complete "As Installed" diagrams that indicate all pieces of equipment and their interconnecting wiring.
   2) Include complete diagrams of the internal wiring for each piece of equipment, including "As Installed" revisions of the diagrams.
   3) The wiring diagrams shall identify the terminals to facilitate installation, maintenance, operation, and testing.

3. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
a. Technical data on all major components of all transfer switches and other products described in this section. Data is required for the transfer switch mechanism, control system, cabinet, and protective devices specifically listed for use with each transfer switch. Include steady state and fault current ratings, weights, operating characteristics, and furnished specialties and accessories.
b. Single Line Diagram: Show connections between transfer switch, power sources and load

4. Certifications:
a. When submitting the shop drawings, submit a certified test report from a recognized independent testing laboratory that a representative sample has passed UL 1008 prototype testing.
b. Two weeks prior to final inspection, submit the following.
   1) Certification by the manufacturer that the ATS conform to the requirements of the drawings and specifications.
   2) Certification by the Contractor that transfer switches have been properly installed, adjusted, and tested.

5. Manufacturer and Supplier Qualification Data
a. The transfer switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

b. The manufacturer of this equipment shall have produced similar equipment for a minimum period of 10 years. When requested, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. Institute of Electrical and Electronic Engineers (IEEE):

446-95 Emergency and Standby Power Systems for Industrial and Commercial Applications

C37.90.1-12 Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

C62.41.1-02 Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits

C62.41.2-02 Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

62.45 AC Voltage Surge Testing

1000-4-6 Conducted Field Immunity

1000-4-11 Voltage Dip Immunity

446 Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications

C. International Code Council (ICC):

IBC-15 International Building Code

D. National Electrical Manufacturers Association (NEMA):

250-14 Enclosures for Electrical Equipment (1000 Volts Maximum)

ICS 6-06 Enclosures

ICS 4-15 Application Guideline for Terminal Blocks

MG 1-16 Motors and Generators

E. National Fire Protection Association (NFPA):

70–17 National Electrical Code (NEC)

99-15 Health Care Facilities

110-16 Emergency and Standby Power Systems

F. Underwriters Laboratories, Inc. (UL):

50-15 Enclosures for Electrical Equipment

508-99 Industrial Control Equipment

891-05 Switchboards

1008-14 Transfer Switch Equipment

G. International Electrical Commission

1000-4-5 (EN 61000-4-5) AC Surge Immunity

1000-4-4 (EN 61000-4-4) Fast Transients Immunity

1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity

1000-4-3 (EN 61000-4-3) Radiated Field Community
PART 2 - PRODUCTS

2.1 MANUFACTURER
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cummins Power Generation
   2. Equipment specifications for this Project are based on automatic transfer switches manufactured by Cummins Power Generation. Switches manufactured by other manufacturers that meet the requirement, if approved not less than two weeks before scheduled bid date. Proposals must include a line-by-line compliance statement based on this specification.
   3. Equipment manufacturer shall be the same as the Generator set controller, and Cloud based monitor and starting vendor to ensure complete product continuity.
   4. Transfer switches utilizing molded case circuit breakers do not meet the requirements of this specification and will not be accepted.

