

JUL 20 1998

ENGINEERING DATA TRANSMITTAL

Page 1 of 1
1. EDT 622268

2. To: (Receiving Organization) Distribution		3. From: (Originating Organization) TWRS Projects/SST Retrieval		4. Related EDT No.: n/a	
5. Proj./Prog./Dept./Div.: W-320 TWRS/TCPN # D2991		6. Design Authority/ Design Agent/Cog. Engr.: JW Bailey, NHC		7. Purchase Order No.: n/a	
8. Originator Remarks: For approval and release of a new supporting document. This document has been generated to ensure retrievability of the Project W-320 "Construction Specification W-320-C5".				9. Equip./Component No.: n/a	
				10. System/Bldg./Facility: 241-C-106	
11. Receiver Remarks: 11A. Design Baseline Document? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No				12. Major Assm. Dwg. No.: n/a	
				13. Permit/Permit Application No.: n/a	
				14. Required Response Date:	

15. DATA TRANSMITTED					(F)	(G)	(H)	(I)
(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	Approval Designator	Reason for Transmittal	Originator Disposition	Receiver Disposition
1	HNF-2534	-	0	Project W-320, 241-C-106 Sluicing, Construction Specification W-320-C5	NA			-

KEY

16. Approval Designator (F) E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)		Reason for Transmittal (G) 1. Approval 2. Release 3. Information			Disposition (H) & (I) 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)			Disposition (H) & (I) 1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged		
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17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN
2	1	Design Authority	<i>JW Bailey</i>	7/18/98	S2-48						
		Design Agent									
2	1	Cog. Eng.	<i>MC Baverly</i>	7/18/98	S2-48						
BD-7400-172-2	08/06/98	MSFE097	<i>JW Bailey</i>	7/18/98	S2-48						
		QA									
		Safety									
		Env.									

18. Signature of EDT Originator <i>M.C. Davyport</i> Date: 7/18/98		19. Authorized Representative Date for Receiving Organization		20. Signature of Cognizant Manager <i>J.W. Bailey</i> Date: 7/18/98		21. DOE APPROVAL (if required) Ctrl. No. <input type="checkbox"/> Approved <input type="checkbox"/> Approved w/comments <input type="checkbox"/> Disapproved w/comments	
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Project W-320, 241-C-106 Sluicing, Construction Specification, W-320-C5

John W. Bailey
Numatec Hanford Co., Richland, WA 99352
U.S. Department of Energy Contract DE-AC09-96RL13200

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Org Code: 8C452 Charge Code: D2991/HANA0600
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Key Words: W-320, Sluicing, Tank 241-C-106, Tank 241-AY-102,
WRSS, Specifications, Construction.

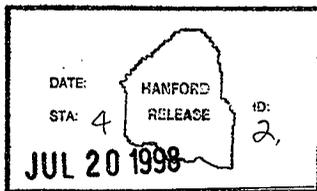
Abstract: This supporting document has been prepared to make the construction specifications for Project W-320, readily available.

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Kara J. Broz
Release Approval

7/20/98
Date



Approved for Public Release

AS-BUILT REV 1

TANK 241-C-106
SLUICING C TANK FARM

Original Issue: 9/14/95

Prepared By

Fluor Daniel Northwest
Richland, Washington

For

Numatec Hanford Corporation

Contract 651005

J.P. Baller for *J.V. Barlow* *06/11/98*
Client Concurrence Date

[Signature] *06-11-98*
Project Manager Date

[Signature] *6-11-98*
Lead Engineer Date

John Wright *6/11/98*
Field Concurrence Date

Danny L. Evans *6/11/98*
Checked By Date

Susan L. Benz *6/11/98*
Prepared By Date

The ECNs affecting specification page attached.

The ECNs affecting specification are as follows:

ECN W-320-121
16640-7, 12, 13

ECN W-320-126
03300-1, 2, 4

ECN W-320-130
15493-3, 6, 10, 11, 15,
17, 18, 19, 21, 22

ECN W-320-139
02668-9

ECN W-320-147
12668-3, 4, 5, 6, 8, 9

ECN W-320-150
16640-10

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ECN W-320-424
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ECN W-320-438
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15493-11

ECN W-320-454
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ECN W-320-458
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ECN W-320-477
16400-15

ECN W-320-485
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ECN W-320-486
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ECN W-320-542
13440-6

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16, 17, 18, 19, 20, 22

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15507-4, 5, 7, 11, 14, 18,
21, 22, 23, 24
16400-3, 4, 9, 15

CONSTRUCTION SPECIFICATION

TANK 241-C-106 SLUICING
PACKAGE 4 - C TANK FARM

Work Order ER4319

Prepared By
ICF Kaiser Hanford Company
Richland, Washington

For the US Department of Energy
Contract DE-AC06-93RL12359

ICF KAISSER ENGINEERS HANFORD	
CONTROLLED DOCUMENT	
STATION NO. 4	
DIST	
DATE	SEP 29 1995
PROJ / WO	W-320
NO	PLE-1

APPROVED

ICF Kaiser Hanford Company (ICF KH)

Danny R. Evans 9/11/95
Principal Lead Engineer Date

Maude Bryson 9/11/95
Technical Documents Date

[Signature] 9-11-95
Safety Date

David Lyle Fort 9/11/95
Environmental Engineering Date

Per telecop from E. Norton
[Signature] 9-11-95
Quality Engineering Date

[Signature] 9/11/95
Construction Date

[Signature] 9/11/95
Project Management Date

Westinghouse Hanford Company (WHC)

Thomas H. May 9/12/95
Projects Department Date

OFFICIAL RELEASE 67
BY WHC
DATE SEP 20 1995
[Signature]

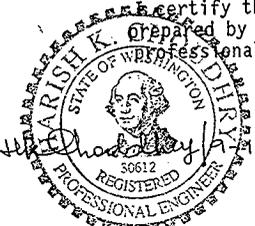
CONSTRUCTION SPECIFICATION

TANK 241-C-106 SLUICING
PACKAGE 4 - C TANK FARM

Prepared by
ICF Kaiser Hanford Company
Richland, Washington

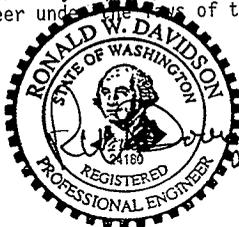
CERTIFICATION

I certify that the indicated sections of this Specification were prepared by me or under my supervision and that I am a registered professional engineer under the laws of the State of Washington.



EXPIRES 10-22-96

Harish K. Choudhry, P.E.
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Section 13440



EXPIRES 3/3/96

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Civil/Structural
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02668, 02831, 03300, 03400, 05055,
05500, 07900, 09805, 09900, 13121



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Section 15493



EXPIRES 11/18/96

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Section 16400



EXPIRES 5/30/97

Gregory P. McDonald, P.E.
Cathodic
Section 16640



EXPIRES 08/05/96

Raymond A. Pina, P.E.
HVAC
Sections 15505, 15507,
15990

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SECTION 01010
SUMMARY OF WORK

PART 1 - GENERAL

1.1 INTRODUCTION

1.1.1 Project W-320, WASTE RETRIEVAL SLUICING SYSTEM (WRSS), is located as shown on Drawing H-2-818423, ~~Sh-7~~. ECN-807

1.1.2 This Specification is for procurement, fabrication and installation of equipment at the "C" Tank Farm, including Operator Station and some equipment just outside the "C" Tank Farm fence, necessary to support the sluicing operation.

1.2 STATEMENT OF WORK

1.2.1 Scope: Work consists of furnishing labor, equipment, and materials to provide the means to procure materials and equipment, fabricate items, excavate and place concrete, and install equipment, piping, wiring, and structures in accordance with the Contract Documents.

1.2.2 Work Included: The following itemization is intended to be broad in scope, and identify major work elements only.

1.2.2.1 Excavation for process and fire protection piping, electrical conduit trenches, and foundations for small structures.

1.2.2.2 Placement of concrete cover blocks, foundations, and equipment pads.

1.2.2.3 Procurement and installation of double walled piping, electrical conduit, fire and raw water piping, chilled water piping, and electrical cable.

1.2.2.4 Procurement and installation of above-ground ventilation system piping between the (HVAC) Process Building and Tank C-106.

1.2.2.5 Core drilling existing concrete.

1.2.2.6 Furnishing and installation of electrical distribution equipment (Specification W-320-P34).

1.2.2.7 Installation of the concrete foundation, and assembly installation of the two Seismic Shutdown Systems with Environmental Enclosures (Specifications W-320-P35 and P36).

1.2.2.8 Fabrication and installation of in-pit pipe "jumpers," including related valves, instruments and wiring.

1.2.2.9 Installation of a vertical submersible pump, horizontal booster pump, and winch assembly into tank access riser pits (Specifications W-320-P17 and W-320-P24).

- 1.2.2.10 Placement of concrete foundation, and installing the HVAC Skid. The skid (Specification W-320-C6), will be furnished by Construction Pkg 5.
- 1.2.2.11 Furnishing and installing a building (Process Building 241-C-91) to enclose the HVAC Skid, and connecting the skid to piping, ducting, electrical, and instrumentation interfaces at the Tank Farm.
- 1.2.2.12 Installing a "sluicer" in the sluice pit and sluicer hydraulic control near sluice pit (W-320-P20).
- 1.2.2.13 Installation of conduit and wiring between tank-top pits and devices, and the operator station or electrical distribution panel or motor starters located in the electrical equipment skid just outside the C-Farm fence.
- 1.2.2.14 Performing construction tests on installed equipment, such as pressure tests on pipe, and insulation and continuity tests on wiring.
- 1.2.2.15 Installing the Chiller Skid (W-320-P2) and Exhaust Skid (W-320-P1), and connecting them to wiring and piping provided by this package.
- 1.2.2.16 Installing the isokinetic sampling system, provided by Specification W-320-P41, on the exhaust skid.
- 1.2.2.17 Installing an air compressor (provided by others) and related piping and services in the existing Service Building 241-C-73, and connecting to piping, electrical, and raw water services.
- 1.2.2.18 Providing, assembling, and installing instrument enclosures IE-1361, IE-1362; control panels CP-01, CP-02, CB-01; and procuring, installing, and wiring instruments mounted therein.
- 1.2.2.19 Installation of electrical and cathodic protection equipment and the pulling and termination of power and control wiring for the C Farm.
- 1.2.2.20 ~~Installation of the In-Tank CCTV viewing system, procured by WHC under Specification WHC-S-0395.~~ *Installation of the 241-C-106 In-Tank Imaging system, procured by WHC under Specification WHC-S-0439.*
- 1.2.3 Work Not Included: The following work elements are part of the Project, are covered by other documents noted, and will be done by others, concurrently with work included in the Project Documents.
 - 1.2.3.1 Fabrication of the Service Building 241-C-73.
 - 1.2.3.2 Fabrication and installation of construction support trailers.
 - 1.2.3.3 Installation of the standby generator.
 - 1.2.3.4 Other work elements denoted "Not in Contract" on Project Documents.
- 1.3 DRAWINGS
 - 1.3.1 Drawings which show work required by the Project Documents are listed on Drawing H-2-818423, Sh-7.

ECN-160

ECN-160

ECN-807

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01019

ITEMS FURNISHED FOR CONSTRUCTION

PART 1 - GENERAL

1.1 REFERENCES: Not Used

1.2 SUBMITTALS: Not Used

1.3 GENERAL

1.3.1 Material and equipment furnished or made available for incorporation into the Work are identified in this Section. Other services and utilities provided are covered in other sections of this Specification.

1.4 EQUIPMENT

1.4.1 Items listed below will be furnished for incorporation into the Work.

1.4.1.1 C-Farm HVAC Skid, fabricated under Construction Specification W-320-C6.

1.4.1.2 Slurry Pump (P-1361) and Slurry Booster Pump (P-1362), procured under Specification W-320-P17.

1.4.1.3 Exhaust skid, procured under Specification W-320-P1.

1.4.1.4 Liquid chiller, procured under Specification W-320-P2.

1.4.1.5 Pump winch and remote controls, procured under Specification W-320-P24.

1.4.1.6 Seismic Shutdown System, procured under Specification W-320-P35.

1.4.1.7 In-Tank CCTV viewing system, procured by WHC under Specification WHC-S-0395.

1.4.1.8 Sluicer mechanism, hydraulic system, and remote control panel, procured under Specification W-320-P20.

1.4.1.9 Electrical equipment skid, procured under Specification W-320-P34.

1.4.1.10 Enclosure for Seismic Shutdown System, procured under Specification W-320-P36.

1.4.1.11 Isokinetic sampling system, procured under Specification W-320-P41.

1.4.1.12 Flow Integrator (FQIT-1361), procured under Construction Specification W-320-C1.

1.4.1.13 Flow element (FE-1363), procured under Construction Specification W-320-C6.

1.4.1.14 Service Building 241-C-73, fabricated under Construction Specification W-320-C1.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01200

PROJECT MEETINGS

PART 1 - GENERAL

1.1 REFERENCES: Not Used

1.2 SUBMITTALS: Not Used

1.3 SUMMARY

1.3.1 Representatives from ICF KH, CONTRACTOR, and major subcontractors shall participate in project meetings. Representatives from Operating Contractor and DOE may attend, as required by items to be discussed.

1.3.2 Meeting times and locations shall be mutually agreed to by CONTRACTOR and ICF KH, and will be held at the Hanford Site in Richland, Washington. Informal design reviews are an exception.

1.3.3 ICF KH will issue notices of meetings, and prepare and issue meeting minutes as promptly as possible after each meeting. Minutes will be distributed to project participants.

1.3.4 When applicable, minutes will identify action items, with assigned followup. Issues resolved will be reported, as well as closed action items.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 SITE LABOR CONFERENCE

3.1.1 Before starting construction at the worksite, CONTRACTOR and subcontractors shall conduct an informational conference concerning Hanford Site labor requirements applicable to the Project. Review the General Conditions relating to labor, and present a proposed work plan with craft utilization requirements.

3.1.2 ICF KH will send a meeting notice to representatives from labor organizations, identified by CONTRACTOR as those with members who may be utilized in construction, and are to attend the conference.

3.2 PRECONSTRUCTION CONFERENCE

3.2.1 A conference will be scheduled and chaired by ICF KH before the start of onsite work. Authorized representatives of CONTRACTOR and major subcontractors shall attend, and ICF KH will advise others having an interest in the Work.

- 3.2.2 The following items will be incorporated into the agenda.
 - 3.2.2.1 Points of contact and key personnel representing Operating Contractor, Safety, Quality Assurance/Quality Control, Acceptance Inspection, and Construction Engineering.
 - 3.2.2.2 Schedule requirements and restraints, submittals and work limitations.
 - 3.2.2.3 Safety, construction progress meetings and their frequency, and certified payrolls.
 - 3.2.2.4 Report requirements and their frequency.
 - 3.2.2.5 ICF KH forms CONTRACTOR is required to use.
 - 3.2.2.6 Quality requirements.
 - 3.2.2.7 Major material and equipment lists.
 - 3.2.2.8 Other pertinent items.
- 3.3 CONSTRUCTION PROGRESS MEETINGS
 - 3.3.1 Meetings will be held every 2 weeks, at times and locations determined at the preconstruction conference, and will be approximately 1 hour long.
 - 3.3.2 ICF KH will chair the meetings, and request attendance of key personnel required. Authorized representatives of CONTRACTOR and pertinent subcontractors shall attend.
 - 3.3.3 The purpose is to monitor status, and provide a forum for exchanging pertinent information related to the Work. Major topics may include the following.
 - 3.3.3.1 Schedule, cost, and construction status.
 - 3.3.3.2 Design and scope changes.
 - 3.3.3.3 Submittal status, key material, and equipment delivery status.
 - 3.3.3.4 Potential problem areas.
 - 3.3.3.5 Inspection and testing status.
 - 3.3.3.6 Action item status, and goals for the next meeting.
 - 3.3.3.7 Other appropriate items.

END OF SECTION

SUBMITTALS

PART 1 - GENERAL

- 1.1 REFERENCES: Not Used
- 1.2 SUBMITTALS: Not Used (See the other sections requiring submittals)
- 1.3 SUBMITTAL CONDITIONS
- 1.3.1 Materials and equipment fabricated or installed without required approved submittals, or which differ from approved drawings or vendor data, are subject to rejection and replacement at CONTRACTOR's expense.
- 1.3.2 Delays arising from failure to submit required drawings and other related data described in Contract Documents, in a timely manner, will not constitute excusable delays for extensions, unless excusable under other provisions of the Contract.
- 1.4 SUBMITTALS REQUIRED
- 1.4.1 Required submittals are defined in Part 1 of the Specification Sections.
- 1.4.2 Submittals are divided into 2 types; those requiring approval and those not requiring approval. Included in the former are submittals of architectural material samples, where ICF KH reserves the right to make final selections. Included in the latter are documents containing vendor information necessary for operations, and information for project records.
- 1.4.3 Submittals are required no later than the times indicated. Those requiring ICF KH approval must be approved before further submittal related procurement, fabrication, or construction is accomplished. This also applies for ICF KH selections made from samples submitted.
- 1.5 SUBMITTAL REVIEWS
- 1.5.1 Submittals requiring approval will be reviewed to verify completeness and conformance to requirements. Appropriate dispositions will be made as specified in Part 3.
- 1.5.2 Allow 21 calendar days for ICF KH review and disposition of submittals. This time period will be measured from date of submittal receipt in ICF KH's office to date of return mailing.
- 1.5.3 Submittals not requiring approval will be reviewed to verify completeness and adequacy for their intended purposes. If acceptable, these items are filed, and finally delivered to Operating Contractor. Unacceptable items will be handled as specified in Part 3.

1.5.4 If a submittal not requiring approval has not been returned within the specified time period, and ICF KH has not informed CONTRACTOR that additional review time is necessary, CONTRACTOR may consider it accepted by ICF KH.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 SUBMITTAL PROCEDURE

- 3.1.1 Transmit submittals using "Data Transmittal/Review," Form KEH 1838. Copies will be supplied during the Preconstruction Conference (see Section 01200).
- 3.1.2 Identify each submittal by submittal number, section/paragraph number and submittal title as shown on the master submittal log included with Contract Documents. The number of copies required includes 2 copies for return to CONTRACTOR. If necessary, provide additional copies required for return to CONTRACTOR.
 - 3.1.2.1 Approval data (for products): Mark each line item package with the specification section and paragraph numbers specifying the product.
 - 3.1.2.2 Vendor information (for products): Mark each line item package with the specification section and paragraph numbers specifying the product, and the item name, manufacturer's name, model or part number, and ICF KH tag number (if specified).
 - 3.1.2.3 Items that require approval: Submit 6 copies, including 1 reproducible.
 - 3.1.2.4 Samples for selections: Submit as required by the Sections of this Specification.
 - 3.1.2.5 Items that do not require approval: Submit ~~10~~ 6 copies. ECN-215
- 3.1.3 Review each submittal for completeness, compliance with Contract Documents, and proper identification before sending to ICF KH. Submittal data shall either be stamped, showing the review process has taken place, or the Data Transmittal form may be stamped "Reviewed for Compliance," and signed. Submittals not stamped or signed will be returned without consideration.
- 3.1.4 Procedures for performing certain types of work must be submitted for approval before work is commenced. Such procedures which have previously been approved by ICF KH, for work similar to that to be accomplished on this Project, may not need to be reapproved. Forward 1 copy of previously approved procedures to ICF KH, by Data Transmittal form, and identify each by section/paragraph number, title, and either procedure number or project number for which the procedure was approved.

Submittals will be reviewed by ICF KH and, if acceptable, retained for record. If a previously approved procedure is not acceptable, the submittal will be returned, with requirements for resubmittal.

3.2 ICF KH PROCESSING

3.2.1 Submittals requiring approval will be stamped by ICF KH, and marked "Approved," "Approved with Exception," or "Not Approved, Revise and Resubmit." Approval of submittals does not relieve CONTRACTOR of responsibility for errors contained therein.

3.2.1.1 Approved submittals are identified by the submittal stamp, with either the "Approved" or "Approved with Exception" box checked. "Approved" signifies general concurrence of submittal conformance with project design concepts and compliance with Contract Document requirements. "Approved with Exception" signifies general concurrence, with noteworthy comments or clarifications. Approval of a specific item shall not be construed as approval of the system or assembly of which that item is a component.

3.2.1.2 A submittal which is not approved is identified as "Not Approved, Revise and Resubmit." The submittal is considered technically deficient, or incomplete, and therefore unacceptable. Resubmittal is required, hence fabrication, procurement, or performance of procedures shall not proceed.

3.2.1.3 Submittals not requiring approval that are found to be incomplete or inadequate will be returned marked "Resubmit." An explanation of the deficiencies will be included, for corrective action by CONTRACTOR.

3.3 RESUBMITTAL

3.3.1 Upon receipt of deficient submittals, make corrections noted on the transmittal, and resubmit complete packages to ICF KH.

END OF SECTION

SECTION 01400

QUALITY ASSURANCE

PART 1 - GENERAL

- 1.1 REFERENCES: Not Used
- 1.2 SUBMITTALS: Not Used
- 1.3 THE ONSITE CONSTRUCTION CONTRACTOR'S QAP WILL BE IMPLEMENTED
- 1.4 INSPECTION AND WITNESS POINTS
 - 1.4.1 Perform specified inspection and testing (see 1.4.3).
 - 1.4.1.1 Provide and maintain an inspection system that will ensure that work performed, including that performed by subcontractors and suppliers, conforms to requirements.
 - 1.4.1.2 Perform, or have performed, inspections and tests required to substantiate conformance to Project requirements. Such inspections shall be documented, indicating the inspector, date, item(s) inspected, and the results of inspection.
 - 1.4.1.3 Perform, or have performed, inspections required by referenced codes and standards. Such inspections shall be documented as in 1.4.1.2 above.
 - 1.4.2 The customer will perform inspections and testing identified in this specification as the customer's responsibility, including the following.
 - 1.4.2.1 Inspection and witness points specified in 1.6.
 - 1.4.2.2 Final acceptance inspection.
 - 1.4.3 Inspection Points: Adhere to inspection points. Personnel shall have completed inspections of, and approved portions of, work in accordance with Project requirements, before notifying the customer for inspection/witnessing.
 - 1.4.3.1 Listed inspection points define the type of inspections required to be performed, and are considered a minimum inspection level for customer involvement.
 - 1.4.3.2 Customer inspection points are defined as follows:
 - a. Receiving (R): Special items of fabrication, equipment, or material scheduled to be delivered to the Project site, or other designated location, which require inspection upon arrival and before installation. Notify the customer within 4 hours after item arrival.
 - b. Construction inspection (H): Required for witnessing of specific construction features, before further construction is allowed to proceed.

c. Witness (W): Selected for inspection at the option of the customer. Work may proceed upon verbal release by the customer, or upon expiration of one hour beyond the scheduled time of witnessing.

- 1.4.3.3 R, H, and W points apply to both onsite and offsite work. Except where a longer period is specified, notify the customer at least four working hours before each point for onsite work. For offsite work, notify the customer at least three working days before each required point.
- 1.4.3.4 R, H, and W points are specified in 1.6.
- 1.5 ELECTRICAL/ELECTRONIC PRODUCT ACCEPTABILITY
 - 1.5.1 Each product shall be listed for intended use in one of following and shall bear listing organization's label. In absence of label, provide documentation that verifies product listing.
 - a. UL Electrical Construction Materials Directory.
 - b. UL Electrical Appliance and Utilization Equipment Directory.
 - c. FM Approval Guide.
 - 1.5.2 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 following.
 - a. OSHA documentation which demonstrates recognition.
 - b. Laboratory documentation that verifies testing in accordance with national code or standard.
 - 1.5.3 If product is not listed by UL or FM and if a nationally recognized laboratory is not available, submit descriptive literature to ICF KH. Literature shall include product specification and description of intended application.

1.6 SCHEDULE OF HOLD AND WITNESS POINTS

INSPECTION POINT NO.	INSPECTION POINT DESCRIPTION	INSPECT		
		POINT	OFFSITE	ONSITE
<u>02200</u> 02200-1	<u>EARTHWORK</u> Approving Backfill Permits	W		X
<u>02225</u> 02225-1	<u>EXCAVATING, BACKFILLING AND COMPACTING FOR UTILITIES</u> Approving Backfill Permits	W		X
<u>02668</u> 02668-1	<u>FIRE WATER SYSTEMS</u> Leak/Pressure Testing	W		X

<u>03300</u>	<u>CAST-IN-PLACE CONCRETE</u>		
03300-1	Approving Pour Slips for Seismic Shutdown Pad and Process Building Pad	W	X
03300-2	Initial SCI Grout Placement	H	X
<u>03400</u>	<u>PRECAST CONCRETE</u>		
03400-1	Approving Pour Slips for Cover Blocks	W	X
<u>05055</u>	<u>EXPANSION ANCHOR INSTALLATIONS</u>		
05055-1	Initial SCI Installation	W	X
<u>09805</u>	<u>SPECIAL PROTECTIVE COATING</u>		
09805-1	Initial Application on Cover Blocks	W	X
<u>13121</u>	<u>METAL BUILDING SYSTEMS</u>		
13121-1	Environmental Conditions Prior to Erection	H	X
<u>13440</u>	<u>INSTRUMENTATION</u>		
13440-1	Electrical Testing	W	X
13440-2	Leak/Pressure Testing	W	X
<u>15507</u>	<u>CONTAMINATED AIR HVAC SYSTEMS</u>		
15507-1	X-Ray Film Reading	W	X
15507-2	Leak/Pressure Testing	W	X
<u>15990</u>	<u>TESTING, ADJUSTING, AND BALANCING</u>		
15990-1	Functional Testing	W	X
<u>15493</u>	<u>CHEMICAL PROCESS PIPING SYSTEM</u>		
15493-1	Initial Welding	W	X
15493-2	X-Ray Film Reading	W	X
15493-3	M-9 Leak/Pressure Testing	H	X
15493-4	Leak/Pressure Testing	W	X
<u>16400</u>	<u>SERVICE AND DISTRIBUTION</u>		
16400-1	Megger Testing	W	X
16400-2	Before Energizing	H	X
<u>16640</u>	<u>CATHODIC PROTECTION</u>		
16640-1	Functional Testing of Reference Electrodes	W	X

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01610

DELIVERY, STORAGE, AND HANDLING

PART 1 - GENERAL

1.1 REFERENCES: Not Used

1.2 SUBMITTALS: Not Used

1.3 SUMMARY

1.3.1 This Section contains generally applicable requirements for delivery, inspection, marking, storage, and handling. Product unique requirements are contained in other sections.

1.4 RAILROAD DELIVERIES

1.4.1 Railroad shipments are possible into boundaries of the Hanford Site. Carload shipments may be made to Richland, Washington, over Washington Central Railroad from Burlington Northern or Union Pacific Railroads.

1.4.2 ICF KH will arrange for movement of rail cars from Richland to available spurs or sidings on the Government owned railroad system, within the Hanford Site. ICF KH is not liable for demurrage charges, or loss or damage to cars or lading, unless loss or damage is the fault of or due to negligence by ICF KH.

1.4.3 Investigate availability of rail spurs or sidings in the Site vicinity. Use of spurs shall be coordinated with other users at the Site. Notify ICF KH at least 2 working days before scheduled arrival of carload shipments.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 DELIVERY

3.1.1 Provide equipment and labor required for unloading, transporting, and handling delivered products. For railroad deliveries, unload each car within 3 working days after arrival, unless a time extension is granted by ICF KH.

3.2 RECEIVING INSPECTION

3.2.1 Arrange for immediate disposal and replacement of products found to be defective, damaged beyond repair, or in otherwise unacceptable condition.

3.2.2 Dry or clean products that have become wet or have accumulated foreign substances during shipment, but have not become damaged.

- 3.2.3 Perform additional identification marking of products when necessary to meet the requirements of this section, and other sections of this Specification.
- 3.3 PRODUCT IDENTIFICATION AND SEGREGATION
- 3.3.1 Provide identification tags or markings for products of similar appearance, or intended for similar use, procured to different specifications, or from different manufacturers.
- 3.3.2 Include the following information, as applicable, on tags, with markings, and preexisting labels: Manufacturer's name, product brand name, specification number, and type, grade or class. Also include additional information required by other sections of this Specification.
- 3.3.3 Segregate tagged or marked products, providing separate storage for each.
- 3.3.4 Preserve the identity of bulk and lot products (those consumed on an "as needed" basis during progress of the work) from the time of receipt at the worksite until use in construction.
- 3.3.4.1 Control the identification and storage of welding materials in accordance with a written filler metal control procedure, maintained at the worksite. The procedure shall specify methods for control by heat or lot number, from receipt of material through consumption during fabrication, and for disposal of contaminated and partially used material.
- 3.3.4.2 When pipe or tube is removed from storage and cut, clearly and permanently remark remaining pieces with either original markings or field code identification symbols, and return to storage.
- 3.3.4.3 Use permanent marking methods on pipe and tube, including pens with water insoluble, indelible ink, crayon, paint, or paint stick. Vibratory etching equipment may be used with the approval of ICF KH. Marking with steel stamps is not acceptable.
- 3.4 STORAGE
- 3.4.1 Basic Storage
- 3.4.1.1 Store packaged products in their original, unbroken packages or containers, with seals and labels intact.
- 3.4.1.2 Store rolled products in an upright position.
- 3.4.1.3 Store products with finished surfaces in a manner to preclude surface damage by mechanical, atmospheric, or other effects.
- 3.4.1.4 Where contact between products could result in damage or rendering useless of 1 or both, store them far enough apart to prevent contact. If close proximity storage is necessary, provide a barrier between them.

- 3.4.1.5 Keep ports, nozzles, ends, and other openings on equipment, tanks, and lengths of pipe and tube capped or plugged during storage.
- 3.4.1.6 Follow manufacturer's recommendations for storage when such recommendations are given.
- 3.4.1.7 Remove, dispose of, and replace products with expired shelf-life dates.
- 3.4.2 Indoor Storage
 - 3.4.2.1 Provide indoor storage for products that can be damaged by, or can deteriorate from, changes in temperature and relative humidity.
 - 3.4.2.2 When required by other sections of this Specification, or when recommended by product manufacturers, provide environmentally controlled storage. Maintain temperature 15.5 to 21 °C (60 to 70 °F), relative humidity below 55%, and provide ventilation.
- 3.4.3 Outdoor Storage
 - 3.4.3.1 Provide skids, pallets, platforms, or other supports for products stored outdoors to prevent ground contact.
 - 3.4.3.2 Provide sunshade protection for products that can be damaged by, or can deteriorate from, exposure to sunlight.
 - 3.4.3.3 Provide weatherproof covers for products that can be damaged by, or can deteriorate from, the effects of contact with rain, snow, ice deposits, or blowing sand and debris.
 - 3.4.3.4 Arrange stacks of stackable products so that condensation, which may accumulate during storage, will drain off.
- 3.5 HANDLING
 - 3.5.1 Provide handling tools and equipment, and use methods designed to prevent occurrence of the following.
 - 3.5.1.1 Impact, rubbing, or other contact damage to ends and surfaces of cylindrical (pipe and tube) type products, or to edges, corners, and surfaces of flat (panel and sheet) type products.
 - 3.5.1.2 Twisting, racking, or other distortion of prefabricated structures and equipment assemblies.
 - 3.5.1.3 Tearing or puncturing of wrappings or coverings, or breaking of seals on packages or cartons.

END OF SECTION

SECTION 01630

PRODUCT OPTIONS AND SUBSTITUTIONS

PART 1 - GENERAL

1.1 REFERENCES: Not Used

1.2 SUBMITTALS

1.2.1 See Section 01300 for submittal procedures.

1.2.2 Approval Required

1.2.2.1 Substitution Approval Request(s): Before start of construction, submit request(s) as required by 1.3.4 and 1.3.5, prepared in accordance with 3.1.

1.2.3 Approval Not Required: None

1.3 SUBSTITUTIONS

1.3.1 Products include those items identified on Drawings as well as in Part 2 of the specification sections.

1.3.2 Product options given in the specification sections represent functionally and physically equivalent items. In addition to generic type, materials, form and size, physical equivalence includes maintainability, reliability, and durability characteristics, as applicable for specific material or equipment items.

1.3.3 A substitute product may be used in place of a product or the product options identified in specification sections, without approval, if it is functionally and physically equivalent as defined above, and is not more hazardous.

1.3.4 Substitution of a product that is functionally but not physically equivalent, as defined above, or is more hazardous, requires submittal of a Substitution Approval Request.

1.3.5 Submittal of a Substitution Approval Request is also required when a product callout in the specification sections includes the phrase "or an approved substitute."

1.3.6 Total quantities of products required in specification sections shall be the same. Differences due to partial quantity substitutions are not acceptable.

1.3.7 Do not use materials and equipment removed from existing structure as substitutes for specified products, unless such use is required or allowed elsewhere in Contract Documents.

1.4 LIMITATIONS AND CONDITIONS

- 1.4.1 Substitutions will not be considered when indicated or implied on fabricator drawings, or product data submittals, without separate Substitution Approval Requests, when requested directly by subcontractors or suppliers, or when acceptance will require substantial revision of Contract Documents.
- 1.4.2 Substitute products that require a substitution approval request shall not be ordered or installed before the request is approved.
- 1.4.3 Only 1 Substitution Approval Request for each product will be considered. When a substitution is not accepted, provide the specified product.
- 1.4.4 ICF KH will review and disposition requests for substitutions within 10 working days, unless evaluation requires extensive comparison or consultation.
- 1.4.5 The same submittals required for original products, by 1.2 of the sections specifying them, are required for accepted substitute products.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 REQUEST PREPARATION

- 3.1.1 Submit a separate request for each substitution, using "Substitution Approval Request," Form KEH 1151. Copies will be supplied during the Preconstruction Conference (see Section 01200).
- 3.1.2 Identify products by specification section and article or paragraph numbers. Provide manufacturer's name and address, trade name of product, and model or catalog number. List fabricators and suppliers as appropriate.
- 3.1.3 To each Substitution Approval Request attach descriptive information for substitute and original products. The information shall consist of drawings, calculations, and data as appropriate to define operational and physical characteristics of products, and establish a basis for comparison.
- 3.1.4 Give an itemized comparison of proposed substitution with specified product, listing variations, with reference to specification section and article or paragraph numbers.
- 3.1.5 Give a quality and performance comparison between the proposed substitute and specified product.
- 3.1.6 Give a cost data comparison between the proposed substitute and specified product, showing the Contract sum net change.

- 3.1.7 List availability of maintenance services and replacement materials.
- 3.1.8 State effect of the substitution on construction schedule, and changes required in other work or products. If a substitute product requires or necessitates revisions to structures, foundations, footings, services, systems, piping, electrical, etc, engineering costs shall be borne by CONTRACTOR. Submit drawings, calculations, and vendor data, clearly showing revisions to accommodate the substitution, for approval.

END OF SECTION

SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 REFERENCES: Not Used

1.2 SUBMITTALS: Not Used

1.3 GENERAL

1.3.1 Hanford Site work requires that certain documents, defined herein, be used to record the construction process, and administration of the Contract. ICF KH will assemble pertinent data for final disposition.

1.3.2 Some data required for project records shall be delivered to ICF KH during the course of construction and contract administration, while other data shall be assembled after completion of construction for delivery to ICF KH.

1.3.3 Certain information for project records is to be recorded on standard ICF KH forms. These forms are identified in the specification sections where required. Copies will be supplied during the Preconstruction Conference (see Section 01200).

1.3.4 Project Record Documents, required by the Contract, shall be prepared, preserved, and delivered to ICF KH. These deliverable documents are in addition to submittals required in Section 01300.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 PROCEDURE

3.1.1 Identification and Marking: Mark documents that will become project records before use for construction. Upon completion, identify documents by title or number.

3.1.1.1 Notes or markings added by hand shall be legible, utilizing permanent nonsmearing marking media, such as ink or felt tip markers, in contrasting color.

3.1.1.2 Mark items to record actual construction, including changes to dimensions and details, manufacturer's name, catalog number, and substitute products.

