ENGINEERING CHANGE NOTICE

**ECN Category**
- Supplemental
- Direct Revision
- Change ECN
- Temporary
- Standby
- Supersede
- Cancel/Void

**Originator's Name, Organization, MSIN, and Telephone No.**
TC Schneider, 75240, L6-37, 376-9032

**Project Title/No./Work Order No.**
Standard Hydrogen Monitoring System / N2165

**Document Numbers Changed by this ECN**
WHC-SD-WH-EII-003 Rev. 0

**Approval Designator**
SQ

**Description of Change**
The following outstanding ECNs are being incorporated:
169005, 169044, 191949, 187920 and 615442

Additional reference drawings are being added by Appendixes D and E.

One Section, 16400, is being replaced with the newest revision of Section 16400.

**Justification (mark one)**
- Criteria Change
- Design Improvement
- Environmental
- Facility Deactivation
- Consec. Error/Omission

**Justification Details**
The incorporation of these outstanding changes will update the specification to current standards and references required for new installation activities.

**Distribution**
- DB Engelman L6-37 (1)
- HN Hinntson R3-26 (1)
- TC Schneider L0-37 (1)
- CR Yao L6-37 (1)
- NE Erhart R3-51 (1)
- RE Larson E6-01 (1)
- Tank Farm Information Center 01 28 (1)
- ICF Kaiser Construction Doc Control 62 53 (1)
- Central Files A3-B8

**Modification Work**
- [ ] Yes (fill out Blk. 12b)
- [X] No (NA Blks 12b, 12c, 12d)

**Design Authority/CoG Engineer Signature & Date**

**Distribution (include name, MSIN, and no of copies)**
- DB Engelman L6-37 (1)
- HN Hinntson R3-26 (1)
- TC Schneider L0-37 (1)
- CR Yao L6-37 (1)
- NE Erhart R3-51 (1)
- RE Larson E6-01 (1)
- Tank Farm Information Center 01 28 (1)
- ICF Kaiser Construction Doc Control 62 53 (1)
- Central Files A3-B8

**Design Baseline Document**
- [ ] Yes
- [X] No

**Related ECN No(s)**
N/A

**Related PO No.**
N/A

**Modification Work Complete**
N/A

**Design Authority/CoG Engineer Signature & Date**

**Modification Work Complete (Temp. or Standby ECN only)**
N/A

**Engineeering Task No.**
ETN-94-0002

**USQ Tracking No.s**
TF-94-0274 and TF-94-0213

**Restored to Original Condition (Temp. or Standby ECN only)**
N/A

**Tanks 02-96-08 82**

**Date**
SEP 27 1996

**STI 37 RELEASE**

**Central Files A3-B8**

**Date**
SEP 27 1996
### Engineering Change Notice

16. Design Verification Required
   - [ ] Yes
   - [x] No

17. Cost Impact
   - [x] Engineering
     - Additional Savings: $500
   - [x] Construction
     - Additional Savings: $N/A

18. Schedule Impact (days)
   - [ ] Improvement
   - [ ] Delay

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

   - Additional SDD/DD Functional Design Criteria
   - Operating Instruction
   - General Design Criteria
   - Conceptual Design Report
   - Equipment Specific
   - ASME Code
   - Human Factor Consideration
   - Computer Software
   - Electro-Circuit Schedule
   - Operational Safety Requirement
   - ICPS Procedure
   - Process Control Manual
   - Process Flow Chart
   - Purchase Requisition
   - Material Control
   - Project Procurement
   - Test Procedures/Specifications
   - Project Procurement
   - Essential Material
   - Purchase Requisition
   - Inventory Adjustment Request

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECM.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

   - Document Number/Revision
   - [ ] Tank Calibration
   - [ ] Health Physics Procedures
   - [ ] Seismic/Stress Analysis
   - [ ] Stress/Design Report
   - [ ] Interlace Control Drawing
   - [ ] Calibration Procedure
   - [ ] Maintenance Procedure
   - [ ] Engineering Procedure
   - [ ] Inspection Plan
   - [ ] Inventory Adjustment Request

21. Approvals

   - [ ] Design Authority
   - [ ] Design Agent
   - [ ] Design
   - [ ] Environ.
   - [ ] Other
   - [ ] Safety
   - [ ] Other

   - [ ] Personnel
   - [ ] Environ.

   - [ ] DEPARTMENT OF ENERGY
   - [ ] Signature or a Control Number that tracks the Approval Signature

   - [ ] ADDITIONAL
Title Standard Hydrogen Monitoring System (SHMS) Equipment Installation Instruction (EII) Document, WHC-SD-WM-EII-003, Direct Revision

Introduction

The SHMS are flammable gas monitoring systems sited on the 200 Area Flammable Gas Watchlist Waste Tanks. Additional SHMS will be located on other tanks that have been identified as having potential for flammable gas release. The WHC-SD-WM-EII-003 was released in 1993 to support the installation of a large number of the SHMS across the 200 Area tank farms. With the design activity for the latest set of SHMS installation ECNs to support project W-369, it was noted that several of the construction specifications and instructions that were originally provided in the SD have been changed or modified. These changes are being incorporated into the SD to make it current.

Scope

The scope of this Safety Screening is to determine if WHC-SD-WM-EII-003 new Revision 1 is bounded by the existing Safety Envelope for the Single Shell, Double Shell and Aging Waste tanks.

Authorization Basis

The AUTHORIZATION BASIS for the proposed change is found in the following documents:

1. WHC-SD-WM-1SB-001, Hanford Site Tank Farm Facilities Iterim Safety Basis, Revision 0
2. WHC-SD-WM-OSR-005, Single-Shell Tank Iterim Operational Safety Requirements, Revision 0-E
3. WHC-SD-WM-OSR-016, Double-Shell Tank Iterim Operational Safety Requirements, Revision 0-D
4. WHC-SD-WM-OSR-004, Aging Waste Facility Iterim Operational Safety Requirements, Revision 0-D
5. WHC-SD-WM-SAR-006, Single-Shell Tank Isolation Safety Analysis Report, Revision 2
### UNREVIEWSD SAFETY QUESTION SCREENING/DETERMINATION FORM (Continued)

---

6. WHC-SD-WN-SAR-034, Overground Transfer Lines SAR Addendum (Stabilization of Single-Shell Tank Waste Storage Tank by Saltwell Pumping), Revision 0-A

7. WHC-SD-WN-SAR-016, Double-Shell Tank Farm Facility 241 AN, AW, AP & SY Safety Analysis Report, Revision 1

**Conclusion**

The proposed changes to the EII are bounded by the Authorization Basis.

### References

1. WHC-SD-WN-EII-003, Standard Hydrogen Monitoring System Equipment Installation Instructions, Revision 1

#### USQ Screening:

<table>
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<tr>
<th>Item</th>
<th>Option</th>
<th>Reason</th>
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<tr>
<td>A. Does the PROPOSED ACTIVITY represent a change to the facility as described in the AUTHORIZATION BASIS?</td>
<td>[X] No</td>
<td>Basis: The facility as described in the AUTHORIZATION BASIS, WHC-SD-WN-18B-001 Rev. 0-J, Chapter 6 only talks about gas monitoring of flammable gas watch list tanks (FGWLT), but does not define the system or installation details. The proposed change does not delete the requirement for flammable gas monitoring.</td>
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<td>B. Does the PROPOSED ACTIVITY represent a change to procedures as described in the AUTHORIZATION BASIS?</td>
<td>[X] No</td>
<td>Basis: None of the procedures in the AUTHORIZATION BASIS refer to the specific gas monitoring equipment or its installation arrangement.</td>
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<td>C. Does the test or experiment represent a test or experiment not described in the AUTHORIZATION BASIS documentation?</td>
<td>[X] No</td>
<td>Basis: The proposed change is not a test or experiment.</td>
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<td>D. Does the PROPOSED ACTIVITY or REPORTABLE OCCURRENCE impact:</td>
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<td></td>
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<tr>
<td></td>
<td>- OSRs or IOSRs?</td>
<td>[X] No</td>
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<tr>
<td></td>
<td>- Approved IOSR Compliance Implementation Plan?</td>
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E. Does the REPORTABLE OCCURRENCE or PIAB involve analytical errors, omissions, and/or deficiencies in the AUTHORIZATION BASIS?

[ ] No  [ ] Yes  [X] N/A  
Basis: This is not a REPORTABLE OCCURRENCE or PIAB.