2.2 GENERAL REQUIREMENTS
A. Automatic transfer switches shall comply with IEEE, NEMA, NFPA, UL, and have the following features:
   1. Automatic transfer switches shall be open transition switches, 4 pole, draw-out construction, electrically operated, mechanically held open contact type, without integral overcurrent protection. Automatic transfer switches utilizing automatic or non-automatic molded case circuit breakers, insulated case circuit breakers, or power circuit breakers as switching mechanisms are not acceptable.
   2. Automatic transfer switches shall be completely factory-assembled and wired such that only external circuit connections are required in the field.
   3. Each automatic transfer switch shall be equipped with an integral bypass/isolation switch.
   4. Ratings:
      a. Phases, voltage, continuous current, poles, and withstand and closing ratings shall be as shown on the drawings.
      b. Transfer switches are to be rated for continuous duty at specified continuous current rating on 60Hz systems.
      c. Maximum automatic transfer switch rating: 800 A.
   5. Markings:
      a. Markings shall be in accordance with UL 1008.
   6. Tests:
      a. Automatic transfer switches shall be tested in accordance with UL 1008. The contacts of the transfer switch shall not weld during the performance of withstand and closing tests when used with the upstream overcurrent device and available fault current specified.
   7. Surge Withstand Test:
      a. Automatic transfer switches utilizing solid-state devices in sensing, relaying, operating, or communication equipment or circuits shall comply with IEEE C37.90.1.
   8. Resistance to Damage by Voltage Transients:
      a. Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
   9. Housing:
      a. Enclose automatic transfer switches in wall- or floor-mounted steel cabinets, with metal gauge not less than No. 14, in accordance with UL 508, or in a switchboard assembly in accordance with UL 891, as shown on the drawings.
      b. Enclosure shall be constructed so that personnel are protected from energized bypass-isolation
components during automatic transfer switch maintenance.

c. Automatic transfer switch components shall be removable without disconnecting external source or load power conductors.

d. Finish: Cabinets shall be given a phosphate treatment, painted with rust-inhibiting primer, and finish-painted with the manufacturer's standard enamel or lacquer finish.

e. Viewing Ports: Provide viewing ports so that contacts may be inspected without disassembly.

10. Operating Mechanism:
   a. Actuated by an electrical operator.
   b. Electrically and mechanically interlocked so that the main contact cannot be closed simultaneously in either normal and emergency position.
   c. Normal and emergency main contacts shall be mechanically locked in position by the operating linkage upon completion of transfer. Release of the locking mechanism shall be possible only by normal operating action.
   d. Contact transfer time shall not exceed six cycles.
   e. Operating mechanism components and mechanical interlocks shall be insulated or grounded.

11. Contacts:
   a. Main contacts: Silver alloy.
   b. Neutral contacts: Silver alloy, with same current rating as phase contacts
   c. Current carrying capacity of arcing contacts shall not be used in the determination of the automatic transfer switch rating, and shall be separate from the main contacts.
   d. Main and arcing contacts shall be visible for inspection with cabinet door open and barrier covers removed.

12. Manual Operator:
   a. Capable of operation by one person in either direction under no load.

13. Replaceable Parts:
   a. Include the main and arcing contacts individually or as units, as well as relays, and control devices.
   b. Automatic transfer switch contacts and accessories shall be replaceable from the front without removing the switch from the cabinet and without removing main conductors.

14. Sensing Features:
   a. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100% of nominal, and dropout voltage is adjustable from 75 to 98% of pickup value. Factory set for pickup at 90% and dropout at 85%.
   b. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
   c. Voltage/Frequency Lockout Relay: Prevent premature transfer to the engine-generator. Pickup voltage shall be adjustable from 85 to 100% of nominal. Factory set for pickup at 90%. Pickup frequency shall be adjustable from 90 to 100% of nominal. Factory set for pickup at 95%.
   d. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
   e. Test Switch: Simulate normal-source failure.
   f. Switch-Position Indication: Indicate source to which load is connected.
   g. Source-Available Indication: Supervise sources via transfer switch normal- and emergency-source sensing circuits.
   h. Normal Power Indication: Indicate "Normal Source Available."
   j. Transfer Override Control: Overrides automatic retransfer control so that automatic transfer switch shall remain connected to emergency power source regardless of condition of normal source. Control panel shall indicate override status.
   k. Engine Starting Contacts: One isolated and normally closed and one isolated and normally open; rated 5 A at 30 V DC minimum.
   l. Engine Shutdown Contacts: Time delay adjustable from zero to 15 minutes, and factory set for 5
minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

m. Engine-Generator Exerciser: Programmable exerciser starts engine-generator(s) and transfers load to them from normal source for a preset time, then retransfers and shuts down engine-generator(s) after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period.