3.1.2 Availability: Keep copies of Project Record Documents in the field office, and make available to ICF KH during progress of the Work.

3.1.3 Storage: Store 1 set in the field office, apart from documents used in construction, and maintain in clean, dry, and legible condition.

- 3.1.4 Delivery: Record delivery of documents by retaining copies of letters of transmittal itemizing delivered items, and reports delivered during the course of work. Retain until construction completion. An alternate means, acceptable to ICF KH, may be used.
- 3.2 ACTIVITY AND ADMINISTRATIVE DOCUMENTS
- 3.2.1 Deliver or retain in accordance with the following.
- 3.2.2 Certified Payrolls: Each week deliver certified payrolls as required by General Conditions, Section 108 to ICF KH and keep copies in the field office until Contract completion. Progress payments will not be processed unless certified payrolls for work periods have been received by ICF KH.
- 3.2.3 Daily Force and Equipment Reports: Before noon each day, deliver 1 copy of a detailed daily force report, covering labor and supervision of CONTRACTOR and subcontractors for previous day. Report shall include a general description of work performed, and list major items of equipment onsite.
- 3.2.4 Weekly Manpower Reports: Prepare weekly manpower reports and deliver, before 10 am on Monday, for previous week, during performance of Contract. Forms will be furnished by ICF KH.
- 3.2.5 Subcontracting Plan Reports: Deliver reports documenting conformance with Subcontracting Plan, as required by General Conditions, Section 89.
- 3.2.6 Backfill Permit: Retain backfill permits approved for work required in Division 2.
- 3.2.7 Soil Compaction Procedure: Retain Forms KEH 0382 completed for work required in Division 2.
- 3.2.8 Pour Slips: After obtaining ICF KH approval of concrete pour slips required in Division 3, deliver copies to ICF KH, and retain CONTRACTOR copies until Contract closeout. After closeout deliver them to ICF KH.
- 3.2.9 Trip Tickets: Deliver copies to ICF KH with each truck load of concrete required in Division 3, and retain CONTRACTOR copies until Contract closeout. After closeout, deliver them to ICF KH.
- 3.3 CONSTRUCTION, QUALITY ASSURANCE, AND SUPPORTING DOCUMENTS
- 3.3.1 Deliver in accordance with the following, when called for in specification sections.
- 3.3.2 Quality Assurance Programs: 1 copy of each supplier's Quality Assurance Program, 15 days before start of fabrication.
- 3.3.3 Drawings: 3 copies of weld (bond) identification drawings, 5 days before start of fabrication.
- 3.3.4 Expansion Anchor Installation Reports: 1 copy within 5 days after completion.

- 3.3.5 NDE Records: 1 copy of weld (bond) NDE records within 5 days after NDE Page 23 completion. These records may be either signed NDE record forms, or signed fabrication drawings with each weld (bond) bearing the inspector's stamp.
- 3.3.6 Material Properties Test Records: 1 copy of test results prior to delivery of material. These records are for acceptance tests of bulk materials and of lots or heats of preformed stock materials and parts.
- 3.3.7 Flushing Records: 1 copy of records verifying acceptable completion of flushing, before testing.
- 3.3.8 Leak/Pressure Testing Records: 1 copy of records verifying acceptable completion of leak and pressure testing, within 5 days after completion.
- 3.3.9 Disinfecting Records: 1 copy of records verifying acceptable completion of sanitary water line disinfecting, 5 days after completion.
- 3.3.10 Electrical Testing: 1 copy of records verifying acceptable completion of electrical insulation, continuity, and grounding tests, within 5 days after completion.
- 3.3.11 Operational Testing: 1 copy of records of component or subsystem operational testing, within 15 days before the start of acceptance testing.
- 3.3.12 Completed Acceptance Test Procedure (Test Results): 1 copy of Acceptance Test Procedure, with test results and other required information entered, within 5 days after completion.
- 3.3.13 Completed Certificate of Compliance: 1 copy of completed Certificate of Compliance, based on the above completed acceptance test procedure, along with that procedure.
- 3.4 PRODUCT SAMPLES AND MANUFACTURER'S INSTRUCTIONS
- 3.4.1 In addition to submittals required in Section 01300, and requirements of this Section, information received by CONTRACTOR (from suppliers) that documents products used, and how they were installed, shall be delivered to ICF KH as Project Records.

END OF SECTION

SECTION 02050

DEMOLITION

PART 1 - GENERAL

- 1.1 REFERENCES: Not Used
- 1.2 SUBMITTALS: Not Used
- 1.3 SEQUENCING AND SCHEDULING: Not Used

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

- 3.1.1 Before beginning cutting or demolition, survey existing work and examine the Drawings and Specifications to determine extent of work. Coordinate work of this Section with other work.

3.2 PREPARATION

- 3.2.1 Personnel Protection: Provide safeguards, including warning signs, barricades, and temporary closures required for protection of construction personnel and others during demolition and removal operations.
- 3.2.2 Property Protection: Take necessary precautions to ensure against damage to existing work that will remain in place, be reused, or remain property of the Operating Contractor.
- 3.2.3 Ensure that structural elements are not overloaded as a result of cutting, removal, or demolition performed. Construct and maintain shoring, bracing, and supports as required.
- 3.2.4 Disconnect existing utility services as directed by the Design Engineer.

3.3 PERFORMANCE

- 3.3.1 Perform demolition work in accordance with approved procedures.
- 3.3.2 Foundations: Remove existing Intake Air Filter Pad completely and backfill as specified in Section 02200.
- 3.3.3 Detach portions of existing Intake Air Filter Assembly as required and, subject to approval by the Design Engineer, other portions necessary to facilitate relocation and reuse as shown on the Drawings.

- 3.3.4 Detach structural steel support frame for Intake Air Filter Assembly at Page 25 base connections and relocate as shown on Drawings in a manner to prevent bending or damage to members. Obtain approval of the Construction Engineer before oxy-fuel cutting.
- 3.3.5 Isolate area where radioactive contamination is present to prevent the spread of contaminants to other areas.
- 3.3.6 Dispose of nonrecyclable concrete, and other combustible and noncombustible materials (other than concrete permitted to remain in place), as directed by the Construction Engineer.
- 3.3.7 Remove temporary cover plate over 241-C-06B Heel Pit and install structural steel replacement deck/working platforms fabricated for 06B Heel Pit under the Equipment Removal System contract. See Drawings H-2-820725 and H-2-820729.
- 3.4 CLEANING
- 3.4.1 Remove debris from site and haul to area designated by the Construction Engineer. Do not dispose of materials by burning.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.1 REFERENCES

1.1.1 The following documents, including others referenced therein, form part of this Section to the extent designated herein.

1.1.1.1 Washington State Department of Transportation (WSDOT)

M 41-10-94 Road, Bridge, and Municipal
Construction

M 41-01-93 Construction Manual

1.2 SUBMITTALS: Not Used

1.3 QUALITY ASSURANCE

1.3.1 Deliverable Documentation: The following documents and records, required by this Section, shall be delivered to Construction Document Control in accordance with Section 01720.

<u>Document</u>	<u>Paragraph</u>
Excavation Permit	3.1.1
Backfill Permit	3.2.1.1a
Soil Compaction Procedure	3.2.1.2a
Soil Compaction Test Results	3.3.1

PART 2 - PRODUCTS

2.1 MATERIALS

2.1.1 Obtain specified soils from excavation or other locations designated by the Construction Engineer.

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% 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% of volume of fill.

2.1.3 Stabilization: Crushed rock, with a maximum fragment size of 3/4-inch.

PART 3 - EXECUTION

3.1 EXCAVATION

- 3.1.1 Obtain an excavation permit before performing excavation. Excavation permits will be provided by the Operating Contractor.
- 3.1.2 If cultural properties (eg, bones, artifacts) are encountered during excavation, stop work. The Hanford Cultural Resources Laboratory will assess the significance of the find.
- 3.1.3 Locate and expose underground utilities by hand tools. Use of heavy equipment and machinery is restricted within 5 feet of suspected underground utilities, and requires approval by the Construction Engineer.
- 3.1.4 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.
- 3.1.5 Footings and Foundations
- 3.1.5.1 Make excavations for footings to depth shown on the Drawings or additional depth necessary to provide undisturbed surface to receive footing. Make excavations to proper width with allowances made for forms and bracing. Make bottom of excavations compact, level, true, and free of loose material.
- 3.1.5.2 If over-excavation occurs where footings are designed to be placed on undisturbed earth, correct at time of placing concrete by extending concrete down to undisturbed earth, or by placement of backfill, compacted as specified in 3.2.1.2b, Method C.
- 3.1.6 In Situ Soils
- 3.1.6.1 Salvage in situ stabilization material and reuse for backfilling and compacting. Contact the Construction Engineer for acceptability of backfill material, if required.
- 3.1.6.2 Conduct in-place density tests on in situ soils, using nuclear density gage, during excavation. Results of tests will be used for testing compaction of backfill and to assure that the density of backfill material placed over the tank dome is equal to or less than the density assumed in the tank safety and structural analyses.
- 3.1.6.3 Excavated material containing concentrations of radioactive materials that can be detected by portable survey instruments normally used for performing radiation surveys is considered contaminated, and shall be sampled and analyzed for content. Contact the Construction Engineer for disposal or reuse within approved contamination level limits set by the Operating Contractor.

~~3.1.7 Where stabilization is required, finish subgrade 3 inches below elevations shown on the Drawings.~~

3.2 PLACEMENT

3.2.1 Fill and Backfill

3.2.1.1 General:

- a. Backfill Permit: Obtain signatures required on the backfill permit for each element to be filled or backfilled. Work not started within 5 calendar days from the time a permit is approved shall not be started until a new permit has been approved. A continuing job that has not had backfill installed within the past 5 calendar days will require a new backfill permit.
- b. Remove debris and organic matter from the area to be filled or backfilled.
- c. Use only specified materials for fill or backfill. Keep materials free of frozen particles, lumps, organic matter, and trash.
- d. Do not place fill or backfill on frozen ground.
- e. Filling or backfilling by sluicing or flooding with water will not be permitted.
- f. Bring fill or backfill up evenly on sides of walls, structures, and utility lines to avoid unbalanced loading. Written approval shall be obtained from the Construction Engineer for other procedures.
- g. Do not place fill or backfill against concrete structure or foundation wall less than 14 days after completion of structure or wall unless written permission from the Design Engineer is obtained. Provide wall support, where noted on the Drawings, before filling or backfilling.

3.2.1.2 Compaction:

- a. Before placement of fill or backfill, demonstrate by physical test at the worksite, that proposed layer depths and the procedure for compaction of soils will provide compaction specified. Prepare "Soil Compaction Procedure", Form KEH-0382, in accordance with the instructions.
- b. Place backfill in accordance with WSDOT M 41-10, Section 2-03.3(14)C and approved procedure as follows.
 - 1) Use Method C under foundations, slabs, and when backfilling around Concrete Pits.
 - 2) Use Method B under pavements and roads, and within 5 feet of buildings, fences, other structures, or poles supporting electric lines or pipe.

c. Compaction control tests will be in accordance with WSDOT M 41-10, Page 29 Section 2-03.3(14)D.

3.2.1.3 Common:

- a. Place fill or backfill in layers not more than 12 inches thick, loose measurement.
- b. Compact each layer, full width, by at least 1 pass of vibratory or rammer-type compactor, pneumatic-tired roller, loaded scraper wheel, grader wheel, or power roller.
- c. Mound over top layer of backfill to depth of 1 inch for each 12 inches of trench depth to maximum mound height of 6 inches.

3.2.1.4 In situ soils:

- a. Compact backfill by depositing soils in 8 inch layers and compacting to density equal to in situ density determined by tests made during excavation. Maintain uniformity of compaction throughout backfill.
- b. Do not use soils containing rocks larger than 3 inches in greatest dimension for compacted backfill.

3.2.2 Finish Grading and Stabilization

- 3.2.2.1 Rake areas disturbed by work, remove surface stones larger than 6 inches and dispose of excess material and debris at an area designated by the Construction Engineer.
- 3.2.2.2 Stabilize areas disturbed by work with a ~~3 inch course of~~ crushed rock ECN-548 specified in 2.1.3. Finish stabilization course to elevations shown on the Drawings.

3.3 FIELD QUALITY CONTROL

- 3.3.1 Soil Compaction Tests: Sampling and testing of compacted fill and backfill will be performed. Frequency of testing shall be in accordance with WSDOT M 41-01, Page 9-52 and as directed by the Construction Engineer to insure uniform compaction of backfill material. Record the results.

END OF SECTION

SECTION 02225

EXCAVATING, BACKFILLING, AND COMPACTING FOR UTILITIES

PART 1 - GENERAL

1.1 REFERENCES

1.1.1 The following documents, including others referenced therein, form part of this Section to the extent designated herein.

1.1.1.1 American Society for Testing and Materials (ASTM)

D 653-90 Standard Terminology Relating to Soil, Rock, and Contained Fluids

1.1.1.2 Washington State Department of Transportation (WSDOT)

M 41-01-93 Construction Manual

M 41-10-94 Road, Bridge, and Municipal Construction

M 46-01-88 w/Revisions through 1994 Materials Branch Laboratory Manual

1.2 SUBMITTALS: Not Used

1.3 QUALITY ASSURANCE

1.3.1 Deliverable Documentation: The following documents and records, required by this Section, shall be delivered to Construction Document Control in accordance with Section 01720.

<u>Document</u>	<u>Paragraph</u>
Excavation Permit	3.1.1
Backfill Permit	3.2.1.1a
Soil Compaction Procedure	3.2.1.2a
Soil Compaction Test Results	3.3.1

PART 2 - PRODUCTS

2.1 MATERIALS

2.1.1 Obtain specified soils from excavation or other locations designated by the Construction Engineer.

- 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% 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% of volume of fill.
- 2.1.3 Bedding for Underground Pipe, Conduit, and Cable: Sand, as defined in ASTM D 653, or excavated sandy material having less than 20% gravel particles, with those particles having a maximum dimension of 1/2-inch.
- 2.1.4 Stabilization: Crushed rock, with a maximum fragment size of 3/4-inch.
- 2.1.5 Plastic Sheet Marker: 3-inch wide detectable tape imprinted with a warning, such as "CAUTION - BURIED INSTALLATION BELOW," at intervals of 4 feet maximum; Reef Industries "Terra Tape Sentry Line 620," with "Terra Clips," or an approved substitute.

PART 3 - EXECUTION

3.1 EXCAVATION

- 3.1.1 Obtain an excavation permit before performing excavation. Excavation permits will be provided by the Operating Contractor.
- 3.1.2 If cultural properties (eg, bones, artifacts) are encountered during excavation, stop work. The Hanford Cultural Resources Laboratory will assess the significance of the find.
- 3.1.3 Locate and expose underground utilities by hand tools. Use of heavy equipment and machinery requires approval by the Construction Engineer.
- 3.1.4 Where 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 prevent interrupting service to existing buildings.
- 3.1.5 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 pipe, conduit, and cable. Excavate trench deep enough to permit placement of compacted bedding, 4 inches minimum thickness, beneath pipe, conduit, and cable 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 pipe couplings so pipe will bear full length of barrel or section. Excavate trench for transfer lines deep enough for 6 inches of compacted bedding beneath pipe.
- 3.1.6 Install shoring to hold materials and surcharge pressure for full depth of trench.

- 3.1.7 Keep trenches free of standing water when laying is in progress.
- 3.1.8 If over-excavation occurs, correct by placement of structural backfill.
- 3.1.9 In Situ Soils
 - 3.1.9.1 Salvage in-situ stabilization material and reuse for backfilling and compacting. Contact the Construction Engineer for acceptability of backfill material, if required.
 - 3.1.9.2 Conduct in-place density tests on in-situ soils, using nuclear density gage, during excavation. Results of tests will be used for testing compaction of backfill.
 - 3.1.9.3 Excavated material containing concentrations of radioactive materials that can be detected by portable survey instruments normally used for performing radiation surveys is considered contaminated, and shall be sampled and analyzed for content. Contact the Construction Engineer for disposal or reuse within approved contamination level limits set by the Operating Contractor.

~~3.1.10 Where stabilization is required, finish subgrade 3 inches below elevations shown on the Drawings.~~

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3.2 PLACEMENT

3.2.1 Fill and Backfill

3.2.1.1 General:

- a. Backfill Permit: Obtain signatures required on the backfill permit for each element to be filled or backfilled. Work not started within 5 calendar days from the time a permit is approved shall not be started until a new permit has been approved. A continuing job that has not had backfill installed within the past 5 calendar days will require a new backfill permit.
- b. Remove debris and organic matter from the area to be filled or backfilled.
- c. Use only select materials for fill or backfill. Keep materials free of frozen particles, lumps, organic matter, and trash.
- d. Do not place fill or backfill on frozen ground.
- e. Filling or backfilling by sluicing or flooding with water will not be permitted.
- f. Bring fill or backfill up evenly on sides of walls, structures, and utility lines to avoid unbalanced loading. Written approval shall be obtained from the Construction Engineer for other procedures.

3.2.1.2 Compaction:

a. Before placement of fill or backfill, demonstrate by physical test at the worksite, that proposed layer depths and the procedure for compaction of soils will provide compaction specified. Prepare "Soil Compaction Procedure," Form KEH-0382, in accordance with the instructions.

b. Place backfill in accordance with WSDOT M 41-10, Section 2-03.3(14)C and approved procedure as follows.

1) Use Method C under pipelines.

2) Use Method B within 5 feet of buildings, fences, other structures, or poles supporting electric lines or pipes.

c. Compaction control tests will be in accordance with WSDOT M 41-10, Section 2-03/3(14)D.

3.2.1.3 Common:

a. Place fill or backfill in layers not more than 12 inches thick, loose measurement.

b. Compact each layer, full width, by at least 1 pass of vibratory or rammer-type compactor, pneumatic-tired roller, loaded scraper wheel, grader wheel, or power roller.

c. Mound over top layer of backfill to depth of 1 inch for each 12 inches of trench depth to maximum mound height of 6 inches.

3.2.1.4 Underground piping, conduit, and cable trenches:

a. Bedding placed beneath pipe, conduit, and cable in trenches shall be material specified in 2.1.3. An alternate material, such as select native bedding material, may be used with written approval from the Construction Engineer.

b. Place and compact bedding in trench prepared as specified in 3.1.5 before laying pipe, conduit, and cable. Compact bedding as specified for structural backfill.

c. Place backfill over joints in underground pipes only after pressure testing of line has been completed.

d. Backfill under conduit and haunches of pipe, around sides, and up to 1 foot above top of pipe, conduit, and cable using bedding material specified in 2.1.3. Place and compact material same as specified for structural backfill. Compact with care, to avoid misalignment of pipe and provide uniform bearing along barrel of pipe. Compact bedding and backfill materials of Transfer lines to 95% of WSDOT M 46-01, Section 600, Test Method 606. Do not compact within 5 feet of any buried utility of unknown type or any utility which may be susceptible to

damage from compaction efforts. This pertains primarily to process lines, identified on the Drawings.

e. Backfill trenches from elevation 1 foot above top of pipe, conduit, and cable as follows.

1) Use structural fill or backfill in locations specified in 3.2.1.2.

2) Use common fill or backfill as specified in 3.2.1.3 for other locations.

f. Do not allow heavy construction equipment to pass over buried lines until at least 2 feet of backfill has been placed over the line or until bridging has been placed across trenching and approved by the Construction Engineer.

3.2.1.5 In situ soils:

a. Compact backfill by depositing soils in 8 inch layers and compacting to density equal to in-situ density determined by tests made during excavation. Maintain uniformity of compaction throughout backfill.

b. Do not use soils containing rocks larger than 3 inches in greatest dimension for compacted backfill.

3.2.2 Plastic Sheet Marker: Place continuously and directly over buried utility lines, 1 foot below finish grade. Place markers over each outside line of multiple lines, if spacing permits. Place intermediate markers spaced 4 feet maximum.

3.2.3 Finish Grading and Stabilization

3.2.3.1 Rake areas disturbed by work, remove surface stones larger than 6 inches, and dispose of excess material and debris at an area designated by the Construction Engineer.

3.2.3.2 Stabilize areas disturbed by work with ~~a 3 inch course of gravel~~ crushed rock specified in 2.1.4. Finish stabilization course to elevations shown on the Drawings.

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3.3 FIELD QUALITY CONTROL

3.3.1 Soil Compaction Tests: Sampling and testing of compacted fill and backfill will be performed. Frequency of testing shall be in accordance with WSDOT M 41-01, Page 9-52 and as directed by the Construction Engineer to insure uniform compaction of backfill materials. Record the results.

END OF SECTION

FIRE WATER SYSTEMS

PART 1 - GENERAL

1.1 REFERENCES

- 1.1.1 The following documents, including others referenced therein, form part of this Section to the extent designated herein.
- 1.1.1.1 American National Standards Institute (ANSI)
Z535.1-1991 Safety Color Code
- 1.1.1.2 American Water Works Association (AWWA)
C104-90 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
~~C110-87 Ductile Iron and Gray Iron Fittings, 3 in. Through 48 in., for Water and Other Liquids~~ ECN-171
ECN-171
C111-90 Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
C151-91 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
~~C500-86 Gate Valves for Water and Sewerage Systems~~ ECN-171
ECN-171
C502-85 Dry-Barrel Fire Hydrants
C600-87 Installation of Ductile-Iron Water Mains and Their Appurtenances
C153-94 *Ductile-Iron Compact Fittings, 3 in. through 24 in. and 54 in. through 64 in. for Water Service* ECN-171
C509-87 *Resilient-Seated Gate Valves for Water and Sewerage Systems* ECN-171
- 1.1.1.3 Factory Mutual System (FM)
Approval Guide 1994 Edition
Data Sheet 3-10 Installation and Maintenance of Private Fire Service Mains and Their Appurtenances

1.1.1.4 Federal Specifications (FS)

HNF-2534, Rev. 0

Page 36

TT-E-489H
NOT 1

Enamel, Alkyd, Gloss, Low VOC Content

TT-P-645B

Primer, Paint, Zinc Molybdate, ~~ANK~~ 2534, Rev. 0
 Type Page 37

- 1.1.1.5 National Fire Protection Association (NFPA)
 - 24 (1992) Installation of Private Fire Service Mains and Their Appurtenances
 - 1963 (1993) Screw Threads and Gaskets for Fire Hose Connections
- 1.1.1.6 Underwriters Laboratories (UL)
 - Fire Protection Equipment Directory 1994

1.2 SUBMITTALS

- 1.2.1 See Section 01300 for submittal procedures.
- 1.2.2 Approval Required
 - 1.2.2.1 Approval data: Before delivery, submit information listed in the Approval Data List in this Section.
 - 1.2.2.2 NFPA Test Certificate: Within 10 days after completion, submit completed Contractor's Materials and Test Certificate for Underground Piping. The Contractor's Materials and Test Certificate shall be signed by CF representative and countersigned by ICF KH A & I. The Contractor's Materials and Test Certificate shall document results of flushing, hydrostatic testing, leak testing, and operational testing of fire hydrants and control valves, and shall note the date the underground water distribution system was left in service. A sample Contractor's Materials and Test Certificate, and instructions for testing and completion of the form are contained in NFPA 24.
- 1.2.3 Approval Not Required
 - 1.2.3.1 Vendor Information: Before installation, submit information listed in the Vendor Information List in this Section.

1.3 SYSTEM DESCRIPTION

- 1.3.1 System maximum operating pressure will *not exceed 200 lb/in² gage.* ECN-182
ECN-182
~~be 150 lb/in² gage.~~
- 1.3.2 Provide restraints in accordance with NFPA 24, Article 8-6 and A-8-6-2, at locations such as tees, plugs, caps, bends, and valves located in long straight pipe runs.
- 1.3.3 Where applicable and where ductile iron pipe is used, restraining mechanical joints listed in the UL Fire Protection Equipment Directory may be substituted for conventional anchoring.

1.3.4 Where concrete thrust blocks are used, make bearing face areas equal to areas shown in NFPA 24, Table 8-6.2.8, multiplied by a factor of 1.33. NFPA 254, Rev. 0
Page 38

1.4 QUALITY ASSURANCE

1.4.1 Product Acceptability: Components of the new underground fire water system shall be current products, and be listed in the UL Fire Protection Equipment Directory, or in the FM Approval Guide, for their intended fire service use.

1.4.2 Deliverable Documentation: The following documents and records, required by this Section, shall be delivered to ICF KH in accordance with Section 01720.

<u>Document</u>	<u>Paragraph</u>
Contractor's Materials and Test Certificate	3.2.1.7, 3.2.3.8, 3.2.4

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 See Section 01610 for general requirements.

PART 2 - PRODUCTS

2.1 SUBSTITUTES

2.1.1 See Section 01630 for substitution approvals.

2.2 MATERIALS

2.2.1 Pipe, Pipe Joints and Fittings: Piping shall be in accordance with NFPA 24, the Drawings and this Section.

2.2.1.1 Pipe: ~~PVC~~, or AWWA C151 Class 50 minimum with AWWA C104 cement lining and AWWA C111 mechanical joints or push-on joints. ECN-147

2.2.1.2 Pipe joints and fittings: ~~PVC~~, or AWWA C110 153 with AWWA C104 cement lining. Joints, retainer type fittings and pressure class ratings shall be compatible with pipe used. ECN-147/171

2.2.2 Reflective Sheeting: 6-inch wide reflective sheeting for placement around fire hydrant body and 3-inch wide sheeting for placement around barricade posts for fire hydrants; Scotchlite No. 3270 silver "Wide-Angle Flat Top," adhesive coated.

2.2.3 Drainage Material for Fire Hydrant Base: 3/8 inch to 1 inch clean crushed rock or gravel.

~~2.2.4 Exterior Protective Coating: Tapecoat Company "TC Enviroprime" and "TC Envirotape."~~ ECN-172
ECN-172

- 2.2.54 Painting Materials
- 2.2.54.1 Primer: FS TT-P-645; National Lead No. 200-41.
- 2.2.54.2 Paint: FS TT-E-489, Class A, Composition G.
- 2.2.54.3 Colors: In accordance with ANSI Z535.1.

ECN-172

2.3 EQUIPMENT

2.3.1 Fire Hydrants: AWWA C502, with compression type main valve that opens against pressure. Inlets shall be 6-inch, with 5-inch minimum valve openings. Hydrants shall have one 4-1/2 inch pumper nozzle and two 2-1/2 inch hose nozzles, including caps and chains. Nozzle threads shall be in accordance with NFPA 1963. Hydrant operating nut and cap nuts shall be National Standard Pentagon in accordance with AWWA C502 and open in counter-clockwise direction. Stem seals shall be O-ring type.

~~2.3.2 Hydrant Connection Valve: AWWA C500, 6 inch, including an adjustable, cast iron valve box. Valve shall open in the counterclockwise direction.~~

ECN-147

~~2.3.3 Gate Valves: AWWA C500, iron body, nonrising stem. Ends shall be as shown on the Drawings.~~

ECN-147

2.3.42 Tapping Assembly

ECN-171

2.3.42.1 ~~Tapping Valve: AWWA C500, nonrising stem, iron body, bronze mounted, MJ or slip on flanged. AWWA C509, resilient wedge, non-rising stem, iron body, bronze mounted, MJ by Flange.~~

ECN-171

2.3.42.2 Tapping Sleeve: Cast iron or epoxy coated steel, split sleeve with o-ring seals, Class 125 150 flanged outlet.

ECN-171

2.3.53 Valve boxes: Cast Iron, adjustable telescoping barrel type, standard design with covers and bases corresponding to valve sizes. Boxes shall be coal tar painted by the manufacturer. Covers shall have the word "WATER" cast in.

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 Install piping and piping accessories in accordance with NFPA 24, FM Data Sheet 3-10, AWWA C600, the Drawings, the manufacturer's instructions, and this Section.

3.1.2 Protect pipe and fittings from impact shocks and dropping.

3.1.3 Keep piping systems clean during work. Once fabrication has started on length of pipe, plug or cap open ends of piping when installation is not in progress to prevent entry of dirt and other foreign material. Inner surfaces of pipe, valves, and fittings shall be smooth, clean, and free of sand, debris and dirt when installed.

- 3.1.4 Where piping is laid in trenches, trenches shall be free of frost/frozen earth and standing water.
- 3.1.5 Install fire mains 3'-6" minimum from top of pipe to finish grade.
- 3.1.6 Perform excavating, backfilling, and grading in accordance with NFPA 24, and Section 02225 as applicable.
- 3.1.7 Install restraints on pipe and piping components in accordance with NFPA 24, Articles 8-6 and A-8-6.2, the Drawings, this section and the manufacturers recommendations, as applicable.
- 3.1.8 Coat carbon steel accessories that will be buried, such as tie-rods and clamps, with protective coating. Allow time for coating to dry before backfilling.
- ~~3.1.9 Do not exceed PVC pipe manufacturer's requirements for pipe alignment curvature. Deflection at PVC pipe joints is not allowable. Where required, pipe shall be deflected or curved uniformly over the total barrel length.~~ ECN-147
- 3.1.109 Install fire hydrants and hydrant connection valves in accordance with the Drawings and this Section.
- 3.1.1110 Install post barricades around fire hydrants in accordance with the Drawings and this Section.
- 3.1.1211 Place drainage material at fire hydrant bases in accordance with AWWA C600, Section 3.7. Separate interfaces between drainage material and compacted earth fill with a layer of 30 pound roofing paper.
- 3.1.1312 Fire hydrant base pads shall be precast concrete, 24 inches minimum diameter (or square) by 4 inches thick, bearing on undisturbed or compacted earth.
- 3.1.1413 Locate centerlines of fire hydrant pumper nozzles between 18 and 22 inches above adjacent finished grade. Orient pumper nozzles toward the roadway or street.
- 3.1.1514 Perform flushing and testing specified in 3.2 before painting and marking.
- 3.1.1615 Painting and Marking
- 3.1.1615.1 Surface preparation, materials and coating application of primer and paint shall be in accordance with Section 09900.
- 3.1.1615.2 Paint entire fire hydrant with 1 coat of primer and 2 coats of yellow enamel.
- 3.1.1615.3 Paint entire length of each barricade post with primer and above ground portion with 2 coats of yellow enamel. ECN-147

3.1.1615.4 After painting is completed, place 6-inch wide reflective band around body of fire hydrant immediately below pumper nozzle. Place 3-inch wide reflective bands around fire hydrant barricade posts as shown on the Drawing. non-0534 ECN-147
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3.2 FIELD QUALITY CONTROL

3.2.1 General

3.2.1.1 Perform flushing and testing of the underground fire main and operational tests of valves and hydrants in accordance with ICF KH ME-6, applicable provisions of NFPA 24, and this specification.

3.2.1.2 Furnish equipment and instruments required to perform flushing and testing.

3.2.1.3 Obtain direction for disposal of waste flushing and testing water from the Construction Engineer.

3.2.1.4 Perform flushing and testing operations while witnessed by the Construction Engineer.

3.2.1.5 Remove and replace apparatus, material, or work which fails during flushing or testing, and retest.

3.2.1.6 Repair damage to site resulting from flushing or testing to the satisfaction of the Construction Engineer.

3.2.1.7 Document flushing, hydrostatic, leak and operational testing on the "Contractor's Materials and Test Certificate for Underground Piping" in accordance with NFPA 24.

3.2.2 Flushing

3.2.2.1 Perform flushing of the underground fire main system in accordance with NFPA 24, Article 8-8.

3.2.2.2 Use a flushing flow in accordance with NFPA 24, Paragraph 8-8.2 and Table 8-8.2, until the water flows clear.

3.2.2.3 Use clean filtered water for flushing the main connected to the Raw Water system, *if a source is readily available nearby. Otherwise, flush main using the Raw Water system source at wet tap tie-in locations.*

ECN-147
|
ECN-147

3.2.3 Hydrostatic Pressure Testing

3.2.3.1 Perform hydrostatic testing of fire main system in accordance with NFPA 24, Article 8-9.

3.2.3.2 Perform testing after piping has been flushed, and before backfill is placed over pipe joints.

- 3.2.3.3 Use calibrated gages with ranges 1-1/2 to 2 times the test pressure. Provide documentation of calibration for each gage used, indicating date of calibration and identifying a calibration method traceable to a known standard. HNF-2534, Rev. 0
Page 42
- 3.2.3.4 Install temporary pressure relief valve(s) during testing of each system. Relief valve(s) shall have a discharge capacity of 125% minimum of the pressurizing device capacity, and be set to operate at 110% maximum of the test pressure. Demonstrate relief valve(s) operation at the following times.
- a. Before relief valve(s) are attached to the system for each series of leak tests.
 - b. Whenever the Construction Engineer has cause to question operating accuracy of relief valve(s).
- 3.2.3.5 Before applying pressure, restrain piping to prevent distortion or displacement during testing.
- ~~3.2.3.6 Coat joints and connections of threaded lines with mixture of powdered blue chalk and water or isopropyl alcohol, and allow to dry before filling piping with water and inspecting for leaks.~~ ECN-192
- 3.2.3.76 Verify that air has been expelled from piping before applying pressure.
- 3.2.3.87 Examine piping joints, fittings, and other potential leak sources during testing. Leaks in piping are not acceptable. Repair leaks and retest. Document the results of leak/pressure testing on the Contractor's Materials and Test Certificate.
- 3.2.3.98 If the piping system is subject to freezing, remove water from lines upon completion of testing.
- 3.2.3.109 Document testing of Underground Piping on Contractor's Materials and Test Certificate for Underground Piping following NFPA 24 guidelines. If system is tested segmentally, indicate continuity in "Remarks" to assure that entire installation has been tested. ECN-192
- 3.2.4 Operational Testing: Perform operational testing of hydrants and valves in accordance with NFPA 24, Article 8-9.4. Document the results on the Contractor's Materials and Test Certificate.

SECTION 02831

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 REFERENCES

1.1.1 The following documents, including others referenced therein, form part of this Section to the extent designated herein.

1.1.1.1 American Society for Testing and Materials (ASTM)

A 90-81 (1991) Test Method for Weight of Coating on Zinc-Coated Galvanized) Iron or Steel Articles

1.1.1.2 Federal Specifications (FS)

RR-F-191K/Gen Fencing, Wire And Post, Metal (And Gates, Chain-Link Fence Fabric, And Accessories) (General Specification)

RR-F-191/1D Fencing, Wire And Post, Metal (Chain-Link Fence Fabric) (Detailed Specification)

RR-F-191/3D Fencing, Wire And Post, Metal (Chain-Link Fence Posts, Top Rails And Braces) (Detailed Specification)

RR-F-191/4D Fencing, Wire And Post, Metal (Chain-Link Fence Accessories) (Detailed Specification)

1.2 SUBMITTALS: Not Used

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 See Section 01610 for general requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

2.1.1 Fence Fabric: FS RR-F-191/1, Type I, 2 inch mesh, 11 gage, 84 inch height, top and bottom salvages twisted and barbed.

2.1.2 Posts, Top Rails and Braces: FS RR-F-191/3, Class 1, Grade A or B, of following sizes.

2.1.2.1 Line posts: SP3.

- 2.1.2.2 Terminal posts and posts set at break in grade: SP4.
- 2.1.2.3 Top rails: SP1.
- 2.1.2.4 Braces: Diagonal truss and horizontal brace, hot-dip galvanized steel rods 3/8-inch diameter with turnbuckle.
- 2.1.2.5 Where posts other than Class 1 are used, they shall be Class 3, 4, or 6, and of equal strength and stiffness as posts specified in 2.1.2.
- 2.1.3 Accessories: FS RR-F-191/4.
 - 2.1.3.1 Wire ties and clips: Zinc-coated steel
 - 2.1.3.2 Tension wire: No. 7 gage zinc-coated steel per FS RR-F-191/4.
 - 2.1.3.3 Miscellaneous accessories: Miscellaneous fittings including bolts, nuts and washers shall be malleable iron, cast iron, or steel, and be hot-dip galvanized.
- 2.1.4 Coating: Fence shall have a zinc coating of uniform thickness, weighing at least 1.2 oz/ft² of surface, as determined by ASTM A 90. Apply coating to parts after fabrication. Repair welds or breaks in galvanized coatings with zinc-rich coating such as ZRC or Galvacon.