USQE No. 1: TC Schneider
Print Name:  
Signature:  7-26-96

USQE No. 2: DD Tate
Print Name:  
Signature:  9-26-96
Standard Hydrogen Monitoring System Equipment Installation Instructions

TC Schneider
Westinghouse Hanford Company, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

EDT/ECN: 165444 UC: 2030
Org Code: W75240 Charge Code: M2165
B&R Code: EW3120072 Total Pages: 56

Key Words: Hydrogen, Hydrogen Monitoring, SHMS, Equipment Installation Instructions

Abstract: This document provides the technical specifications for the equipment fabrication, installation, and sitework construction for the Standard Hydrogen Monitoring System.

The Standard Hydrogen Monitoring System is designed to remove gases from waste tank vapor space and exhaust headers for continual monitoring and remote sample analysis.

TRADEMARK DISCLAIMER. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

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Approved for Public Release

A 6400-073 (10/95) DEE231
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<td>BD Groth</td>
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<td>D-A</td>
<td>Replace &quot;H-2-88604&quot; with &quot;H-2-81830&quot; per ECN 189005 at page 40 and 41.</td>
<td>BD Groth</td>
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<td>D-B</td>
<td>Modify - Step 2.1.3.1, page 16 / Step 2.2.1.4, page 17 / Steps 2.1.3 and 2.1.4 page 24 per ECN 189004.</td>
<td>BD Groth</td>
</tr>
<tr>
<td>D-C</td>
<td>Modify - Section 1.0 page 1 / Sections 1.1 and 1.2.1 page 4 / Section 1.4 page 5 &amp; Add - Appendix B to page 42 and 43 per ECN 191949.</td>
<td>AE Wilder</td>
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<tr>
<td>D-D</td>
<td>Modify - TABLE OF CONTENTS page ii / Section 1.0 page 1 / Sections 1.1 and 1.2.1 page 4 / Section 1.4 page 5 and Add - Appendix C to page 44 and 45 per ECN 187920.</td>
<td>AE Wilder</td>
</tr>
<tr>
<td>D-E</td>
<td>Modify - Step 2.1.4, page 34 per ECN 615442.</td>
<td>AE Wilder</td>
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<tr>
<td>RS</td>
<td>Incorporate ECNs identified through Rev. 0-D-E, Add - Appendixes D and E and revise section 16400 per Direct Rev. ECN 165444.</td>
<td>MF Erhart, GN Hanson</td>
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STANDARD HYDROGEN MONITORING SYSTEM
EQUIPMENT INSTALLATION INSTRUCTIONS (CONSTRUCTION SPECIFICATIONS)

REVISION 1

WHC-SD-WM-EII-003

September, 1996

INSTALLATION INSTRUCTION APPROVALS:

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<th>Instrumentation Cog. Engr Date</th>
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<tr>
<td>SHMS Systems Engineer</td>
<td>Date</td>
<td>Project Cog. Engineer Date</td>
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<tr>
<td>SHMS System Manager</td>
<td>Date</td>
<td>West Tank Farm Operations Date</td>
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<tr>
<td>Project Manager</td>
<td>Date</td>
<td>East Tank Farm Operations Date</td>
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<tr>
<td>Quality Assurance</td>
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(See EDT-131705 for original approvals.)
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<td>15. APPENDIX E - Document Listing</td>
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1.0 INTRODUCTION

This document provides the technical specifications for the fabrication, installation of the equipment, and sitework construction activities for the Standard Hydrogen Monitoring System (SHMS). These instructions (specifications) consist of a number of technical sections which are organized in accordance with the Construction Specification Institute standard construction specification division format.

The Scope of the Work covered by these instructions is defined in Section 01010 of this document. The drawings and related documents which delineate the work are listed in Appendixes A, B, C, D and E. Any special work procedures required to install the equipment on the individual waste storage tanks will be covered in the associated installation ECNs. The technical specifications and instructions for the work are contained in Divisions 2 through 16.

2.0 SYSTEM DESCRIPTION

2.1 General

The SHMS is designed to remove vapor space or exhaust duct gas samples from waste storage tanks for analysis. Both double and single shell tank gas monitoring may be required.

Under normal conditions the vapor space in the double shell waste tanks is under negative pressure and contains a uniform mixture of gasses. The tank contents potentially create a release of gas which may cause a temporary rise in tank pressure and an increased concentration of hydrogen gas in the vapor space. Ventilation air into the tank washes the released gas out through the existing exhaust system until a uniform gas mixture in the vapor space is once again achieved. The SHMS is designed to monitor the portion of hydrogen present in the gas being sampled.

Under normal conditions, the vapor space in the single shell waste tanks is at atmospheric pressure and contains a mixture of gasses. The tank contents potentially create a release of gas which may cause a temporary rise in tank pressure and an increased concentration of hydrogen in the vapor space. The increased tank pressure moves the released gasses out through the existing filter system until a stable gas mixture in the vapor space is once again obtained.
For a more detailed description of the SHMS design parameters, refer to WHC-SD-WM-CR-043, the Design Requirements and Criteria for a Hydrogen Monitoring System for Tanks 103-SY and 104-AN and WHC-SD-WM-SDD-001, the Standard Hydrogen Monitoring System Design Description.

The Standard Hydrogen Monitoring System consists of a number of pieces of equipment, and the major items are identified and addressed in more detail in the following paragraphs.

2.2 Local Cabinet Assemblies

A local cabinet assembly is located on or near the tank being monitored. Gases will be continuously sampled from a selected location in the tank vapor space or in the tank exhaust duct. Each sample point is associated with a single local cabinet assembly. The sample will flow through 1/2-inch stainless steel, insulated and heat traced, tubing lines to the local cabinet where the samples will be analyzed for hydrogen gas concentrations. The data from the hydrogen monitoring instruments will be displayed by a digital meter and a strip chart recorder in the local cabinet. Instrument and alarm signal termination points will be provided in the local cabinet for connection to remote data logging and alarm displays. The local cabinet will be provided with grab sample stations to provide additional gas analysis capabilities.

The enclosures are to be modified to accept the gas sample/monitoring equipment. Panel modifications, and fabrication and installation of internal tubing and instrumentation equipment will be performed by the Contractor.

2.3 Vacuum Pumps

The gas sample is drawn from the tank by a vacuum pump located adjacent to the local cabinet. The pump will be installed on a steel support stand mounted to the concrete pad on the north side of the local cabinet. The sample will be drawn through the local cabinet and into the sample pump through a flexible stainless steel hose. The pump outlet will be connected to the 1/2 inch stainless steel return line through a flexible stainless steel hose and check valve. From the vacuum pump the sample gas will be routed to the discharge point through 1/2 inch stainless steel heat traced tubing.

2.4 Site Power

A single phase 240/120 30 Ampere circuit will be required for each local instrumentation cabinet. The power will be routed to the local cabinet as identified by the associated ECN to site documents listed on H-2-87275, SHMS Drawing Index Tree. The power will be installed by the Contractor.
2.5 Compressed Gas Bottle Racks

A three-bottle unit storage rack for calibration gas bottles (size 1A) will be fabricated and located adjacent to the local cabinet. The rack has been designed to resist SDC 4.1 Safety Class 3 seismic loads and will be securely anchored to concrete pads with expansion anchors. Sheet metal hoods will be provided over the tops of the bottles to protect the pressure regulators and valves. Gas tubing will be field routed from the gas bottles to the local cabinet.

3.0 DEFINITIONS

Terms, abbreviations, and/or terminology, if used in the technical sections of these installation instructions, are defined as follows:

3.1 Owner: Department of Energy (DOE)

3.2 Operating Contractor: Westinghouse Hanford Company (WHC)

3.3 Contractor: Kaiser Engineers Hanford (KEH)

3.4 Operations Engineer: Authorized representative of WHC Tank Farm Operations section.

3.5 Construction Engineer: Authorized representative of KEH Construction Engineering organization.

3.6 Plant Manager: WHC Manager of Tank Farm Operations.

3.7 Nuclear Safety: Representation of WHC Nuclear Safety organization.

3.8 Design Engineer: WHC Cognizant Engineer for the specific item of work under consideration (noted on Drawing title block).

3.9 Project Engineer: Authorized representative of WHC Tank Farm Projects section.
SECTION 01010

SUMMARY OF WORK

PART I - GENERAL

1.1 Introduction

This Instruction is for the fabrication, construction, and installation of a Standard Hydrogen Monitoring System as detailed on the Construction Drawings (see Schedule of Drawings in Appendixes A, B, C, D and E).