15. Controls:
   a. Controls shall provide indication of switch status and be equipped with alarm diagnostics.
   b. Controls shall control operation of the automatic transfer switches.

16. Factory Wiring: Train and bundle factory wiring and label either by color-code or by numbered/lettered wire markers. Labels shall match those on the shop drawings.

17. Annunciation, Control, and Programming Interface Components: Devices for communicating with remote programming devices, annunciators, or control panels and paralleling switchgear shall have open-protocol communication capability matched with remote device.

18. Elevator Pre-Transfer Signal Relay: Provide a pre-signal relay on all automatic transfer switches that will indicate to an elevator controller or controllers that a transfer or re-transfer is about to occur.

2.3 SEQUENCE OF OPERATION

A. The specified voltage decrease in one or more phases of the normal power source shall initiate the transfer sequence. The automatic transfer switch shall start the engine-generator(s) after a specified time delay to permit override of momentary dips in the normal power source.

B. The automatic transfer switch shall transfer the load from normal to emergency source when the frequency and voltage of the engine-generator(s) have attained the specified percent of rated value.

C. Engine Start: A voltage decrease, at any automatic transfer switch, in one or more phases of the normal power source to less than the specified value of normal shall start the engine-generator(s) after a specified time delay.

D. Transfer to Emergency System Loads: Automatic transfer switches for Emergency System loads shall transfer their loads from normal to emergency source when frequency and voltage of the engine-generator(s) have attained the specified percent of rated value. Only those switches with deficient normal source voltage shall transfer.

E. Transfer to Equipment Branch Loads: Automatic transfer switches for Equipment Branch loads shall transfer their loads to the engine-generator on a time-delayed, staggered basis, after the Emergency System switches have transferred. Only those switches with deficient normal source voltage shall transfer.

F. Retransfer to Normal (All Loads): Automatic transfer switches shall retransfer the load from emergency to normal source upon restoration of normal supply in all phases to the specified percent or more of normal voltage, and after a specified time delay. Should the emergency source fail during this time, the automatic transfer switches shall immediately transfer to the normal source whenever it becomes available. After restoring to normal source, the engine-generator(s) shall continue to run unloaded for a specified interval before shut-down.

2.4 BYPASS-ISOLATION SWITCH

A. Provide each automatic transfer switch with two-way bypass-isolation manual type switch. The bypass-isolation switch shall permit load by-pass to either normal or emergency power source and complete isolation of the automatic transfer switch, independent of transfer switch position. Bypass and isolation shall be possible under all conditions including when the automatic transfer switch is removed from service.

B. Operation: The bypass-isolation switch shall have provisions for operation by one person through the movement of a maximum of two handles at a common dead front panel in no more than 15 seconds. Provide a lock, which must energize to unlock the bypass switch, to prevent bypassing to a dead source. Provide means to prevent simultaneous connection between normal and emergency sources.

1. Bypass to normal (or emergency): Operation of bypass handle shall allow direct connection of the load to the normal (or emergency) source, without load interruption or by using a break-before-make design, or provide separate load interrupter contacts to momentarily interrupt the load.
a. Ensure continuity of auxiliary circuits necessary for proper operation of the system.

b. A red indicating lamp shall light when the automatic transfer switch is bypassed.

c. Bypassing source to source: If the power source is lost while in the bypass position, bypass to the alternate source shall be achievable without re-energization of the automatic transfer switch service and load connections.

2. Isolation: Operation of the isolating handle shall isolate all live power conductors to the automatic transfer switch without interruption of the load.

a. Interlocking: Provide interlocking as part of the bypass-isolation switch to eliminate personnel-controlled sequence of operation, and to prevent operation to the isolation position until the bypass function has been completed.

b. Padlocking: Include provisions to padlock the isolating handle in the isolated position.

c. Visual verification: The isolation blades shall be visible in the isolated position.