2.2 MIXES

- 2.2.1 Concrete: Minimum compressive strength of 2000 lb/in² at 28 days.

PART 3 - EXECUTION

3.1 INSTALLATION

- 3.1.1 Install fence true to line and grade in locations shown on the Drawings and in accordance with this Section.
 - 3.1.2 Setting Posts
 - 3.1.2.1 Set posts in concrete, plumb and true to line. Space line posts evenly, 10 feet maximum, between end and gate posts.
 - 3.1.2.2 Holes for setting line posts shall be 8 inches to 12 inches in diameter and 3 feet deep. Holes for setting gate and end posts shall be 10 inches to 17 inches in diameter and 3'-6" deep. Set post ends 6 inches above bottom of hole.
 - 3.1.2.3 Firmly support posts to prevent movement or deflection until concrete has set 24 hours minimum.
 - 3.1.3 Bracing Posts: Horizontally brace gate, corner and terminal posts with steel pipe using brace attachments, and diagonally brace from the base of gate, corner, and terminal posts to the midheight of adjacent line posts using steel rods with truss attachments.

- 3.1.4 Tension Wires: Install top and bottom tension wires to stabilize wire fabric.
- 3.1.4.1 Install top tension wire through 1/4 inch holes drilled in each post, except gate posts drilled 3 inches below the top in each post.
- 3.1.4.2 Install bottom tension wires through 1/4 inch holes in each post, except gate posts, 4 inches above finish grade.
- 3.1.5 Attaching and Stretching Fabric
- 3.1.5.1 Thread tension bars through end loops of each section of fabric and tie to end, corner, and gate posts with tension bands spaced not more than 15 inches on centers.
- 3.1.5.2 Fasten fabric to posts with ties spaced not more than 14 inches on centers. Topmost tie shall be as near top of fabric as possible; lowest tie as near bottom of fabric as possible.
- 3.1.5.3 Tie fabric to top and bottom tension wires with wire clips or ties spaced 24 inches maximum on centers.
- 3.1.5.4 Stretch fence fabric taut.
- 3.1.5.5 Dress barbed ends of barbed top fabric approximately 2 to 3 inches above top tension wire. Straighten each barb as needed to present unbroken line above and below tension wire.
- 3.1.5.6 Bottom of fabric shall extend to within 2 inches of finish grade.
- 3.1.6 Bolt Heads: Locate bolt heads on outside of fence.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 REFERENCES

1.1.1 The following documents, including others referenced therein, form part of this Section to the extent designated herein.

1.1.1.1 American Concrete Institute (ACI)

- 117-90 Tolerances for Concrete Construction and Materials
- 301-89 Structural Concrete for Buildings
- 306.1-90 Cold Weather Concreting

1.1.1.2 American Society for Testing and Materials (ASTM)

- A 185-94 *Steel Welded Wire Fabric, Plain, for Concrete Requirement* ECN-126
- A 615-92b Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- A 853-91 Steel Wire, Carbon, for General Use
- C 94-92a Ready-Mixed Concrete
- C 531-85 (1990) Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts and Monolithic Surfaces
- C 579-91 Test Method for Compressive Strength of Chemical Resistant Mortars and Monolithic Surfacing
- C 827-87 Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
- C 1107-91a Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

1.1.1.3 Washington State Department of Transportation (WSDOT)

- M 41-10-94 Road, Bridge, and Municipal Construction

1.2 SUBMITTALS: *Not Used*

~~1.2.1 See Section 01300 for submittal procedures.~~

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1.2.2 ~~Approval Required: None~~

1.2.3 Approval Not Required

~~1.2.3.1 Commercial grade item documentation: Before fabrication/installation, submit reports of inspections and tests of items specified in 2.3.1.~~

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1.3 QUALITY ASSURANCE

1.3.1 Deliverable Documentation: The following documents and records, required by this Section, shall be delivered to Construction Document Control in accordance with Section 01720.

<u>Document</u>	<u>Paragraph</u>
Pour Slip and Trip Tickets	3.2.2.1
Material Test Results	2.3.1 , 3.4.1, 3.4.2

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1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 See Section 01610 for general requirements.

PART 2 - PRODUCTS

2.1 SUBSTITUTES

2.1.1 See Section 01630 for substitution approvals.

2.2 MATERIALS

2.2.1 Concrete: ACME preapproved mix design No. 6452.

2.2.2 Measuring, Mixing, and Delivery: In accordance with ASTM C 94.

2.2.3 Reinforcing Steel

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

2.2.3.2 Tie wire: ASTM A 853 carbon steel, 0.062-inch (16-gage) minimum, annealed.

2.2.3.3 *Welded wire fabric: ASTM A 185*

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2.2.4 Joint Materials

2.2.4.1 Epoxy resin: In accordance with WSDOT M 41-10, Section 9-26, Type II, Grade 2, Class B or C; QCM Company EAS8 Class A, Adhesive Engineering "Concresive 1001 LPL," or Protex Industries "Probond 822."

2.2.4.2 Expansion joint filler: See Section 07900.

2.2.4.3 Sealant: See Section 07900.

2.2.5 Grout

2.2.5.1 Nonshrink Grout: ASTM C 1107; Sika Corporation "Sika Grout 212," or Master Builders "Masterflow 713."

2.2.5.2 Nonshrink Epoxy Grout: ASTM C 827; U.S. Grout Corporation "Five Star HF Epoxy Grout" or approved substitute. (10,000 psi min in 7 days)

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- 2.2.6 Forms: Wood, steel, plywood, or Masonite Corporation "Concrete Form Presdwood," as required for various specified finishes.
- 2.2.7 Form Coating Materials: Symons Corporation "Magic Kote," AC Horn Incorporated "Form Shield," or Burke Company "Burke Release No. 1."

~~2.3 MATERIAL QUALITY ASSURANCE~~

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~~2.3.1 Commercial Grade Item Acceptance: If the following items, specified in 2.2, are procured as commercial grade items, they shall be inspected or tested as specified below. Document the results in reports.~~

~~2.3.1.1 Nonshrink Epoxy Grout specified in Section 2.2.5.2-~~

~~a. Grout shall show no shrinkage (0.0%) and a maximum 2.0% expansion from time of placement when tested according to ASTM C 827, modified to use a ball with a specific gravity between 0.9 and 1.1.~~

~~b. The grout shall show a minimum 7 day compressive strength of 16,000 psi when tested according to ASTM C 579.~~

~~c. The grout shall show a maximum coefficient of thermal expansion of 30×10^{-6} in/in/ F when tested according to ASTM C 531.~~

~~d. The grout shall show creep equal to or less than 5.0×10^{-3} in/in at 180 F for one year with a load of 400 psi when tested according to CPR Creep Test.~~

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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 and approved submittals. 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 below.

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. In freezing weather forms shall be treated with oil or stearate.

3.1.1.4 Clean forms of foreign material before placing concrete.

3.1.2 Core Drilling

3.1.2.1 Obtain scanning services to locate rebar and embedments, excluding inside surfaces of existing pits.

3.1.2.2 Precautions shall be taken for the containment of drilling lubricants/ Page 53
water as required.

- 3.1.2.3 Core drill locations shall be as specifically dimensioned on the Drawings. In the event that a dimension has been specified, and an embedment (rebar, conduit, etc) is detected during scanning, the Construction Engineer shall be contacted for resolution.
- 3.1.2.4 Verify that the kill switch device on the core drill is operational.
- 3.1.2.5 Approach surface "breakthrough" cautiously to minimize and control penetration of the drill.
- 3.1.2.6 Do not cut rebar embedment unless written permission from design engineer is obtained.
- 3.1.2.7 Sketch a grid of the rebar and/or embedment location on the outside surface of concrete.
- 3.1.2.8 Prepare a "Core Drilling Record" form KEH-1969 in accordance with the instructions, identifying the final hole locations and the rebar/grid or embedment.

3.2 INSTALLATION

3.2.1 Reinforcing Steel

- 3.2.1.1 Fabricate bars to dimensions shown on the Drawings, within tolerances shown in ACI 301, Section 5.6.
- 3.2.1.2 Tag in accordance with the bar list.
- 3.2.1.3 Place as shown on the Drawings, within tolerances specified in ACI 117, Section 2.2.
- 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 the concrete protection dimension given in ACI 301, Section 5.7, except where shown otherwise on the Drawings.
- 3.2.1.7 Reinforcement shall be supported and fastened together to prevent displacement by construction loads, or placement of concrete beyond specified tolerances. Reinforcement supported from the ground shall rest on precast, square concrete blocks, sized 100 mm (4 inches) minimum, having a compressive strength equal to the specified compressive strength of the concrete being placed. Other means of support require prior approval by the Construction Engineer.
- 3.2.1.8 *Overlap welded wire fabric wherever successive mats or rolls are continuous, in such a way that overlap measured between outermost cross wires of each fabric sheet is spacing of cross wires plus 50 mm (2 inches) minimum. Tie splices with wire.*

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3.2.2 Concrete

3.2.2.1 Before placing:

- a. Approve the "Pour Slip," including identification of sections of structure to be placed, maximum size of coarse aggregate, and design strength.

b. For each truck load, collect the "Trip Ticket." "Trip Tickets" shall contain information listed in ASTM C 94, Paragraphs 16.1.1 through 16.1.10, and the water/cement ratio.

- 3.2.2.2 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.
- 3.2.2.3 Temper only as permitted in ACI 301, Section 7.5.
- 3.2.2.4 Place nonshrink grout where shown on the Drawings, in accordance with manufacturer's recommendations.
- 3.2.2.5 Weather conditions: Protect concrete during placement in accordance with ACI 301, Sections 7.6 and 8.4. Cold weather concreting procedure shall be in accordance with ACI 306.1.
- 3.2.2.6 Construction joints: Make in accordance with ACI 301, Section 6.1, and as detailed on the Drawings. Coat joints with epoxy resin, where shown on the Drawings, in accordance with manufacturer's recommendations.
- 3.2.2.7 Embedded items: Install in accordance with ACI 301, Sections 6.4 and 6.5.
- 3.2.2.8 Expansion joints: Make in accordance with ACI 301, Section 6.2 and details on the Drawings.
- 3.2.2.9 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.
- 3.2.2.10 Consolidation: Consolidate concrete slabs in accordance with ACI 301, Section 11.6.
- 3.2.3 Form Removal and Concrete Repair
 - 3.2.3.1 Form removal: Remove in accordance with ACI 301, Section 4.5.
 - 3.2.3.2 Cut back form ties and examine concrete surfaces for defects. Repair only after permission for patching is given by the Construction Engineer.
 - 3.2.3.3 Place concrete repair mortar within 1 hour after mixing. Do not retemper mortar.
 - 3.2.3.4 Repair surface defects in accordance with ACI 301, Sections 9.1, 9.2 and 9.3. Cure concrete repairs the 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 the following ACI 301 sections.

- a. Surfaces exposed to earth backfill Section 10.2.1
- b. Interior surfaces Section 10.2.2
- c. Exterior surfaces exposed to weather Section 10.2.2
- d. Related unformed surfaces Section 10.5
- e. Surfaces to receive special protective coating Section 10.3.2

3.2.4.2 Unformed surfaces: Finish in accordance with the following ACI 301 sections.

- a. Interior floors Section 11.7.3
- b. Exterior equipment slabs Section 11.7.3
- c. Exterior slabs subject to foot traffic Section 11.7.4

3.3 CURING

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

3.3.2 Do not use curing compound on surfaces to receive sealer/hardener or special protective coating.

3.4 FIELD QUALITY CONTROL

3.4.1 Concrete Testing: Sample and test concrete in accordance with ACI 301, Sections 16.3.4, 16.3.5, 16.3.6 and 16.3.8. Record the results.

3.4.2 ~~Nonshrink Epoxy Grout Installation: The quality control inspector will inspect SC 1 epoxy grout installations in accordance with manufacturer's recommendations and paragraph 2.3.1.1 of this Section.~~ *Nonshrink Epoxy Grout: test epoxy grout in accordance with ASTM C-579, Method B. Testing is required for only one material formulation. Provide six test specimens for each material formulation. Record the results.* ECN-290

3.5 PROTECTION

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

3.5.2 Protect concrete from mechanical damage in accordance with ACI 301,
Section 12.4.

END OF SECTION

SECTION 03400

PRECAST CONCRETE

PART 1 - GENERAL

1.1 REFERENCES

- 1.1.1 The following documents, including others referenced therein, form part of this Section to the extent designated herein.
- 1.1.1.1 American Concrete Institute (ACI)
- | | |
|----------|--|
| 301-89 | Structural Concrete for Buildings |
| 306.1-90 | Cold Weather Concreting |
| 349-90 | Code Requirements for Nuclear Safety Related Concrete Structures |
- 1.1.1.2 American Society for Testing and Materials (ASTM)
- | | |
|-----------|---|
| A 36-91 | Structural Steel |
| A 53-90b | Pipe, Steel, Black & Hot-Dipped, Zinc-Coated Welded & Seamless |
| A 108-90a | Steel Bars, Carbon, Cold Finished, Standard Quality |
| A 307-92a | Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength |
| A 615-92b | Deformed and Plain Billet-Steel Bars for Concrete Reinforcement |
| C 94-92a | Ready-Mixed Concrete |
| C 156-93 | Test Method for Water Retention by Concrete Curing Materials |
- 1.1.1.3 American Welding Society (AWS)
- | | |
|---------|-------------------------------|
| D1.1-92 | Structural Welding Code-Steel |
|---------|-------------------------------|
- 1.1.1.4 Prestressed Concrete Institute (PCI)
- | | |
|------------|---|
| MNL-116-85 | Manual for Quality Control for Plants and Products of Precast and Prestressed Concrete Products |
|------------|---|
- 1.2 SUBMITTALS: Not Used

1.3 QUALITY ASSURANCE

1.3.1 Deliverable Documentation: The following documents and records, required by this Section, shall be delivered to Construction Document control in accordance with Section 01720.

<u>Document</u>	<u>Paragraph</u>
Pour Slip and Trip Tickets	3.2.3.1
Materials Test Results	3.4.1

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 See Section 01610 for general requirements

PART 2 - PRODUCTS

2.1 SUBSTITUTES

2.1.1 See Section 01630 for substitution approvals.

2.2 MATERIALS

2.2.1 Concrete: ACME preapproved mix design No. 6452.

2.2.2 Delivery: In accordance with ASTM C 94.

2.2.3 Reinforcing Steel

2.2.3.1 Steel bars: ASTM A 615, deformed, Grade 60, except No. 3 ties shall be Grade 40.

2.2.3.2 Fabricate reinforcing bars within tolerances listed in ACI 301, Sections 5.6 and 5.7, free of bends not required by the Drawings.

2.2.3.3 Tag steel in accordance with the bar list.

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

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

2.2.6 Round Mechanical Tubing: See Section 05500.

2.2.7 Fasteners

2.2.7.1 Weld Studs: Nelson Stud Welding Company, Type H4L.

2.2.7.2 Bolts: ASTM A 307, Grade B.

2.2.8 Forms: Wood, steel, plywood, or Masonite Corporation "Concrete Form Board," as required for various finishes specified in PCI MNL-116, Article 3.5.3.

2.2.9 Bondbreaker: Compatible with adhesive for resilient flooring.

PART 3 - EXECUTION

3.1 PREPARATION

3.1.1 Form Construction: Installation, surface preparation, true line setting, and reuse of forms shall be in accordance with PCI MNL-116, Article 5.1.2 and 5.1.3, or as directed by the Construction Engineer.

3.2 INSTALLATION

3.2.1 Reinforcing Steel

3.2.1.1 Place as shown on the Drawings, within tolerances specified in PCI MNL-116, Article 6.4.

3.2.1.2 Do not force reinforcing bars into concrete after initial set has started.

3.2.1.3 Minimum concrete protection for reinforcement shall be in accordance with ACI 349, Section 7.7.2, except where shown otherwise on the Drawings.

3.2.1.4 Additional reinforcement required for handling and erection shall be the responsibility of the Contractor and manufacturer.

3.2.2 Cast-In Items: Place within tolerances specified in PCI MNL-116, Article 5.1.5. Perform welding and welding inspection in accordance with AWS D1.1.

3.2.3 Concrete

3.2.3.1 Before Placing:

a. Approve the "Pour Slip," including identification of sections of structure to be placed, maximum size of coarse aggregate, and design strength.

b. For each truck load, collect the "Trip Ticket." "Trip Tickets" shall contain information listed in ASTM C 94, subparagraphs 16.1.1 through 16.1.10, and the water/cement ratio.

3.2.3.2 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 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, reinforcing, or embedded items.

- 3.2.3.3 Temper only as permitted in ACI 301, Section 7.5.
- 3.2.3.4 Weather conditions: Protect concrete during placement in accordance with ACI 301, Section 8.4. Cold weather concreting procedure shall be in accordance with ACI 306.1.
- 3.2.3.5 Consolidation: In accordance with ACI 301, Section 11.6.
- 3.2.4 Form Removal and Concrete Repair
 - 3.2.4.1 After form removal, cut back form ties and inspect surfaces for defects. Repair only after permission for patching is given by the Construction Engineer.
 - 3.2.4.2 Place concrete repair mortar within one hour after mixing. Do not retemper mortar.
 - 3.2.4.3 Repair surface defects in accordance with PCI MNL-116, Articles 3.5.4 and 3.5.5. Cure concrete repairs the same as new concrete.
- 3.2.5 Concrete Finishes and Tolerances
 - 3.2.5.1 Formed surfaces: Start finishing of concrete following repair and complete within 96 hours after forms have been removed. Finish formed surfaces in accordance with ACI 301, Section 10.3.2.
 - 3.2.5.2 Related unformed surfaces: Finish in accordance with ACI 301, Section 10.5.
- 3.3 CURING
 - 3.3.1 Cure concrete in accordance with ACI 301, Section 12.2. Where curing compound of surface membrane type is used, it shall retain at least 85% of water in concrete for 72 hours after placement as determined in accordance with ASTM C 156.
 - 3.3.2 Do not use curing compound on surfaces to receive sealer/hardener or special protective coating.
- 3.4 FIELD QUALITY CONTROL
 - 3.4.1 Concrete Testing: Sample and test concrete in accordance with ACI 301, Sections 16.3.4, 16.3.5, 16.3.6, and 16.3.8. Record the results.
 - 3.4.2 Cracking Acceptability: Kinds, causes of cracking, prevention and control, and recommendations for acceptability shall meet the requirements of PCI MNL-116, Article 6.3.2.

3.5 PROTECTION

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

3.5.2 Protect concrete from mechanical damage in accordance with ACI 301, Section 12.4.

END OF SECTION

SECTION 05055

EXPANSION ANCHOR INSTALLATIONS

PART 1 - GENERAL

1.1 REFERENCES: Not Used

1.2 SUBMITTALS

1.2.1 See Section 01300 for submittal procedures.

1.2.2 Approval Required

1.2.2.1 Expansion anchor evaluation reports: Before delivery, submit reports as specified in Part 2, and installation requirements.

1.2.3 Approval Not Required: None

1.3 QUALITY ASSURANCE

1.3.1 Deliverable Documentation: The following documents and records, required by this Section, shall be delivered to Construction Document Control in accordance with Section 01720.

Document

Paragraph

Expansion Anchor Installation Reports 3.4.2

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 See Section 01610 for general requirements.

PART 2 - PRODUCTS

2.1 SUBSTITUTES

2.1.1 See Section 01630 for substitution approvals.

2.2 MATERIALS

2.2.1 Expansion anchors (~~Safety Classes 1 and 2~~ Safety Class and Safety Significant): Hilti Fastening Systems "Kwik-Bolt II" (no substitutes allowed). ECN-807
ECN-807

2.2.2 Expansion anchors (~~Safety Classes 3 and 4~~ General Services): Industry standard wedge type, having a published evaluation report (by the International Conference of Building Officials), with anchor descriptions, tables of allowable tension and shear loads, and test findings. ECN-807

PART 3 - EXECUTION

3.1 EXAMINATION

- 3.1.1 Examine areas where expansion anchors are to be installed and notify the Construction Engineer in writing of conditions detrimental to proper and timely completion of work as specified in 3.3. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- 3.2.1 Prepare setting drawings, diagrams, templates, and instructions for installation of expansion anchors to be embedded in concrete or masonry construction.

3.3 INSTALLATION

- 3.3.1 Install expansion anchors in accordance with manufacturer's recommendations.

3.4 FIELD QUALITY CONTROL

- 3.4.1 Expansion Anchor Installations: The Quality Control Inspector will inspect Safety Class 1 and 2 installations.

- 3.4.2 Expansion Anchor Inspection: Document inspection results on the "Expansion Anchor Installation Report," Form KEH-1910.

END OF SECTION

SECTION 05500
METAL FABRICATIONS

PART 1 - GENERAL

1.1 REFERENCES

1.1.1 The following documents, including others referenced therein, form part of this Section to the extent designated herein.

1.1.1.1 American Society of Mechanical Engineers (ASME)

B&PVC	Boiler and Pressure Vessel Code
Section V	Nondestructive Examination
Section IX	Welding and Brazing Qualifications
B31.3-1993	Chemical Plant and Petroleum Refinery Piping

1.1.1.2 American Society for Nondestructive Testing (ASNT)

SNT-TC-1A	Recommended Practice
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1.1.1.3 American Society for Testing and Materials (ASTM)

A 36-91	Structural Steel
A 53-90b	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A 123-89a	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 307-92a	Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
A 519-94	Seamless Carbon and Alloy Steel Mechanical Tubing
A 563-92a	Carbon and Alloy Steel Nuts
A 786-93	Rolled Steel Floor Plates
F 844-90	Washers, Steel, Plain (Flat), Unhardened for General Use

1.1.1.4 American Welding Society (AWS)

D1.1-94	Structural Welding Code - Steel
D1.3-89	Structural Welding Code - Sheet Steel

D9.1-90

Sheet Metal Welding Code

QC1-88

Certification of Welding Inspectors

1.2 SUBMITTALS

1.2.1 See Section 01300 for submittal procedures.

1.2.2 Approval Required

1.2.2.1 Drawings: For metal fabrications not shown on manufacturer's data sheets: Before fabrication, submit fabrication drawings and bill of materials. Include plans, elevations, details, sections, and connections. Show thickness, type, grade, class of metal, fasteners, anchorage, and accessory items where applicable.

~~1.2.2.2 Manufacturer's data: Before delivery, submit the following.~~

~~a. Copies of manufacturer's specifications.~~

~~b. Dimensioned diagrams.~~

~~c. Installation instructions for manufactured items.~~

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1.2.3 Approval Not Required: None.

1.3 QUALITY ASSURANCE

1.3.1 Welding Processes - Structural Metal Work

1.3.1.1 Procedures for welding components shall have been qualified in accordance with the following.

a. For structural steel, in accordance with AWS D1.1.

b. For sheet steel (structural), in accordance with AWS D1.3.

c. For sheet metal (seal welding), in accordance with AWS D9.1.

1.3.1.2 Qualification in accordance with the ASME B&PVC Section IX may be substituted for the above requirements.

1.3.2 Welding Personnel - Structural Metal Work

1.3.2.1 Personnel performing welding shall have been qualified in accordance with the respective Codes of 1.3.1.1.

1.3.2.2 Qualification in accordance with the ASME B&PVC Section IX may be substituted for the above requirement.

1.3.3 Welding Nondestructive Examination (NDE) Personnel

1.3.3.1 Visual weld examinations shall be performed, and appropriate documentation prepared by Certified Welding Inspectors (CWI) who have

received certification in accordance with AWS QC1. Certified Associate Welding Inspectors (CAWI), certified in accordance with the above standard, may perform examinations when under immediate direction of CWIs.

- 1.3.3.2 Qualification in accordance with the ASME B&PVC Section V, Article 9 may be substituted for the above requirement.
- 1.3.3.3 Welding related examination documentation shall be signed or stamped by individuals performing examinations. Where CAWIs perform examinations, documentation shall be signed or stamped by both CAWIs and CWIs under whom examinations were performed.
- 1.3.3.4 Personnel performing other welding NDE shall be certified in accordance with the Contractor's written practice, which shall meet the requirements of ASNT SNT-TC-1A.
- 1.3.4 Deliverable Documentation: The following documents and records, required by this Section, shall be delivered to Construction Document Control in accordance with Section 01720.

<u>Document</u>	<u>Paragraph</u>
Process and Personnel Qualification	1.3.2, 1.3.3
Weld Examination Results	3.5.2.1, 3.5.2.2

1.4 DELIVERY, STORAGE, AND HANDLING

- 1.4.1 See Section 01610 for general requirements.

PART 2 - PRODUCTS

2.1 SUBSTITUTES

- 2.1.1 See Section 01630 for substitution approvals.

2.2 MATERIALS

- 2.2.1 Rolled Steel Shapes, Plates, and Bars: ASTM A 36.
- 2.2.2 Steel Pipe: See Section 03400.
- 2.2.3 Hand Rail: Zinc-coated ASTM A 53, Grade B, Schedule 40.
- 2.2.4 Round Mechanical Tubing: ASTM A 519, Carbon Steel.
- 2.2.5 Fasteners
 - 2.2.5.1 Bolts: ASTM A 307, Grade A or B.
 - 2.2.5.2 Nuts: ASTM A 563, Grade A, heavy hex.
 - 2.2.5.3 Washers: ASTM F 844, circular.

- 2.2.5.4 Expansion anchors: See Section 05055.
- 2.2.5.5 Weld studs: Nelson Stud Welding Company Type H4L.
- 2.2.6 Welding Electrodes: E70XX.
- 2.2.7 Nonshrink Grout: See Section 03300.
- 2.2.8 Paint: See Section 09900.
- 2.2.9 Zinc-Rich Coating: Southern Coating Incorporated "Galvicon," or ZRC Products Company "ZRC."
- 2.2.10 Floor Plate: Diamond tread.
 - 2.2.10.1 Steel: ASTM A 786, using ASTM A 36 material.
- 2.3 FABRICATION
 - 2.3.1 General
 - 2.3.1.1 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.
 - 2.3.1.2 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.
 - 2.3.1.3 Jointing and intersections: Accurately made, tightly fitted, and in true planes with adequate fastenings.
 - 2.3.1.4 Pipe handrails and posts: Fabricate using steel pipe in accordance with the Drawings.
 - 2.3.2 Miscellaneous Steel Items: Supply required clips, frames, equipment supports, and other fabrications 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.

- 2.3.3 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.
- 2.3.3.1 Galvanizing: Galvanize ferrous products shown on the Drawings in largest sections practicable after fabrication, by hot-dip process in accordance with ASTM A 123. Coating shall be at least 2.8 ounces of zinc for each ft² of surface.
- 2.3.3.2 Touch up damaged zinc surfaces with zinc-rich coating. Apply in accordance with the manufacturer's instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- 3.1.1 Examine areas where metal fabrications are to be installed and notify the construction Engineer in writing of conditions detrimental to proper and timely completion of work as specified in 3.3. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- 3.2.1 Prepare setting drawings, diagrams, templates, and instructions for installation of anchorages, such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors, to be embedded in concrete. Coordinate with the Construction Engineer for delivery of items to Site.

3.3 INSTALLATION

- 3.3.1 Expansion Anchor Installation: See Section 05055.
- 3.3.2 Install metal fabrications plumb, level or as shown on the Drawings.
- 3.3.3 Make field connections as neatly as possible with joints flush and smooth. Grind smooth exposed field welds and polish before field painting. Repair welds in galvanized work with 2 coats of zinc-rich coating.
- 3.3.4 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.

3.4 APPLICATION

- 3.4.1 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.

3.5 FIELD QUALITY CONTROL

- 3.5.1 Perform visual inspection to verify stud spacings and edge distances as specified and shown on Drawings.

- 3.5.2 Nondestructive Weld Examination (NDE)
- 3.5.2.1 Perform visual examination of welds in accordance with AWS D1.1, paragraph 6.5.5, unless noted otherwise on the Drawings. Record the results.
- 3.5.2.2 Visual weld examination performed in accordance with requirements of ASME B31.3, Paragraph 344.2.2 may be substituted for the above requirement. Acceptance criteria shall be in accordance with ASME B31.3, Table 341.3.2A. Record the results.

END OF SECTION

SECTION 07900

JOINT SEALERS

PART 1 - GENERAL

1.1 REFERENCES

1.1.1 The following documents, including others referenced therein, form part of this Section to the extent designated herein.

1.1.1.1 American Society for Testing and Materials (ASTM)

- | | |
|-----------------|---|
| D 994-71 (1982) | Preformed Expansion Joint Filler for Concrete (Bituminous Type) |
| D 1056-91 | Flexible Cellular Materials - Sponge or Expanded Rubber |

1.1.1.2 Federal Specifications (FS)

- | | |
|----------------------|---|
| TT-C-00598C
AMD 1 | Caulking Compound, Oil And Resin Base Type (For Building Construction) |
| TT-S-00227E
AMD 3 | Sealing Compound: Elastomeric Type, Multi-Component (For Caulking, Sealing And Glazing In Buildings And Other Structures) |
| TT-S-00230C
AMD 2 | Sealing Compound: Elastomeric Type, Single Component (For Caulking, Sealing, And Glazing In Buildings And Other Structures) |

1.2 SUBMITTALS

1.2.1 See Section 01300 for submittal procedures.

1.2.2 Approval Required

1.2.2.1 Manufacturer's application instructions: Before application, submit manufacturer's instructions for cleaning, priming, and applying sealants, adhesives, and caulking for each material and condition of application.

1.2.3 Approval Not Required: None

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 See Section 01610 for general requirements. Store materials indoors.

PART 2 - PRODUCTS

2.1 SUBSTITUTES

2.1.1 See Section 01630 for substitution approvals.

2.2 MATERIALS

2.2.1 General: Container labels shall show name of material, date of manufacture, mixing instructions, shelf life, and curing time.

2.2.2 Sealants

2.2.2.1 Type I, 2-component polysulfide: FS TT-S-00227, Type II, nonsag type.

2.2.2.2 Type II, 1-component polysulfide: FS TT-S-00230, Type II, nonsag type.

2.2.2.3 Type III, polyurethane: FS TT-S-00227, Type I, Class A, multi-component, self-leveling type.

2.2.2.4 Caulking Compound: FS TT-C-00598, oil-base type.

2.2.3 Primer: Nonstaining type, recommended by manufacturer of sealant or caulking compound for the intended application.

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

2.2.5 Expansion Joint Filler: ASTM D 994, or Watson Bowman & Acme Corporation "W" Series.

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

2.2.7 Gasket: ASTM D 1056; Williams Products Incorporated, Everlastic Closed Cell Neoprene Type NN-1 1040 series.

2.2.8 Adhesive: Williams Products Incorporated, No. 37A.

PART 3 - EXECUTION

3.1 PREPARATION

3.1.1 Clean joints and surfaces to be sealed, adhered, or calked, removing dirt, dust, oil, grease, mortar, and other foreign materials.

3.1.2 Remove loose particles with wire brush. Blow out joints with dry, oil free compressed air. Remove wax or oil using Inland Technologies "Citrasafe," or "Safety Prep."

3.1.3 Follow recommendations of manufacturer of sealing, adhesive and caulking materials for each condition of application. Prevent foreign materials from joint and surface cleaning to become intermixed with sealing, adhesive and caulking materials.

3.2 APPLICATION

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 Apply primer to concrete after concrete has cured 28 days minimum.

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 Apply 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 Apply adhesives and 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 Use polyurethane sealant in joints of concrete floors and walkways. For other sealant applications, use 1-component or 2-component polysulfide.

3.2.4.3 Apply Type I sealant to precast concrete joints.

3.2.4.4 Apply Type II sealant to sheet metal joints.

3.2.4.5 Apply sealant to clean and dry joints only.

3.2.4.6 Apply exterior sealing material when ambient temperature is 40 to 100°F.

3.2.4.7 Apply sealing materials with guns having proper size nozzles and sufficient pressure to fill spaces and voids solid. Where use of guns is impractical, hand tools approved by the Construction Engineer may be used.

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

3.2.4.9 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.

END OF SECTION

SECTION 09805

SPECIAL PROTECTIVE COATING

PART 1 - GENERAL

1.1 REFERENCES

1.1.1 The following documents, including others referenced therein, form part of this Section to the extent designated herein.

1.1.1.1 Steel Structures Painting Council (SSPC)

SP 2-82 Hand Tool Cleaning

SP 3-82 Power Tool Cleaning

1.2 SUBMITTALS

1.2.1 See Section 01300 for submittal procedures.

1.2.2 Approval Required

1.2.2.1 List of materials: Before delivery, submit complete list of materials, colors and location to be used, to substantiate compliance with the Drawings and this Section. List shall enumerate percentage of volatile and nonvolatile materials and percentage of component parts of each type of material. Colors will be selected by the Construction Engineer.

1.2.3 Approval Not Required: None

1.3 QUALITY ASSURANCE

1.3.1 Deliverable Documentation: The following documents and records, required by this Section, shall be delivered to Construction Document Control in accordance with Section 01720.

Document

Paragraph

Coating Application Test Results 3.4.1

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 See Section 01610 for general requirements.

1.4.2 Do not open containers before inspection and acceptance by the Quality Control Inspector. Labels shall not be removed under any circumstance.

1.5 PROJECT CONDITIONS

1.5.1 Environment for Coating: Coat exterior surfaces only when ambient and surface temperatures are 50 to 90°F, and ambient temperature is at least 5°F above the dewpoint.

PART 2 - PRODUCTS

2.1 SUBSTITUTES

2.1.1 See Section 01630 for substitution approvals.

2.2 MATERIALS

2.2.1 Coating Materials: Products of Protective Coatings Division of Ameron, Brea, California or approved substitute.

2.2.2 Concrete Filler: Nu-Klad 114A Epoxy Filler Compound.

2.2.3 Primers

2.2.3.1 New cover block concrete surfaces: Nu-Klad 105A Primer and Sealer or Amerlock 400.

2.2.3.2 New cover block/plug ferrous metal surfaces: Amerlock 400.

2.2.4 Finish Coatings

2.2.4.1 All new cover block/plug surfaces: PSX 700 Siloxane.

PART 3 - EXECUTION

3.1 EXAMINATION

3.1.1 Examine surfaces scheduled to receive coatings for conditions that will adversely affect execution, permanence, or quality of work, and which cannot be put into acceptable condition through preparatory work as specified in 3.2.

3.1.2 Report conditions that could adversely affect proper application of coatings, in writing, to the Construction Engineer as specified in 3.3. Do not begin surface preparation, or coating application, until defects have been corrected, and conditions made suitable.

3.2 PREPARATION

3.2.1 New Cover Block Concrete Surfaces

3.2.1.1 Before application, sweep and dust space or area to receive coating.

3.2.1.2 Clean concrete surfaces of laitance, oil, stains, dust and other foreign material.

a. Where laitance has not been removed, treat concrete with uniform application of 1 of following solutions.

- 1) 1 part 10% solution muriatic acid and 3 parts water.
- 2) 5% solution of trisodium phosphate.

b. When solution ceases to foam, rinse thoroughly with clean water and scrub with stiff bristle brush. Allow treated area to thoroughly dry. Scratches, cracks, holes and abrasions shall be cut back to proper key and filled with Nu-Klad 114A.

c. Allow concrete to cure 30 days before coating is applied, except coating may be applied after concrete has cured 21 days if moisture content of concrete is less than 12%.

3.2.2 New Cover Block/Plug Ferrous Metal Surfaces

3.2.2.1 Prepare surfaces for finish systems specified in accordance with recommendations of finish material manufacturers and SSPC-SP 2, -SP 3.

3.2.3 Postpriming

3.2.3.1 Feather abrasions, chips, skips, and holidays occurring in prime coat by sanding and recoat with material and color to minimum dry film thickness specified.