1.2 Contractor Statement of Work

1.2.1 Scope: Work consists of furnishing labor, equipment, and materials to provide the Standard Hydrogen Monitoring System in accordance with this Specification and the applicable Operating Contractor Documents referenced in Appendixes A, B, C, D and E.

1.2.2 Work Included: Following itemization is intended to be broad in scope to identify major work elements and is not all inclusive.

1.2.2.1 Perform demolition work, as required, in accordance with approved procedures and direction of Operations Engineer. The demolition work will be in support of site installation preparation. It shall be the responsibility of the contractor to properly package and document any hazardous, radioactive or mixed waste generated as a result of the demolition and construction activities. The construction contractor shall make every effort to reduce the quantity and toxicity of any generated waste. The contractor shall follow the guidelines for waste handling and segregation per Tank Farm Operations manual TO-100-052. Any specific questions relative to this topic should be directed to the Environmental Waste Operations manager.

1.2.2.2 Furnish and install the prefabricated heat traced stainless steel tubing lines and supports from tank riser or exhaust header sample point to the gas monitoring local cabinet and from the vacuum pumps to sample exhaust point.

1.2.2.3 Install all the required heat tracing control system appurtenances.

1.2.2.4 Install vacuum pump and stand including power, flexible tubing and controls.
1.2.2.5 Construct the local cabinet and gas bottle rack reinforced concrete equipment pad.

1.2.2.6 Furnish, fabricate and install the gas bottle rack.

1.2.2.7 Fabricate and install local cabinets including internal tubing and electrical and enclosure modifications.

1.2.2.8 Furnish and install prefabricated heat traced gas tubing and supports from gas bottle racks to local cabinets.

1.2.2.9 Install power conductors and necessary electrical appurtenances from the facility power distribution point to the local cabinets.

1.2.2.10 Furnish and install the alarm cable and conduit, as required, from the local cabinet to the remote annunciation point.

1.2.2.11 Furnish and install the remote data logger cable and conduit, as required, from the local cabinet to the remote data logging point.

1.2.3 Work Not Included: Following items of work are not included in this defined task.

1.2.3.1 Items shown on the Drawings to be done by others.

1.3 Acceptance Testing

The acceptance testing of the hydrogen monitoring system shall be performed by the Contractor in accordance with the Acceptance Test Procedure (ATP) prepared by the Operating Contractor.

1.4 Drawings

Drawings and documents which show work to be accomplished by the Contractor are listed in the Schedule of Drawings, in Appendixes A, B, C, D and E to The System Description section of this document, and are also shown on Drawing H-2-87275, the Drawing Index Tree.

PART 2 - PRODUCTS

Not Used
PART 3 - EXECUTION

3.1 Inspection: No Field Quality Control or Acceptance Inspection (AI) services will be required by these instructions. All required inspection (or other Quality Services' duties) will be as directed by separate Letter of Instruction (LOI) to the Contractor.
PART 1 - GENERAL

1.1 References

1.1.1 The references are included in the following text and on the design Drawings.

1.2 Submittals

1.2.1 None required.

PART 2 - PRODUCTS

2.1 Materials

2.1.1 General: Obtain select soils from excavation or other designated locations. Obtain onsite approval for soils.

2.1.2 Fill or Backfill

2.1.2.1 Structural: Well graded soil mixtures which may contain cobbles up to 3 inches in greatest dimension if uniformly distributed and not constituting more than 20 percent of volume of fill.

2.1.2.2 Common: Well graded soil mixtures containing cobbles up to 8 inches in greatest dimension if uniformly distributed and not constituting more than 40 percent of volume of fill.

2.1.3 Bedding for Underground Conduit and Cable: Sand, defined in ASTM D 653, or excavated sandy material having less than 20 percent gravel particles and maximum dimension of 1/2 inch.

2.1.4 Stabilization: Crushed rock, maximum size of particles 3/4 inch.

2.1.5 Location Marker: 3-inch wide, detectable plastic tape imprinted at maximum 4-foot intervals with warning such as "CAUTION - BURIED INSTALLATION BELOW." "Terra Tape Sentry Line 620" with "Terra Clips," both by Reef Industries, or approved substitute.
PART 3 - EXECUTION

3.1 Excavation

3.1.1 Obtain excavation permit before performing excavation.

3.1.2 Locate and expose underground utilities by hand tools. Use of heavy equipment and machinery is subject to approval of Construction Engineer.

3.1.3 Slope sides of excavations or trenches more than 4 feet deep in accordance with 29 CFR 1926, Subpart P, Appendix B, Table B-1.

3.1.4 Do not store excavated or other material closer than 2 feet from edge of excavation unless barrier is erected to retain excavated materials. Store and maintain materials in a manner that they are prevented from falling or sliding into excavation.

3.1.5 Wherever slopes of excavations will intersect existing underground lines or structures such as building foundations, underground piping, electrical ducts or direct buried electrical lines, install shoring or other means of support to prevent overstressing existing structure or underground lines or to prevent interrupting service to existing buildings.

3.1.6 Footings and Foundations - Not required

3.1.7 Trenches for Underground Conduit and Cable

3.1.7.1 Make excavations to line and grade shown on the Drawings and wide enough to make connections. Excavate with near vertical sides from bottom of trench up to 1 foot above utility lines. Excavate trench deep enough to permit placement of compacted sand bedding, 4 inches minimum thickness, beneath lines except where excavation is in undisturbed sand which will serve as bedding or where lines are to be encased in concrete. Pare holes in trench bottoms for conduit couplings so conduit will bear full length of barrel or section.

3.1.7.2 Keep trenches free of standing water when laying is in progress.

3.1.7.3 If over-excavation occurs, correct by placement of backfill.

3.1.8 Soils in Contaminated Zones

3.1.8.1 Salvage in situ stabilization material and reuse after backfilling and compacting.
3.1.8.2 Conduct in-place density tests on in situ soils, using nuclear density gage, during excavation. Results of tests shall be used for testing compaction of backfill.

3.1.9 Where stabilization is required, finish subgrade 2 to 3 inches below elevations shown on the Drawings.

3.2 Backfill and Fill - Utility Lines

3.2.1 Before laying utility lines, place specified bedding in a 4-inch layer. Compact layer uniformly to 95% of maximum density as determined by ASTM D 1557.

3.2.2 Keep trenches free of standing water during laying of utility lines.

3.2.3 After laying utility lines, ensure that lines have been pressure tested before backfilling and filling. Place loose 8-inch layers of specified bedding under haunches, around sides and up to 12 inches above top of utility line. Compact each layer uniformly to 95% of maximum density as determined by ASTM D 1557, or for in place density, per ASTM D 2922. During compaction, exercise care to avoid pipe/conduit misalignment and to provide uniform bearing along pipe/conduit barrel.

3.2.4 Place loose 4-inch layers of backfill and fill in remaining trench depth. Use specified common backfill and fill. Compact each layer uniformly to 95% of maximum density as determined by ASTM D 1557, or for in place density, per ASTM D 2922.

3.2.5 Place specified location marker continuously and directly over buried utility lines at depth of 12 inches below finish grade. Place marker continuously and directly over each outside line of multiple lines and if spacing between outside line markers exceeds 4 feet place sufficient intermediate markers to maintain 4 feet maximum spacing between adjacent markers.
PART 1 - GENERAL

1.1 References

1.1.1 The references are included in the following text and on the design Drawings.

1.2 Submittals

1.2.1 Concrete Materials, Mix Design, and Mix Proportions: Submit concrete materials, mix design, and mix proportions in accordance with ACI 301, Sections 3.8 and 16.7.3. Define each material to be used in concrete and state amount, by weight, to be utilized per cubic yard of plastic mix. This requirement is waived if pre-approved mix designs are used.

PART 2 - PRODUCTS

2.1 Materials

2.1.1 Concrete: Pre-approved mix design number 6441 by ACME Materials and Construction Company, or ready-mix concrete consisting of following materials:

2.1.1.1 Cement: ASTM C 150, Type II (Low Alkali)

2.1.1.2 Aggregates: ASTM C 33, maximum size 3/4-inch

2.1.1.3 Air-entraining admixture: Meeting the requirements of ASTM C 260, Sika Chemical Company "SIKA AER", Chem-Masters Corp "Adz-Air", or Protex Industries "AES".