3. Testing: It shall be possible to test (normal electrical operation) the automatic transfer switch and engine-generator(s) with the isolation contacts closed and the load bypassed without interruption of power to the load.

C. Ratings: The electrical capabilities and ratings of the bypass-isolation switch shall be compatible with those of the associated automatic transfer switch, including any required additional withstand tests.

2.5 REMOTE ANNUNCIATOR SYSTEM

A. Remote annunciator panel shall annunciate conditions for indicated automatic transfer switches. Annunciation shall include the following:

1. Sources available, as defined by actual pickup and dropout settings of automatic transfer switch controls.

2. Switch position.

3. Switch in test mode.

4. Failure of communication link.

B. Remote annunciator panel shall be visual and audible type with LED display panel, audible signal, and silencing switch.

1. Panel shall indicate each automatic transfer switch monitored, the location of automatic transfer switch, and the identity of load it serves.

2. Mounting: Steel cabinet, flush or surface mounted, as shown on the drawings.

2.6 REMOTE ANNUNCIATOR AND CONTROL SYSTEM

A. Include the following functions for indicated automatic transfer switches:

1. Indication of sources available, as defined by actual pickup and dropout settings of automatic transfer switch controls.

2. Indication of automatic transfer switch position.

3. Indication of automatic transfer switch in test mode.

4. Indication of failure of communication link.

5. Key-switch or user-code access to control functions of panel.

6. Control of automatic transfer switch test initiation.

7. Control of automatic transfer switch operation in either direction.

8. Control of time-delay bypass for transfer to normal source.

B. Malfunction of remote annunciator and control system or communication link shall not affect functions of automatic transfer switches. Automatic transfer switch sensing, controlling, or operating functions shall not depend on remote annunciator and control system for proper operation.
C. Transfer Switch Control Panel: The transfer switch shall have a microprocessor-based control with a sealed membrane panel incorporating pushbuttons for operator-controlled functions, and LED lamps for system status indicators. The panel shall also include an alphanumeric display for detailed system information. Panel display and indicating lamps shall include permanent labels.

1. The indicator panel LEDs shall display:
   a. Which source the load is connected to (Source 1 or Source 2)
   b. Which source or sources are available
   c. When switch is not set for automatic operation, the control is disabled
   d. When the switch is in test/exercise mode
2. The indicator shall have pushbuttons that allow the operator to activate the following functions:
   a. Activate pre-programmed test sequence
   b. Override programmed delays, and immediately go to the next operation
   c. Reset the control by clearing any faults
   d. Test all of the LEDs by lighting them simultaneously

3. The alphanumeric digital display shall be vacuum fluorescent-type, clearly visible in both bright sunlight and no-light conditions over an angle of 120 degrees, and shall display the following:
   a. AC voltage for all phases, normal and emergency
   b. Source status: connected or not connected
   c. Load data, including voltage, AC current, frequency, KW, KVA, and power factor.

4. The display panel shall be password-protected, and allow the operator to view and make adjustments:
   a. Set nominal voltage and frequency for the transfer switch
   b. Adjust voltage and frequency sensor operation set points
   c. Set up time clock functions
   d. Set up load sequence functions
   e. Enable or disable control functions including program transition
   f. View real-time clock data, operation log (hours connected, times transferred, failures) and service history

D. Control Functions: Functions managed by the control shall include:

1. Software adjustable time delays:
   a. Engine start (prevents nuisance genset starts in the event of momentary power fluctuation): 0 to 120 seconds (default 3 sec)
   b. Transfer normal to emergency (allows genset to stabilize before load is transferred): 0 to 120 seconds (default 3 sec)
   c. Re-transfer emergency to normal (allows utility to stabilize before load is transferred from genset): 0 to 30 minutes (default 3 sec)
   d. Engine cooldown: 0 to 30 minutes (default 10 min)
   e. Programmed transition: 0 to 60 seconds (default 3 sec)