3.2.3.2 Previously coated surfaces shall be recoated only after existing film is completely dry.

3.2.3.3 Protect coating from rain until dry to touch.

3.2.4 Protection

3.2.4.1 Provide and install drop cloths, shields, and other protective devices required to protect surfaces adjacent to areas being coated. Keep spatter, smears, droppings, and over-run of coating materials to minimum and remove as coating work progresses. Report all spills to the Construction Engineer.

3.2.4.2 Remove and store electrical fixtures, outlets and switch plates, mechanical diffusers, escutcheons, 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.

3.3 APPLICATION

3.3.1 General

3.3.1.1 Before any surface is coated, it shall be clean, dry, undamaged and free of all contaminants. Round off all rough welds and remove all weld spatter.

3.3.1.2 All specified surface preparation shall meet the specification of the Coating Schedule and shall be done before application can begin on the area to be coated.

3.3.1.3 All coatings shall be applied under favorable environmental conditions as specified in manufacturer's product literature.

- 3.3.1.4 Coating shall be prepared and applied in accordance with manufacturer's recommendations, and proper induction time shall be observed for epoxies when required by manufacturer. Failure to comply with this requirement will be cause for rejection of the work.
- 3.3.2 Apply with equipment recommended by manufacturer.
- 3.3.3 Identify each coat of opaque material by its relation to color of finish coat. Prime coat shall be darkest tint of specified color with each succeeding coat lighter, up to finish coat, which shall be color, tint and sheen specified. Tints of identical coats of identical color and material shall not vary.

3.4 FIELD QUALITY CONTROL

- 3.4.1 Inspection: The Quality Control Inspector will perform tests to ascertain that coating materials have been applied as specified in this Section.

3.5 CLEANING

- 3.5.1 Furnish and maintain at site, closed metal containers for disposal of waste materials. Place materials spotted or soaked with paint, oil, or solvents in containers.
- 3.5.2 Brushes, rollers, spatulas, and spray equipment shall be thoroughly cleaned after each use and shall contain no oils, thinners, or other residue after cleaning.
- 3.5.3 Remove empty cans from site at end of each shift.

- 3.5.4 At completion of coating work, remove materials, containers, rags, cloths, brushes, and other equipment from site. Clean up spills.

3.6 COATING SCHEDULE

Minimum Wet Film Thickness and Percentage of Film Forming Solids by Volume	Minimum Dry Film Thickness
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3.6.1 New Cover Block Concrete Surfaces

Prime and Sealer:	Nu-Klad 105A or Amerlock 400	NA	NA
Second:	PSX 700 Siloxane	7	5 mils
Finish:	PSX 700 Siloxane	7	5 mils

3.6.2 New Cover Block Ferrous Metal Surfaces and Lifting Bails

Prime:	Amerlock 400	NA	NA
Second:	PSX 700 Siloxane	7	5 mils
Finish:	PSX 700 Siloxane	7	5 mils

END OF SECTION

SECTION 09900

PAINTING

PART 1 - GENERAL

1.1 REFERENCES

1.1.1 The following documents, including others referenced therein, form part of this Section to the extent designated herein.

1.1.1.1 American Society for Testing and Materials (ASTM)

D 4258-1983 (R1988) Surface Cleaning Concrete for Coating

1.1.1.2 Federal Specifications (FS)

SS-S-1996 Sealer, Water and Weather Resistant,
Reinst for Asphalt, Concrete, and Masonry
Surfaces

1.1.1.3 Painting and Decorating Contractors of America (PDCA)

Architectural Specification 1984
Manual

1.1.1.4 Steel Structures Painting Council (SSPC)

SP 2-82 Hand Tool Cleaning

SP 3-82 Power Tool Cleaning

1.2 SUBMITTALS

1.2.1 See Section 01300 for submittal procedures.

1.2.2 Approval Required

1.2.2.1 ~~List of materials: Before delivery, submit list including manufacturers' names, specifications, recommendations, and other data necessary to show compliance with requirements. List of materials: Before delivery, submit complete list of materials, colors and location to be used, to substantiate compliance with the Drawings and this Section. List shall enumerate percentage of volatile and nonvolatile materials and percentage of component parts of each type of material. Colors will be selected by the Construction Engineer.~~

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1.2.2.2 Color samples: Before delivery, submit samples in form of 3 by 5-inch color chips. Describe coating material, manufacturer, and color identification on reverse face of each chip. Colors will be selected by the Construction Engineer. Retain 1 set of approved samples at site for use as quality standard of final finishes.

1.2.3 Approval Not Required: None

1.3 QUALITY ASSURANCE

1.3.1 Deliverable Documentation: The following documents and records, required by this Section, shall be delivered to Construction Document Control in accordance with Section 01720.

<u>Document</u>	<u>Paragraph</u>
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Coating Application Test Results	3.4.1
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1.3.2 Use manufacturers and products listed in the PDCA Architectural Specification Manual, Chapter 7.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 See Section 01610 for general requirements. Store materials indoors.

1.5 PROJECT CONDITIONS

1.5.1 Environmental Requirements

1.5.1.1 Temperature: Unless otherwise recommended by the coating manufacturer, apply coatings when ambient and surface temperatures are 45 to 95°F.

a. Apply epoxy coatings when conditions are within humidity and temperature limits recommended by the coating manufacturer.

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

1.5.1.2 Weather: Do no exterior work on unprotected surfaces if it is raining or moisture from other source is present or expected before applied finishes can dry or attain proper cure without damage.

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

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

c. Humidity: Follow manufacturer's directions for extremes.

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

1.5.1.4 Illumination: Provide temporary lighting to attain minimum surface lighting level of 15 fc/ft².

PART 2 - PRODUCTS

2.1 SUBSTITUTES

2.1.1 See Section 01630 for substitution approvals.

2.2 MATERIALS

- 2.2.1 Furnish materials identified in PDCA Architectural Specification Manual, Chapters 5, 6, and 7 for systems scheduled in 3.6.
- 2.2.2 Furnish ready-mixed materials.
- 2.2.3 Concrete Sealer/Hardener
- 2.2.3.1 New concrete construction, excluding cover blocks: FS SS-S-1996, Type II (Top Surface).
- 2.2.4 New Cover Block Surfaces: See Section 09805.

PART 3 - EXECUTION

3.1 EXAMINATION

- 3.1.1 Examine surfaces scheduled to receive finish for conditions that will adversely affect execution, permanence, or quality of work and which cannot be put into acceptable condition through preparatory work specified in 3.2.
- 3.1.2 Report conditions that may affect proper application of finish as specified in 3.3, in writing, to the Construction Engineer. Do not begin surface preparation or coating application until defects have been corrected, and conditions are made suitable.

3.2 PREPARATION

3.2.1 Protection

- 3.2.1.1 Protect finished work of other trades and the following.
 - a. Brass, bronze, copper, plated metals, and stainless steel not scheduled for further finish.
 - b. Materials having complete factory finish, such as electrical switchplates, lighting fixtures, and finish hardware.
- 3.2.1.2 As work proceeds, and upon completion of work, promptly remove spills, splashes, or splatters from products by methods not damaging to affected surfaces.
- 3.2.1.3 Repair or replace surfaces damaged by painting work as directed by the Construction Engineer.
- 3.2.1.4 Remove electrical outlet and switch plates, mechanical diffusers, escutcheons, registers, surface hardware, fittings, fastenings, and similar items before starting work. Carefully store, clean, and reinstall items upon completion of work in each area. Do not use cleaning agents detrimental to permanent lacquer finishes.

3.2.2 Ferrous Metals

- 3.2.2.1 Prepare surfaces for finish systems specified in accordance with recommendations of finish material manufacturers, the PDCA Architectural Specification Manual, Chapters 3 and 3R, and SSPC-SP 2, -SP 3.
- 3.2.2.2 Obtain written approval for dry or liquid abrasive blasting from the Construction Engineer.

3.2.3 Concrete Surfaces

- 3.2.3.1 Curing period: Concrete shall be allowed to cure 28 days minimum before the application of a concrete sealer/hardener, or as recommended by the manufacturer of the concrete sealer/hardener.
- 3.2.3.2 Form release agents: Agents used during concrete construction shall be removed, unless known to be compatible with the concrete sealer/hardener selected.
- 3.2.3.3 Concrete curing compounds: Compounds shall be removed unless known to be compatible with the concrete sealer/hardener selected.
- 3.2.3.4 Contaminants: Oil, grease, and materials considered deleterious by the concrete sealer/hardener manufacturer shall be removed in accordance with the manufacturer's written recommendations, followed by washing of contaminated areas with detergent and water in accordance with ASTM D 4258.
- 3.2.3.5 Sweeping and hosing: Clean areas to be treated with a fine bristle broom, or scrub, hose off with water, and let dry to remove surface dust, dirt, and contamination. Pressurized air may be used provided the equipment is oil-free.

3.3 APPLICATION

- 3.3.1 Do not open containers until approved by the Quality Control Inspector. Labels must not be removed under any circumstances.
- 3.3.2 Mix materials in an ambient temperature above 45°F in a well ventilated and heated area, in accordance with the manufacturer's recommendations.
- 3.3.3 Perform work in accordance with manufacturers instructions, PDCA Architectural Specification Manual, and this Section.
- 3.3.4 Take precordance with tent fire hazards and spontaneous combustion. Place cotton waste, cloths, and hazardous materials in containers and remove from the worksite daily.
- 3.3.5 Improperly treated surfaces, and holidays shall be repaired using the materials specified for the original work, unless otherwise specified, in accordance with written recommendations of the sealer/hardener manufacturer.

3.4 FIELD QUALITY CONTROL

- 3.4.1 Inspection and testing will be performed by the Quality Control Inspector. Document results of tests.
- 3.4.2 Meet the requirements of PDCA Architectural Manual for "CUSTOM" material and work, unless otherwise specified.

3.5 CLEANING

- 3.5.1 Furnish and maintain at site, closed metal containers for disposal of waste materials. Place materials spotted or soaked with paint, oil, or solvents in containers.
- 3.5.2 Brushes, rollers, spatulas, and spray equipment shall be thoroughly cleaned after each use and shall contain no oils, thinners, or other residue after cleaning.
- 3.5.3 Remove empty cans from site at end of each shift.
- 3.5.4 At completion of coating work, remove materials, containers, rags, cloths, brushes, and other equipment from site. Clean up spills.

3.6 SCHEDULES

3.6.1 Paint and Finish

- 3.6.1.1 Paint exposed miscellaneous ferrous metal surfaces, unless otherwise specified, as follows:

a. ~~Apply two coats of Amerlock 400, 5 mils thick per coat (DFT), in accordance with the manufacturer's instructions.~~ Apply one prime coat of Ameron "Amerlock 400" 5 mil thick (DFT), in accordance with manufacturer's instructions.

b. ~~Apply one finish coat of Amercoat 450 HS, 2 to 3 mils thick (DFT), in accordance with the manufacturer's instructions.~~ Apply one finish coat of Ameron "PSX 700", 3 mil thick (DFT), in accordance with manufacturer's instructions.

- c. Do not paint threaded surfaces before assembly.
- d. Do not paint nameplates.

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END OF SECTION

SECTION 13121

METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 REFERENCES

- 1.1.1 The following documents, including others referenced therein, form part of this Section to the extent designated herein.
- 1.1.1.1 American Institute of Steel Construction, Inc (AISC)
ASD Allowable Stress Design (Manual of Steel Construction) 9th Edition
- 1.1.1.2 American Iron and Steel Institute (AISI)
Design of Cold-Formed Steel Structural Members 1986 Edition
- 1.1.1.3 American Society of Civil Engineers (ASCE)
7-93 Minimum Design Loads for Buildings and Other Structures
- 1.1.1.4 American Society for Testing and Materials (ASTM)
- A 446-91 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
- A 525-91b Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
- C 665-91 Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
- E 90-90 Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
- E 283-84 Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors
- E 331-86 Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
- E 413-87 Classification for Rating Sound Insulation

- 1.1.1.5 American Welding Society (AWS)
 - D1.1-94 Structural Welding Code-Steel
 - D1.3-89 Structural Welding Code-Sheet Steel
 - D9.1-90 Sheet Metal Welding Code
- 1.1.1.6 Builders Hardware Manufacturers Association (BHMA)
 - A156.1-1988 Butts and Hinges
 - A156.2-1989 Bored and Preassembled Locks and Latches
 - A156.4-1986 Door Controls--Closers
 - A156.6-1986 Architectural Door Trim
 - A156.18-1987 Materials and Finishes
- 1.1.1.7 International Conference of Building Officials (ICBO)
 - UBC Uniform Building Code (1991)
- 1.1.1.8 Metal Building Manufacturers Association (MBMA)
 - Low Rise Building Systems Manual 1986 Edition
- 1.1.1.9 Underwriters Laboratories (UL)
 - Building Materials Directory 1993
- 1.2 SUBMITTALS
 - 1.2.1 See Section 01300 for submittal procedures.
 - 1.2.2 Approval Required
 - 1.2.2.1 Erection instructions and diagrams: Before delivery, submit documentation necessary to erect building and install components. Documentation shall include the following.
 - a. Anchor bolt layouts and sizes.
 - b. Structural connections.
 - c. Roofing and siding connections.
 - d. Joint sealing and caulking.
 - e. Door frame installation.

- f. Wall penetration frame installation.
 - g. Flashings.
 - h. Accessory installation.
 - i. Details and instructions necessary for assembly.
 - j. Fabrication drawings necessary to supplement instructions and diagrams.
 - k. Separate hardware list for each door.
- 1.2.2.2 Samples: Before delivery, submit color samples from the manufacturer's standard selection.
- 1.2.3 Approval Not Required
- 1.2.3.1 Certificate of compliance: With delivery, submit a certificate from manufacturer attesting that materials meet requirements of this Section and referenced documents.
- 1.3 SYSTEM DESCRIPTION
- 1.3.1 Metal Building: Single span structure, rigid frame, beam and column type.
- 1.3.1.1 Primary framing: Rigid frame of rafter beams and columns, braced end frames, end wall columns and wind bracing.
- 1.3.1.2 Secondary framing: Purlins, girts, eave struts, flange bracing, sill supports, clips and other items required for complete installation.
- 1.3.1.3 Wall and roof system: Preformed metal panels of vertical profile, insulation, liner sheets, and accessory components.
- 1.3.2 Design Criteria: Building and component design shall be in accordance with applicable sections of AISC ASD, AISI Design Specification, the MBMA Manual, and the ICBO UBC.
- 1.3.2.1 Basic design shall include live, dead, snow, wind, and seismic loads. Other design loads, either static or dynamic, shall be considered auxiliary loads.
- 1.3.2.2 Vertical live and snow loads:
- a. Design roof covering for either a 50 lb/ft² uniformly distributed load, or 200 pound concentrated live load over a 1 by 1 foot area located at the center of maximum roof panel span, whichever produces greater stress.
 - b. Design primary framing and purlins for 20 lb/ft² snow or live load uniformly distributed over supported roof area.

- 1.3.2.3 Wind loads: Design in accordance with ASCE 7-93, Section 6, using following criteria.
 - a. Basic wind speed: 70 mi/h.
 - b. Importance factor: $I=1.07$ (for 100 year recurrence level).
 - c. Exposure category: C.
- 1.3.2.4 Seismic loads: Based on seismic accelerations of the ICBO UBC, Section 2312, for Seismic Zone 2B.
- 1.3.2.5 Auxiliary loads: Design roof framing for an auxiliary load of 10 lb/ft² to accommodate loads imposed on the building from piping, lighting fixtures, heating units, and equipment, including the automatic fire sprinkler system.
- 1.3.2.6 Maximum deflection in roofing or roof panels shall not exceed 1/180th of spans, and maximum deflection in siding or wall panels shall not exceed 1/90th of spans.
- 1.3.2.7 Provide drainage to exterior for water entering or condensation occurring within cladding system.
- 1.3.2.8 Thermal resistance:
 - a. Wall system: R value of 11.
 - b. Roof system: R value of 19.
- 1.3.2.9 Welding and Inspection: Perform to the following requirements.
 - a. Structural steel connections in accordance with AWS D1.1.
 - b. Structural sheet steel in accordance with AWS D1.3.
 - c. Sheet metal (seal welding) in accordance with AWS D9.1.
- 1.4 DELIVERY, STORAGE, AND HANDLING
 - 1.4.1 See Section 01610 for general requirements.
 - 1.4.2 Damaged or defaced components may be repaired, if repairs are acceptable to the Construction Engineer.
 - 1.4.3 Store hardware items separately with fasteners and instructions, for individual use.
- 1.5 WARRANTY
 - 1.5.1 Buildings shall be warranted against water leaks, caused by normal atmospheric exposure, for a period of 5 years.

1.5.2 Warranty shall start upon final acceptance of Work, or the date the Operating Contractor takes possession, whichever is earlier.

PART 2 - PRODUCTS

2.1 SUBSTITUTES

2.1.1 See Section 01630 for substitution approvals.

2.2 MANUFACTURED UNITS

2.2.1 Wall, Roof, and Soffit Systems

2.2.1.1 Sheet steel stock: ASTM A 446, galvanized to ASTM A 525 G 90. Factory color finished.

2.2.1.2 Wall system: 0.0217-inch (26-gage), exposed fastening panels.

2.2.1.3 Roof system: 0.0276-inch (24-gage), concealed fastening, standing seam configuration.

2.2.2 Insulation and Vapor Barriers

2.2.2.1 Blanket and batt insulation: ASTM C 665. Insulation containing asbestos is not acceptable. Insulation shall be listed in the UL Building Materials Directory, and have a "flame spread" of 25 maximum, and "smoke developed" of 50 maximum.

a. Wall insulation: Type II batts, with minimum thermal resistance of R-11, faced with aluminum foil vapor barrier covering on 1 side. Insulation shall be capable of fitting into available space without compressing more than 10% in thickness.

b. Roof insulation: Type II batts, with minimum thermal resistance of R-19, faced with aluminum foil vapor barrier covering on 1 side.

2.2.2.2 Vapor barrier for unfaced batt insulation: Polyethylene sheets, 4 mils thick. Vapor barrier shall be listed in the UL Building Materials Directory, and have a "flame spread" of 25 maximum, and "smoke developed" of 50 maximum.

2.2.3 Wall Liner

2.2.3.1 Minimum thickness: 0.0217-inch (26-gage) flush panels, maximum 1 inch profile, zinc-coated (galvanized) to ASTM A 525 G90 with factory precoated finish.

2.2.3.2 Liner shall extend from floor to ceiling including ceiling. Provide matching metal trim at base of wall liner, top of wall liner, around openings in walls and roof and over interior and exterior corners.

2.2.4 Sealant: Manufacturer's standard elastomeric, nonstaining type.

- 2.2.5 Fasteners: Manufacturer's standard type, finished to match adjacent surface when exterior exposed.
- 2.2.6 Accessories: Flashing, trim, caps, and similar metal accessories shall be of same thickness, material and finish used for adjacent wall or roof coverings.
- 2.2.7 Closure Strips: Formed of compressed rubber, synthetic rubber, bituminous impregnated materials, or metal of same respective type as roof and wall panels, and standard with manufacturer. Molded closure strips shall be free of open voids and shall not absorb or retain water. Closure strips shall be formed to match corrugations or configurations of roofing or siding being used and provided, where shown and necessary, for weathertight construction.
- 2.2.8 Doors, Frames, and Hardware
 - 2.2.8.1 Doors: Minimum thickness; 1-3/4 inches thick, constructed of 0.0396-inch (20-gage) hot dipped galvanized steel, economy type, meeting STC 34 as tested according to ASTM E 90 and E 413. Air infiltration shall meet ASTM E 283. Water infiltration shall meet ASTM E 331.
 - 2.2.8.2 Door leaf: Full flush (plain).
 - 2.2.8.3 Door frame: 0.0516-inch (18-gage) galvanized steel. Door frame shall consist of door posts, door jamb, door header, header reinforcement, sill plate, clips and extensions as required. Door frame shall be knock down type with upper ends of members butted to provide square and solid joints for threaded fastener attachments.
 - 2.2.8.4 Door jambs: 5-3/4 inches deep with unequal rabbets (1-15/16 inch, 1-9/16 inch). Face width shall be 2 inches with double return. Jambs shall be retained at floor line by a sill plate with slips welded at each end. Jambs shall have brackets welded at fixed locations for attachment of door posts.
 - 2.2.8.5 Door and frame finish: Manufacturer's standard.
 - 2.2.8.6 Threshold and weatherstripping: Threshold shall be BHMA A156.6 aluminum extrusion with mill finish drilled and countersunk for attachment to floor and shall have notched ends to fit the door jamb rabbets; Pemko. Weatherstripping shall be a concealed door sweep of EPDM material. Perimeter weatherstripping shall be an adhesive backed press-on flexible black TPE material, factory installed on the frame, astragal or mullion.
 - 2.2.8.7 Door hardware: Closer shall conform to BHMA A156.4, Type C02063; Corbin or an approved substitute. Closer reinforcement shall be 0.1084-inch (12-gage) galvanized steel, field installed in door header. Hinges shall be BHMA A156.1, two 1-1/2 pair of 4-1/2 by 4-1/2 inch steel hinges, full mortise 0.134-inch thick, plain bearing action, with nonremovable button-tip pin; Stanley or an approved substitute. Hinges shall be primed and painted in accordance with the manufacturer's standard.

- 2.2.8.8 Lock set: BHMA A156.2, Series ~~1000~~ 2000 or 4000, Grade 1. Lock set function shall be latch bolt retracted by key in the outside knob only. Corbin or an approved substitute.
- 2.2.8.9 Lock cylinders: Furnish 5-pin tumbler cylinders with Corbin 67 keyway, and 2 keys for each lock set. Key locks to match existing master-key system as directed by the Construction Engineer.
- 2.2.8.10 Fasteners: Furnish necessary screws, bolts, or other fasteners of suitable size and type to anchor hardware in position. Match hardware finish. Furnish with expansion shields, toggle bolts, or other appropriate anchors.
- 2.2.8.11 Hardware finish: BHMA A156.18, 26D dull chrome finish, unless otherwise noted.
- 2.2.9 Ventilator (Louver): End wall, ventilator/louver openings to be provided complete with framing and weather flashing in preparation for the installation of the end wall ventilators by others. Construction of the framed openings shall be in accordance with the manufacturer's standard details. The location of openings and all other requirements shall be in accordance with the Project drawings.
- 2.2.10 Nonshrink Grout: See Section 03300.
- 2.2.11 Finish: Precoated enamel on steel with color selected from manufacturer's standards by the Construction Engineer. Provide 1 quart of each color used to the Operating Contractor along with recommended application instructions.

PART 3 - EXECUTION

3.1 INSTALLATION

- 3.1.1 Erect under favorable environmental conditions and in accordance with manufacturer's approved erection instructions and diagrams.
- 3.1.2 Set structural elements on nonshrink grout.
- 3.1.3 Insulate dissimilar materials, not compatible when in contact, from each other by gaskets or insulating compounds.
- 3.1.4 Wall and Roof Systems
 - 3.1.4.1 Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.
 - 3.1.4.2 Fasten cladding system to structural supports, aligned level and plumb.
 - 3.1.4.3 Use concealed fasteners for roof system and exposed fasteners for wall system.
 - 3.1.4.4 Apply sealant or gasket materials to prevent weather penetration, and to protect against rodent penetration.

- 3.1.4.5 Installed systems shall be free of rattles, noise due to thermal movement, and wind whistles.
- 3.1.5 Attach louvers and ventilators to supporting construction to assure rain-tight installation in accordance with the manufacturer's instructions and the Drawings.
- 3.1.6 Anchor doors and windows, including frames and hardware, to supporting construction, install plumb and true, and adjust to provide proper operation.
- 3.1.7 Insulation: Except as otherwise shown on the Drawings or approved, install insulation against covering and between supporting members to present neat appearance. Lap and fasten blanket insulation facing to provide tight joints.
- 3.1.8 Fasten wall liner into place to present neat appearance.
- 3.1.9 Field Painting
 - 3.1.9.1 Upon detection, wire brush and touch-up abraded or corroded spots on shop-painted surfaces with the same material used for the shop coat.
 - 3.1.9.2 Paint exposed, shop primed ferrous surfaces on building exterior, shop primed door and window surfaces and interior surfaces of wall lines as specified in Section 09900.
 - 3.1.9.3 Touch-up factory color finished surfaces, with manufacturer's recommended touch-up paint, as necessary.
- 3.2 FIELD QUALITY CONTROL
 - 3.2.1 Inspect the final installation for compliance with this Section and approved submittals. Inspection shall include verification of materials and configuration in accordance with approved submittals. Verify that fasteners have been installed and tightened in accordance with the manufacturer's recommendations.

END OF SECTION

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 See Section 01610 for general requirements.

1.4.2 Uncoil and cut tubing only in lengths needed; do not re-coil tubing.
Cap or cover the ends of cut lengths.

PART 2 - PRODUCTS

2.1 SUBSTITUTES

2.1.1 See Section 01630 for substitution approvals.

2.2 MATERIALS

2.2.1 Tubing, Valves, and Fittings: See the Pipe Codes in this section, and details on the Drawings.

2.2.2 Antiseize Lubricant for Male Pipe Threads: Loctite Company No. 59290 pipe sealant, with teflon, or an approved substitute, on pipe and fittings.

2.2.3 Wiring and other materials required to complete instrumentation installation are specified in Section 16400 and on the Drawings, and shall be in accordance with NFPA 70.

2.2.4 Instrument Identification Tags: 3/4 by 2 by 0.0478-inch (18-gage) minimum thickness stainless steel, with 1/4-inch stamped or engraved characters.

2.2.4.1 ~~Tags shall show the following:~~ Field tags, as a minimum, shall show Equipment Part Number.

~~Equipment Part Number
Instrument Range
Purchase Order Number
Project Number (W-320)~~

ECN-458

ECN-458

2.2.4.2 Tag Attachment Wire: 20-gage, solid, stainless steel.

2.2.5 Equipment/Instrument Nameplates: Laminated plastic 1/16 inch thick, white surface and black core as shown on Figure 1.

ECN-458

2.3 EQUIPMENT

2.3.1 Provide instruments consisting of individual instrument devices as specified in the Data Sheets.

2.3.2 Instrument Enclosures: Provide Enclosures IE-1361 and IE-1362 and accessories as shown on the Drawings.

2.3.3 Instrument Cabinets: Provide Cabinets CP-01 and CP-02 and accessories as shown on the Drawings.

2.3.4 Control Cabinet: Provide Control Cabinet CB-01 and accessories as shown on the Drawings.

2.4 FABRICATION

- 2.4.1 Fabricate 7 leak detection assemblies and 2 level detection assemblies as shown on the Drawings.
- 2.4.2 Fabricate and assemble Instrument Racks IR-1362 and IR-1363, as shown on the Drawings, for installation in the Service Building 241-C-73. Paint as specified in Section 09900.
- 2.4.3 Fabricate and assemble a flow regulating station, as shown on the Drawings, for installation at the exhaust hatchway above Tank C-106. Paint as specified in Section 09900.
- 2.4.4 Fabricate and assemble Instrument Enclosures IE-1361 and IE-1362 as shown on Drawings for installation into the Process Building 241-C-91 and the Electrical Equipment Skid 241-C-51. Fabricate and assemble Instrument Cabinets CP-01 and CP-02, and Control Cabinet CB-01 as shown on the Drawings for installation into Construction Trailer MO-211. Cut holes in blank panels for instruments as shown on the Drawings, and in accordance with the instrument manufacturer's mounting requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- 3.1.1 Install material and equipment in accordance with the Drawings and manufacturer's instructions. Attach identification tags to instruments with the specified wire.
- 3.1.2 Install assembled Instrument Racks IR-1362 and IR-1363 in the Service Building 241-C-91 as shown on the Drawings. Mount and wire instruments on the rack.
 - 3.1.2.1 Install Instrument Enclosures IE-1361, IE-1362, Instrument Cabinets CP-01 and CP-02, and Control Cabinet CB-01 as shown on the Drawings. Install and wire instruments and terminal blocks.
- 3.1.3 Cut tubing with tube cutter and clean burrs and metal chips from ends. Blow clean with dry, oil-free air or nitrogen and re-cap or re-cover ends, if not installed immediately. Use open-end or tubing wrenches; do not use adjustable wrenches. Ensure that thread sealant does not intrude into tubing or fitting internals.
- 3.1.4 Bend tubing to radii as great or greater than minimum radii recommended by the manufacturer. Use methods and equipment which produce bends free of wrinkles, bulges, kinks, or flat spots.
- 3.1.5 Install exposed tubing on straight parallel runs laid flat against supports. Space supports 3 feet on centers. Gang tubes vertically wherever possible or support with tray. Stagger fittings on ganged runs as needed to prevent congestion.
- 3.1.6 Support tubing bundles as unit to prevent separation of tubes from bundles.

- 3.1.7 Slope tubing runs 1/4 in/ft downward toward the process connection.
- 3.1.8 Provide expansion loops or slack as needed to prevent damage from expansion or contraction on tubing runs. Expansion loops shall retain the 1/4 in/ft slope.
- 3.1.9 Recommended shop equipment for filling the pressure measuring system is shown on Figure 2. Remove the plug from the ball valve and install shop equipment. With the valve opened, and the 3-way ball positioned to allow evacuation, use the vacuum pump to evacuate air from the pressure measurement system cavity. When the vacuum gage reads between 25 and 30 inHg (mercury), position the 3-way ball to allow silicon oil (Dow-Corning DC-200, 100 CST, or an approved substitute) to be drawn into the system cavity (approximately 30 ml). After filling, close the valve, remove shop equipment, and reinstall the plug.
- 3.1.10 Flushing
 - 3.1.10.1 Flush instrument air lines with clean, dry, oil-free air or nitrogen before connecting to instruments. Test discharged air for cleanliness by blowing through clean white cloth over end of tube until cloth shows no visible trace of dirt, oil, or moisture.
 - 3.1.10.2 Provide documented evidence that flushing has been accomplished in accordance with this Section. Deliver to Quality Control Inspector before testing.
- 3.1.11 Wiring
 - 3.1.11.1 ~~Electrical power wiring and signal wiring shall be in accordance with the National Electrical Code, NFPA 70, Section 16400 of this Specification, and the Drawings. Electrical power wiring, control wiring and signal wiring shall be in accordance with the National Electric Code, NFPA 70 and the Drawings.~~ ECN-601
 - 3.1.11.2 Instrument signal wiring shall be as specified but shall not be smaller than No. 16 AWG stranded tinned copper wire shielded and twisted unless otherwise recommended by the instrument manufacturer. Control wiring shall be Type SIS or THHN and shall not be smaller than 14 AWG. ECN-601
 - 3.1.11.3 Instruments requiring 120 V ac electrical input power shall be wired with a 3/C No. 16 AWG Type SO or SJO cable, length as required, and shall not be longer than 36 inches with a male instrument power plug NEMA L5-15P. Cable grip clamps shall be provided at both ends of the cable. Duplex receptacle(s) (with isolated ground) NEMA L5-15R mounted in a single gang box with cover plate unless noted otherwise on Drawings shall be located as close to the instruments requiring power as required.
 - 3.1.11.4 Instrument and electrical equipment shall be grounded in accordance with the National Electrical Code, NFPA 70, and as shown on the Drawings.
 - 3.1.11.5 Instrument signal wiring routing in parallel with ac power, or control wiring shall have 6 inches minimum separation. Instrument signal wiring crossing power wiring shall be as close to right angles as possible.

3.1.11.6 Wiring within instrument panel shall be run in plastic or metallic wiring duct or conduit. Where the use of wiring duct or conduit is not

practical, wires shall be run open, bundled, and bound with cable ties at regular intervals not exceeding 12 inches. Wires within bundles shall be run parallel to one another. Bundles shall have a uniform appearance, a circular cross section, and be securely fastened to the cabinet framework.

- 3.1.11.7 Wires shall be identified as shown on the Drawings, at each end with imprinted tubular plastic wire markers as specified in Section 16400.
- 3.1.12 Nameplates
 - 3.1.12.1 Engrave and fill Annunciator windows as shown on the Drawings.
 - 3.1.12.2 Engrave nameplates with the information shown on the Drawings and in accordance with Figure 1.
 - 3.1.12.3 Attach nameplates to equipment and panels as shown on the Drawings and in accordance with Figure 1.
- 3.2 FIELD QUALITY CONTROL
 - 3.2.1 Testing: Use test instruments which bear valid calibration stamps showing dates of calibration and expiration dates of stamps. Calibration and accuracy of instruments shall be certified by an independent testing laboratory having standards traceable to the National Institute of Standards and Technology.
 - 3.2.2 Pneumatic Tests
 - 3.2.2.1 Valve out all instruments at the valve manifold.
 - 3.2.2.2 Coat all compression fittings and threaded joints with an approved liquid leak detection solution such as snoop.
 - 3.2.2.3 Pressure instrument tubing with air or dry nitrogen to the test pressures listed on Pipe Code I-31. Hold pressure for 10 minutes. Repair any leaks found and re-test until no leakage occurs.
 - 3.2.2.4 Return valve lineup to operational requirements.
 - 3.2.3 Electrical Tests: Test instrument wiring as specified in Section 16400, and the following.
 - 3.2.3.1 Disconnect wires from instruments and test the continuity of every wire from instruments or sensing elements to read-out or alarm device, or farthest terminal point, as appropriate. Resistance shall be 10 ohms maximum. Record the readings.
 - 3.2.3.2 With conductors disconnected from instruments, but with shields connected to ground, measure and record resistances between each conductor and its related shield. Resistance shall be greater than 100 megohms.
 - 3.2.3.3 Reconnect wires.

PIPE CODE I-31			
Service	Max Operating Pressure lb/in ² gage	Test Pressure lb/in ² gage	Max Operating Temp °F
<i>Flush Filtered Water</i>	133	146	120
Raw Water	160	176	120
Instrument Air	120/100	132/110	120/100
Purge Air	20	30	120
Ventilation	5	10	120
Sizes	1/4-inch	3/8 and 1/2-inch	3/4, 1 and 1-1/2-inch
Tubing	ASTM A 269, Grade TP 304 or 304L or 316 annealed, seamless stainless steel. Buried tubing: Use insulated and heat-trace tubing as shown on Drawings.		
Wall Thickness	0.035-inch nominal	0.049-inch minimum	0.065-inch minimum
Fittings	Type 316 stainless steel, flareless type; Crawford Fittings "Swagelok," or Parker "CPI."		
Valves	Use valves shown on the Drawings.		

ECN-485/505
ECN-485

ECN-542

PRESSURE INSTRUMENTS
(Based on ISA S20.40)

GENERAL

- 1. Tag Number: (See Note 3) Service Slurry Pressure
- 2. Function: Record Indicate Control Blind
Trans Other _____
- 3. Case: Mfr Std Nom Size 2" OD X 3" Long
Color: Mfr Std Other _____
- 4. Mounting: Flush Surface Yoke Other Direct
- 5. Enclosure Class: General Purpose Weather Proof Explosion Proof
Class (See Note 5)
For use in intrinsically safe system Other _____
- 6. Power Supply: 117 V, 60 Hz V ac (See Note 4) V dc

TRANSMITTER

- 10. Output: 4-20 mA 10-50 mA 21-103 kPa (3-15 psig)
Other 2mv per volt of excitation for full scale
For receiver, see form Y-0502 and Y-0517

ECN-177

ELEMENT

- 17. Service: Gage Press Vacuum Absolute Compound
- 18. Element Type: Diaphragm Helix Bourdon Bellows
Other Bonded Strain Gauge
- 19. Material: 316 SST Ber Copper Other _____
- 20. Range: Fixed Adj Range _____ Set at _____
Overrange protection to 1000 psig
- 21. Process Data: Press: Normal 312 psig Max 476 psig Element
Range 0 -500 psig (See Note 6)
- 22. Process Conn: 1/4" npt 1/2" npt Other Female
Location: Bottom Back Other _____

PRESSURE INSTRUMENTS
(Based on ISA S20.40)

OPTIONS

25. Options: Filter-Rgltr _ Supply Gage _ Output Gage _
_____ Charts Diaph Seal _ Type _____
Diaph _____ Bot Bowl _____ Conn _____
Capillary: Length _____ Matl _____
Other 1. Mating cable connectors with 100' cable.
Connector installed on transducer end only.
2. Transducer to operate from 40 to 120°F.
26. Manufacturer: Sensotec Model TJE Code No. AP121CR or an approved
substitute.