2.1.1.4 Properties

a. Minimum allowable compressive strength: 3000 psi at 28 days.

b. Slump: 4 inch (maximum) in accordance with ACI 301, Section 3.5 (before addition of high-range water-reducing admixture, if used).

c. Air content: In accordance with ACI 301, Table 3.4.1.

d. Proportions: In accordance with ACI 301, Sections 3.8, 3.9 and ASTM C 94.
2.1.1.5 Mixing: In accordance with ASTM C 94.

2.1.1.6 Delivery: In accordance with ASTM C 94.

2.1.2 Reinforcing Steel

2.1.2.1 Steel bars: ASTM A 615, deformed, Grade 60.

2.1.2.2 Welded wire fabric: ASTM A 185.

2.1.2.3 Tie wire: Carbon steel, 0.062 inch minimum, annealed, in accordance with ASTM A 653.

2.1.3 Joint Materials

2.1.3.1 Expansion joint filler: See Section 07900.

2.1.3.2 Sealant: See Type II, Section 07900.

2.1.3.3 Neoprene Gaskets: See Section 05500.

2.1.4 Nonshrink Grout: Nonmetallic type "Five Star Grout" by US Grout Corp, "Sik Grout 212" by Sika Corp, or "Masterflow 713" by Master Builders.

2.1.5 Rigid foundation insulation: Styrofoam SM or SB brand by Dow Chemical company, ASTM C 578, Type IV.

2.1.6 Insulation Adhesive: Styrofoam construction adhesive by Dow Chemical Company or Contech PL300 Foam Board Adhesive.

2.1.7 Forms: Wood, steel, plywood, or similar to Masonite Corporation "Concrete Form Presdwood", as required for various specified finishes.

2.1.8 Form Coating Materials: Magic Kote by Symons Corp, Form Shield by AC Horn Inc, or Burke Release #1 by the Burke Company.

2.1.9 Concrete Bonding Agents:

2.1.9.1 High strength epoxy adhesive: Use one of the following materials in accordance with manufacturer's written instructions:


   b. Brutem 17, manufactured by Master Builders.

   c. Probond 821, manufactured by Protex Industries.
PART 3 - EXECUTION

3.1 Preparation

3.1.1 Form Construction

3.1.1.1 Install formwork in accordance with ACI 301, Section 4.2. Interior shape and rigidity shall be such that finished concrete will meet the requirements of the Drawings within tolerances specified in ACI 117, Section 4.

3.1.1.2 Prepare form surfaces in accordance with ACI 301, Section 4.4 using specified form coating materials, or as described in subparagraph 3.1.1.3.

3.1.1.3 Forms for surfaces which will be permanently concealed from view may be saturated with water before placing concrete instead of other treatment, except in freezing weather forms shall be treated with oil or stearate.

3.1.1.4 Clean forms of foreign material before placing concrete.

3.2 Installation

3.2.1 Reinforcing Steel

3.2.1.1 Fabricate bars accurately to dimensions shown on the Drawings, within tolerances shown in ACI 301, Section 5.6.

3.2.1.2 Tag in accordance with bar list.

3.2.1.3 Place as shown on approved submittals within tolerances specified in ACI 301, Section 5.7.

3.2.1.4 Tie to prevent displacement during placement of concrete.

3.2.1.5 Do not force into concrete after initial set has started.

3.2.1.6 Place with dimension of concrete protection equal to minimum given in ACI 301, Section 5.7, except where shown otherwise on the Drawings.

3.2.1.7 Place welded wire fabric on chairs and lap 2 mesh at splices. Tie splices with wire.
3.2.2 Concrete

3.2.2.1 Before ordering, obtain approval of required submittals.

3.2.2.2 Before batching, obtain approval of formwork and reinforcement by the Construction Engineer.

3.2.2.3 Before placing:
   a. Approve "Pour Slip" including appropriate reference to specific portion of structure to be placed, maximum size of coarse aggregate, design, strength, admixture, and slump.
   b. For each truck load, collect "Trip Ticket". "Trip Ticket" shall contain information listed in ASTM C 94, subparagraphs 16.1.1 through 16.1.10, and include water/cement ratio.

3.2.2.4 Place in accordance with ACI 301, Sections 8.1, 8.2, and 8.3. Do not drop (free fall) more than 5 feet. Insert vibrator vertically if possible, into concrete and reach small distance into concrete in next lower layer. Do not insert vibrators into lower courses that have reached initial set. Take care to avoid allowing head of vibrator to come in contact with forms, reinforcement, or embedded items.

3.2.2.5 Temper only as permitted in ACI 301, Section 7.5.

3.2.2.6 Place nonshrink grout where shown on the Drawings and in accordance with manufacturer's recommendations.

3.2.2.7 Weather conditions: Protect concrete during placement in accordance with ACI 301, Sections 7.6 and 8.4. Cold weather concreting shall be in accordance with ACI 305.1.

3.2.2.8 Construction joints: Make in accordance with ACI 301, Section 6.1.

3.2.2.9 Embedded items: Install in accordance with ACI 301, Sections 6.4 and 6.5.

3.2.2.10 Expansion joints: Make in accordance with ACI 301, Section 6.2 and details on the Drawings.

3.2.2.11 Placing concrete against earth: Place on or against firm, damp surfaces free of frost, ice and free water. Do not place until required compaction has been obtained. Dampen earth surfaces to receive fresh concrete.
3.2.2.12 Consolidation: Consolidate concrete slabs in accordance with ACI 301, Section 11.6.

3.2.2.13 Preformed insulation: Install in accordance with manufacturers printed instructions. Provide protective U-channel edge coverings at exposed edges.

3.2.3 Concrete Repair and Form Removal

3.2.3.1 Form removal: Remove in accordance with ACI 301, Section 4.5.

3.2.3.2 Examine concrete surfaces for defects. Repair only after permission for patching is given by Construction Engineer.

3.2.3.3 Place concrete repair mortar within one hour after mixing. Do not retemper mortar.

3.2.3.4 Surface defect repair: Repair in accordance with ACI 301, Sections 9.1, 9.2 and 9.3. Cure concrete repairs same as new concrete.

3.2.4 Concrete Finishes and Tolerances

3.2.4.1 Formed surfaces: Start finishing following concrete repair and complete within 96 hours after forms have been removed. Finish in accordance with sections of ACI 301 noted below.

   a. Surfaces exposed to earth backfill Section 10.2.1
   b. Exterior surfaces exposed to weather Section 10.2.2
   c. Related unformed surfaces Section 10.5

3.2.4.2 Unformed surfaces: Finish in accordance with sections of ACI 301 noted below.

   a. Exterior equipment slabs Section 11.7.3
   b. Exterior slabs subject to foot traffic Section 11.7.4
3.3 Curing and Protection

3.3.1 Curing

3.3.1.1 Cure concrete in accordance with ACI 301, Section 12.2. Clear curing compounds shall be tinted or applied surfaces marked to delineate extent of spraying.

3.3.1.2 Do not use curing compound on concrete surfaces to receive flooring or special protective coating.

3.3.2 Protection

3.3.2.1 Protect concrete during extreme weather conditions in accordance with ACI 301, Section 12.3.

3.3.2.2 Protect concrete from mechanical injury in accordance with ACI 301, Section 12.4.
PART I - GENERAL

1.1 References

1.1.1 The references are included in the following text and on the design drawings.

1.2 Submittals

1.2.1 None required.

1.3 Quality Assurance

1.3.1 Qualification of Welding Personnel and Procedures

1.3.1.1 Personnel and procedures for welding structural steel shall have been qualified in accordance with AWS D1.1 before welding. Qualification in accordance with ASME Section IX may be substituted for this requirement.

1.3.1.2 Personnel and procedures for welding sheet metal shall have been qualified in accordance with AWS D9.1 before welding. Qualification in accordance with ASME Section IX may be substituted for this requirement.

1.3.2 Qualification of Nondestructive Examination (NDE) Personnel

1.3.2.1 Visual weld examinations and appropriate documentation shall be performed by Certified Welding Inspectors (CWI) who have received certification in accordance with AWS QC-1. Certified Associate Welding Inspectors (CAWI), certified in accordance with above standard, may be used to perform examination when under immediate direction of CWI. Welding related examination documentation shall be signed, or stamped by individual performing examination. Where CAWIs are used for examinations, documentation shall be signed, or bear CAWI's stamp in addition to CWI's under whom examinations were performed.