2. Undervoltage sensing: three-phase normal, three-phase emergency source.
3. Over-voltage sensing: three-phase normal, three-phase emergency source.
4. Over/under frequency sensing:
   a. Pickup: +/- 5 to +/-20% of nominal frequency (default 10%)
   b. Dropout: +/-1% beyond pickup (default 1%)
   c. Dropout time delay: 0.1 to 15.0 seconds (default 5 sec)
   d. Accurate to within +/- 0.05 Hz
5. Voltage imbalance sensing:
   a. Dropout: 2 to 10% (default 4%)
   b. Pickup: 90% of dropout
   c. Time delay: 2.0 to 20 seconds (default 5 sec)
6. Phase rotation sensing:
   a. Time delay: 100 msec
7. Loss of single-phase detection:
   a. Time delay: 100 msec

E. Control features shall include:
1. Programmable genset exerciser: A field-programmable control shall periodically start and run the generator with or without transferring the load for a preset time period, then re-transfer and shut down the generator after a preset cool-down period.

2. In event of a loss of power to the control, all control settings, real-time clock setting and the engine start-time delay setting will be retained.

3. The system continuously logs information including the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. An event recorder stores information, including time and date-stamp, for up to 50 events.

4. Re-Transfer Inhibit Switch: Inhibits automatic re-transfer control so automatic transfer switch will remain connected to emergency power source as long as it is available regardless of condition of normal source.

5. Transfer Inhibit Switch: Inhibits automatic transfer control so automatic transfer switch will remain connected to normal power source regardless of condition of emergency source.

F. Control Interface
1. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.
2. The transfer switch shall be provided with a network communication card, and configured to allow network-based communication with the transfer switch and other network system components, including the generator set(s) provided for the Project.
3. Unassigned Auxiliary Contacts: Two normally open, 1-pole, double-throw contacts for each switch position, rated 10A at 240 VAC.

G. Engine Starting Contacts
1. One isolated and normally closed pair of contacts rated 10A at 32 VDC minimum.

H. Remote annunciation and control system shall include the following features:
1. Touchscreen type operator interface.
2. Control and indication means grouped together for each automatic transfer switch.
3. Label each indication and control group. Indicate the automatic transfer switch it controls, the location of the automatic transfer switch, and the identity of the load that it serves.
5. Mounting: Steel cabinet, flush or surface mounted, as shown on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install automatic transfer switches and associated remote components in accordance with the NEC, as shown on the drawings, and manufacturer’s instructions.

B. Anchor automatic transfer switches with rustproof bolts, nuts, and washers not less than 12 mm (1/2 inch) diameter, in accordance with manufacturer’s instructions, and as shown on drawings.

C. In seismic areas, automatic transfer switches shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.

D. Mount automatic transfer switches on concrete slab. Unless otherwise indicated, the slab shall be at least 100 mm (4 inches) thick. The top of the concrete slab shall be approximately 100 mm (4 inches) above finished floor. Edges above floor shall have 12.5 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 100 mm (8 inches) beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulk or sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface. Concrete work shall be as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

E. Anchor remote control and/or annunciator panel to wall.

3.2 CONNECTIONS
A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
B. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.

C. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.

D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 ACCEPTANCE CHECKS AND TESTS

A. An authorized representative of the automatic transfer switch manufacturer shall technically supervise and participate during all of the field adjustments and tests. Major adjustments and field tests shall be witnessed by the COTR. The manufacturer’s representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer’s recommendations.

B. Perform manufacturer’s required field tests in accordance with the manufacturer’s recommendations. In addition, include the following:

1. Visual Inspection and Tests:
   a. Compare equipment nameplate data with specifications and approved shop drawings.
   b. Inspect physical, electrical, and mechanical condition.
   c. Confirm correct application of manufacturer's recommended lubricants.
   d. Verify appropriate anchorage, required area clearances, and correct alignment.
   e. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.
   f. Verify grounding connections.
   g. Verify ratings of sensors.
   h. Vacuum-clean enclosure interior. Clean enclosure exterior.
   i. Exercise all active components.
   j. Verify that manual transfer warning signs are properly placed.
   k. Verify the correct operation of all sensing devices, alarms, and indicating devices.