-
- NOTES: 1) Items 7 through 9, 11 through 16, and 23 and 24 are not required.
2) Instrument accuracy shall be within $\pm 0.25\%$ of full scale.
3) Tag Numbers: PE-1362 and PE-1363.
4) Item 6: Transducer excitation power from transmitter shown on Data Sheet Y-0502.
5) Item 5: Hermetically sealed stainless steel case.
6) Item 21: Instrument shall accept a vacuum of 30 in. Hg at the pressure port with no detrimental effects.

RECEIVER INSTRUMENTS
(Based on ISA S20.1a)

GENERAL

1. Tag Number: (See Note 4) PISL-1363 Service Slurry Pressure ECN-186
2. Function: Record Indicate Control Blind
Integ Deviation Other (See Note 2)
3. Case: Mfr Std Nom Size 4" W x 2" H x 5" Deep
- Color: Mfr Std Other _____
4. Mounting: Flush Surface Rack Multi-Case
Other _____
For multiple case, see form Y- _____
5. Enclosure Class: Gen Purpose Weatherproof Explosion Proof ECN-151
Class _____
For use in intrinsically safe system Other _____
6. Power Supply: 117 V, 60 Hz Other: _____ V ac _____ V dc
9. Scales: Type Digital (PSIG) _____
Range 1 19999 2 _____ 3 _____ 4 _____

INPUTS

16. Signals: 4-20 mA 10-50 mA 21-103kPa (3-15 psig)
Other Compatible with Sensor on Data Sheet Y-0501
17. Number: 1 2 3 4
18. Power for Xmtr: External This instrument
Number of independent supplies One
For transmitters, see Data Sheet Y-0501

ALARMS

19. Switches: Quantity 2 Form C Rating 1 Amp, 120VAC
20. Function: Measured Variable Deviation
Contacts to actuate on measurement (field selectable)
Other _____
22. MFR & Model No.: Sensotec Model GM or an approved substitute
(Part No. AF213, 51b, 52e, 58a, 59b) ECN-160

-
- NOTES: 1) Items 7, 8, 10 through 15, and 21 are not required.
- 2) Item 2: Solid state electronic signal conditioner/amplifier and digital display ~~and with~~ low alarm switch for transducer element ~~on~~ see Data Sheet Y-0501. ECN-186
ECN-186
- 3) Adjustment: Span, zero and shunt calibration.
- 4) ~~Tag Numbers: PISL 1362 and PISL 1363.~~ ECN-186
- 54) Accuracy: $\pm 0.25\%$ of full scale. ECN-186

ANNUNCIATORS
(Based on ISA S20.2a)

GENERAL

1. Tag Number: ANN-1361 Location Operator's Station-M0211
2. Cabinet Size: 4 Rows High By 4 Columns Wide
3. Mounting: Flush Panel Surface
4. Cabinet Style: Plug-In Light Boxes Swing Door
Remote Logic Cabinet Watertight Door
5. Rating: General Purpose Weatherproof
Explosion Proof Class _____
Group _____ Division _____
6. Power Supply: 117 V, 60 Hz 125 V dc 12 V dc 24 V dc
Other: _____

DISPLAY

7. Backlighted Nameplates: White Translucent Other (See Note 2)
Size (See Note 3)
8. Alarm Points Per Lightbox: 1 2 3 4
Lamps Per Alarm: 1 2 3 4

LOGIC

11. Logic: Electro-Mechanical Relay Solid-State Electronic
Mercury Bottle Fluidic
12. Location: In Display Cab Remote Cab Strip Chassis
13. Style: Gen Purpose Weatherproof Explosion Proof
Class Group Division Intrinsically Safe
14. Field Contact Voltage: 117 V ac 12 V dc 125 V dc Other 24 V dc
15. On Alarm, Actuating Contacts: Open Close Field Selectable Form _____

ANNUNCIATORS
 (Based on ISA S20.2a)

FEATURES

- 16. Required: Lock-In of Momentary Alarms Auxiliary Contacts
 Sequential Alarm Circuit
- 18. Other: Fail-Safe Circuit To Signal Own Failure
 Operational Test Lamp Test
- 19. Flasher: Remote In Cabinet
- 20. Acknowledge: Common Unit Light Audible
 Pushbutton
 Location: In Cabinet Remote Other (See Note 4) _____
- 21. Reset: Common Unit Light Audible
 Pushbutton
 Location: In Cabinet Remote Other (See Note 4) _____

SEQUENCE

22. STAGE	VISUAL SIGNAL	AUDIBLE SIGNAL	
Normal	OFF	OFF	
Alert	Flashing	ON	
Acknowledge	Steady On	OFF	
Return to Normal	OFF Steady On	OFF	ECN-151
Reset	Steady On OFF	OFF	ECN-151
Test	Flashing	ON	

ISA Sequence Number: A M (ISA S18.1) ECN-151

OPTIONS

- 23. Horn: Panalarm No. NT2-24D (Remote)
- 27. Power Supply: 24 V dc - Panalarm No. 90PX120AC24FC450W
 Location: Remote mounting
- 28. Signal Converter: RS422 to RS232 converter with 10 feet of cable from annunciator cabinet to converter and 10 feet of cable from converter to modem (See Note 5)
- 29. Manufacturer: Panalarm
 Model No.: Series 90 or approved substitute (See Note 5)

ANNUNCIATORS
(Based on ISA S20.2a)

-
- NOTES: 1) Items 9, 10, 17, 24, 25, and 26 are not required.
- 2) Item 7: Nameplates shall be white. 8 red and 20 yellow colored filters for installation behind white nameplates shall be provided.
- 3) Item 7, Nameplate Size: 1-7/16" H x 3-5/16" W (Nominal) for each alarm point.
- 4) Pushbuttons (Acknowledge, Reset and Test) shall be integrally mounted.
- 5) The annunciator shall re-transmit abnormal occurrences via RS422 to RS232 converter and Buyer's telephone modem to Buyer's computer (TMACS). The RS422 to RS232 converter shall be SENCON CIM801-TS or approved substitute.

ANNUNCIATORS
(Based on ISA S20.2a)

GENERAL

- 1. Tag Number: ANN-1362 Location Process Bldg 241-C-91
- 2. Cabinet Size: 4 Rows High By 4 Columns Wide
- 3. Mounting: Flush Panel Surface
- 4. Cabinet Style: Plug-In Light Boxes Swing Door
Remote Logic Cabinet Watertight Door
- 5. Rating: General Purpose Weatherproof
Explosion Proof Class _____
Group _____ Division _____
- 6. Power Supply: 117 V, 60 Hz 125 V dc 12 V dc 24 V dc
Other: _____

DISPLAY

- 7. Backlighted Nameplates: White Translucent Other (See Note 2)
Size (See Note 3)
- 8. Alarm Points Per Lightbox: 1 2 3 4
Lamps Per Alarm: 1 2 3 4

LOGIC

- 11. Logic: Electro-Mechanical Relay Solid-State Electronic
Mercury Bottle Fluidic
- 12. Location: In Display Cab Remote Cab Strip Chassis
- 13. Style: Gen Purpose Weatherproof Explosion Proof
Class Group Division Intrinsically Safe
- 14. Field Contact Voltage: 117 V ac 12 V dc 125 V dc Other 24 V dc
- 15. On Alarm, Actuating Contacts: Open Close Field Selectable Form _____

ANNUNCIATORS
 (Based on ISA S20.2a)

FEATURES

16. **Required:** Lock-In of Momentary Alarms Auxiliary Contacts
 Sequential Alarm Circuit
18. **Other:** Fail-Safe Circuit To Signal Own Failure
 Operational Test Lamp Test
19. **Flasher:** Remote In Cabinet
20. **Acknowledge:** Common Unit Light Audible
 Pushbutton
 Location: In Cabinet Remote Other (See Note 4) _____
21. **Reset:** Common Unit Light Audible
 Pushbutton
 Location: In Cabinet Remote Other (See Note 4) _____

SEQUENCE

22. STAGE	VISUAL SIGNAL	AUDIBLE SIGNAL	
Normal	OFF	OFF	
Alert	Flashing	ON	
Acknowledge	Steady On	OFF	
Return to Normal	OFF Steady On	OFF	ECN-151
Reset	Steady On OFF	OFF	ECN-151
Test	Flashing	ON	

ISA Sequence Number: A M (ISA S18.1) ECN-151

OPTIONS

23. **Horn:** Panalarm No. NT2-24D (Remote)
27. **Power Supply** 24 V dc - Panalarm No. 90PX120AC24FC450W
Location: Remote mounting
29. **Manufacturer:** Panalarm
Model No.: Series 90 or approved substitute.

ANNUNCIATORS
(Based on ISA S20.2a)

-
- NOTES: 1) Items 9, 10, 17, 24 through 26, and 28 are not required.
- 2) Item 7: Nameplates shall be white. Two red and 16 yellow filters for installation behind white nameplates shall be provided.
- 3) Item 7, Nameplate Size: 1-7/16" H x 3-5/16" W (Nominal) for each alarm point.
- 4) Pushbuttons (Acknowledge, Reset and Test) shall be integrally mounted.

ANNUNCIATORS
(Based on ISA S20.2a)

GENERAL

1. Tag Numbers: (See Note 5) _____ Location Elec. Skid 241-C-51
2. Cabinet Size: 10 Rows High By 1 Columns Wide
3. Mounting: Flush Panel Surface
4. Cabinet Style: Plug-In Light Boxes Swing Door
Remote Logic Cabinet Watertight Door
5. Rating: General Purpose Weatherproof
Explosion Proof Class _____
Group _____ Division _____
6. Power Supply: 117 V, 60 Hz 125 V dc 12 V dc 24 V dc
Other: _____

DISPLAY

7. Backlighted Nameplates: White Translucent Other (See Note 2)
- Size (See Note 3)
8. Alarm Points Per Lightbox: 1 2 3 4
- Lamps Per Alarm: 1 2 3 4

LOGIC

11. Logic: Electro-Mechanical Relay Solid-State Electronic
Mercury Bottle Fluidic
12. Location: In Display Cab Remote Cab Strip Chassis
13. Style: Gen Purpose Weatherproof Explosion Proof
Class Group Division Intrinsically Safe
14. Field Contact Voltage: 117 V ac 12 V dc 125 V dc Other 24 Vdc
15. On Alarm, Actuating Contacts: Open Close Field Selectable Form C

ANNUNCIATORS
(Based on ISA S20.2a)

FEATURES

16. **Required:** Lock-In of Momentary Alarms Auxiliary Contacts
Sequential Alarm Circuit
18. **Other:** Fail-Safe Circuit To Signal Own Failure
Operational Test Lamp Test
19. **Flasher:** Remote In Cabinet
20. **Acknowledge:** Common Unit Light Audible
Pushbutton
Location: In Cabinet Remote Other (See Note 4) _____
21. **Reset:** Common Unit Light Audible
Pushbutton
Location: In Cabinet Remote Other (See Note 4) _____

SEQUENCE

22. STAGE	VISUAL SIGNAL	AUDIBLE SIGNAL	
Normal	OFF	OFF	
Alert	Flashing	ON	
Acknowledge	Steady On	OFF	
Return to Normal	OFF Steady On	OFF	ECN-151
Reset	Steady On OFF	OFF	ECN-151
Test	Flashing	ON	

ISA Sequence Number: A M (ISA S18.1) ECN-151

OPTIONS

23. **Horn:** Integral
27. **Power Supply**
Location: In logic cabinet
28. **Auxiliary Relay:** Auxiliary relay for horn output, 2 Form C contacts, 5 A at 120 V ac, 60 Hz, mounted within enclosure.
29. **Manufacturer:** Panalarm
Model No.: Series 910 Model 910AC120T24D2HIWB1 or approved substitute

ANNUNCIATORS
(Based on ISA S20.2a)

-
- NOTES: 1) Items 9, 10, 17, 24, 25 and 26 are not required.
- 2) Item 7: Nameplates shall be white.
- 3) Item 7, Nameplate Size: 3/8" H x 2" W (Nominal) for each alarm point.
- 4) Pushbuttons (Acknowledge, Reset and Test) and horn shall be integrally mounted.
- 5) Instrument Tag Numbers: ANN-1363A and ANN-1363B

ANNUNCIATORS
(Based on ISA S20.2a)

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GENERAL

1. Tag Number: ANN-1364 _____ Location Service Bldg 241-C-73
2. Cabinet Size: 10 _____ Rows High By 1 _____ Columns Wide
3. Mounting: Flush Panel Surface
4. Cabinet Style: Plug-In Light Boxes Swing Door
Remote Logic Cabinet Watertight Door
5. Rating: General Purpose Weatherproof
Explosion Proof Class _____
Group _____ Division _____
6. Power Supply: 117 V, 60 Hz 125 V dc 12 V dc 24 V dc
Other: _____

DISPLAY

7. Backlighted
Nameplates: White Translucent Other (See Note 2)
Size (See Note 3)
8. Alarm Points Per
Lightbox: 1 2 3 4
Lamps Per Alarm: 1 2 3 4

LOGIC

11. Logic: Electro-Mechanical Relay Solid-State Electronic
Mercury Bottle Fluidic
12. Location: In Display Cab Remote Cab Strip Chassis
13. Style: Gen Purpose Weatherproof Explosion Proof
Class Group Division Intrinsically Safe
14. Field Contact
Voltage: 117 V ac 12 V dc 125 V dc Other 24 V dc
15. On Alarm, Actuating
Contacts: Open Close Field Selectable Form C

ANNUNCIATORS
(Based on ISA S20.2a)

FEATURES

16. Required: Lock-In of Momentary Alarms Auxiliary Contacts
Sequential Alarm Circuit
18. Other: Fail-Safe Circuit To Signal Own Failure
Operational Test Lamp Test
19. Flasher: Remote In Cabinet
20. Acknowledge: Common Unit Light Audible
Pushbutton
Location: In Cabinet Remote Other (See Note 4) _____
21. Reset: Common Unit Light Audible
Pushbutton
Location: In Cabinet Remote Other (See Note 4) _____

SEQUENCE

STAGE	VISUAL SIGNAL	AUDIBLE SIGNAL	
Normal	OFF	OFF	
Alert	Flashing	ON	
Acknowledge	Steady On	OFF	
Return to Normal	OFF Steady On	OFF	ECN-151
Reset	Steady On OFF	OFF	ECN-151
Test	Flashing	ON	

ISA Sequence Number: A M (ISA S18.1) ECN-151

OPTIONS

23. Horn: ~~Integral~~ Remote-Panalarm Model #NT2-120A ECN-151
27. Power Supply
Location: In logic cabinet
28. Auxiliary Relay: Auxiliary relay for horn output, 2 Form C contacts, 5 A at 120 V ac, 60 Hz, mounted within enclosure.
29. Manufacturer: Panalarm
Model No.: Series 910; Model 910AC120-T24D2H1SM4 or approved substitute- T24D2SM4. ECN-151
ECN-151

ANNUNCIATORS
(Based on ISA S20.2a)

-
- NOTES: 1) Items 9, 10, 17, 24, 25, and 26 are not required.
- 2) Item 7: Nameplates shall be white.
- 3) Item 7, Nameplate Size: 3/8" H x 2" W (Nominal) for each alarm point.
- 4) Pushbuttons (Acknowledge, Reset and Test) and horn shall be mounted on door of enclosure.

DIFFERENTIAL PRESSURE INSTRUMENTS
(Based on ISA S20.20)

GENERAL

1. Tag Number: PDISH-1365
Service RW strainer, high differential pressure alarm
2. Function: Record Indicate Control Blind
Trans Integ Other Switches for HI alarm
3. Case: Mfr Std Nom Size 5" dia by 7" long
Color: Mfr Std Other _____
4. Mounting: Flush Surface Yoke Other _____
5. Enclosure Class: General Purpose Weatherproof Explosion Proof
6. Power Supply: 117 V, 60 Hz Other _____ V ac _____ V dc
9. Scale: Type Analog dial Range: 0-10 psid

UNIT

17. Service: Flow Level Diff Pressure
18. Element Type: Diaphragm Bellows Other Mfg's Std
19. Material: Body Metal Element Mfg's Std
20. Rating: Overrange _____ Body Rating 200 psig
21. Diff Range: Fixed Adjustable _____ Set At 10 psid
23. Process Data: Fluid Water Max Temp 120°F Max Press 160 psig
24. Process Conn: 1/2" npt Other 1/4" NPT

ALARMS

25. Switches: Quantity 2 Form DPDT Rating 10 A at 120 V ac
26. Function: Measured Var Deviation
Contacts to close on increase in pressure
(See Note 3)
28. Manufacturer: Dwyer Instruments, Inc.
Model Number: 43210B or an approved substitute

-
- NOTES: 1) Items 7, 8, 10 through 16, 22, and 27 are not required.
2) Instrument accuracy shall be within $\pm 3\%$ of full scale.
3) Alarm switches to be field adjustable.

TEMPERATURE INSTRUMENTS (FILLED SYSTEM)

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(Based on ISA S20.11a)

GENERAL

1. Tag No.: TE/TSHL-13617 Service: Service Bldg Temp HI/LO alarm
2. Function: Record Indicate Control Blind
Trans Other Alarm contacts
3. Case: Mfr Std Nom Size _____ Color: Mfr Std Other
4. Mounting: Flush Surface Yoke Other
5. Enclosure Class: General Purpose Weatherproof Explosion Proof

ELEMENT

17. Fill: SAMA CLASS IIC
18. Process Data: Temp: Normal 75°F Max 120°F Max Press 1 ATM
19. Range: Fixed Adj Range 40 to 225°F Set At Field set
Ovrrange Protection to 360°F
20. Bulb: Type Vapor Press Thermal System (See Note 4)
Material 316 SS Extension: _____ Length None
Type _____ Size: Mfr Std Conn: (See Note 4)

OTHER

23. Alarm Switches: Quantity 2 Form C Rating 10 A / 125 V ac
24. Function: Temp (See Note 2)
26. Manufacturer: SOR
Model Number: 201-V1-AA125-U9-C7A-TT or an approved substitute

-
- NOTES: 1) Items 6 through 16, 21, 22, and 25 are not required.
2) One contact to actuate at high setpoint, one contact to actuate at low setpoint.
3) Setpoint shall be repeatable within ± 2 °F over the full span of 40 to 225 °F.
4) The bulb will be exposed to the building temperature and shall be rigid and direct mounted.

RECEIVER INSTRUMENTS
(Based on ISA S20.1a)

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GENERAL

1. Tag Number: See Sheet 2 Service See Sheet 2
2. Function: Record Indicate Control Blind
Integ Deviation Other Alarm switches
3. Case: Mfr Std Nom Size 4" W x 2" H x 6" D (1/8 DIN)
Color: Mfr Std Other _____
4. Mounting: Flush Surface Rack Multi-Case
Other _____
For multiple case, see form Y-_____
5. Enclosure Class: Gen Purpose Weatherproof Explosion Proof
Class Mfr Std
For use in intrinsically safe system Other _____
6. Power Supply: 117 V, 60 Hz
9. Scales: Type 3-1/2 active digits
Range 1 See Sh 2 2 _____ 3 _____ 4 _____

INPUTS

16. Signals: 4-20 mA 10-50 mA 21-103kPa (3-15 psig)
Other 2-wire system (loop powered)
17. Number: 1 2 3 4
18. Power for Xmtr: External This instrument
Number of independent supplies _____
For transmitters, see form Y-_____

ALARMS

19. Switches: Quantity 2 Form C Rating 2A at 120 Vac
20. Function: Measured Variable Deviation
Contacts to Actuate on measurement increase/decrease.
Other Field selectable
22. Mfr & Model No: Rochester Instrument Systems Model TM-3481 with TM-341
Dual Relay Alarm Card Part No. TM-3481-1-1 or an
approved substitute

RECEIVER INSTRUMENTS
(Based on ISA S20.1a)

- NOTES: 1) Items 7, 8, 10 through 15, and 21 are not required.
2) Accuracy: $\pm 0.25\%$ of full scale.
3) Item 9: Scale type shall be 3-1/2 active digits.

Tag No	Scale Ranges	Service
PDISH-13611	0 - 15 inH ₂ O	Condenser high differential pressure
PDISH-13612	0 - 15 inH ₂ O	Mist eliminator high differential pressure
PDISH-13613	0 - 15 inH ₂ O	Metal filter high differential pressure
PI-13611*	-5 - +10 inH ₂ O	Tank 241-C-106 dome pressure
IISH-13635	0 - 20 AMP AC	Recirculating fan motor high amps
IISH-1363	0 - 150 AMP AC	Slurry submr pump motor high amps
IISH-1361	0 - 350 AMP AC	Slurry booster pump motor high amps
PISL 1364	0 - 200 psig	Instrument air header pressure low
FI-13616*	0 - 400 gpm	Slurry flow

ECN-151

*Not furnished with dual relay alarm card.

RECEIVER INSTRUMENTS
(Based on ISA S20.1a)

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GENERAL

1. Tag Number: See Sheet 2
Service Temperature-indicating switches
2. Function: Record Indicate Control Blind
Integ Deviation Other Alarm
3. Case: Mfr Std Nom Size 4" W x 2" H 6" D (1/8 DIN)
Color: Mfr Std Other _____
4. Mounting: Flush Surface Rack Multi-Case
Other _____
For multiple case, see Form Y-_____
5. Enclosure Class: Gen Purpose Weatherproof Explosion Proof
Class Mfr Std

For use in intrinsically safe system Other _____
6. Power Supply: 117 V, 60 Hz Other: _____ V ac _____ V dc
9. Scales: Type Digital 3-1/2 active digits
Range 1 (See Note 3) 2 _____ 3 _____ 4 _____

INPUTS

16. Signals: 4-20 mA 10-50 mA 21-103 kPa (3-15 psig)
Other 3 wire 100 ohm platinum RTD
17. Number: 1 2 3 4
18. Power for Xmtr: External This instrument
Number of independent supplies _____
For transmitters, see Form Y-_____

ALARMS

19. Switches: Quantity 2 Form C Rating _____
20. Function: Measured Variable Deviation
Contacts to Open on measurement increase
Other Field selectable

RECEIVER INSTRUMENTS
(Based on ISA S20.1a)

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22. Mfr & Model No.: Rochester Instrument Systems Model TM-3483 with TM-341
Dual Relay Alarm Card. Part No. TM-3483-1-1-1-0 or an
approved substitute

NOTES: 1) Items 7, 8, 10 through 15, and 21 are not required.

2) Tag numbers:

TISH 13620	TISH/TSHH 13614	TISH-13614A
TISH 13621	TISH/TSHH 13615	TISH-13615
TISH 13625	TISH/TSHH 1363	TISH-13614B
	TISH/TSHH 1364	TISHH-13615

ECN-177

ECN-177

3) Span to be field adjustable, 0.199 to 1999 °F.

4) Accuracy: ± 0.25% of full scale.

5) Alarm contact settings to be independently adjustable over the full span.

RECEIVER INSTRUMENTS
(Based on ISA S20.1a)

HNF-2534, Rev. 0
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GENERAL

1. Tag Number: (See Note 2)
Service Single-loop controllers
2. Function: Record Indicate Control Blind
Integ Deviation Other _____
3. Case: Mfr Std Nom Size 3" W x 6" H x 8" Deep
Color: Mfr Std Other _____
4. Mounting: Flush Surface Rack Multi-Case
Other _____
For multiple case, see Form Y-_____
5. Enclosure Class: Gen Purpose Weatherproof Explosion Proof
Class _____
For use in intrinsically safe system Other _____
6. Power Supply: 117 V, 60 Hz Other: _____ V ac _____ V dc
9. Scales: Type Vertical digital segmented bar (50 segments)
Range 1 (See Note 6)

CONTROLLER

10. Control Modes: P = Prop (Gain) I = Integral (Auto-Reset)
D = Derivative (Rate) Sub: s = Slow f = Fast
P PI PD PID I_f D_f I_s D_s
Other User configurable (See Note 6)
11. Action: On measurement increase, output: Increases (See Note 3)
Decreases
12. Auto-Man Switch: None Mfr Std Other _____
13. Set Point Adj: Manual External Remote Other _____
14. Manual Regulator: None Mfr Std Other _____
15. Output: 4-20 mA 10-50 mA 21-103 kPa (3-15 psig)
Other _____

RECEIVER INSTRUMENTS
(Based on ISA S20.1a)

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INPUTS

16. Signals: 4-20 mA _ 10-50 mA _ 21-103 kPa (3-15 psig) _
Other (See Note 4) _____
17. Number: 1 2 _ 3 _ 4 _
18. Power for Xmtr: External _ This instrument
Number of independent supplies _____
For transmitters, see Form Y- _____

ALARMS

19. Switches: Quantity 2 Form C Rating _____
20. Function: Measured Variable _ Deviation _
Contacts to _____ on measurement _____
Other (See Note 3) _____

22. Mfr & Model No: ABB Kent-Taylor Modcell-2050R or an approved substitute

NOTES: 1) Items 7, 8 and 21 are not required.

- 2) Tag Numbers: PIC-1361 (PIC/PSH/PSL)
SIC-1361
~~TIC-13622~~ (TIC/TSH) TI-13622 (TI/TSH)

ECN-690

- 3) Field selectable.
- 4) Field selectable for 4-20 mADC or RTD.
- 5) Accuracy: $\pm 0.25\%$ Full Scale.
- 6) Controller characteristics

Alphanumeric Displays: 3 Engineering, programmable, 8 characters each.
3 Status, programmable, 8 characters each.
Controls Available: On/Off, Heat/Cool, position feedback, P, PI or full PID, programmable, anti-windup, direct/reverse output, output limiting, auto/manual

Auto Tuning: On-demand
Gain: 0.1 to 125
Integral (Rate): 0.01 to 120 repeats per minute
Derivative (D): 0.1 to 999.9 seconds

RECEIVER INSTRUMENTS
(Based on ISA S20.1a)

HNF-2534, Rev. 0
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GENERAL

1. Tag Number: LI/LSH-1362 Service Tank Level Indicator
2. Function: Record Indicate Control Blind
Integ Deviation Other High Alarm
3. Case: Mfr Std Nom Size 4" H x 5" W x 14" Deep
Color: Mfr Std Other _____
4. Mounting: Flush Surface Rack Multi-Case
Other _____
For multiple case, see Form Y-_____
5. Enclosure Class: Gen Purpose Weatherproof Explosion Proof
Class _____
For use in intrinsically safe system Other _____
6. Power Supply: 117 V, 60 Hz Other: _____ V ac _____ V dc
9. Scales: Type Digital, software adjustable
Range 1 0-300 in 2 _____ 3 _____ 4 _____

INPUTS

16. Signals: 4-20 mA 10-50 mA 21-103 kPa (3-15 psig)
Other Enraf-Nonius, GPU protocol (proprietary)
17. Number: 1 2 3 4
18. Power for Xmtr: External This instrument
Number of independent supplies _____
For transmitters, see Form Y-_____

ALARMS

19. Switches: Quantity 2 Form C Rating 10 A at 250 V ac
20. Function: Measured Variable Deviation
Contacts to close on measurement increase
Other System fail relay option
21. Options: Filter-Rgltr Supply Gage Charts
Internal Illumination Other (See Note 3)
22. Manufacturer: ENRAF, MODEL 878 Panel Indicator or an approved
substitute (See Note 2)

RECEIVER INSTRUMENTS
(Based on ISA S20.1a)

HN-2534, Rev 0

-
- NOTES: 1) Items 7, 8, and 10 through 15 are not required.
- 2) This device is to operate in conjunction with an ENRAF transmitter Model 854 ATG servo powered level gage presently installed in Hanford Waste Tank 241-C-106.
- 3) Provide the "Fail Relay" option.

D

RECEIVER INSTRUMENTS (Based on ISA S20.1a)

GENERAL

- 1. Tag Number: ZI 12616 Service Winch Position _____
- 2. Function: Record Indicate Control Blind
Integ Deviation Other Alarm Switches _____
- 3. Case: Mfr Std Nom Size 4" H x 2" W x 6" Deep
Color: Mfr Std Other _____
- 4. Mounting: Flush Surface Rack Multi Case
Other _____
For multiple case, see Form Y _____
- 5. Enclosure Class: Gen Purpose Weatherproof Explosion Proof
Glass _____
For use in intrinsically safe system Other _____
- 6. Power Supply: 115 V, 60 Hz Other: _____ V ac _____ V dc
- 9. Scales: Type Analog, Vertical
Range 1 0 300 inches

INPUTS

- 16. Signals: 4 20 mA 10 50 mA 21 103 kPa (3 15 psig)
Other _____
- 17. Number: 1 2 3 4
- 18. Power for Xmtr: External This instrument
Number of dependent supplies _____
For transmitters, see Form Y _____

ALARMS

- 19. Switches: Quantity 2 Form C Rating 5A, 120 V ac
- 20. Function: Measured Variable Deviation
Contacts to _____ on measurement _____
Other Field Selectable (See Note 2) _____
- 21. Options: Filter Rgltr Supply Gage Charts
Internal Illumination Other (See Note 3) _____
- 22. Manufacturer Model No.: LFE Inc. 371 K or approved substitutes

RECEIVER INSTRUMENTS
(Based on ISA S20.1a)

GENERAL

1. Tag Number: ZI-13616 Service Winch Position
2. Function: Record Indicate Control Blind
Integ Deviation Other Alarm Switches
3. Case: Mfr Std Nom Size 4" H x 2" W x 6" D (1/8 DIN)
Color: Mfr Std Other _____
4. Mounting: Flush Surface Rack Multi-Case
Other _____
For multiple case, see Form Y-_____
5. Enclosure Class: Gen Purpose Weatherproof Explosion Proof
Class _____
For use in intrinsically safe system Other _____
6. Power Supply: 117 V, 60 Hz Other: _____ V ac _____ V dc
9. Scales: Type Digital, 4 1/2 Digits
Range 1 0-300 inches

INPUTS

16. Signals: 4-20 mA 10-50 mA 21-103 kPa (3-15 psig)
Other _____
17. Number: 1 2 3 4
18. Power for Xmtr: External This instrument
Number of independent supplies _____
For transmitters, see Form Y-_____

ALARMS

19. Switches: Quantity 2 Form C Rating 2A, 120 V ac
20. Function: Measured Variable Deviation
Contacts to _____ on measurement _____
Other Field Selectable (See Note 2)
21. Options: Filter-Rgltr Supply Gage Charts
Internal Illumination Other (See Note 3)
22. Manufacturer Model No.: Precision Digital Model PD690 or approved substitutes

D

E

~~RECEIVER INSTRUMENTS~~
~~(Based on ISA S20.1a)~~

~~Form Y 0513~~
~~Sheet 2 of 2~~

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~~NOTES: 1) Items 7, 8, and 10 through 15 are not required.~~

~~2) One alarm contact to actuate on increasing value (ZSH 13616A);
and another independent alarm contact to actuate on decreasing
value (ZSL 13616A).~~

~~3) Accuracy: $\pm 0.5\%$ of full scale span.~~

ECN-606

E

T

E

D

RECEIVER INSTRUMENTS
(Based on ISA S20.1a)

-
- NOTES: 1) Items 7, 8, and 10 through 15 are not required.
- 2) One alarm contact to actuate on increasing value (ZSH-13616A);
and another independent alarm contact to actuate on decreasing
value (ZSL-13616A).
- 3) Accuracy: $\pm 0.1\%$ of full-scale span.

ECN-606

RECEIVER INSTRUMENTS
(Based on ISA S20.1a)

HNF-2534, Rev D

GENERAL

1. Tag Number: PR 1361/PR 1362/FR 13616 SPARE ECN-186/674
Service Tank pressure recorder
2. Function: Record Indicate Control Blind
 Integ Deviation Other _____
3. Case: Mfr Std Nom Size 3" wide x 6" high x 22" deep
 Color: Mfr Std Other _____
4. Mounting: Flush Surface Rack Multi-Case
 Other _____
 For multiple case, see Form Y-_____
5. Enclosure Class: Gen Purpose Weatherproof Explosion Proof
 Class Mfr Std
 For use in intrinsically safe system Other _____
6. Power Supply: 117 V, 60 Hz Other: _____ V ac _____ V dc
7. Chart: Strip 4 inches wide Roll 15 feet long Fold _____
 Circular _____ Time Marks Configurable
 Range Configurable Number 1
8. Chart Drive: Speed 1 to 60 in/hr Power Internal-electric
9. Scales: Type Software configurable - thermal dot matrix
 Range 1 (See Note 3) 2 _____ 3 _____ 4 _____

INPUTS

16. Signals: 4-20 mA 10-50 mA 21-103 kPa (3-15 psig)
 Other _____
17. Number: 1 2 3 4 ECN-186
18. Power for Xmtr: External This instrument
 Number of independent supplies _____
 For transmitters, see Form Y-_____
21. Options: (See Note 4)
22. Mfr & Model No: ABB Kent-Taylor Mod 30, 1701J or approved substitute

RECEIVER INSTRUMENTS
(Based on ISA S20.1a)

-
- NOTES: 1) Items 10 through 15, 19 and 20 are not required.
- 2) Accuracy: $\pm 0.25\%$ of full-scale span.
- 3) Recorder Characteristics: Trending, configurable chart range, speeds and scales, timing marks, date marks, internal diagnostics, self-contained.
- 4) Seller shall provide a portable configurator to configure the operating parameters of the recorder. Portable configuration shall be ABB Mod 30, 1700D or an approved substitute.

PRESSURE INSTRUMENTS
(Based on ISA S20.40)

GENERAL

1. Tag Number: PISL-1364 Service INSTR AIR PRESS
2. Function: Record Indicate Control Blind
Trans Other ALARM SWITCH
3. Case: Mfr Std Nom Size 4-1/2" DIAL SIZE
Color: Mfr Std Other _____
4. Mounting: Flush Surface Yoke Other _____
5. Enclosure Class: Gen Purpose Weather Proof Explosion Proof
Class _____
For use in intrinsically safe system Other

ELEMENT

17. Service: Gage Press Vacuum Absolute Compound
18. Element Type: Diaphragm Helix Bourdon Bellows
Other Mfr Std
19. Material: 316 SST Ber Copper Other Mfr Std for Air
20. Range: Fixed Adj Range _____ Set at _____
Ovrrange protection to _____
21. Process Data: Press: Normal 100PSI Max 160PSI Element Range 0-300
22. Process Conn: 1/4" npt 1/2" npt Other Mfr Std
Location: Bottom Back Other _____

ALARMS

23. Switches: Quantity 2 Form C Rating 10A-125VAC
24. Function: Press Deviation
Contracts to OPEN on increase in pressure.
26. MFR & MODEL NO: Ametek, US Gauge Division, Model 3050

- NOTES: (1) Items 6-16 & 25 are not required.
(2) Accuracy: 1/2 of 1% of span for indicator.

PRESSURE GAGES
 (Based on ISA S20.41a)

GENERAL

- 1. Type: Direct Reading 3-15 lb receiver _
 Other _____
- 2. Mounting: Surface _ Local Flush _
- 3. Dial: Diameter 4-1/2" (nom) Color White
- 4. Case: Cast Iron _ Aluminum _ Phenol
 Other _____
- 5. Ring: Screwed _ Hinged _ Slip _ Std
 Other _____
- 6. Blow-Out Prot: None _ Back Disc _ Solid Front _
 Other _____
- 7. Lens: Glass _ Plastic
- 9. Nom Accuracy Req'd: ±1%
- 10. Mfr & Model NO: US Gauge 1981 or an approved substitute
- 11. Press Element: Bourdon _ Bellows _ Other Mfr Std
- 12. Element Matl: Bronze _ Steel _ ___ SST Other Mfr Std
- 13. Socket Matl: Bronze _ Steel _ ___ SST Other Mfr Std
- 14. Connection: 1/4" npt _ 1/2" npt Other _____
 Bottom Back _
- 15. Movement: Bronze _ SST _ Nylon _
 Other Mfr Std

TABLE

Qty	Tag Number	Range	Operating Pressure	Service
1	PI-1365	0-169 PSIG	90 PSIG	AIR

NOTES: (1) Items 8 & 16 are not required.