1.4 Delivery, Storage, and Handling

1.4.1 Deliver metal fabrications to site at time convenient for installation. If exposed to inclement weather, protect fabrications with paper, plastic, or other weatherproof covering and store off ground.
PART 2 - PRODUCTS

2.1 Materials

2.1.1 Rolled Steel Shapes, Plates, and Bars: ASTM A 36.

2.1.2 Steel Pipe: ASTM A 53 (black), standard weight, Schedule 40.

2.1.3 Fasteners (unless otherwise shown on Drawings):

2.1.3.1 Bolts: ASTM A 307, Grade A or B.

2.1.3.2 Nuts: ASTM A 563, Grade A, heavy hex.

2.1.3.3 Washers: ASTM F 844, flat circular.

2.1.3.4 Expansion anchors: Kwik-Bolt II (Kwik-Bolt) or Hilti Drop-in (HDI) manufactured by Hilti Fastening Systems or Red Head Wedge Anchor manufactured by Phillips Drill Company.

2.1.3.5 Weld studs: Nelson Stud Welding Company Type H4L.

2.1.4 Diamond Tread Floor Plate, Steel: Meeting the requirements of ASTM A 786, using ASTM A 36 material.

2.1.5 Steel bars and rods: ASTM A108, minimum yield 36,000 psi, maximum carbon content 0.35 percent.

2.1.6 Nonshrink Grout: See Section 03300.

2.1.7 Paint: See Section 09900.

2.1.8 Isolating Tape: No. 162.03 Elastic Compound Tape by Inmont Corp, or Kling-Felt No. 213 by Products Research and Chemical Corp.

2.1.9 Supports: Interchangeable channels, channel spring nuts, and bolts, Unistrut, manufactured by Unistrut Corp.

2.1.9.1 Channels: 1-5/8 inches wide and 7/8 or 1-5/8 inches deep.

2.1.9.2 Channel spring nuts: Manufacturer's standard.

2.1.9.3 Bolts for use with channel spring nuts: Manufacturer's standard.

2.1.10 Support Clamps for Rigid Steel Conduit: Manufacturer's standard.

2.1.12 Gasket adhesive: Plyobond by Goodyear Rubber Co.

2.1.13 Aluminum plate: ASTM B209, Grade 6061-T651.


2.1.16 Stainless Steel Sheet: ASTM A157, A176d, A240, type 304/304L or 316/316L.

2.2 Fabrication

2.2.1 General

2.2.1.1 Verify measurements and take field measurements necessary before fabrication. Provide miscellaneous bolts and anchors, supports, braces, and connections necessary for completion of metal fabrications. Cut, reinforce, drill, and tap metal fabrications shown to receive finish hardware and similar items. Weld or bolt connections as shown on the Drawings.

2.2.1.2 Workmanship: Form metal fabrications to shape and size, with sharp lines, angles, and true curves. Drilling and punching shall produce clean, true lines and surfaces. Execute and finish work in accordance with fabrication Drawings.

2.2.1.3 Jointing and intersections: Accurately made, tightly fitted, and in true planes with adequate fastenings.

2.2.1.4 Perform welding of carbon steel connections in accordance with AWS D1.1, using E70XX. Use wire feed if done in shop.

2.2.1.5 Perform welding of stainless steel sheet in accordance with ASME Section IX.

2.2.2 Miscellaneous Steel Items: Supply required clips, frames, equipment supports, and other fabrications as shown on the Drawings. Fabricate parts from standard structural sections or shapes, to sizes required. Wherever miscellaneous parts are exposed, grind edges, corners, and rough cuts smooth and free of snags. Shop paint parts except those to be embedded in concrete or masonry, or those which require other specific finishes.
2.2.3 Finishes: Prime ferrous metal in accordance with Section 09900. Do not coat members to be embedded in concrete or masonry, surfaces and edges to be field welded, or items to be galvanized.

PART 3 - EXECUTION

3.1 Inspection

3.1.1 Site Inspection: Examine areas where metal fabrications are to be installed and notify Operations Engineer in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in manner compatible with requirements for installation.

3.1.2 Furnish templates as required for installation of anchorages, such as concrete inserts, anchor bolts, conduit, and miscellaneous items having integral anchors, to be embedded in concrete. Coordinate with Construction Engineer for delivery of items to Site.

3.1.3 Nondestructive Weld Examination (NDE): Perform visual examination in accordance with AWS D1.1, Paragraph 6.5.5.

3.2 Installation

3.2.1 Install components into metal fabrication as shown on the Drawings.

3.2.2 Install metal fabrications plumb, level or as shown on the Drawings.

3.2.3 Make field connections as neatly as possible with joints flush and smooth. Grind smooth exposed welds and polish before field painting.

3.2.4 Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, protect surfaces with isolating tape to prevent galvanic or corrosive action.

3.2.5 After installation has been approved, clean and paint connections with primer. Touch-up shop prime coat wherever damaged. Repair breaks in galvanized coatings with zinc-rich coating.
SECTION 07200

INSULATION

PART 1 - GENERAL

1.1 References

1.1.1 The references are included in the following text and on the design Drawings.

1.2 Submittals

1.2.1 None required.

1.3 Delivery, Storage, and Handling

1.3.1 Deliver materials to site in original sealed containers or packages bearing manufacturer’s name and brand designation. Where materials are covered by referenced specification, containers or packages shall bear specification number, type, and class as applicable.

1.3.2 Store and handle materials in manner to protect from damage during entire construction period.

1.3.3 Store insulation off ground and under cover to protect against weather, moisture, and physical damage.

PART 2 - PRODUCTS

2.1 Materials

2.1.1 RTV Foam: See Section 07900.

2.1.2 Local Panel Insulation: As shown on the Drawings.

2.1.3 Tubing Insulation: As shown on the Drawings.

PART 3 - EXECUTION

3.1 Installation

3.1.1 Local Panel Insulation: Install in accordance with manufacturer’s recommendations.

3.1.2 Tubing Insulation: Install in accordance with manufacturer’s recommendations.
PART 1 - GENERAL

1.1 References

1.1.1 The references are included in the following text and on the design Drawings.

1.2 Submittals

1.2.1 None required.

1.3 Delivery, Storage, and Handling

1.3.1 Deliver materials to site in manufacturer's original containers unopened, and labels intact.

1.3.2 Store and handle materials to prevent inclusion of foreign materials or exposure to temperatures exceeding 90 F.

1.3.3 Discard sealants, caulking compounds, or components outdated as indicated by shelf life date.

PART 2 - PRODUCTS

2.1 Materials

2.1.1 General: Container labels shall show name and address of manufacturer, date of manufacture, name of material, associated hazards, precautions, mixing instructions, shelf life, and curing time.

2.1.2 Sealants

2.1.2.1 Type I, 2 component polysulfide: Nonsag type meeting the requirements of FS TT-S-00227, Type II, and bearing Thiokol Chemical Corporation's "Tested and Approved" seal.

2.1.2.2 Type II, 1 component polysulfide: Nonsag type meeting the requirements of FS TT-S-00230, Type II, and bearing Thiokol Chemical Corporation's "Tested and Approved" seal.

2.1.2.3 Type III, polyurethane: Multi-component, self leveling type, meeting the requirements of FS TT-S-00227, Type I, Class A.
2.1.3 Caulking Compound: Oil-base type meeting the requirements of FS TT-C-00598.

2.1.4 Primer: Nonstaining type, recommended by manufacturer of sealant or caulking compound for intended service.

2.1.5 Backer Rod: Closed-cell polyethylene foam rod, approximately 25 percent larger than width of joint in which to be installed.

2.1.6 Expansion Joint Filler: Watson Bowman & Acme Corporation "W" series, or bituminous type meeting the requirements of ASTM D 994.

2.1.7 Bond Breaker Tape: Polyethylene tape with pressure-sensitive adhesive.

PART 3 - EXECUTION

3.1 Preparation

3.1.1 Clean joints to be sealed or caulked of dirt, dust, oil, grease, mortar, or other foreign materials.

3.1.2 Follow recommendations of manufacturer of sealing or caulking materials for each condition of application.

3.1.3 Remove loose particles with wire brush. Blow out joints with oil and moisture-free compressed air. Remove wax or oil with methyl ethyl ketone or Xylol.

3.2 Installation

3.2.1 Primer

3.2.1.1 Prime joints when and as recommended by sealant or caulking manufacturer for each condition of application.

3.2.1.2 Do not apply primer to concrete until concrete has cured at least 28 days.

3.2.2 Back-Up

3.2.2.1 Install backer rod in joints where polysulfide sealant is to be applied. Install with proper tool, in accordance with manufacturer's instructions and to correct depth for sealant shape specified. Where depth of joint is not sufficient for installation of backer rod, use bond-breaker tape to prevent 3 point adhesion.
3.2.2.2 Install bond-breaker tape over expansion joint filler, in joints where polyurethane sealant is to be applied.