2. Electrical tests:
   a. Perform insulation-resistance tests.
   b. After energizing circuits, demonstrate the interlocking sequence and operational function for each automatic transfer switch at least three times.
      1) Test bypass-isolation unit functional modes and related automatic transfer switch operations.
      2) Power failure of normal source shall be simulated by opening upstream protective device. This test shall be performed a minimum of five times.
      3) Power failure of emergency source with normal source available shall be simulated by opening upstream protective device for emergency source. This test shall be performed a minimum of five times.
      4) Low phase-to-ground voltage shall be simulated for each phase of normal source.
      5) Operation and settings shall be verified for specified automatic transfer switch operational feature, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, and supplemental features.
      6) Verify pickup and dropout voltages by data readout or inspection of control settings.
      7) Verify that bypass and isolation functions perform correctly, including the physical removal of the automatic transfer switch while in bypass mode.

   b. Ground-fault tests: Verify that operation of automatic transfer switches shall not cause nuisance tripping or alarms of ground fault protection on either source.

   c. When any defects are detected, correct the defects and repeat the tests as requested by the COTR at no additional cost to the Government.

3.4 FIELD SETTINGS VERIFICATION

A. Manufacturer's Field Service: The supplier of the transfer switch(es) and associated equipment shall inspect, test, and adjust components, assemblies, and equipment installations, including connections, and report results in writing.
B. Manufacturer’s representative shall perform tests and inspections and prepare test reports.
C. After installing equipment and after electrical circuitry has been energized, installer shall test for compliance with requirements.
   1. Perform recommended installation tests as recommended in manufacturer’s installation and service manuals.
   2. After energizing circuits, demonstrate interlocking sequence and operational function for each switch.
      a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
      b. Verify time-delay settings.
      c. Verify that the transfer switch is accurately metering AC voltage and current.
      d. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
   1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
   2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
E. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial.

3.5 DEMONSTRATION
A. After generator set installation, the generator and transfer switch supplier shall conduct a complete operation, basic maintenance, and emergency service seminar covering generator set and transfer switch equipment, for up to 10 people employed by the Owner.
   1. The seminar shall include instruction on operation of the transfer equipment, normal testing and exercise, adjustments to the control system, use of the PC based service and maintenance tools provided under this contract, and emergency operation procedures.
   2. The class duration shall be at least 8 hours in length, and include practical operation with the installed equipment.

3.6 SERVICE AND SUPPORT
A. The manufacturer shall supply the Service Provider with a complete set of the service and maintenance software required to support the product. The software shall be provided at a training class attended by the user, to qualify the user in proper use of the software. The software shall have the following features and capabilities:
   1. The software shall allow adjustment of all functions described herein, adjustment of operating levels of all protective functions, and programming of all optional functions in the controller. Adjustments shall be possible over modem from a facility that is remote from the generator set.
   2. The software shall be capable of storing and displaying data for any function monitored by the generator set control. This data shall be available in common file formats, and on graphical “strip chart” displays.
   3. The software shall automatically record all control operations and adjustments performed by any operator or software user, for tracking of changes to the control.
   4. The software shall display all warning, shutdown, and status changes programmed into transfer switch controller. For each event, the control shall provide information on the nature of the event, when it last occurred, and how many times it has occurred.
3.7 FOLLOW-UP VERIFICATION
   A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that
      the automatic transfer switches are in good operating condition and properly performing the intended
      function.

3.8 INSTRUCTION
   A. Furnish the services of a factory-trained technician for one 4-hour training period for instructing personnel in
      the maintenance and operation of the automatic transfer switches, on the dates requested by the COTR.

END OF SECTION