PRESSURE INSTRUMENTS
(Based on ISA S20.40)

GENERAL

1. Tag Number: PIT/PSL-1362 Service Slurry Pressure
2. Function: Record Indicate Control Blind
Trans Other (see note 2)
3. Case: Mfr Std Nom Size 4" W x 4" H x 5" Deep
- Color: Mfr Std Other _____
4. Mounting: Flush Surface Yoke Other _____
5. Enclosure Class: General Purpose Weather Proof Explosion
Proof Class _____
For use in intrinsically safe system Other _____
6. Power Supply: 117 V. 60 Hz _____ V ac _____ V dc
9. Scales: Type Digital (PSIG) _____
Range 1 19999 2 _____ 3 _____ 4 _____

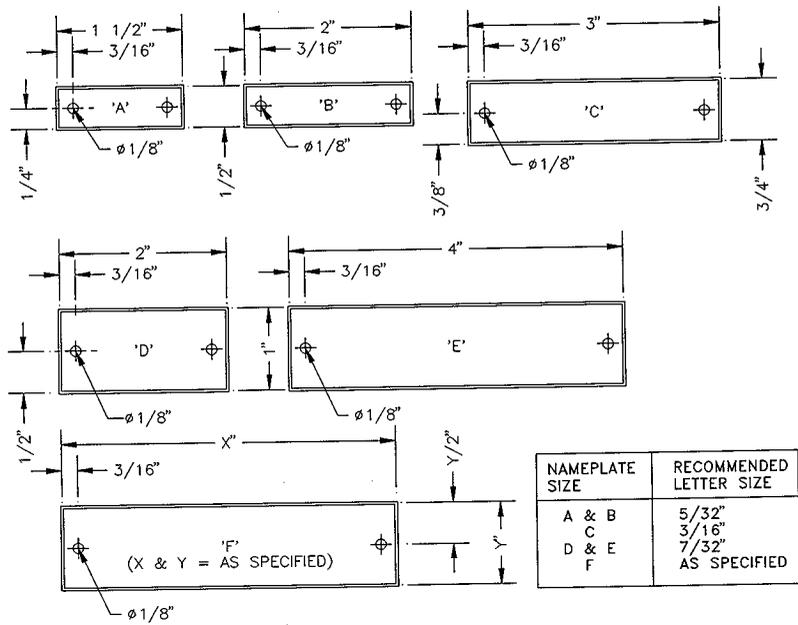
TRANSMITTER

10. Output: 4-20 mA 10-50 mA 21-103 kPa (3-15 psig)
Other _____
For receiver, see Form Y-0514

ALARMS

23. Switches: Quantity 2 Form C Rating 1 Amp, 120 Vac
24. Function: Press Deviation
Contacts to close on increase in pressure.
26. MFR & MODEL NO: Sensotec Model GM or an approved substitute
(Part no. AE213, 56a & 58a)

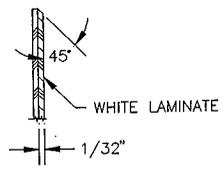
-
- NOTES: (1) Items 7, 8, 11-22 & 25 are not required.
- (2) Item 2: Solid state electronics signal conditioner/
amplifier/transmitter with digital display and low alarm
switch. For transducer element see Data Sheet Y-0501.
- (3) Adjustment: Span, zero and shunt calibration.
- (4) Accuracy: $\pm 0.25\%$ of full scale.



NAMEPLATE SIZE	RECOMMENDED LETTER SIZE
A & B	5/32"
C	3/16"
D & E	7/32"
F	AS SPECIFIED

3/32" SAMPLE 7/32" SAMPLE
 1/8" SAMPLE 1/4" SAMPLE
 5/32" SAMPLE 5/16" SAM
 3/16" SAMPLE

SAMPLE LETTERING SIZES



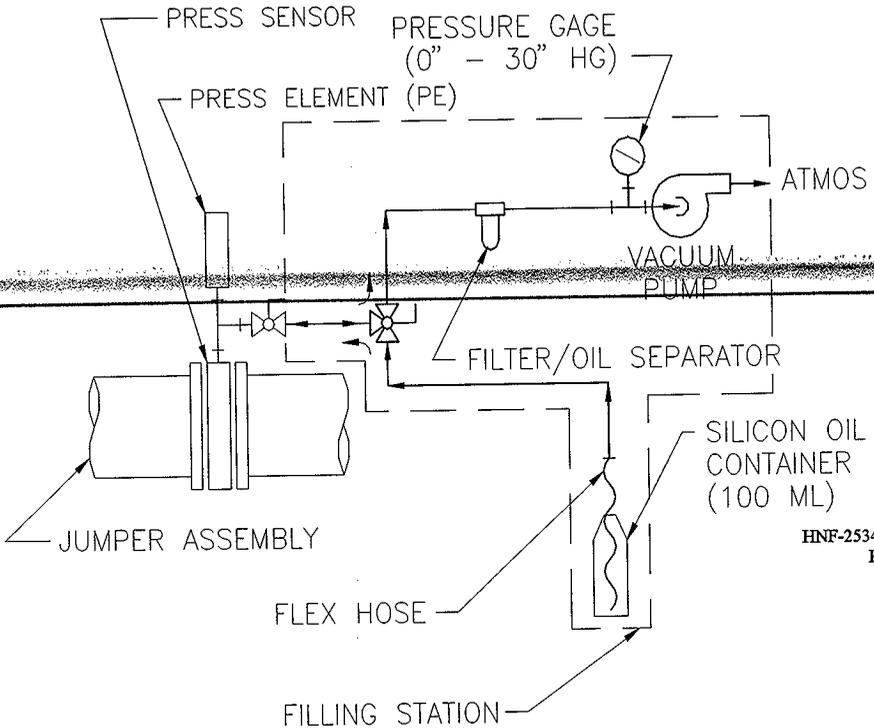
DETAIL OF EDGES

NOTES:

1. MATERIAL SHALL BE 1/16" THICK LAMINATED PLASTIC STOCK WITH WHITE SURFACE AND BLACK CORE.
2. EDGES OF NAMEPLATES SHALL BE BEVELED AS SHOWN AND SHALL BE SMOOTH AND WITHOUT BURRS. LETTERS SHALL BE SHARP AND CLEAR, SIMILAR TO THE STYLE SHOWN.
3. USE 4-40 x 3/8" LONG, BINDING HEAD, SELF-TAPPING MACHINE SCREWS OR PULL STEM RIVETS TO FASTEN PLATES TO PANELS. DRILL NO. 39 HOLES IN PANEL. CONTACT ADHESIVE SHALL NOT BE USED.

EQUIPMENT NAMEPLATE

Figure 1



FILLING METHOD

Figure 2

Project No. W-320-C5

Project Title Tank 241-C-106 Sluicing

Specification Section 13440

VENDOR INFORMATION LIST
 ("X" Indicates Required Data)

1	2	3	4	5	VENDOR INFORMATION (VI)												
					Instructions	Installation			Control Diagram	Circuit or Data	Certified Test	Specifications	Equipment Weights	Drawings	Dimensional		
EPN IDENTIFICATION	DESCRIPTION	REFERENCE DRAWING	SPECIFICATION PARAGRAPH		Installation	Operation	Maintenance	Spare Parts List	Data Sheets	Illustrative Cuts							
PE-1362 PE-1363	Pressure Transducer		Y-0501	X	X	X	X	X	X	X	X	X	X	X	X	X	ECN-151/160
P&S-1362 P&S-1363	Pressure Indicating Switch		Y-0502	X	X	X	X	X	X	X	X	X	X	X	X	X	ECN-186/160
ANN-1361	Annunciator		Y-0503	X	X	X	X	X	X	X	X	X	X	X	X	X	
ANN-1362	Annunciator		Y-0504	X	X	X	X	X	X	X	X	X	X	X	X	X	
ANN-1363A ANN-1363B	Annunciator		Y-0505	X	X	X	X	X	X	X	X	X	X	X	X	X	
ANN-1364	Annunciator		Y-0506	X	X	X	X	X	X	X	X	X	X	X	X	X	
POISH-1365	Differential Pressure Indicating Switch		Y-0507	X	X	X	X	X	X	X	X	X	X	X	X	X	ECN-160
TE/TSHL-13617	Temperature Switch		Y-0508	X	X	X	X	X	X	X	X	X	X	X	X	X	ECN-151
POISH-13611 POISH-13612 POISH-13613 PL-13611 FL-13616 P&S-13624 ISH-13635 ISH-1363 ISH-1361	Digital Indicator/Switch		Y-0509	X	X	X	X	X	X	X	X	X	X	X	X	X	ECN-160

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Project No. W-320-C5

Project Title Tank 241-C-106 Sluicing

Specification Section 13440

VENDOR INFORMATION LIST
("X" Indicates Required Data)

1	2	3	4	5													
				VENDOR INFORMATION (V/I)													
EPN IDENTIFICATION	DESCRIPTION	REFERENCE DRAWING	SPECIFICATION PARAGRAPH	Dimensional Drawings	Equipment Weights	Specifications	Certified Test Data	Circuit or Control Diagram	Instructions				Spare Parts List	Data Sheets	Illustrative Cuts	ECN-160	
									Installation	Operation	Maintenance						
TISH-13620 TISH-13621 TISH-13625 TISH/ TSHH-13614 TISH/ TSHH-13615 TISH/ TSHH-1363 TISH/ TSHH-1364	Temp. Indicator/Switch		Y-0510	X		X	X	X	X	X	X	X	X	X	X	X	ECN-160
PIC-1361 SIC-1361 PIC-13622 TL-13622	Single Loop Controller		Y-0511	X		X		X	X	X	X	X	X	X	X		ECN-690 ECN-690
LHSH-1362	Liquid Level Indicator		Y-0512	X		X		X	X	X	X	X	X	X	X	X	
ZI-13616	Winch Position Indicator		Y-0513	X		X		X	X	X	X	X	X	X	X	X	ECN-160
PP-1364 SPACE	Tank Pressure 3-Pen Recorder		Y-0514	X		X		X	X	X	X	X	X	X	X	X	ECN-674
PISL-1364	Pressure Indicator Switch Low		Y-0515	X		X		X	X	X	X	X	X	X	X	X	ECN-151/177
PI-1365	Pressure Indicator		Y-0516	X		X		X						X	X	X	ECN-151
PI/PISL-1362	Pressure Indicating Transmitter/Switch Low		Y-0517	X		X								X	X	X	ECN-185
																	ECN-1534
																	Rev 0
																	Page 141

Project No. W-320-C5

Project Title Tank 241-C-106 Sluicing

Specification Section 13440

VENDOR INFORMATION LIST
("X" Indicates Required Data)

1	2	3	4	5												
				VENDOR INFORMATION (VI)												
EPN IDENTIFICATION	DESCRIPTION	REFERENCE DRAWING	SPECIFICATION PARAGRAPH	Dimensional Drawings	Weights	Specifications	Certified Test Data	Circuit or Control Diagram	Instructions				Spare Parts List	Data Sheets	Illustrative Cuts	
									Installation	Operation	Maintenance					
LDS-1361 LDS-1363 LDS-1364 LDS-1365 LDS-1366 LDS-1368 LDS-1369 LDS-13612 LSH-1361 LSL-1368 LSL-1369 LSH-1369	Leak Detection Relay	H-2-818588		X	X	X	X	X	X	X	X	X			X	
LH-1361/BS-13620C	Indicator Light (typ)/Illuminated Push Button (typ)	H-2-818591		X	X	X	X	X	X	X	X	X			X	ECN-177
HS-13630C	Illuminated Pushbutton (typ)	H-2-818541		X	X	X	X	X	X	X	X	X			X	ECN-177
IE-1361	Instrument Enclosure	H-2-818588		X									X		X	
IE-1362	Instrument Enclosure	H-2-818594		X									X		X	
CP-01	Instrument Cabinet	H-2-818596		X									X		X	
CP-02	In-Tank Imaging Cabinet	H-2-818592		X									X		X	
CB-01	Control Cabinet	H-2-818591		X									X		X	

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SECTION 15493

CHEMICAL PROCESS PIPING SYSTEMS

PART 1 - GENERAL

1.1 REFERENCES

- 1.1.1 The following documents, including others referenced therein, form part of this Section to the extent designated herein.
- 1.1.1.1 American National Standard Institute (ANSI)
A13.1-1993 Identification of Piping Systems
- 1.1.1.2 American Society of Mechanical Engineers (ASME)
B16.3-1992 Malleable Iron Threaded Fittings, Classes 150 and 300
B16.5-1988 Pipe Flanges and Flanged Fittings
B16.9-1993 Factory-Made Wrought Steel Buttwelding Fittings
B31.3-1993 Chemical Plant and Petroleum Refinery Piping
NQA-1-1994 Quality Assurance Program Requirements for Nuclear Facility Applications
- 1.1.1.3 American Society for Nondestructive Testing (ASNT)
ASNT-TC-1A Recommended Practice (1988 Edition)
- 1.1.1.4 American Society for Testing and Materials (ASTM)
A 47-90 Ferritic Malleable Iron Castings
A 53-90b Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
A 105-92 Forgings, Carbon Steel, for Piping Components
A 106-91 Seamless Carbon Steel Pipe for High-Temperature Service
A 182-92a Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
A 193-92 Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

A 194-92a	Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
A 197-87 (1992)	Cupola Malleable Iron
A 234-92a	Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
A 307-92a	Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
A 312-92a	Seamless and Welded Austenitic Stainless Steel Pipes
A 351-91b	Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts
A 403-91	Wrought Austenitic Stainless Steel Piping Fittings
A 563-92a	Carbon and Alloy Steel Nuts
B 62-93	Composition Bronze or Ounce Metal Castings
1.1.1.8	Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)
SP-58 (1988)	Pipe Hangers and Supports - Materials, Design and Manufacture
SP-69 (1991)	Pipe Hangers and Supports - Selection and Application
SP-80, 1987	Bronze Gate, Globe, Angle and Check Valves
SP-89, 1991	Pipe Hangers and Supports - Fabrication and Installation Practices
1.1.1.9	Steel Structures Painting Council (SSPC)
SP 3-82	Power Tool Cleaning
SP 6-85	Commercial Blast Cleaning
1.1.1.5	American Waterworks Association (AWWA)
C-213-91	Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

1.1.1.6 Federal Standards (FED STD)

FED-STD-595B

Colors Used in Government Procurement

1.1.1.7 Federal Specification (FS)

TT-E-489

Enamel, Alkyd, Gloss, Low VOC Content

1.2 SUBMITTALS

1.2.1 See Section 01300 for submittal procedures.

1.2.2 Approval Required

1.2.2.1 Approval data: Before delivery, submit information listed in the Approval Data List in this Section.

1.2.2.2 *Certified material test reports (CMTRs): Before delivery, submit legible reports, certified by responsible manufacturer of materials used in the fabrication of pipe, fittings, flanges, bolting, and weld rods for pipe codes below. Report shall present results of chemical analysis and physical test specified by ASME and ASTM Codes and standard specifications for production lots and heats of materials. Submit separate reports for the following:*

- a. *Pipe Code M-9; Service Supernate (SN) and Slurry (SL) lines.*
- b. *Pipe Code M-26a; Service, Supernate (SN) and Slurry (SL) Line Encasements.*

1.2.2.3 *Material traceability shall be maintained through fabrication for materials requiring CMTRs.*

1.2.3 Approval Not Required

~~1.2.3.1 Certificates of conformance~~

~~a. With delivery, submit a legible certificate, certified by equipment manufacturer or supplier, stating that materials used in fabrication of valve bodies and bonnets, and equipment pressure boundary surfaces meet requirements of the Drawings and this Section, for pipe codes and services listed below.~~

- ~~1) Pipe Code M 5; Service, Raw Water (RAW).~~
- ~~2) Pipe Code M 7; Service, Instrument Air (IA).~~
- ~~3) Pipe Code M 26a; Service, Supernate, Slurry, and Drain Line Encasements (ENCs).~~
- ~~4) Pipe Code M 24; Service, Drain~~

ECN-130

ECN-130

ECN-597

ECN-597/130

~~1.2.3.2 Certified Material Test Reports (CMTRs): With delivery, submit legible reports, certified by responsible manufacturer of materials used in fabrication of tubing, pipe, fittings, flanges, bolting, and piping attachments and weld rod for pipe codes and services listed below. Reports shall present results of chemical analysis and physical tests specified in ASME and ASTM Codes and Standard Specifications for production lots and heats of materials. Submit separate reports for the following.~~

~~a. Pipe Code M 9; Service, Supernate (SN) and Slurry (SL)~~

~~1.2.3.3 Material traceability shall be maintained through fabrication for materials requiring CMTRs.~~

ECN-130

1.2.3.2 Vendor information: Before installation, submit information listed in the Vendor Information List in this Section.

1.3 QUALITY ASSURANCE

1.3.1 Safety Related Products: Safety *Significant Class-2* products and fabricated portions of *Safety Significant Class-2* piping shall be procured from qualified suppliers. These suppliers shall have a quality assurance program meeting the ASME NQA-1 Basic Requirements 1, 2, 4 through 15 and 17. ECN-807
ECN-807

1.3.2 Welding Qualifications

1.3.2.1 Qualification of welding personnel and procedures: Personnel and procedures for welding pressure retaining components along with attachments hereto, and pipe supports, shall be qualified in accordance with ASME B31.3, Paragraph 328.2.

1.3.2.2 Qualification of Nondestructive Examination (NDE) Personnel:

a. Visual weld examination shall be performed in accordance with ASME B31.3.

b. Personnel performing other NDE shall be certified in accordance with Contractor's written practice, which shall meet the requirements of ASNT-TC-1A, before performing NDE. Use level II personnel to interpret test results.

1.3.3 Deliverable Documentation: The following documents and records, required by this Section, shall be delivered to ICF KH Construction Document Control in accordance with Section 01720.

<u>Document</u>	<u>Paragraph</u>
Welding Qualification	1.3.3
Welding Examination Documentation	3.2.1.6
Flushing/Mechanical Cleaning Verification	3.2.2.5
Leak/Pressure Test Certification	3.2.3.1b

1.4 DELIVERY, STORAGE AND HANDLING

1.4.1 See Section 01610 for general requirements.

PART 2 - PRODUCTS

2.1 SUBSTITUTES

2.1.1 See Section 01630 for substitution approvals.

2.2 MATERIALS

2.2.1 Piping, Tubing, and Fittings: See the Pipe Codes in this Section, and details on the Drawings.

2.2.1.1 Close or butt nipples are not permitted, unless shown on the Drawings.

- 2.2.2 Pipe Joint Sealant (Lubricant) for Threaded Joint: For design temperatures up to 500°F, use nonhardening teflon paste: Chesterton "Goldend" No. 7298, Federal Process Company "JC-30," or Lake Chemical Company "Slic-Tite."
- 2.2.3 Protective coating for piping in contact with earth.
- 2.2.3.1 Carbon steel piping: Field and Factory applied exterior protective coating; AWWA C213, fusion bonded epoxy coating of 14 Mills minimum thickness, Scotchkote 206N or approved substitute.
- 2.2.4 Painting: See Section 09900 and piping identification in accordance with Appendix A.
- 2.2.5 Nonshrink Grout: See Section 03300.
- 2.2.6 Pipe Supports: Pipe supports shall be as shown, with standard components selected in accordance with MSS SP-69, that satisfy the criteria of MSS SP-58.

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 General

3.1.1.1 Fabricate and install pipe and tubing in accordance with ASME B31.3 (for normal service), Drawings and this Section. *Pipe codes M-5 and M-7 piping systems shall be fabricated using threaded connections and pipe codes M-9 and M-26a piping systems shall be fabricated using welded connections unless otherwise shown on the drawings.*

ECN-261
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ECN-261

3.1.1.2 Cut pipe and tubing using methods which result in clean, straight cuts.

3.1.1.3 Ream pipe and tubing to nominal inside diameter after cutting. Remove burrs from threads before assembly.

3.1.1.4 Tools to be used on stainless steel shall be clearly marked "for use on stainless steel only."

3.1.1.5 Bend pipe and tubing in accordance with ASME B31.3, and meet tolerances given in ASME B31.3. Use methods and equipment which produce bends substantially free of wrinkles, bulges, or kinks. When wall thickness, diameter, and bend radius indicate possibility of wall collapse during bending, fill pipe or tubing with clean silica sand or fusible material similar to Cerro-bend, manufactured by Cerro Corporation.

a. Application of heat to facilitate a pipe bend shall be brought to the attention of the Responsible Engineer for direction and disposition prior to the application of the heat.

b. Cold springing pipe permitted only if specified on the Drawings.

3.1.1.6 Make joints in threaded piping systems with joint sealant specified. Apply sealant to male threads only.

- 3.1.1.7 Install tubing fittings in accordance with the manufacturer's instructions.
- 3.1.1.8 Carbon steel embedded in concrete shall be bare.
- 3.1.1.9 Keep piping systems clean. Piping systems shall be inspected before, during and after installation.
 - a. Once fabrication has started, plug or cap ends of piping when installation is not in progress. Cap or plug openings in fabricated pipe spool assemblies until installation in the piping system. Leave ends of spare lines capped or blind flanged when installation has been completed.
- 3.1.1.10 High point vents shall not be provided on SN and SL piping. Provide drain taps at low points to ensure complete drainage and drying in piping systems using water for cleaning and leak/pressure testing. Venting may be provided by loosening flanges having minimum of 4 bolts.
- 3.1.1.11 Pipe supports: Install as shown on the Drawings, in accordance with manufacturer's instructions, and applicable recommended procedures of MSS SP-89.
- 3.1.1.12 Direction shall be obtained from the Operating Contractor for the disposal of waste flushing and testing water.
- 3.1.1.13 Lead shall not be allowed for counterweighting in remotely replaceable components.
- 3.1.2 Underground Piping
 - 3.1.2.1 Trenches: Excavate, backfill, and compact in accordance with Section 02225.
 - 3.1.2.2 Place piping supports on undisturbed soil, or backfill placed and compacted in accordance with Sections 02200 and 02225.
 - 3.1.2.3 Survey piping systems for elevation and location before final tie-in welds to pits, risers, or fixed items. Complete placement of supports and meet Specification and Drawing requirements before survey. Elevation and location shall be in accordance with the Drawings. After final tie-ins survey piping system again for final acceptance.
- 3.1.3 Welding
 - 3.1.3.1 Weld piping, attachments to pressure retaining components, and pipe supports in accordance with ASME B31.3 and Project Drawings.
 - 3.1.3.2 Protect outdoor welding operation from rain and wind by using barriers to protect welder and weld joint.
 - 3.1.3.3 Gas Tungsten Arc Welding (GTAW) process shall be used for root pass welds of all carbon steel encasement pipes, *where stainless steel inner pipes cannot be protected weld splatter.*

ECN-130
ECN-130

- 3.1.3.4 Complete piping welds before tie-in welds to pits, risers, or fixed items.
- 3.1.3.5 Remove backing strips if used.
- 3.1.4 Weld Identification
 - 3.1.4.1 Prepare weld maps using project drawings or sketches which show relative positions of pressure containing welds and attachment welds to pressure retaining components.
 - 3.1.4.2 Assign and record weld numbers on weld maps as welds are made.
 - 3.1.4.3 Place the welder identification symbol and weld number adjacent to welds upon completion. Place the identification symbol approximately every 3 feet on long seams or large weldments, using one of the marking methods specified in Section 01610.
 - 3.1.4.4 Do not reuse weld numbers. If a weld bond is completely replaced, assign a new number.
 - 3.1.4.5 Show heat/lot numbers on weld maps for materials requiring Certified Material Test Reports.
- 3.1.5 Perform NDE, flushing, leak/pressure testing specified in 3.2 before coating application.
- 3.1.6 Exterior Protective Coating
 - 3.1.6.1 Protect carbon steel pipe and fittings exposed to earth backfill with specified coating.
 - a. Clean carbon steel surfaces to white metal by sandblasting in accordance with SSPC SP 6. Where blasting is impracticable, clean by power wire brushing in accordance with SSPC SP 3.
 - b. Heat and apply specified tape in accordance with AWWA C213 and manufacturer's instructions.
 - 3.1.6.2 After installation, examine carbon steel pipe having factory applied exterior protective coating, and joints, fittings, and short lengths of pipe having field applied exterior protective coating materials.
 - a. Use electrical holiday detector in accordance with AWWA C213.
 - b. Repair damage to coating in accordance with AWWA C213.
- 3.1.7 Piping Identification: Identify exposed piping systems as to fluid carried and direction of flow in accordance with Appendix A.
- 3.1.8 Equipment Tag Features
 - 3.1.8.1 Blanks: 3/4 by 2-inch (unless legends require longer tags), with a 1/8-inch attachment wire hole, 3/16-inch from one end.

- 3.1.8.2 Characters: Use 1/8-inch stamped or engraved characters.
- 3.1.8.3 Legends: Provide the following information, unless otherwise specified in the Drawings.
 - a. ICF KH part number
- 3.1.8.4 Attach identification tags to valves and other equipment as required.
- 3.2 FIELD QUALITY CONTROL
 - 3.2.1 Nondestructive Examination (NDE) of Welds shall be performed to the extent defined in ASME B31.3, Paragraph 341.4.
 - 3.2.1.1 Perform NDE for each pipe code listed in the schedule in 3.3.
 - 3.2.1.2 Visual examination: Perform in accordance with ASME B31.3, Paragraph 344.2. Acceptance criteria shall conform to ASME B31.3, Table 341.3.2A.
 - 3.2.1.3 Radiographic examination (RT): Perform in accordance with ASME B31.3, Paragraph 344.5. Acceptance criteria shall conform to ASME B31.3, Table 341.3.2A.
 - a. Identify radiographic film with weld identification number and project or work order number assigned to work covered by this Section.
 - b. Prepare radiographic examination reports as follows.
 - 1) List each radiographic exposure location (0-1, 1-2, ...) individually on radiographic examination report.
 - 2) Indicate location acceptability or rejectability and note discontinuities whether rejectable or not.
 - 3) When report includes radiographs of welds which have been repaired, indicate which welds are repair welds and how many times each weld has been repaired.
 - c. If additional welding is performed on weld area which has already been examined radiographically, this area is repair area. Identify subsequent radiographs by "R-1, R-2", etc.
 - 3.2.1.4 Perform in-process examination in accordance with ASME B31.3, Paragraph 344.7.
 - 3.2.1.5 Perform random visual examination of piping support welds in accordance with ASME B31.3, Paragraph 344.2.

3.2.1.6 NDE documentation:

- a. Document examination of pressure containment welds and welds to pressure containing components for piping systems on NDE/Weld Record Form KEH-0433. See Form KEH-0433 for instructions for recording weld identification drawings, weld numbers, welder identification, welding procedure numbers, weld filler material, visual examinations, nondestructive examinations, and for noting satisfactory completion of leak/pressure testing.
- b. Required NDE shall be completed and documented before starting leak/pressure testing.
- c. NDE/Weld Record information and weld maps specified in 3.1.4 may be incorporated on a single format or traveler for a specific work package.
- d. Document examination of pipe supports by recording on sketches or NDE/Weld Record form.

3.2.1.7 *Liquid Penetrant (dye penetrant) Examination (PT): Perform in accordance with ASME B31.3, paragraph 344.4. Acceptance criteria shall conform to ASME B31.3, paragraph 341.3.2.*

ECN-347
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ECN-347

3.2.2 Cleaning and Flushing

3.2.2.1 After NDE is complete and before leak/pressure testing the system, or before connecting the system into existing systems, clean piping internal surfaces mechanically or by flushing.

3.2.2.2 Mechanical cleaning: Remove loose dirt, scale, and debris by brushing, wiping, high pressure water jetting, or other mechanical method approved.

a. When high pressure water jetting or other mechanical cleaning method utilizing water is used, and leak/pressure testing will not be performed immediately after cleaning, dry piping systems by blowing dry oil-free air or nitrogen through lines.

b. Dry until the relative humidity of discharge air is equal to that of inlet air. Use drain taps at low points of piping system to ensure complete drainage and drying. Cap lines or reconnect to system to maintain cleanliness.

3.2.2.3 Water flushing:

a. Remove strainer screens before flushing, except those protecting control equipment. Clean screens protecting control equipment before flushing, if necessary, and after flushing is complete. Remove steam traps from line before flushing.

b. Flush piping with water for 1 minute minimum, and until effluent is clean and contains no visible particulate matter. Flushing pressure shall not exceed maximum operating pressure specified in pipe codes. Flushing water supply shall have sufficient capacity to produce a flow velocity of 4 to 6 ft/s in largest pipe size, with pipe full. Provide flow measurement in flushing water supply line to be used as basis for

verification of flow velocities in piping system by the Construction Engineer. Page 153

3.2.2.4 Pneumatic flushing: For Instrument Air (IA),
Nitrogen Line (N_2) and Encasement Lines (ENC) only.

- a. Isolate instruments by valving, plugging, or disconnecting.
- b. Blow lines clean with dry, oil-free air or nitrogen at 20 to 30 lb/in² gage, until discharge air has no visible particulate matter, or for 5 minutes minimum. If Pipe Code maximum operating pressures are lower, use those pressures.
- c. If leak/pressure testing is not performed immediately after flushing, cap lines or reconnect to system to maintain cleanliness.

3.2.2.5 Provide documented evidence that flushing or mechanical cleaning has been accomplished as specified in this Section.

3.2.3 Leak/Pressure Testing

3.2.3.1 General:

- a. After completion of flushing, perform leak/pressure testing of pipe in accordance with ASME B31.3 and this Section. Use calibrated gages with ranges 1-1/2 to 2 4 times the test pressure. ECN-201
- b. Document testing of each piping system on "Leak/Pressure Test Certification" Form KEH-1757. Use separate forms to describe and record each piping system. Under "Description" describe piping system in enough detail for correlation to weld identification drawings, shop fabrication drawings, or Project Drawings as applicable. For systems tested segmentally, indicate continuity in "Description" to assure that entire systems have been tested.
- c. Pipe joints, fittings, welds and other potential leak sources to be tested shall be visible and accessible during tests.
- d. Install one temporary relief valve during testing. Relief valve shall have a discharge capacity of 125% of capacity of the pressurizing device, and be set to operate at 1-1/3 maximum of the test pressure for hydrostatic testing and not higher than test pressure plus the lesser of 50 lb/in² or 10% of the test pressure for pneumatic testing. Tag each relief valve used to show serial number, inspector, date, and pressure setting.
- e. Install necessary restraining devices, before applying test pressure, to prevent distortion or displacement of piping.
- f. Isolate instruments and other items which could be damaged by test pressures.
- g. Continuously maintain test pressure for 10 minutes minimum. Examine joints, welds and connections. Piping system, shall show no visual evidence of weeping or leaking.

h. Visually examine piping and tubing joints, fittings, welds and other potential leak sources, including welds which attach wear plates, anchors, etc to piping systems, during testing.

i. Complete testing of piping before field application of insulation or protective coating. Pipe with factory applied protective coating shall be considered as having been tested before protective coating application.

3.2.3.2 Hydrostatic pressure testing:

a. Perform in accordance with ASME B31.3, Paragraph 345.4.

b. Test piping systems with removable jumper assemblies without jumpers in place. Test jumper assemblies as shown on the Drawings.

c. Purge air from piping systems during filling, before applying pressure.

d. Coat welded piping joints, fittings, and other potential leak sources, including welds attaching wear plates, anchors, etc, to piping systems, with a mixture of powdered blue chalk and water or isopropyl alcohol. Allow to dry before filling piping with water and inspecting for leaks.

e. Remove water from tabulated piping systems after testing and dry by blowing dry, oil-free air or nitrogen through lines. Dry until the relative humidity of discharge air is equal to that of inlet air. Use drain taps at low points of piping systems to ensure complete drainage and drying.

3.2.3.3 *Pneumatic Pressure Testing: For Instrument Air (IA), Nitrogen Line (N₂) and Encasement Lines (ENC) only.*

ECN-130/248

a. Perform in accordance with ASME B31.3, paragraph 345.5.

b. Perform test with dry, oil free air or nitrogen on piping systems.

ECN-130/248

3.2.3.4 *Final Connections:*

ECN-347/454

Final connections, as defined in this section, shall be exempt from the requirements of Leak/Pressure Testing and shall be In-Process Examined. Welds shall have their first and last pass Liquid Penetrant Examined. See paragraphs 3.2.1.4 and 3.2.1.7 respectively. Connection welds are defined as follows:

1. 4" SL-100-M9, and 6" ENC-M26a, at N42960.40' and W42843.16'.

2. 4" SN-200-M9, and 6" ENC-M26a, at N42903.40' and W48255.66'.

ECN-347/454

3. Welds on either end of the weld nipple connecting the spool piece through the pit walls to the first elbow on 2" ENC DR-M26a at the following approximate locations:

ECN-358/
446/438

a. N42963.28' and W48243.16'

ECN-358/
446/438

b. N42902.40' and W48255.66'.

- 4. Non pressure containing welds between the encasements and their anchorage plates on the exterior wall of the 6" ECN M26a encasements referenced above. ECN-358
ECN-358
- 5. Attachment weld to the 2" radiation monitor in port A and port B. ECN-446
- 6. Attachment weld to the 6" vent port.
- 7. Attachment weld where the chain guide support welds to the 2" DR-306-M9. ECN-446

3.3 SCHEDULES

3.3.1 Schedule of Pipe Weld NDE/Testing

NDE/NDT Method	Pipe Codes						
	M-5	M-7	M-9 (SC2 and SC3)	M-26a			
Visual							
Fitup							
Root Pass							
Cover Pass	(C)(D)	(C)(D)	(C)(D)	(C)(D)			
Liquid Penetrant							
Root Pass							
Cover Pass							
Magnetic Particle							
Root Pass							
Cover Pass							
Radiographic							
Completed Weld	(E)(B)	(E)(B)	(E)(B)				
Leak/Pressure							
Completed Weld	A	A	A	A			
Other							
<p>Legend:</p> <ul style="list-style-type: none"> A. Requires witnessing and acceptance by a certified inspector. B. Requires acceptance of radiographs and documentation by Level II or higher. C. Random Visual Examination for 5% of all circumferential welds, full penetration welds on branch connections and attachment welds to pipe. D. 100% visual examination of longitudinal welds. E. Random radiography for 5% of all primary circumferential welds. In-process examination may be performed in lieu of radiography. 							

PIPE CODE M-5 (Safety Class 3 General Service)			
Service	Max Operating Pressure lb/in ² gage	Test Pressure lb/in ² gage	Max Operating Temp °F
Raw Water (RAW)	160	240	100
Sizes	all		
Pipe	ASTM A 53, Type E, Grade B black steel, or ASTM A 106, Grade B.		
Wall Thickness	Schedule 40		
Nipples	Same schedule as pipe, close or butt not permitted.		
Fittings (1)	Class 150, ASTM A 47, Grade 32510 or 35018, or ASTM 197, threaded in accordance with ASME B16.3.		
Unions	Class 150, ASTM A 47, Grade 32510 or 35018, or A 197, threaded in accordance with ASME B16.3, bronze to iron seat. No buried unions.		
Flanges	Class 150, ASTM A 105, raised face, weld neck, in accordance with ASME B16.5. Bore to match pipe ID. Use flat face where mating to flat face flanges.		
Bolting	ASTM A 193, Grade B6, alloy steel studs, and ASTM A 194, Grade 2, heavy hex nuts.		
Gaskets	Compressed fiber, nonasbestos, 1/16-inch thick sheet; Garlock "Blue-Gard" Style 3100. Use full face gaskets with flat face flanges.		
(1) For inaccessible or underground lines use ASME B16.9, material in accordance with ASTM A 234, Grade WPB, wall thickness to match pipe.			