3.2.3 Joint Dimensions: Except as recommended otherwise by manufacturer, make depth of sealant joints 1/2 of joint width.

3.2.4 Sealant and Caulking

3.2.4.1 Perform sealing and caulking work using specified materials and proper tools in accordance with manufacturer's recommendations for conditions of each application.

3.2.4.2 For joint sealant applications, use 1 component or 2 component polysulfide.

3.2.4.3 Apply sealant Type II to sheet metal joints.

3.2.4.4 Apply sealant to clean and dry joints only.

3.2.4.5 Do not apply exterior sealing material when ambient temperature is below 40 F or above 100 F.

3.2.4.6 Apply sealing materials with guns having proper size nozzles and using sufficient pressure to fill spaces and voids solid. Where use of gun is impractical, proper hand tools, as approved, may be used.

3.2.4.7 Tool sealant after installation as required to properly fill joint and produce smooth surface.

3.2.4.8 Take necessary precautions to prevent contact of sealants or caulking with adjacent surfaces. If necessary, apply masking tape in continuous strips in alignment with edge of joint. Remove masking tape after joints have been tooled.
SECTION 09900

PAINTING

PART I - GENERAL

1.1 References

1.1.1 The references are included in the following text and on the design Drawings.

1.2 Submittals

1.2.1 None required.

1.3 Delivery, Storage, and Handling

1.3.1 Deliver materials to site in sealed, original, labeled containers, each bearing manufacturer's name and address, data of manufacture, name of materials, associated hazards, precautions, type of paint, brand name, color designation and instructions for mixing and reducing.

1.3.2 Store materials at minimum ambient temperature of 45°F in well ventilated and heated area or areas.

1.3.3 Take precautions to prevent fire hazards and spontaneous combustion.

1.4 Project Conditions

1.4.1 Environmental Requirements

1.4.1.1 Temperature

a. Unless otherwise recommended by paint manufacturer, apply coatings when ambient and surface temperatures are between 45°F and 95°F.

b. Provide temporary heat as required until specified surface and air temperatures exist for required time period. Maintain temporary heat for 24 hours after paint and finish application.
1.4.1.2 Weather

a. Do not exterior work on unprotected surfaces if it is raining or moisture from other source is present, or expected before applied paints can dry or attain proper cure without damage.

b. Allow wet surfaces to dry and attain required temperatures and conditions specified before proceeding with work, or continuation of previously started work.

c. Do not apply finish in areas where dust is being generated.

1.4.1.3 Ventilation: Provide adequate continuous ventilation required for drying various materials as recommended by paint manufacturer.

1.4.1.4 Illumination: Do not proceed with work unless minimum lighting level of 15 footcandles is provided on surfaces to be painted or finished. Provide temporary lighting to attain lighting level specified.

PART 2 - PRODUCTS

2.1 Materials

2.1.1 Terms used are defined in ASTM D 16.

2.1.2 Pretreatment Wash for Metals: MS OOD-P-15328.

2.1.3 Primers: Water borne rust inhibitive metal primer. Environmentally acceptable powder coating will be allowed as an alternative to painting.

2.1.4 Paints: Exterior semigloss water borne metal top coat enamel. Environmentally acceptable powder coating will be allowed as an alternative to painting.

2.1.5 Other Materials: Materials not specifically described but required to achieve specified finishes shall be of high quality and of manufacture approved by Construction Engineer.

2.1.6 Colors and Tints: Paint manufacturer's standard colors and tints including shades and colors of stains.
PART 3 - EXECUTION

3.1 Preparation

3.1.1 New Surface

3.1.1.1 Surfaces to be coated shall be in proper condition to accept, and assure proper adhesion of coating system.

3.1.1.2 Remove mildew by scrubbing with trisodium phosphate, bleach and detergent solution, then rinse with potable water and let dry.

3.1.1.3 Ferrous metals

a. For shop primed surfaces, apply phosphoric acid etch solution at field welded or abraded spots and let set for time recommended by acid etch manufacturer, rinse with potable water, and when dry, apply prime coat. Wash primed surfaces free of dirt, oil and grease.

b. Prepare ferrous metals in accordance with SSPC-SP 3. Mill scale may be present on cleaned surface providing it is fully anchored, gives metallic appearance and does not cover more than 30 percent of surface, except mill scale will not be permitted on surfaces subject to temperatures in excess of 200 F. Prime ferrous metals within 4 hours after preparation.

3.1.1.4 Galvanized and nonferrous metals: Solvent clean in accordance with SSPC-SP 1 and treat with vinyl type wash coat meeting the requirements of SSPC-Paint 27.

3.1.2 Existing Surfaces

3.1.2.1 General: Remove loose, blistered, scaled, or crazed finish to bare base material by scraping and (or) light sandblasting. Where new work joins existing, prepare existing surfaces extending to nearest break in plane. Wash surfaces with trisodium phosphate and water or other solution as required to remove accumulated film of wax, oil, grease, smoke or other foreign matter which would impair bond of, or cause bleed through, new finishes. After washing, rinse with potable water and let dry. Apply liquid deglosser or approved surface preparation material on gloss surfaces.

3.1.2.2 Ferrous metal: Sand rough edges of bare areas to feather edge at adjacent sound paint. Remove rust and loose paint to bare metal, solvent wash, then apply primer overlapping existing finish.
3.1.3 Mixing and Thinning

3.1.3.1 General: Packaged paint may be thinned before application where necessary to suit conditions of surface, temperature, weather, and method of application. Follow manufacturer's instructions or recommendations for thinning packaged paint. Use of thinner shall not relieve Contractor from obtaining complete hiding. Do not mix paints of different manufacturers.

3.1.3.2 Pretreatment wash: Mix by adding 1 volume of acid component to 4 volumes of resin component. Add acid component slowly to resin component with constant stirring. Use within 8 hours. Material may be reduced with normal butyl alcohol or 99 percent isopropyl alcohol, if thinning is required to maintain wet spray.

3.1.4 Protection

3.1.4.1 Cover or otherwise protect finished work of other trades, surfaces not to be painted or surfaces not concurrently being painted.

3.1.4.2 Provide sufficient drop cloths, shields and protective equipment to prevent spray or drippings from fouling surfaces not being painted, including surfaces in paint storage and preparation areas.

3.1.4.3 Place cotton waste, cloths and materials which may constitute fire hazard in closed metal containers and remove daily from site.

3.1.4.4 Where toxic materials, and both toxic and explosive solvents are used, take appropriate precautions in accordance with manufacturer's recommendations and applicable safety regulatory agencies. In applying acid etch coating or solutions to metals provide ventilation and take protective measures to meet requirements of safety regulatory agencies.

3.1.4.5 Remove and store electrical fixtures, outlets and switch plates, surface hardware, fittings and fastenings before starting work. Clean and reinstall upon completion of work in each area. Use no solvent or abrasives to clean hardware that will remove lacquer finish normally used on some items.

3.2 Application

3.2.1 Surfaces to be Painted and Finished: Paint surfaces scheduled or shown. Finish factory primed materials in accordance with this Section.

3.2.2 General: Paint may be applied by brush, roller or spray unless otherwise specified. At time of application, paint shall show no signs of deterioration. Maintain uniform suspension of pigments during application.
3.2.2.1 Apply paint so finished surfaces are free of runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete. Apply each coat as film of uniform thickness. Use rollers of type designed for coating to be applied and surface to be coated. Ensure that surfaces including edges, corners, crevices, welds, and rivets receive film thickness equivalent to adjacent painted surfaces.

3.2.2.2 Touch up suction spots or make overall application of primer or sealer on first coat on surfaces to produce uniform color and gloss.

3.2.3 Coating Progress: Allow time between successive coats to permit proper drying. Modify drying times to suit abnormal environmental conditions. Oil base or oleoresinous solvent-type paints are ready for recoating when paint feels firm, does not deform or feel sticky under moderate pressure of thumb, and application of another coat of paint does not cause lifting or loss of adhesion of undercoat.

3.2.4 Time Between Surface Preparation and Painting: Apply first coat on surfaces that have been cleaned, pretreated and otherwise prepared for painting as soon as practicable after such pretreatment has been completed, but before deterioration of prepared surface.