PIPE CODE M-5 (~~Safety Class 3~~ General Service)

Valves	Class 150, ASTM B 62, bronze body, threaded ends, in accordance with MSS SP-80 for gate, globe and check.
Gate	Union bonnet, solid wedge disc, rising stem. Crane No. 431UB Powell Fig. 2714
Globe	Union bonnet, composition disc, rising stem. Crane No. 7TF Powell Fig. 150
Angle	Union bonnet, composition disc, rising stem. Crane No. 17TF Powell Fig. 151
Check	Threaded in cap, Y-pattern, swing, composition disc. Crane No. 137 Powell Fig. 596
Ball	3 piece, brass body, 316 stainless steel ball, teflon seats and body seal, threaded ends. Powell Fig. 4301T Worcester No. 416TSE

PIPE CODE M-7 (Safety Class 3 General Service)			
Service	Max Operating Pressure lb/in ² gage	Test Pressure lb/in ² gage	Max Operating Temp. °F
Instrument Air (IA)	100	150/110	100
Instrument Air (IA)	20	30/22	100
Sizes	All		
Pipe	ASTM A 53, Type E, Grade B, or ASTM A 106, Grade B.		
Wall Thickness	Schedule 40		
Nipples	Schedule 40		
Fittings (1)	Class 150, ASTM A 47, Grade 32510 or 35018, or A 197, threaded in accordance with ASME B16.3.		
Unions	Class 150, ASTM A 47, Grade 32510 or 35018, or A 197, threaded in accordance with ASME B16.3, bronze to iron seat. No buried unions.		
Flanges	Class 150, ASTM A 105, raised face, weld neck, in accordance with ASME B16.5. Bore to match pipe ID. Use flat face where mating to flat face flanges.		
Bolting	ASTM A 193, Grade B6, alloy steel studs, and ASTM A 194, Grade 2, heavy hex nuts.		
Gaskets	Compressed fiber, nonasbestos, 1/16-inch thick sheet; Garlock "Blue-Gard" Style 3100. Use full face gaskets with flat face flanges.		
(1) For inaccessible or underground lines use ASME B16.9, material in accordance with ASTM A 234, Grade WPB, wall thickness to match pipe.			

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PIPE CODE M-7 (Safety Class 3 General Service)	
Valves	ASTM B 62, Class 150, bronze body, threaded ends, in accordance with MSS SP-80 for gate, globe, angle, and check.
Gate	Union bonnet, solid wedge disc, rising stem.
Globe	Crane No. 431UB Powell Fig. 2714 Union bonnet, composition disc, rising stem.
Angle	Crane No. 7TF Powell Fig. 150 Union bonnet, composition disc, rising stem.
Check	Crane No. 17TF Powell Fig. 151 Threaded in cap, Y-pattern, swing, composition disc.
Ball	Crane No. 137 Powell Fig. 596 3 piece, brass body, chrome plated brass ball, teflon seats and body seal, threaded ends. Powell Fig. 4301T Worcester No. 416TSE

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**PIPE CODE M-9 (Safety Class 2 and 3
 Safety Significant and General Service)**

Service	Max Operating Pressure lb/in ² gage	Test Pressure lb/in ² gage	Max Operating Temp °F
Supernate (SN) (SC 2)	320	480	180
Slurry (SL) (SC 2)	320	480	180
Flush Water (FL) (SC 3)	133 150	200 225	120 200
Drain (DR) (SC 3)	60	90	100
Sizes	All		
Pipe	ASTM A 312, Grade TP 304L, seamless.		
Wall Thickness	Schedule 40S		
Fittings	ASTM A 403, Class WP 304L, buttwelding in accordance with ASME B16.9, wall thickness to match pipe- ASTM A403, Class WP 304L, buttwelding in accordance with ASME B16.9 or ASTM A 182, Grade F 304L, socket welding in accordance with ASME B16.11. Wall thickness to match pipe.		
Flanges	ASTM A 182, Grade F 304L, Class 150, forged, raised face, weld neck in accordance with ASME B16.5. Bore to match pipe ID. Use flat face where mating to flat face flanges.		
Bolting	ASTM A 193, Grade B8, alloy steel studs and ASTM A 194, Grade 8F heavy hex nuts.		
Gaskets	Spiral wound, non-asbestos, 0.175" thick, with 1/8" thick carbon steel gage ring; Garlock Guardian Type CR or Flexitallic Style CG with Flexite super filler. Use full face gaskets with flat face flanges; Garlock "Blue-Gard" Style 3000.		
Ball Valves	ASTM A 351, Grade CF8M, Class 150, socket butt welded ends, teflon gaskets and seals. 2 way with stainless steel ball. Worcester Series 59 PBM valve SP Series, PBM Code H.		

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ECN-130

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 ECN-130

PIPE CODE M-26a (Safety Class 3 General Service)			
Service	Max Operating Pressure lb/in ² gage	Test Pressure lb/in ² gage	Max Operating Temp °F
Supernate Line Encasement (ENC)	320	480 352	180
Slurry Line Encasement (ENC)	320	480 352	180
Drain Line Encasement (ENC)	60	90 66	180
Size	A11		
Pipe Grade	Carbon steel, ASTM A 106 Grade B.		
Wall Thickness	Schedule 40		
Fittings	Wrought carbon steel, ASTM A234, Grade WPB, butt welding in accordance with ANSI B 16.9 (schedule to match pipe).		
Flanges	Class 150 for Drain line Encasements, Class 300 for Supernate and Slurry Line Encasements, forged steel, ASTM A105, weldneck in accordance with ANSI B16.5 (bore to match pipe I.D.)		
Gaskets	Compressed fiber, nonasbestos, 1/16" thick sheet, Garlock "Blue Gard" style 3100. Use full face gaskets with flat face flanges.		
Bolting	Carbon steel, heavy hex head series bolts, ASTM A307, Grade B and heavy hex nuts, ASTM A563, Grade A.		
Valve	ASTM B 62, Class 150, 3-piece, carbon steel body, stainless steel ball, teflon seats and body seals, butt welded ends		
Ball	PBM No. 2-SPE-37-BW2		

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PIPE CODE M-24 (Safety Class 3 General Service)			
Service	Max Operating Pressure	Test Pressure	Max Operating Temp
Drain (DR)	20 Psig	30 Psig	100 °F
Size	A11		
Pipe	Carbon steel, ASTM A 106 Grade B.		
Wall Thickness	Schedule 80		
Fittings	Class 150, ASTM A47, Grade 32510 or 35018; or A197, threaded in accordance with ASME B 16.3.		
Globe Valve	Class 150, ASTM B62, bronze body, Union bonnet, Composition disc., rising stem, in accordance with MSS-SP-80. Crane No. 7TF Powell Fig. 150		

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PIPE CODE M-33b (Safety Class 3 General Service)			
Service	Max Operating Pressure (PSIG)	Test Pressure (PSIG)	Max Operating Temp °F
Nitrogen Pump Seal Purge (N ₂)	450	495	120
Sizes	1/2" and smaller		over 1/2"
Tubing	ASTM A 269, Grade TP 304, 304L or 316 annealed, seamless, stainless steel. Buried tubing: PVC (or polyethylene) coated 0.032" thick. Parker fluid connectors #1 SST or approved equal.		
Wall Thickness	0.035"		0.049"
Fittings (Above Ground)	Type 316 stainless steel, flareless type; Crawford fittings "Swagelok", or Parker "CPI".		
Fittings (Buried)	Type 316 stainless steel, automatic tube weld type; Crawford fittings, "Cajon", or Parker fluid connectors.		

ECN-246

1. GENERAL

The identification of piping systems shall be in accordance with the American Standard Scheme for the Identification of Piping Systems, ANSI A13.1, as supplemented herein.

2. LOCATION

a. Except as provided below, identification shall be located adjacent to outlets, valves, flanges, unions, changes-in-direction, where pipes pass through walls, floors, or ceilings, and along an uninterrupted length of pipe at maximum intervals of 50 feet. Each line or branch in a room shall have at least one identification.

b. Where a number of outlets, valves, flanges, unions, or changes of direction make identification at each item impracticable, they may be spaced at approximate 6 foot intervals, preferably adjacent to valves.

c. Legend shall be located on the pipe so that it can be read easily from the operator's normal viewing position. Labels shall be placed on the readily visible lower quadrant of overhead pipes, and on an upper quadrant of pipes below normal eye level. Above ceilings, labels shall be placed in locations most readily visible from access positions.

3. LEGEND

a. Positive identification of a piping system content shall be by lettered legend giving the name of the content in full or abbreviated form. Legends may also be as specified on drawings or in other specifications.

b. Abbreviation of words in the legend may be used only where unavoidable due to space limitations.

c. The legend shall include the nominal operating pressure for steam, compressed air, and when specified, the pressure or temperature for other materials.

d. An arrow indicating the direction of flow shall be placed near the legend on pipes normally having a flow in one direction only. The color and size of the arrow shall be consistent with the color and size of the legend letters.

e. Legend shall be located on or adjacent to the classification color band.

4.

APPROVED LABELS

a. Legend and color classification may be accomplished by the use of approved labels conforming to this Standard and which are suitable for the temperature of the surface to which they are to be applied. Approved labels include the following.

ALL-TEMPERATURE PIPE MARKERS
W. H. Brady Company
727 West Glendale Avenue
Milwaukee, Wisconsin 53201

TEL-A-PIPES
Westline Products Division
Thomas & Betts Company
220 South Rose Street
Los Angeles, California 90012

b. Single-word labels may be combined to form complete legends. Individual-letter labels shall not be so combined.

c. Labels shall be installed after painting is complete.

5.

CLASSIFICATION COLOR

a. When use of classification colors is specified, they shall conform to Table 1.

Table 1			
Classification	Band or Label Color	Legend/Arrow Color	Approximate Color No. (FED-STD-595)
Dangerous	Yellow	Black (17038)	13655 (yellow)
Safe	Green	Black (17038)	14260 (green)

b. Paint, if used, shall conform to FS TT-E-489, Class A, for synthetic gloss enamel.

c. Classification colors shall conform to Table 2.

Table 2. Classification Colors.	
Material	Color
Steam	Yellow
Sanitary Water (SW)	Green
Process Sodium Hydroxide (NaOH)	Yellow
Raw Water (RW)	Green

END OF APPENDIX

SECTION 15505

UNCONTAMINATED AIR HVAC SYSTEMS

PART 1 - GENERAL

1.1 REFERENCES

- 1.1.1 The following documents, including others referenced therein, form part of this Section to the extent designated herein.
- 1.1.1.1 Air Movement and Control Association (AMCA)
211-1994 Certified Ratings Program - Air Performance
- 1.1.1.2 Federal Specifications (FS)
TT-S-00230C, AMD 2 Sealing Compound: Elastomeric Type, Single Component (For Caulking, Sealing and Glazing In Buildings and Other Structures)
- 1.1.1.3 Underwriters Laboratories (UL)
Electrical Construction and Utilization Equipment Directory 1994

1.2 SUBMITTALS

- 1.2.1 See Section 01300 for submittal procedures.
- 1.2.2 Approval Required
- 1.2.2.1 Approval Data: Before delivery, submit information listed in the Approval Data List in this Section.
- 1.2.3 Approval Not Required
- 1.2.3.1 Vendor Information: Before installation, submit information listed in the Vendor Information List in this Section.

1.3 SYSTEM DESCRIPTION

- 1.3.1 Provide heating and ventilation for the process building.

1.4 DELIVERY, STORAGE, AND HANDLING

- 1.4.1 See Section 01610 for general requirements.

PART 2 - PRODUCTS

2.1 SUBSTITUTES

- 2.1.1 See Section 01630 for substitution approvals.

2.2 MATERIALS

2.2.1 Painting: See Section 09900

2.2.2 Penetration Sealants: FS TT-S-00230, Type II, Class A, 1-component polyurethane, nonsag type, light-colored.

2.3 EQUIPMENT

2.3.1 Unit Heater (UH-1361 and UH-1362): Chromalox Model LUH-04-43, Horizontal Unit: 3-phase, 480 V, 4 kW, 5A or an approved substitute. Provide adjustable thermostat that can be set from 40 °F to 90 °F. Heaters shall be horizontal flow, forced air design. Heaters shall be supplied with wall mounting brackets.

2.3.2 Centrifugal Wall Ventilator (FN-1364): 1/8 hp, 1640 rpm, 560 scfm minimum at 0.1875 in H₂O external static pressure. The fan shall be wall mounted and direct drive type. Motor shall be Class 1, Group D. Bearings shall be permanently lubricated and permanently sealed. Ventilator shall be UL listed and ~~be~~ the AMCA 211 Certified. Rating ECN-197
Seal. Cook, Type ACW-D, Model 100W15DM (with birdscreen) or an approved substitute. ECN-197

2.3.3 Exhaust Damper: Damper frame shall be 21 by 21 inches, flangeless for inside duct work. Damper shall have adjustable return spring. Greenheck Model WD-400 or an approved substitute.

2.3.4 Intake Damper Assembly (F-1368): Damper size shall be 20 by 20 inches, flangeless for inside duct work installation. Damper shall have an adjustable return spring. Greenheck WD-400 or an approved substitute. A filter sleeve shall be installed between damper and louver to fit a 2 inch thick by 20- by 20-inch filter. Farr 30/30 or an approved substitute. Access door with snap latches shall be provided for filter removal. Louver shall be stationary type, 20 by 20 inches, with flange.

2.3.5 Air Inlet Louver (F-1368): Louver shall be stationary type, 20 by 20 inches, with flange. Louver shall have a removable bird screen, Greenheck ESJ-201 or an approved substitute.

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 Equipment

3.1.1.1 Install where shown on the Drawings, in accordance with the manufacturer's instructions.

3.1.1.2 Prime and paint in accordance with Section 09900. Paint containing lead is not acceptable.

3.2 FIELD QUALITY CONTROL

3.2.1 Inspection, verification and testing of equipment shall be performed in accordance with Section 15990.

SECTION 15507

CONTAMINATED AIR HVAC SYSTEMS

PART 1 - GENERAL

1.1 REFERENCES

- 1.1.1 The following documents, including others referenced therein, form part of this Section to the extent designated herein.
- 1.1.1.1 American National Standards Institute (ANSI)
- | | |
|------------|---|
| A13.1-1981 | Scheme for the Identification of Piping Systems |
|------------|---|
- 1.1.1.2 Air-Conditioning and Refrigeration Institute (ARI)
- | | |
|------------|--|
| ARI 410-91 | Forced-Circulation Air Cooling and Air Heating Coils |
|------------|--|
- 1.1.1.3 American Society of Mechanical Engineers (ASME)
- | | |
|-------------|---|
| B16.3-1992 | Malleable - Iron Threaded Fittings |
| B16.5-1992 | Pipe Flanges and Flanged Fittings |
| B16.9-1993 | Factory-Made Wrought Steel Buttwelding Fittings |
| B16.11-1991 | Forged Steel Fittings, Socket Welding & Threaded |
| B31.3-1993 | Chemical Plant and Petroleum Refinery Piping |
| NQA-1-1994 | Quality Assurance Program Requirements for Nuclear Facilities |
- 1.1.1.4 American Society for Nondestructive Testing (ASNT)
- | | |
|-----------|----------------------|
| SNT-TC-1A | Recommended Practice |
|-----------|----------------------|
- 1.1.1.5 American Society for Testing and Materials (ASTM)
- | | |
|-----------|--|
| A 53-93a | Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless |
| A 105-93b | Forgings, Carbon Steel, for Piping Components |
| A 106-94 | Seamless Carbon Steel Pipe for High Temperature Service |

A 182-92a	Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
A 193-93a	Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
A 194-93a	Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
A 234-92a	Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
A 240-88a	Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels
A 276-89	Stainless and Heat Resisting Steel Bars and Shapes
A 312-93	Seamless and Welded Austenitic Stainless Steel Pipes
A 403-93	Wrought Austenitic Stainless Steel Piping Fittings
C 449-88	Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
C 547-77	Mineral Fiber Preformed Pipe Insulation
D 1056-91 67	Flexible Cellular Materials - Sponge or Expanded Rubber
	ECN-197
1.1.1.6	American Welding Society (AWS)
	D1.1-94 Structural Welding Code Steel
	D1.3-89 Welding Sheet Steel and Structures
	D9.1-90 Sheet Metal Welding Code
1.1.1.7	Federal Specifications (FS)
	HH-I-558C Insulation, Blankets, Thermal (Mineral Fiber, Industrial Type)
	TT-S-00230C, AMD 2 Sealing Compound: Elastomeric Type, Single Component (For Caulking, Sealing and Glazing In Buildings and Other Structures)

TT-E-489H
NOT 1

Enamel, Alkyd, Gloss, Low VOC Content

- 1.1.1.8 Federal Standards (FED STD)
 - FED-STD-595B Colors Used in Government Procurement
- 1.1.1.9 Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)
 - SP-89, 1991 Pipe Hangers and Supports - Fabrication and Installation Practices
- 1.1.1.10 Underwriters Laboratories (UL)
 - Building Materials Directory 1994
 - Electrical Construction and Utilization Equipment Directory 1994
- 1.2 SUBMITTALS
 - 1.2.1 See Section 01300 for submittal procedures.
 - 1.2.2 Approval Required
 - 1.2.2.1 Approval data: Before delivery, submit information listed in the Approval Data List in this Section.
 - 1.2.2.2 Certified material test reports: Before delivery, submit legible reports, certified by responsible manufacturer of materials used in fabrication of tubing, pipe, fittings, flanges, bolting, and weld rod for pipe codes and services listed below. Reports shall present results of chemical analysis and physical tests specified in ASTM Codes and Standard Specifications for production lots and heats of materials. Submit separate reports for the following:
 - a. Pipe Code M-42; Service, Vent.
 - 1.2.2.3 Traceability history: Before fabrication, submit a work plan detailing the proposed method of maintaining records of specific locations of each item covered by a report.
 - 1.2.2.4 Material traceability (including heat/lot numbers) shall be maintained through fabrication for materials requiring Certified Material Test Reports.
 - 1.2.2.5 Quality Assurance Programs: Before delivery, submit documentation for programs specified in 1.4.4.

1.2.3 Approval Not Required

1.2.3.1 Vendor information: Before installation, submit information listed in the Vendor Information List in this Section.

1.2.3.2 Certificates of conformance: With delivery, submit a legible certificate, certified by equipment manufacturer or supplier, stating that materials used in fabrication of the "Pressure Seal Loops" (Pipe Code M-42: Service, Vent) meet the requirements of Drawings and this Section.

1.3 SYSTEM DESCRIPTION

1.3.1 Safety Class ~~±~~ System: The seal loop piping (Pipe Code M-42) is Safety Class ~~±~~ and is stainless steel pipe. ECN-807
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1.3.2 ~~Safety Class 3~~ General Services Systems: ECN-807

1.3.2.1 Ventilation system consists of stainless steel piping and duct for exhaust air of Tank C-106 that contains radioactive contaminants. A short section of the ventilation system is carbon steel pipe. A cooling coil will be installed in an existing ventilation system.

1.3.2.2 Chill water piping (carbon steel) will be installed underground from the Chiller Skid to the Process Building.

1.4 QUALITY ASSURANCE

1.4.1 Duct insulating materials shall be listed in the UL Building Materials Directory, and carry the UL mark.

1.4.2 Welding Qualifications

1.4.2.1 Qualification of welding and procedures (Pipe Codes M-4, M-8, and M-42): Personnel and procedures for welding pressure retaining components along with attachments hereto, and pipe supports, shall be qualified in accordance with ASME B31.3, Paragraph 328.2.

1.4.2.2 Qualification of Nondestructive Examination (NDE) Personnel

a. Visual weld examination shall be performed in accordance with ASME B31.3.

b. Personnel performing other NDE shall be certified in accordance with Contractor's written practice, which shall meet the requirements of ASNT-TC-1A. Use Level II personnel to interpret results.

1.4.2.3 Extent of Application: The above qualification requirements also apply for preliminary fabrication of parts, when fabrication is accomplished in shops other than the materials supplier shops, but not necessarily at the worksite.

1.4.3 Deliverable Documentation: The following documents and records, HNF-2534, Rev. 0
required by this Section, shall be delivered to Construction Document Page 178
Control (Buyer) in accordance with Section 01720.

<u>Document</u>	<u>Paragraph</u>
Welding Qualification	1.4.3
Welding Examination Documentation	3.2.1.6a
Flushing/Mechanical Cleaning Verification	3.2.6.1
Leak/Pressure Test Certification	3.2.8.1b

1.4.4 Safety Related Products: Safety Class 1 (Pipe Code M-42) products shall be procured from qualified suppliers having documented Quality Assurance Programs meeting ASME NQA-1 basic requirements I-18, ~~all sections and supplements.~~ ECN-807
ECN-197
ECN-197

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 See Section 01610 for general requirements.

PART 2 - PRODUCTS

2.1 SUBSTITUTES

2.1.1 See Section 01630 for substitution approvals.

2.2 MATERIALS

2.2.1 Pipe, Duct and Fittings: See the Pipe and Duct Codes in this Section, and details on the Drawings.

2.2.1.1 Material and weight shall be as specified in the Pipe Code for each piping system.

2.2.1.2 Close or butt nipples are not permitted, unless shown on the Drawings.

2.2.2 Pipe Joint Sealant (Lubricant) for Threaded Joints: Nonhardening teflon paste, Chesterton "Goldend" No. 7298, Federal Process Company "JC-30," or Lake Chemical Company "Slic-Tite."

2.2.3 Ductwork Insulation: Provide uniform thickness for each duct size and piece of equipment.

2.2.3.1 Insulation and adhesive shall have UL fire hazard classifications of 25 maximum for flame spread and 50 maximum for smoke developed.

2.2.3.2 Insulation corrosive and moisture adsorption characteristics shall be in accordance with FS HH-I-558.

2.2.3.3 Insulation for exterior surfaces of outdoor duct and housings:
 1 1/2-inch thick Glass fiberboard, 3 lb/ft³, minimum density,
 6 lb/ft²; Manville No. 817 Spin-Glas board.

2.2.3.4 Weatherproofing: Foster "Sealfas" G.P.M. 35-00 mastic, with
 "Mast-A-Fab" reinforcing membrane.

2.2.3.5 Accessories

a. Mechanical Fasteners: Stick-Clips, Gemco insulation hangers with
 washers or type recommended by insulation manufacturer.

b. Cement: ASTM C 449; Pabco Pabcote No. 127

2.2.3.6 Duct insulation schedule:

Service	Insulation Thickness (inches)
Ventilation D-3	2

2.2.4 Painting: See Section 09900.

2.2.5 Outdoor Pipe Insulation Applications

a. ASTM C 547 molded, sectional, rigid fiberglass pipe covering,
 Glass Type 1 for temperatures up to 450 °F.

ECN-197

b. Metal jacket: Provide circumferential seam closure with straps
 (bands), or tape with metal foil backing, and silicone sealant to
 provide weathertight joints, 0.016-inch minimum aluminum sheet.

c. Straps (Bands): Aluminum, with protective coating, 3/8-inch
 minimum wide and 0.005-inch minimum thick.

d. Tape: 3-inch wide pressure sensitive metallic foil scrim kraft
 (FSK) tape; Nashua FSK or Ideal No. 491 FSK. Tape is applicable to
 aboveground chill water piping (Pipe Code M-4).

2.2.5.1 Insulating cement for forming insulation covering over fittings and
 valves: ASTM C 449. Cements that contain asbestos are not acceptable.

2.2.5.2 Outdoor piping insulation schedule

Service	Pipe Size (inches)	Insulation Thickness (inches)
Chilled Water (M-4, above ground)	3	1-1/4
Ventilation M-8	all sizes	1-1/2

2.2.6 Underground Pipe Insulation

2.2.6.1 Factory fabricated, preinsulated pipe units consisting of the fluid carrier pipe, polyurethane foam insulation and moisture barrier outer jacket.

2.2.6.2 Rigid polyurethane insulation for below grade piping: Sprayed foam-in-place 2-component system with minimum apparent overall density of 2.1 lb/ft³, approximately 95% closed cells, "k" factor of approximately 0.14 Btu·in/h·ft²·°F at 73 °F, and minimum compressive strength of 30 lb/in² parallel to rise. Jacket shall be PVC with wall thickness 0.060 inches minimum, Perma-Pipe/Ricwell insulated piping Systems, "Terra-Gard," Intergy Incorporated, or an approved substitute.

2.2.6.3 Underground Piping insulation schedule

Service	Pipe Size (inches)	Insulation Thickness (inches)
Chilled Water (M-4, below ground)	3	1-1/4

2.2.7 Pipe Supports: Standard, manufactured components as shown on the Drawings. Pipe supports and attachments welded to pressure containment boundaries may be noncertified material (does not apply to Safety Class 1), provided the material bears a type identifying mark, is suitable for welding, and compatible with the material to which it is attached.

ECN-807

2.2.8 Glycol Solution: Glycol solution shall consist of 46% glycol and 54% distilled water by volume. Total system volume is approximately 477 gallons for tank exhaust ventilation system. The glycol shall be an industrially inhibited propylene glycol (phosphate based) with dyed color to facilitate leak detection. Contractor is responsible for disposal/handling of glycol.

2.2.9 Material Limitations for Stainless Steel Components

2.2.9.1 Tape and adhesive leachable chloride content shall not exceed 15 ppm, and leachable fluoride content not to exceed 10 ppm. 3M Company preservation sealing tape No. 481, 9 mil thick, or Kendall Company Polyken Division No. 226. Materials which contact stainless steel piping and components during fabrication and shipping shall not exceed these limits.

2.2.9.2 Grinding or machining of stainless steel shall be done only with tools which are allocated specifically for use on stainless steel. Use of grinding compounds containing halogens is strictly prohibited. Wire brushing of stainless steel shall be done with stainless steel brushes that are new or have not been used on material other than stainless steel.

- 2.2.9.3 Water used for cleaning or flushing shall be limited to a chloride content of 25 ppm maximum. Cleaning solutions shall not contain halogenated compounds.
- 2.2.10 Penetration Sealants: FS TT-S-00230, Type II, Class A, 1-component polyurethane, nonsag type, light-colored.
- 2.2.11 Identification Tags: 0.0478-inch (18-gage) minimum thickness stainless steel.
- 2.2.12 Tag Attachment Wire: 20-gage, solid, stainless steel.
- 2.3 EQUIPMENT
- 2.3.1 Valves: Specified in Pipe Codes, unless shown otherwise on the Drawings.
- 2.3.2 Butterfly valves:

Valve No.	Size, inches	Type-Keystone	Operator	Pipe/Duct Code
HV-13643	8	Model 992	Notch plate handle	M-8
HV-136140	12	Model 992	30:1 handwheel gear operator	D-3
HV-136151	8	Model 992	Notch plate handle	M-8

- 2.3.3 Oil Level Gage (LG-1366 and LG-1367): 1/4-inch straight, positive vented, McMaster Carr, Catalog 90 No. 1141K37 or an approved substitute. (Safety Class 3)
- 2.3.4 Air Inlet Cooling Coil (CC-1361)
- 2.3.4.1 Coil covered by this Section is preassembled, flanged casing and frame, draw-through type. Horizontal coil selection procedures, capacities, and pressure drops in accordance with ARI 410. Coil will not be ARI certified. Make provisions for coil to be insulated and installed outdoors by ICF KH. Coil shall be Super Radiator Model 30x48-12R-58/168 or approved substitute.
- 2.3.4.2 See the Data Sheet CC-1361 of this Section for performance requirements.
- 2.3.4.3 Construction
 - a. Tubes, fins, and headers: Mechanically bonded. Minimum tube wall thickness: 0.035 inch. Maximum 14 fins per inch. 3-inch MNPT pipe end coolant connections. The inlet coolant connection shall be 2.25 inches from the bottom of the casing, 2.5 inches from the left side (facing connections) and the pipe end not to exceed 36 inches from the centerline of the coil. The outlet coolant connection shall be 2.25 inches from the top of the casing, 2.5 inches from the right side (facing connections), and the pipe end not to exceed 36 inches from the centerline of the coil.

b. Frame and casings: Welded airtight. 0.0598-inch (16-gage) minimum, with flange attachments on each end (non predrilled hole pattern). Limit operating deflection to 1 in 200 maximum, at 7.0 in H₂O suction pressure, with integral structural bracing. Provide flange clearance for assembly with gaskets and bolts. Provide provisions for mounting on a supporting base. Provide duct attachment flanges: 30 inch height (duct size), 56 inch length (duct size), 18 inch wide (flange to flange distance).

c. Configuration: Drainable coil, with threaded plugs for vent and drain.

d. Material: Vendor to select materials for a two year design life based on an air stream containing a light mist at 7.2 pH concentration.

- 2.3.4.4 Condensate drain provision: Cross break and pitch to 3/4 inch FPT drain connection in casing. Seal weld joints and corners of casing bottom.
- 2.3.4.5 Coil shall have been air tested, under water, at 150 psig. No leakage is allowed.

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 Equipment

3.1.1.1 Install where shown on the Drawings and in accordance with the manufacturer's instructions.

3.1.1.2 Prime and paint in accordance with Section 09900. Paint containing lead is not acceptable.

3.1.2 Piping

3.1.2.1 Fabricate and install pipe and tubing in accordance with ASME B31.3 (for normal service), the Drawings, and this Section. *Pipe codes M-4, M-8, and M-42 piping systems shall be fabricated using welded connections unless otherwise shown on the drawings.* ECN-261
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3.1.2.2 Cut pipe and tubing using methods which result in clean, straight cuts. Do not use tubing cutters on tubing utilizing compression fittings.

3.1.2.3 Ream pipe and tubing to nominal inside diameter after cutting. Remove burrs from threads before assembly.

3.1.2.4 Tools marked for stainless steel shall be used on stainless steel only.

- 3.1.2.5 Bend pipe and tubing in accordance with ASME B31.3, and meet tolerances given in ASME B31.3. Use methods and equipment which produce bends substantially free of wrinkles, bulges, or kinks. When wall thickness, diameter, and bend radius indicate possibility of wall collapse during bending, fill pipe or tubing with clean silica sand or fusible material similar to Cerro-bend, manufactured by Cerro Corporation.
 - a. Application of heat to facilitate a pipe bend shall be brought to the attention of the responsible engineer for direction and disposition.
 - b. Cold springing pipe permitted only if specified on the Drawings.
- 3.1.2.6 Make joints in threaded piping systems with joint sealant specified. Apply sealant to male threads only.
- 3.1.2.7 Install tubing fittings in accordance with the manufacturer's instructions.
- 3.1.2.8 Carbon steel embedded in concrete shall be bare.
- 3.1.2.9 Keep piping systems clean. Once fabrication has started, plug or cap ends of piping when installation is not in progress. Cap or plug openings in fabricated pipe spool assemblies until installation in the piping system. Leave ends of spare lines capped or blind flanged when installation has been completed.
- 3.1.2.10 Provide vents at high points to purge air pockets and drain taps at low points to ensure complete drainage and drying in piping systems using water for cleaning and leak/pressure testing. Venting may be provided by loosening flanges having minimum of 4 bolts.
- 3.1.2.11 Pipe supports: Install as shown on the Drawings, in accordance with manufacturer's instructions, and applicable recommended procedures of MSS SP-89.
- 3.1.2.12 Cleaning: Internal and external surfaces to be thermally cut or welded shall be clean and free from paint, oil, rust, scale and other material that would be detrimental to either the weld or the base metal when heat is applied.
- 3.1.3 Welding
 - 3.1.3.1 Weld piping, attachments to pressure retaining components, and pipe supports in accordance with ASME B31.3.
 - 3.1.3.2 Protect outdoor welding operation from rain and wind by using barriers to protect welder and weld joint.
 - 3.1.3.3 Complete piping welds before tie-in welds to valve pits, risers, or fixed items.
 - 3.1.3.4 Remove backing strips if used.

- 3.1.3.5 Weld duct in accordance with AWS D9.1. Weld duct supports in accordance with AWS D1.3 or AWS D1.1, as applicable.
- 3.1.4 Weld Identification
 - 3.1.4.1 Prepare weld maps, which show relative positions of pressure containing welds and attachment welds to pressure retaining components.
 - 3.1.4.2 Assign weld numbers to pressure containing welds and attachment welds to pressure retaining components as made. Record weld numbers on weld maps as welds are made.
 - 3.1.4.3 Place the welder identification symbol adjacent to welds upon completion. Place the identification symbol approximately every 3 feet on long seams or large weldments, using one of the marking methods specified in Section 01610.
 - 3.1.4.4 Do not reuse weld numbers. If a weld is completely replaced, assign a new number.
 - 3.1.4.5 Show heat/lot numbers on weld maps for materials requiring Certified Material Test Reports (Safety Class ±).
- 3.1.5 Piping Insulation
 - 3.1.5.1 Preformed
 - a. Apply after leak/pressure testing of line has been completed. Apply to pipe surfaces free of water, oil, dirt, loose scale, or other foreign material.
 - b. Abut sections and fill broken corners with insulating cement.
 - c. Install outdoor metal jacketed insulation in accordance with manufacturer's recommendations. Position longitudinal joints to shed water. Cover circumferential joints with sealing compound, secure in place with specified straps (bands) or tape. Apply straps (bands) or tape at mid point of 3-foot insulation sections.
 - d. Insulate valves and fittings in pipe lines smaller than 4 inches with insulating cement. Apply cement in accordance with manufacturer's recommendations.
 - e. Insulate valves and fittings in 4 to 14-inch pipe lines with sectional or block insulation of same material used on adjacent pipe, with same total thickness. Securely wire in place with 16-gage wire, and cover with 20-gage, 1 by 1-inch wire mesh, or glass fabric, stretched tightly over surface and fastened in place. Top insulation with 1/2-inch minimum thickness coating of insulating cement to present a smooth surface.
 - f. Mitered sections of straight jacketed pipe insulation may be used for fittings and elbows as an alternative to 3.1.5.1d and 3.1.5.1e.

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Cement mitered metal jacketed insulation joints with weatherproof seal and specified tape. Cement nonmetallic jacketed insulation joints with weatherproof seal and apply seal strips with lap adhesive.

g. Insulate flanges with sectional or block insulation of same material used on pipe. Terminate insulation on pipe adjacent to flanges with bevel far enough from flanges to permit removal of flange bolts. Insulate flanges to a thickness of 1/2-inch less than adjacent pipe covering to allow for 1/2-inch cement finish. Flange insulation shall extend 2 inches over ends of pipe insulation. Wire flange insulation in place and cover with 1/2-inch minimum thickness layer of insulating cement.

h. Wrap unjacketed insulation, for outdoor applications, applied to flanges, fittings, and valves with glass fabric over wet coat of weatherproof sealant lapping joints at least 2-inches. Apply second coat of weatherproof sealant, 1/8-inch wet thickness, after first coat has dried.

i. Seal penetrations of jacket for hanger rods and clamps for outdoor applications with weatherproof sealant.

3.1.5.2 Underground Pipe Insulation

a. Install in accordance with manufacturer's recommended procedure. *Field kits provided by insulation manufacturer may not be suitable for some underground elbow configurations. These elbow joints shall not be sprayed with polyurethane insulation.*

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b. Side-wall retainers may be used to ensure uniform width and height of sprayed insulation.

3.1.6 Piping Identification: Identify exposed piping systems as to fluid carried and direction of flow as specified in Appendix A.

3.1.7 Underground Piping Excavating

3.1.7.1 Trenches: Excavate, backfill, and compact in accordance with Sections 02200 and 02225.

3.1.7.2 Place piping supports on undisturbed soil, or backfill placed and compacted in accordance with Section 02200.

3.1.7.3 Survey piping systems for elevation and location before final tie-in welds to valve pits, risers, or fixed items. Complete placement of supports and meet Specification and Drawing requirements before survey. Elevation and location shall be in accordance with the Drawings. After final tie-ins survey piping system again for final acceptance.