3.2.5 Pretreatment Wash Coat: Apply vinyl-type wash coat by brush or spray. Maintain wet spray at all times.

3.3 Cleaning

3.3.1 At completion of each day, remove painting materials, empty containers, rags, cloths, brushes, or other equipment. Store or dispose of as appropriate.

3.3.2 As work proceeds and upon completion, promptly remove paint where spilled, splashed or spattered.

3.3.3 At conclusion of work, leave premises neat and clean to satisfaction of Quality Services.
3.4 Painting and Finish Schedule

3.4.1 Exterior and Interior

3.4.1.1 Ferrous Metal, Enamel, Gloss

Pretreatment: MS DOD-P-15328 0.5 mil
Prime Coat: FS TT-P-645 1.5 mil
2nd Coat: FS TT-E-489, Class A 1.5 mil
Finish: FS TT-E-489, Class A 1.5 mil

3.4.2 Use products of same manufacturer within coating system.
PART I - GENERAL

1.1 References

1.1.1 The references are included in the following text and on the design drawings.

1.2 Submittals

1.2.1 Leak Test Procedure: Submit leak test procedure for review.

1.3 Delivery, Storage, and Handling

1.3.1 Do not drag tubing across floors or surface that may damage surface of tubing.

1.3.2 Use open-end or tubing wrenches. Do not use adjustable wrenches.

1.4 Quality Assurance

1.4.1 Qualification of Welding Personnel and Procedures: Personnel and procedures for welding pressure retaining components along with attachments thereto, and pipe supports, shall have been qualified in accordance with ASME B31.1 before welding

1.4.2 Qualification of Nondestructive Examination (NDE) Personnel

1.4.2.1 Visual weld examinations and appropriate documentation shall be performed by Certified Welding Inspectors (CWI) who have received certification in accordance with AWS QC-1. Certified Associate Welding Inspector (CAWI), certified in accordance with above standard, may perform examinations when under immediate direction of CWI. Welding related examination documentation shall be signed or stamped by individual performing examination. Where CAWI's are used for examinations, documentation shall be signed or stamped by both CAWI and CWI under whom examinations were performed.

1.4.2.2 Personnel performing other NDE shall be certified in accordance with Contractor's written practice, which shall meet the requirements of ASNT No. SNT-TC-1A
PART 2 - PRODUCTS

2.1 Materials

2.1.1 Tubing, Valves, and Fittings Provide in accordance with Pipe Codes and Drawings

2.1.1.1 Small parts valves and fittings shall be cleaned by immersion in acetone followed by a rinse in demineralized water and finally ethyl alcohol. The parts shall indicate clean with no residue left on a white cloth swab.

2.1.1.2 Tubing shall be cleaned by flushing or swabbing with acetone followed by a rinse of demineralized water and finally ethyl alcohol. The tubing to be installed in the field may be precleaned and capped prior to installation.

2.1.2 Wiring and other materials required to complete instrumentation installation are specified in Section 16400 and on the Drawings

2.1.3 Joint Lubricant Where antisieze lubricant is required on male pipe threads, use only teflon tape

2.1.4 Tubing Insulation As shown on the Drawings

PART 3 - EXECUTION

3.1 Installation

3.1.1 Install equipment in accordance with the Drawings and manufacturer’s instructions

3.1.2 Fabricate and install tubing and fittings in accordance with ASME B31.1, the Drawings, and the following

3.1.2.1 Cut tubing with tube cutter, then clean burrs and metal chips from ends. Swab clean the cut ends with denatured alcohol or MEK, then re-cap or cover ends if not being installed immediately to maintain the cleanliness of the tubing.

3.1.2.2 Bend tubing to radius as great or greater than minimum radius recommended by manufacturer. Use methods and equipment which produce bends free of wrinkles, bulges, kinks, or flat spots. Bend tubing in accordance with ASME B31.1 and meet tolerances in ASME B31.1 and PFI ES-24.
3.1.2.3 Install exposed tubing on straight parallel runs laid flat against supports. Space supports at 5 foot (maximum) centers for 1/2-inch tubing, and at 3 foot centers for 1/4-inch tubing, or as shown on the Drawings. Gang tubes vertically wherever possible. Stagger fittings on ganged runs as needed to prevent congestion.

3.1.2.4 Provide slack as needed to prevent damage from expansion or contraction on tubing runs.

3.1.2.5 Use compression type fittings specified in Pipe Codes for tubing runs unless otherwise shown on the Drawings. For NPT fittings and joints, use only teflon tape as the joint lubricant.

3.1.3 Welding

3.1.3.1 Weld tubing, attachments to pressure retaining components, and pipe supports where shown on the Drawings in accordance with ASME B31.1. Obtain Operating Contractor approval prior to commencing any welding activities in the Tank Farm (see Section 01100).

3.1.3.2 Protect outdoor welding operation from rain and wind by using barriers to protect welder and weld joint.

3.1.4 Flushing: Flush sample and calibration gas lines with dry nitrogen before connecting to instruments. Test discharged flush gas for cleanliness by blowing through clean white cloth over end of tube. Verify that cloth shows no visible trace of dirt, oil, or moisture. Any visible trace of dirt or oil will require that the tubing be re-cleaned per Paragraph 2.1.1.2.

3.1.5 Cleanliness: Maintain tubing in its as-cleaned condition during installation by use of caps and by exercising care during installation.
SECTION 16400
ELECTRICAL INSTALLATION

PART 1 - GENERAL

11 References

111 The references are included in the text that follows

12 Submittals

121 Approval Required

13 Quality Assurance

131 Electrical/Electronic Product Acceptability

1311 Each product shall be listed for intended use in 1 of the following and shall bear listing organization's label. In absence of label, provide documentation that verifies product listing

a FM Approval Guide

b UL Electrical Appliance and Utilization Equipment Directory

c UL Electrical Construction Materials Directory

1312 If product is not listed in above directories or guide, provide product which has been tested and certified by a laboratory which has been nationally recognized in accordance with 29 CFR 1910.7. Provide the following

a OSHA documentation which demonstrates recognition

b Laboratory documentation that verifies testing in accordance with national code or standard

1313 If product is not listed by UL or FM and if a nationally recognized laboratory is not available, submit descriptive literature to Design Engineer. Literature shall include product specification and description of intended application.
PART 2 - PRODUCTS

2.1 Materials

2.1.1 Conductors: UL 83, stranded copper with Type THWM/THHN or XHHW insulation, of type and AWG size specified on the Design Documents.

2.1.2 Cable: NEC Type MC, number of conductors and size as shown on the Design Documents.

2.1.3 Conduit

2.1.3.1 Rigid metal conduit: UL 6 or ANSI C80.1.

2.1.3.2 PVC-coated rigid steel conduit: NEMA RN 1.

2.1.3.3 Flexible conduit, liquidtight: UL 360

2.1.4 Conduit Fittings

2.1.4.1 Fittings for rigid steel and ENT conduit: UL 514B or NEMA FB 1.

2.1.4.2 Fittings for flexible metal conduit: UL 514B

2.1.4.3 Fittings for entries into sides and tops of UL 50 or NEMA JCS 6, Type 3, 3R or 12 enclosures: Myers-type watertight fittings or sealing type locknuts.

2.1.4.4 Couplings: Erickson type.

2.1.5 Wire Connectors

2.1.5.1 Terminal lugs: UL 486A, Crimp type with ring or spade lug with turned up tips, nylon or vinyl insulated.

2.1.6 Identification Materials and Plates:

2.1.6.1 Conduit Markers: Conduit markers shall be stainless steel indented marker plates, Panduit Corp., Catalog No. MMP350-C, held in place with stainless steel ties, Panduit Corp., Catalog No. MLT4S-CP. Characters shall be 3/16 inch in height minimum, indented with indenter marker press, Panduit Corp., Catalog No. [MPIB7], or approved substitutes.

2.1.6.2 Wiremarkers: Imprinted tubular plastic.
2.1.6.3 Equipment nameplates: Laminated plastic, 2 mm (1/16 inch) thick with white surface and black core, sized to meet legend requirements. Edges beveled and smooth. Engraved nomenclature sharp and clear. Engraved manufacturer's standard nameplates may be used if equal in quality and legibility.

2.1.7 Lubricant and Sealant for Conduit Thread: Conductive compound providing anti-seize and corrosion protection. Thomas & Betts "KOPR-SHIELD" or approved substitute.

2.1.8 Marker for Buried Conduit: See Section 02200

2.1.9 Penetration Sealant:

2.1.10 Nonfirestopping: FS TT-S-00230, Type II, Class B, polysulfide base, light-colored.

2.1.11 Sealing Compound for Conduit: "Sealex" by Porcelain Products Company or Duct Seal by Gardner-Bender, or approved substitute.

2.1.12 Supports:

2.1.12.1 Conduit supports: 1-hole clamps with clampbacks, or Unistrut with clamps.

2.1.13 Tape


2.1.13.2 Conduit protection tape: UL 510.

2.1.13.3 Electrical color coding tape: UL 510.


2.1.15 Junction and Pull Boxes: Gasketed screw cover for outdoor use, size as shown on the Design Documents.

2.1.16 Wireway: Steel, UL 870 or NEMA ICS 6, Type 3R, cross-section as shown on the Design Documents and length as required.

2.1.17 Plastic cable ties: Size as required, Panduit Corp., or approved substitute.
2.2 Equipment

2.2.1 Circuit breaker, UL 489 or NEMA AB 1 molded case, bolt-on type, See One Line Diagram or Panelboard Schedule for voltage rating, trip and frame size and number of poles. Short circuit interrupting rating shall match rating of existing overcurrent devices where circuit breaker is used in existing equipment.

2.2.2 Transformer/Panelboard Assembly

Transformer and Panelboard rated and sized as shown on the Design Documents. Transformer/Panelboard Assembly shall have a NEMA ICS 6, type 3R (outdoor) enclosure, be provided with a panelboard directory and be a MINI POWER-ZONE, Square D Co. or approved substitute.

2.2.3 Safety Switch: NEMA KS 1, heavy duty type, 240 Vac, 30 ampere, 2-pole, non-fusible, NEMA Type 3R enclosure.

2.2.4 Grounding and Bonding Equipment: UL 467.

PART 3 - EXECUTION

3.1 Preparation

3.1.1 Field Measurements: Scale dimensions on the Design Documents show desired and approximate locations of equipment. Actual locations, distances, and levels shall be governed by field conditions.

3.2 Installation

3.2.1 General

3.2.1.1 Perform work in accordance with NFPA 70, the Design Documents and these instructions.

3.2.1.2 Fasten equipment to structural members of building or metal supports attached to structure, or to concrete surfaces.

   a. Use clamping devices for attachments to structural steel. When clamping is impractical, obtain approval from Construction Engineer before drilling, punching, cutting, or welding to building structural steel members for support attachments.

   b. Fasten equipment to metal wall panels with weld studs, bolts or self-tapping metal screws.
3.2.1.3 Locate equipment and conduit approximately where shown on the Design Documents.

3.2.1.4 Do not install conduit, raceways, and boxes in positions that interfere with work done by other trades.

3.2.1.5 Identify components with nameplates bearing legends shown on the Design Documents.

3.2.1.6 Attach nameplate on equipment, with metal screws.

3.2.1.7 Use appropriate calibrated special tools when installing devices for which special installation tools are recommended by manufacturer.

3.2.1.8 For excavation and backfill of soil see Section 02200.

3.2.2 Grounding Systems

3.2.2.1 Underground conductors and connections: Install in accordance with the NEC and as shown on the Design Documents.

3.2.2.2 System grounding: Solidly connect neutral conductor of each separately derived system to ground in accordance with NEC and as shown on the Design Documents.

3.2.2.3 Equipment grounding: Connect metal equipment to ground in accordance with NEC and as shown on the Design Documents.

3.2.2.4 Intrinsic Safety Grounding Conductor: Install and connect as shown on the Design Documents.

3.2.3 Conduit

3.2.3.1 Use rigid metal above grade and PVC coated steel below grade.

3.2.3.2 Use liquidtight flexible metal inside SHMS cabinet where shown on the Design Documents.

3.2.3.3 Install concealed conduits as directly as possible, with bend radii as long as possible. Install exposed conduit parallel with or at right angles to building lines.

3.2.3.4 Make elbows, offsets, and bends uniform and symmetrical. Bend conduit with approved bending devices.
3.2.3.5 Cut ends square, round, and remove burrs. Conduit shall be clean, dry, and free of debris. Immediately after installation, plug or cap exposed ends with standard accessories until wires are installed.

3.2.3.6 Use specified fittings for conduit except that threaded hubs or sealing type locknuts shall be used outdoors and in locations where moisture is present. Use couplings where required. Do not use running threads.

3.2.3.7 Install without moisture traps wherever possible.

3.2.3.8 Set up joints in conduit installed in concrete, underground, or exposed to weather, with high temperature, antiseize, conductive thread lubricant and sealant.

3.2.3.9 Verify stub-up locations with final equipment arrangements. Install exposed conduit stubbing up through concrete slab straight and plumb, lined up, and uniformly spaced. Install at sufficient depth below slab to eliminate part of bend above top of slab. Cap or plug stub-up before placing concrete.

3.2.3.10 Wrap conduit passing from concrete to air with conduit protection tape from 3 inches in concrete to 12 inches minimum in earth, or 3 inches in air, unless conduit is PVC coated.

3.2.3.11 Seal openings around conduit at exterior wall penetrations using specified sealant. Make seals waterproof, and finish sealant flush with surrounding wall surfaces.

3.2.3.12 Apply sealing compound after installation of conductors, at wireway and in conduits that penetrate concrete pads.

3.2.3.13 Install PVC-coated conduit in accordance with manufacturer's instructions. Repair coating, damaged during handling or installation, using PVC paint recommended by conduit manufacturer.

3.2.3.14 Permanently label conduits at both ends with numbers shown on design documents. On conduits of 10 foot or less, place labels at centers only.

3.2.3.15 Use specified conduit supports to secure conduit.

3.2.3.16 Slope conduit down to promote moisture drainage.

3.2.4 Junction and Pull Boxes: Install as shown on the Design Documents.
3.2.5 Wireway: Install as shown on the Design Documents.

3.2.6 Cables and Conductors

3.2.6.1 Do not bend cables or conductors installed in raceways to less than manufacturer's recommended minimum bending radii. Blind power circuits separately with nylon cable ties, at 18-inch intervals. Lay cables in wireway in straight parallel lines, and avoid crossing.

3.2.6.2 Use lubricant recommended by cable or conductor manufacturer, or wire pulling compound specified, when pulling cable or conductors through conduit.

3.2.6.3 Maximum pulling tension on cables and conductors as recommended by manufacturer.

3.2.6.4 Do not install or handle cables or conductors with thermoplastic insulation or jacket when ambient temperature is 15 °F or lower.

3.2.6.5 Identification: Identify conductors, by wire numbers, with wiremarkers. Attach wiremarkers at termination points within 2-inches of wire terminations. Marker nomenclature shall be visible without moving wires or markers.

3.2.6.6 Identify "Intrinsically Safe" cables and conductors as indicated on the Design Documents in accordance with the NEC.

3.2.6.7 Coding: Paint or pressure-sensitive electrical color coding tape may be used for coding conductors instead of colored insulation on No. 8 AWG and larger wire for phase (ungrounded) conductors, and No. 4 AWG and larger wire for neutral (grounded) conductors and equipment grounding conductors only. Maintain phase color coding, in accordance with following table, for feeder circuits up to and including equipment connections.
### Conductor/Cable Connections and Terminations

#### 3.2.7.1 Connect conductors to terminal blocks, binder screw, or stud-type terminals with terminal lug-type connectors.
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WHC-SD-WM-DA-085  241-SY-101 GAS MONITOR SYSTEM DESIGN SUPPORT ANALYSIS
WHC-SD-WM-SDD-001  STANDARD HYDROGEN MONITORING SYSTEM SYSTEM DESIGN DESCRIPTION
WHC-SD-WM-CR-043  DESIGN REQUIREMENTS AND CRITERIA FOR A HYDROGEN MONITORING SYSTEM FOR TANKS 103-SY AND 104-AN
WHC-SD-WM-EII-003  STANDARD HYDROGEN MONITORING SYSTEM EQUIPMENT INSTALLATION INSTRUCTIONS
WHC-SD-WM-CSDD-004  STANDARD HYDROGEN MONITORING SYSTEM COMPUTER SOFTWARE DESIGN DESCRIPTION
WHC-SD-WM-CSCM-013  STANDARD HYDROGEN MONITORING SYSTEM COMPUTER SOFTWARE CONFIGURATION MANAGEMENT PLAN
WHC-SD-WM-DRR-034  STANDARD HYDROGEN MONITORING SYSTEM DESIGN REVIEW REPORT
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