3.1.8 Duct

3.1.8.1 Fabricate duct in accordance with the Drawings and Duct Code D-3.

3.1.8.2 Test as specified in 3.2.8.4 before installing external insulation.

3.1.9 Duct Insulation

- 3.1.9.1 Surfaces to receive insulation shall be clean, free of moisture, oil, dirt, scale, rust, and other foreign material.
- 3.1.9.2 Insulation and finish materials shall be dry when installed.
- 3.1.9.3 Install a uniform thickness of insulation on each duct size.
- 3.1.9.4 Make installations continuous through sleeves and prepared openings, unless shown otherwise on the Drawings.
- 3.1.9.5 Score or groove insulation to fit contours of duct. Fill and seal scores, grooves, joints, and penetrations with insulating cement.
- 3.1.9.6 Where insulation abuts uninsulated surfaces, seal joints with mastic.
- 3.1.9.7 Outdoor Duct: Install insulation of 2 inches on exterior surfaces (see 2.2.3.3). Wrap insulation with two 1/8 inch wet coats of membrane reinforced mastic meeting the requirements of 2.2.3.4. Apply in accordance with manufacturers instructions.
- 3.1.9.8 Attach insulation to metal duct surfaces with adhered clips and washers of 2.2.3.5, and 100% coverage of insulation cement. Space clips 12 inches maximum on centers.

3.1.10 Identification Tag Features

- 3.1.10.1 Blanks: 3/4 by 2-inches (unless legends require longer tags), with a 1/8-inch attachment wire hole 3/16 inches in from one end.
- 3.1.10.2 Characters: Use 1/4-inch stamped or engraved characters.
- 3.1.10.3 Legends: Provide the part number, unless otherwise specified on the Drawings. Obtain information from the Data Sheets in this Specification, or the Drawings.
- 3.1.10.4 Attach identification tags to valves, instruments and other equipment with twisted wire or adhesive, as required. Use enough wire to produce 1-inch minimum installed lengths.

3.2 FIELD QUALITY CONTROL

3.2.1 Nondestructive Examination (NDE) of Welds for Piping

- 3.2.1.1 Perform NDE for each pipe code listed in the schedule in 3.3. Extent of required examination shall be in accordance with ASME B31.3, paragraph 341.4.1. Acceptance criteria for NDE shall be in accordance with ASME B31.3, paragraph 341.3.
- 3.2.1.2 Visual examination: Perform in accordance with ASME B31.3, Paragraph 344.2.

- 3.2.1.3 Radiographic examination (RT): Perform in accordance with ASME B31.3, Page 187 Paragraph 344.5.
- a. Identify radiographic film with weld identification number and project or work order number assigned to work covered by this Section. In process examination in accordance with ASME B31.3, paragraph 344.7 may be substituted for Radiography.
 - b. Prepare radiographic examination reports as follows.
 - 1) List each radiographic exposure location (0-1, 1-2, ...) individually on radiographic examination report.
 - 2) Indicate location acceptability or rejectability and note discontinuities whether rejectable or not.
 - 3) When report includes radiographs of welds which have been repaired, indicate which welds are repair welds and how many times each weld has been repaired.
 - c. If additional welding is performed on weld area which has already been examined radiographically, this area is repair area. Identify subsequent radiographs by "R-1, R-2", etc.
- 3.2.1.4 Perform 5% random examination of piping supports for all pipe code systems, except M-42 Vent (VT), in accordance with ASME B31.3, Paragraph 344.2.
- 3.2.1.5 For Safety Class 1 systems (Pipe Code M-42), perform 100% examination of piping supports in accordance with ASME B31.3, paragraph 344.2. ECN-807
- 3.2.1.6 NDE documentation:
- a. Document all examinations of pressure containment welds and welds to pressure containing components for piping systems on NDE/Weld Record Form KEH-0433 or similar. See Form KEH-0433 or similar for instructions for recording weld maps, weld numbers, welder identification, welding procedure numbers, weld filler material, visual examinations, nondestructive examinations, and for noting satisfactory completion of leak/pressure testing.
 - b. Required NDE shall be completed and documented before starting leak/pressure testing.
 - c. NDE/Weld Record information and weld maps specified in 3.1.4 may be incorporated on a single format or traveler for a specific work package.
 - d. Document examination of pipe supports by recording on sketches or NDE/Weld Record form.
- 3.2.1.7 *In-Process Examination: Perform in accordance with ASME B31.3, paragraph 344.7.* ECN-742
- 3.2.1.8 *Liquid Penetrant (Dye Penetrant) examination (PT): Perform in accordance with ASME B31.3, paragraph 344.4.* ECN-742

- 3.2.2 Nondestructive Examination (NDE) of welds for ducting.
- 3.2.2.1 Production welds shall be visually inspected in accordance with AWS D9.1.

- 3.2.2.2 Acceptance criteria for welds shall be in accordance with AWS D9.1.
- 3.2.3 Nondestructive Examination (NDE) of welds for duct supports.
- 3.2.3.1 Welds shall be visually inspected in accordance with AWS D1.3 or AWS D1.1, as applicable.
- 3.2.3.1 Acceptance criteria for welds shall be in accordance with AWS D1.3 or AWS D1.1, as applicable.
- 3.2.4 Flushing/Testing Preparation: Obtain direction for disposal of waste flushing and testing water from the Operating Contractor prior to generation of wastes.
- 3.2.5 Cleaning and Flushing
- 3.2.5.1 After fabrication and NDE is complete and before leak/pressure testing the system, or before connecting the system into existing systems, clean piping internal surfaces mechanically or by flushing as follows.

Service	Pipe Code	Cleaning Method
Chill Water	M-4	Water Flush or paragraph 3.2.6
Ventilation	M-8	Water Flush or paragraph 3.2.6
Pressure Relief	M-42	Water Flush or paragraph 3.2.6

- 3.2.5.2 Mechanical cleaning: Remove loose dirt, scale, and debris by brushing, wiping, high pressure water jetting, or other mechanical method approved by the Construction Engineer.
 - a. When high pressure water jetting or other mechanical cleaning method utilizing water is used, and leak/pressure testing will not be performed immediately after cleaning, dry piping systems by blowing dry oil-free air or nitrogen through lines.
 - b. Dry until the relative humidity of discharge air is equal to that of inlet air. Use drain taps at low points of piping system to ensure complete drainage and drying. Cap lines or reconnect to system to maintain cleanliness. Note, humidity measurements from inlet and exhaust shall be converted to the same pressure to verify equality.
- 3.2.5.3 Water flushing:
 - a. Remove strainer screens before flushing, except those protecting control equipment. Clean screens protecting control equipment before flushing, if necessary, and after flushing is complete.
 - b. Flush piping with water for 1 minute minimum, and until effluent is clean and contains no visible particulate matter. Flushing pressure shall not exceed maximum operating pressure specified in pipe codes. Flushing water supply shall have sufficient capacity to produce a flow

velocity of 4 to 6 ft/s in largest pipe size, with pipe full. Provide flow measurement in flushing water supply line to be used as basis for verification of flow velocities in piping system by the Construction Engineer.

- 3.2.6 Mechanical cleaning may be substituted for flushing if approved by the Construction Engineer.
- 3.2.6.1 Provide documented evidence that flushing or mechanical cleaning has been accomplished as specified in this Section.
- 3.2.7 Duct Cleaning
- 3.2.7.1 Provide necessary equipment, scaffolding, and materials for cleaning ductwork.
- 3.2.7.2 Remove debris from inside of new duct, then vacuum to remove small particles of rubbish and dust.
- 3.2.7.3 Replace duct section(s) removed for cleaning and those that have been damaged.
- 3.2.8 Leak/Pressure Testing of Piping
- 3.2.8.1 General:
- a. After completion of flushing and NDE, perform leak/pressure testing of pipe in accordance with ASME B31.3 and this Section. Use calibrated gages with ranges 1-1/2 to 2 4 times the test pressure. ECN-203
 - b. Document testing of each piping system on "Leak/Pressure Test Certification" Form KEH-1757 or similar form. Use separate forms to describe and record each piping system. Under "Description" describe piping system in enough detail for correlation to weld maps, shop fabrication drawings, and Project Drawings as applicable. For systems tested segmentally, indicate continuity in "Description" to assure that entire systems have been tested.
 - c. Pipe joints, fittings, and other potential leak sources to be tested shall be visible and accessible during tests.
 - d. Install one temporary relief valve during testing. Relief valve shall have a discharge capacity of 125% of capacity of the pressurizing device, and be set to operate at 1-1/3 maximum of the test pressure for hydrostatic testing and not higher than test pressure plus the lesser of 50 lb/in² or 10% of the test pressure for pneumatic testing. Tag each relief valve used to show serial number, inspector, date, and pressure setting.
 - e. Install necessary restraining devices, before applying test pressure, to prevent distortion or displacement of piping.
 - f. Isolate instruments and other items which could be damaged by test pressures.

g. Continuously maintain test pressure for 10 minutes minimum. Examine welds, joints and connections. Piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of weeping or leaking.

h. Visually examine piping, weld joints and tubing joints, fittings, and other potential leak sources, including welds which attach wear plates, anchors, etc to piping systems, during testing.

i. Complete testing of piping before field application of insulation or protective coating. Pipe with factory applied protective coating shall be considered as having been tested before protective coating application.

3.2.8.2 Pneumatic pressure testing:

a. Perform in accordance with ASME B31.3, Paragraph 345.5. Leaks may be detected by bubble method or equivalent method.

b. Perform testing with dry, oil-free air or nitrogen on tabulated piping systems.

Service	Pipe Code
Ventilation	M-4
Ventilation	M-8
Ventilation	M-42

3.2.8.3 Hydrostatic pressure testing:

a. Perform in accordance with ASME B31.3, Paragraph 345.4.

b. Obtain written approval of method of disposal of water used for testing from Operating Contractor.

c. Purge air from piping systems during filling, before applying pressure.

d. Coat welded piping joints, fittings, and other potential leak sources, including welds attaching wear plates, anchors, etc, to piping systems, with a mixture of powdered blue chalk and water or isopropyl alcohol. Allow to dry before filling piping with water and inspecting for leaks.

e. Remove water from tabulated piping systems after testing and dry by blowing dry, oil-free air or nitrogen through lines. Dry until the

relative humidity of discharge air is equal to that of inlet air. drain taps at low points of piping systems to ensure complete drainage and drying.

Service	Pipe Code
Chill Water	M-4

- 3.2.8.4 Leak/Pressure Testing of Ductwork (Duct Code D-3): Perform in the presence of the Quality Control Inspector unless otherwise instructed in writing. ~~Test is required for new duct from Tank C-106 to valve HV-136140.~~ ECN-231
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- Pressurize the duct to a pressure of + 6"W.G. With test boundary under continuous pressure, examine pressure boundaries of duct for leaks.
 - Test duration shall be 15 minutes minimum, plus additional time as necessary for finding leaks.
 - No leakage is allowed at + 6"W.G.
 - Examine joints and other potential leak sources during testing. Leaks may be detected by bubble method or electronic sound detection. Repair detectable leaks and retest the system.
 - Document ductwork testing on "Leak/Pressure Test Certification," Form KEH-1757 or similar form.
- 3.2.8.5 *Final connections: Final connections, as defined in this Section, shall be exempt from the requirements of Leak/Pressure Testing and shall be In-process Examined, Welds shall have their first and last pass Liquid Penetrant Examined. See paragraphs 3.2.1.7 and 3.2.1.8, respectively. Final connection welds are defined as follows:* ECN-742
- 3" CWS-803-M4 where it connects to Valve HV-13636.
 - 3" CWR-850-M4 where it connects to a spool piece and where the the spool piece connects to the short radius elbow (just before Valve HV-13635). ECN-742
- 3.2.9 Safety Related Product Inspections: ICF KH will perform the following inspections on Safety Class 1 (Pipe Code M-42) components. Document inspections on Form KEH-0137 or similar. ECN-807
- 3.2.9.1 Prior to welding, verify the internal diameters of the following components (see Drawing H-2-818477 for additional details).

Item No.	Component
11	6-inch Schedule 40 pipe
12	6-inch flange
13	6-inch elbow, short radius
14	6-inch return, 180 degree short radius
16	Gasket

At each end of component, approximately 1/2 inch into component, measure 2 internal diameters, approximately 90 degrees from each other. The gasket only requires 2 internal diameter measurements. The average internal diameter for each component shall be greater than 5.9 inches.

- 3.2.9.2 Following welding and prior to installation, verify that Dimension "A" of the assemblies is 5.8 ± 0.09 inches, as shown on Drawing H-2-818477. Detail-B. The wall thickness of pipe at Dimension "A" may be measured prior to welding. Page 194
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- 3.2.10 Chill Water System Filling: After completion of pressure testing, fill the chill water systems with glycol/water mixture. Exercise care in venting the system to prevent air blocks.

3.3 SCHEDULES

3.3.1 Schedule of Pipe Weld NDE/Testing

	Pipe Codes						
	M-4	M-8	M-42				
NDE/NDT Method							
Visual	A	A	A				
Fitup							
Root Pass							
Cover Pass							
Liquid Penetrant							
Root Pass							
Cover Pass							
Magnetic Particle							
Root Pass							
Cover Pass							
Radiographic							
Completed Weld	B	B	B				
Leak/Pressure							
Completed Weld							
Other							
<p>Legend: A. Visual examination of at least 5% of fabrication welds.</p> <p>B. Not less than 5% of circumferential butt welds shall be examined fully by random radiography. In-process visual examination may be performed in lieu of radiography.</p>							

DUCT CODE D-3 (Safety Class 3 General Service)			
Service	Max Operating Pressure " W.G.	Test Pressure " W.G.	Max Operating Temp °F
Ventilation (VT) Package 4	-6/+6	+ 6	120
Duct Material	Gage as shown on Drawings. Stainless steel sheet, ASTM A 240, Type 304L. Stainless steel shapes, ASTM A 276, Type 304L. Slip-on flanges: Light weight, stainless steel, Alaska Copper Works SK-37, or an approved substitute.		
Fittings	For threaded fittings, ASTM A182, GR F 304L, ASTM B16.11		
Duct Construction	As shown on the Drawings and as specified in this Section.		
Duct Welding	Butt type welding with full penetration weld on seams. Companion angle flanges shall be seal welded to duct, or as noted on the Drawings.		
Duct Support	As specified on Drawings.		
Gaskets	Oil Resistant, Closed Cell Rubber, ASTM D 1056, Type 202 SCE-43 , 1/4" thick. Installed gaskets shall have dovetail corners or <i>Gore-Tex gasket tape ASTM F104 (F428331)</i> .		
Fasteners	Bolts, ASTM A 193, Grade B8. Heavy hex nuts, ASTM A 194, Grade 8F, UNC threads.		
Flange	F. H. Maloney or approved substitute. Type E, polyethylene sleeve, single washers.		
Isolation Sets	Keystone, Model 992 or approved substitute.		
Butterfly	Stainless Steel Cast Iron, Class 150, EPR/EPDM Seats.		

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PIPE CODE M-4 (Safety Class 3 General Service)			
Service	Max Operating Pressure lb/in ² gage	Test Pressure lb/in ² gage	Max Operating Temp °F (see Note 2)
Chilled Water Supply (CWS)	75	113	60
Chilled Water Return (CWR) See Note 1, Package 4	75	113	60
Sizes	All sizes		
Pipe	ASTM A 53, Type E or S, Grade B black steel or ASTM A 106, Grade B		
Wall Thickness	Schedule 40		
Nipples	Same schedule as pipe.		
Fittings	ASTM A 234, Grade WPB, wrought steel, buttwelding in accordance with ASME B16.9. Wall thickness to match pipe.		
Unions	As shown on Drawings		
Flanges	ASTM A 105, Class 150, raised face, weld neck, in accordance with ASME B16.5. Bore to match pipe ID. Use slip-on for sizes 8-inch and larger. Use flat face where mating to flat face flanges. ASTM A 105, Class 150, raised face, threaded in accordance with ASME B16.3, as specified on Drawing.		
Bolting	ASTM A 193, Grade B6, alloy steel studs, and ASTM A 194, Grade 2, heavy hex nuts.		
Gaskets	Compressed fiber, nonasbestos, 1/16-inch thick sheet; Garlock "Blue-Gard" Style 3000. Use full face gaskets with flat face flanges.		
Ball Valve	Pittsburg Brass Manufacturing Co., Model SP, standard trim, carbon steel, Class 150, BW ends		
Automatic Air Vent	Armstrong, Model AAE-750, standard trim, FNPT ends		
Flange Isolation Sets	F. H. Maloney or approved substitute. Type E, polyethylene sleeve, single washers.		
3-Way	Pittsburg Brass Manufacturing Co., Model MP, standard trim, carbon steel, Class 150, BW ends		
Balancing Valve	Bell & Gossett, Model CB-3, NPT ends, bronze/brass, std trim, w/molded insulation, class 150 or approved substitute		
1)	Short sections of piping in accordance with Pipe Code M-4 are required to mate an existing carbon steel ventilation systems to the new stainless steel ventilation system. The short sections shall be tested and insulated in accordance with Pipe Code M-8 and Duct Code D-3, as applicable.		
2)	Actual start-up condition temperature may reach 106 °F.		

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PIPE CODE M-8 (Safety Class 3 General Service)			
Service	Max Operating Pressure inches water gage	Test Pressure lb/in ² gage	Max Operating Temp °F
Ventilation (VT) Package 4 see Note 1	-40/+40	15	120
Sizes	All sizes		
Pipe	ASTM A 312, Grade TP 304L, seamless.		
Wall Thickness	Schedule 40S		
Fittings	ASTM A 403, Class WP 304L, buttwelding in accordance with ASME B16.9, wall thickness to match pipe. For threaded fittings, ASTM A182, GR F 304L, ASME B16.11, as specified on Drawing.		
Flanges	ASTM A 182, Grade F 304L, Class 150, forged, raised face, weld neck in accordance with ASME B16.5. Bore to match pipe ID. Use flat face where mating to flat face flanges.		
Bolting	ASTM A 193, Grade B8, alloy steel studs, and ASTM A 194, Grade 8F, heavy hex nuts.		
Gaskets	Ethylene Propylene Rubber (EPR), 1/16" thick. Use full face gaskets with flat face flanges. Garlock "Blue-Gard" style 3700.		
Butterfly Valves	Keystone, Model 992 or approved substitute. Stainless Steel, Class 150, EPR/EPDM Seats.		
Flange Isolation Sets	F. H. Maloney or approved substitute. Type E, Neoprene coated phenolic, polyethylene sleeve, single washers.		
Ball Valves	Pittsburg Brass Manufacturing Co., Model SP, Standard Trim, SST, Class 150, BW ends		
1)	A short section of piping in accordance with Pipe Code M-8 is required for the new stainless steel ventilation system. The short sections shall be tested in accordance with 3.2.8.3 & 4.		

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PIPE CODE M-42 (Safety Class ±)			
Service	Max Operating Pressure inches water gage	Test Pressure lb/in ² gage	Max Operating Temp °F
Vent (VT) (see Note 1)	-6/+6	15	120
Size	6-inch		
Pipe	ASTM A 312, Grade TP 304L, seamless.		
Wall Thickness	Sch 40S		
Fittings	Stainless Steel, ASTM A 403, Class WP 304L, butt welding in accordance with ASME B16.9, wall thickness to match pipe.		
Half Coupling	2000 psi, ASTM A 182, Grade F 304		
Flanges	ASTM A 182, Grade F 304L, Class 150, forged, raised face, weld neck in accordance with ASME B16.5. Bore to match pipe ID. Use flat face where mating to flat face flanges.		
Bolting	ASTM A 193, Grade B8, alloy steel studs, and ASTM A 194, Grade 8F, heavy hex nuts.		
Gaskets	Compressed fiber, nonasbestos, 1/16" thick sheet: Garlock "Blue-Gard" Style 3000. Use full face gaskets with flat face flanges. <i>Non-Safety Class 1</i>		
1)	Qualified supplier required for all pressure boundary material, reference 1.4.5 4.		

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Cooling capacity: Maintain the following conditions.

- a. Inlet air temperatures: 115°F DB and 67°F WB.
- b. Outlet air temperatures: 40°F DB.
- c. Air flowrate: 2300 standard cubic feet per minute.
- d. Static air pressure drop across coil: 1.0 inH₂O maximum.
- e. Cooling medium: chilled water/propylene glycol mixture supplied at 110 gal/min and 33°F.
- f. Water pressure drop across coil: 23 feet H₂O maximum.
- g. Cooling medium properties:
 1. 46% (by volume) inhibited propylene glycol and water solution.
 2. Specific Heat: 0.82 Btu/lb
 3. Density: 65.5 lb/ft³
 4. Thermal Conductance: 0.21 Btu*ft/h*ft²*°F
 5. Viscosity: 15 cps

TO BE FURNISHED BY VENDOR

- h. Fin height: _____
- i. Fin length: _____
- j. Fins per inch: _____
- k. Number of rows: _____
- l. Number of circuits: _____
- m. Coil capacity rating (Btu/h): _____

1. GENERAL

The identification of piping systems shall be in accordance with the American Standard Scheme for the Identification of Piping Systems, ANSI A13.1, as supplemented herein.

2. LOCATION

a. Except as provided below, identification shall be located adjacent to outlets, valves, flanges, unions, changes-in-direction, where pipes pass through walls, floors, or ceilings, and along an uninterrupted length of pipe at maximum intervals of 50 feet. Each line or branch in a room shall have at least one identification.

b. Where a number of outlets, valves, flanges, unions, or changes of direction make identification at each item impracticable, they may be spaced at approximate 6 foot intervals, preferably adjacent to valves.

c. Legend shall be located on the pipe so that it can be read easily from the operator's normal viewing position. Labels shall be placed on the readily visible lower quadrant of overhead pipes, and on an upper quadrant of pipes below normal eye level. Above ceilings, labels shall be placed in locations most readily visible from access positions.

3. LEGEND

a. Positive identification of a piping system content shall be by lettered legend giving the name of the content in full or abbreviated form. Legends may also be as specified on drawings or in other specifications.

b. Abbreviation of words in the legend may be used only where unavoidable due to space limitations.

c. The legend shall include the nominal operating pressure for steam, compressed air, and when specified, the pressure or temperature for other materials.

d. An arrow indicating the direction of flow shall be placed near the legend on pipes normally having a flow in one direction only. The color and size of the arrow shall be consistent with the color and size of the legend letters.

e. Legend shall be located on or adjacent to the classification color band.

4. APPROVED LABELS

a. Legend and color classification may be accomplished by the use of approved labels conforming to this Standard and which are suitable for the temperature of the surface to which they are to be applied. Approved labels include the following.

ALL-TEMPERATURE PIPE MARKERS
W. H. Brady Company
727 West Glendale Avenue
Milwaukee, Wisconsin 53201

TEL-A-PIPES
Westline Products Division
Thomas & Betts Company
220 South Rose Street
Los Angeles, California 90012

b. Single-word labels may be combined to form complete legends. Individual-letter labels shall not be so combined.

c. Labels shall be installed after painting is complete.

5. CLASSIFICATION COLOR

a. When use of classification colors is specified, they shall conform to Table 1.

Classification	Band or Label Color	Legend/Arrow Color	Approximate Color No. (FED-STD-595)
Dangerous	Yellow	Black (17038)	13655 (yellow)
Safe	Green	Black (17038)	14260 (green)

b. Paint, if used, shall conform to FS TT-E-489, Class A, for synthetic gloss enamel.

c. Classification colors shall conform to Table 2.

Material	Color
Ventilation (VT)	Yellow
Chill Water (CW)	Green

SECTION 15990

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 REFERENCES

1.1.1 The following documents, including others referenced therein, form part of this Section to the extent designated herein.

1.1.1.1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

HVAC Systems--Testing, 1983, 1st Edition
Adjusting and Balancing

1.2 SUBMITTALS

1.2.1 See Section 01300 for submittal procedures.

1.2.2 Approval Required: None

1.2.3 Approval Not Required

1.2.3.1 Testing data: Upon completion of testing and adjusting, submit records on SMACNA forms or similar forms, dated and signed by the subcontractor who performed the work verifying results of tests required in 3.3.

1.3 QUALITY ASSURANCE

1.3.1 See Section 01400 for quality assurance.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

3.1.1 Testing shall be performed on heating and cooling units (AC-1361 and AC-1362) on seismic enclosures (241-C-51A and 241-C-51B), air-conditioning unit (AC-1363) on electrical equipment skid (241-C-51), and process building heaters (UH-1361 and UH-1362).

3.1.2 Examine systems to be tested, and their associated Project Record Documents. Verify that equipment has been prepared for operation in accordance with factory instructions, that equipment operation has been checked in accordance with system specification requirements, and that cleaning has been completed as required.

3.2 PREPARATION

3.2.1 Verify that filters of the required sizes and types are in place and clean.

3.2.2 Inspect all factory and field wiring for loose connections.

3.2.3 Verify that dampers are set in their correct position.

3.3 FUNCTIONAL TESTING OF HVAC SYSTEMS

3.3.1 Electric Heating Unit(s) (UH-1361, UH-1362, AC-1361, AC-1362, and AC-1363)

3.3.1.1 Set the thermostat for a heating demand, turn on power to the unit.

3.3.1.2 Check unit voltage with unit running. Power must be within range shown on unit nameplate or vendor data. Check amperage draw of unit. Refer to unit nameplate or vendor data for correct running amps and verify compliance with measured value.

3.3.1.3 Verify unit operates satisfactorily.

3.3.2 Cooling Unit(s) (AC-1361, AC-1362, and AC-1363)

3.3.2.1 Set the thermostat for a cooling (or heating, as applicable) demand, turn on power to the unit.

3.3.2.2 Check unit voltage with the unit running. Power must be within the unit nameplate range, or vendor data. Check amperage draw of the unit. Refer to the unit nameplate, or vendor data, for correct running amperage. Verify compliance with the measured value.

3.3.2.3 Measure inlet air dry-bulb and wet-bulb temperature. Measure outlet air dry-bulb and wet-bulb temperature. Verify unit performance is within manufacturer's performance specifications.

3.2.3 Centrifugal Wall Ventilator (FN-1364)

3.3.3.1 Set the thermostat for a cooling demand, turn on power to the fan per manufacturer's instruction.

3.3.3.2 Check fan voltage with fan running. Power must be within range shown on fan nameplate or vendor data. Check amperage draw of fan. Refer to fan nameplate or vendor data for correct running amps and verify compliance with measured value.

3.3.3.3 Verify damper(s) open during exhaust fan operation, fan rotation is correct and fan operates satisfactorily.

END OF SECTION

SECTION 16400
SERVICE AND DISTRIBUTION

PART 1 - GENERAL

1.1 REFERENCES

1.1.1 The following documents, including others referenced therein, form part of this Section to the extent designated herein.

1.1.1.1 American National Standards Institute (ANSI)

C80.1-1990 Rigid Steel Conduit--Zinc Coated

C80.3-1983 Electrical Metallic Tubing-Zinc Coated

C82.1c-1990 Fluorescent Lamp Ballasts

1.1.1.2 American Society of Mechanical Engineers (ASME)

NQA-1-1994 Quality Assurance Requirements for
Nuclear Facility Applications

1.1.1.3 American Society for Testing and Materials (ASTM)

B3-90 Soft or Annealed Copper Wire

1.1.1.4 Code of Federal Regulations (CFR)

Title 47 Telecommunication

Part 18 Industrial, Scientific, and Medical
Equipment

1.1.1.5 Federal Specifications (FS)

W-C-375B Circuit Breakers, Molded Case; Branch
NOT 1 Circuit And Service

W-F-406E Fittings For Cable, Power, Electrical
And Conduit, Metal, Flexible

W-S-896E Switches, Toggle (Toggle And Locks),
AMD 2, NOT 1 Flush Mounted (General Specification)

TT-S-00230C Sealing Compound: Elastomeric Type,
AMD 2 Single Component (For Caulking,
Sealing, And Glazing In Buildings And
Other Structures)

WW-C-566C Conduit, Metal, Flexible

- 1.1.1.6 Institute of Electrical and Electronic Engineers (IEEE)
587-1980 Guide for Surge Voltages in Low-Voltage AC Power Circuits
- 1.1.1.7 National Electrical Manufacturers Association (NEMA)
 - FB 1-1988 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
 - FU 1-1986 Low Voltage Cartridge Fuses
 - ICS 2-1993 Controllers, Contacts, and Overload Relays
 - ICS 6-1993 Industrial Controls and Systems Enclosures
 - KS 1-1990 Enclosed Switches
 - WC 7-1988 Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
 - WD 1-1983 (R1989) General Requirements for Wiring Devices
- 1.1.1.8 National Fire Protection Association (NFPA)
70 (1993) National Electrical Code
- 1.1.1.9 Revised Code of Washington (RCW)
Title 19 Business Regulations - Miscellaneous
Chapter 19.28 Electricians and Electrical Installations
- 1.1.1.10 Underwriters Laboratories (UL)
 - 198D-1995 Safety Class K Fuses, Fifth Edition
 - 467-1993 Grounding and Bonding Equipment
 - 508-1988 Industrial Control Equipment
 - 797-1993 Electrical Metallic Tubing
 - 1062-1993 Unit Substation

1.1.1.11 Washington Administrative Code (WAC)

Title 296	Department of Labor and Industries
Chapter 296-46	Safety Standards - Installing Electrical Wires and Equipment - Administrative Rules
Chapter 296-401	Certification of Competency for Journeyman Electricians

1.2 SUBMITTALS

1.2.1 See Section 01300 for submittal procedures.

1.2.2 Approval Required

1.2.2.1 Approval data: Before delivery, submit information listed in the Approval Data List in this Section.

1.2.3 Approval Not Required

1.2.3.1 Vendor information: Before installation, submit information listed in the Vendor Information List in this Section.

1.2.3.2 Electrical contractor's license: Before installation, submit a copy of license required by RCW 19.28 and WAC 296-46-940.

1.3 QUALITY ASSURANCE

1.3.1 Contractor's Quality Assurance Program: See Section 01400.

1.3.2 Safety Class \pm (SC \pm) products: SC \pm items shall be procured from qualified suppliers. These suppliers shall have a quality assurance program meeting the ASME NQA-1. ECN-807

1.3.3 Electrical/Electronic Product Acceptability: Provide labeling and documentation in accordance with Section 01400.

1.3.4 Maintain electrical contractor's license in current status. Ensure that personnel performing work under this Section have certificates of competence required by RCW 19.28 and WAC 296-401. Certificates shall be available at worksite for review.

1.3.5 Deliverable Documentation: The following documents and records, required by this Section, shall be delivered to Construction Document Control in accordance with Section 01720.

<u>Document</u>	<u>Paragraph</u>
Electrical Test Results	3.3.2.3

1.4 PERMITS

- 1.4.1 Obtain and conspicuously post following permits before starting work under this Section.
 - 1.4.1.1 Core Drilling/Tie-In Permit (Form WHC A-5600-118): Required for each element of work involving core drilling or utility tie-in.
 - 1.4.1.2 Hot Work Permit (Form KEH 2235.00): Required for each location in which work involves welding, cutting, grinding, soldering, heating, spark generation or open flame.

1.5 DELIVERY, STORAGE, AND HANDLING

- 1.5.1 See Section 01610 for general requirements.

1.6 FURNISHED EQUIPMENT

- 1.6.1 The following items will be furnished for installation under this Section. Upon request, one copy of approved vendor data submittals will also be furnished. See Section 01019.

- 1.6.1.1 Electrical Equipment Skid with MCC (W-320-P34)
- 1.6.1.2 Seismic Shutdown System (Safety Class ±) (W-320-P35)
- 1.6.1.3 Seismic Shutdown Missile Shield/Enclosure (W-320-P36)
- 1.6.1.4 In-Tank CCTV viewing system (WHC procurement)
- 1.6.1.5 In-Line Booster Pump VSD (W-320-P17)
- 1.6.1.6 Exhaust Fan VSD (W-320-P1)
- 1.6.1.7 Heating Coil SCR Control Panel (W-320-P7)

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PART 2 - PRODUCTS

2.1 SUBSTITUTES

- 2.1.1 See Section 01630 for substitution approvals.

2.2 MATERIALS

- 2.2.1 Connectors and Terminal Lugs: Solderless, pressure type, rated for use with copper or aluminum conductors, with insulating caps or covers rated for system utilization voltage. Connectors shall be spade type with turned up tips and as specified below. See Section 2.3.9 for terminal blocks to be used for instrumentation and control circuits.

- 2.2.1.1 For conductors No. 8 AWG and smaller:
 - a. Ideal Industries, Incorporated "Wire-Nuts."
 - b. Thomas and Betts Company "Sta-Kon."
 - c. 3M Company "Scotchlok."
- 2.2.1.2 For conductors No. 6 AWG and larger:
 - a. Burndy Engineering Company "Screw Pressure Connectors" or "Hylug."
 - b. Thomas and Betts Company "Lock-tite."
- 2.2.1.3 Cable connector: Relief type as shown on the Drawings.
- 2.2.1.4 Ground connector: Burndy type K2C "Servit Post" or equal; size as required.
- 2.2.2 Conduit, Fittings, and Boxes
 - 2.2.2.1 Conduit: ANSI C80.1, C80.3, FS WW-C-566, and UL 797.
 - 2.2.2.2 All conduit shall have an integral ground conductor.
 - 2.2.2.3 Fittings for rigid steel and EMT conduit: NEMA FB 1. Use compression type, threadless fittings with EMT.
 - 2.2.2.4 Fittings for flexible metal conduit: FS W-F-406, squeeze type.
 - 2.2.2.5 Use "Myers" type watertight fittings, or sealing type locknuts, for conduit entries into sides or tops of NEMA ICS 6 Type 3, 3R, or 4 enclosures.
 - 2.2.2.6 Couplings: Erickson type.
 - 2.2.2.7 Interior lighting fixture outlet boxes: 4-inch octagonal pressed steel.
 - 2.2.2.8 Exterior lighting fixture outlet boxes: Cast with threaded hubs.
 - 2.2.2.9 Interior light switch and receptacle outlet boxes: Pressed steel with cover.
 - 2.2.2.10 Exterior receptacle outlet boxes: Cast metal type FD.
- 2.2.3 Conductors
 - 2.2.3.1 Conductors: NEMA WC 7, stranded copper, rated for 90 °C, with type THWN/THHN or XHHW insulation, of type and AWG size specified on the Drawings.
 - 2.2.3.2 Ground Conductors: Grounding cable shall be stranded or solid bare copper wire in accordance with ASTM B 3 and size specified on the Drawings.

- 2.2.4 Ground Rods: Copper bonded ground rods as shown on the Drawings, in accordance with UL 467.
- 2.2.5 Wire Pulling Compound: Electro Compound Company "Y-er Eas," or American Polywater Corporation "Polywater."
- 2.2.6 Tape
- 2.2.6.1 Plastic insulating tape: 3M Company "Scotch No. 33+."
- 2.2.6.2 Conduit protection tape: 3M Company "Scotchrap No. 50."
- 2.2.6.3 Underground conduit plastic sheet marker: See Section 02225.
- 2.2.7 Insulating Putty: 3M Company "Scotchfil," General Electric Company No. 8389, or Kearney Company "Airseal."
- 2.2.8 Conduit Sealing Compound: Porcelain Products Company "Sealex" or Kerite Company "Kerite."
- 2.2.9 Penetration Sealants: FS TT-S-00230, Type II, Class A, 1-component polyurethane, non-sag type, light colored.
- 2.2.10 Supports
- 2.2.10.1 Individual conduit hangers: Factory made springable wrought steel clamps, or malleable iron split and hinged rings. For suspended conduit, clamps or rings shall be bolted to, or interlocked with threaded suspension rod.
- 2.2.10.2 Conduit supports: 1-hole clamps with clambacks, or Unistrut with clamps.
- 2.2.10.3 Lighting fixture and equipment supports: 1-5/8-inch channel; Unistrut or Kindorf.
- 2.2.10.4 Expansion Anchors: See Section 05055.
- 2.2.11 Wiremarkers: Imprinted tubular plastic.
- 2.2.12 Conduit labels: Brady marking film.
- 2.2.13 Equipment Nameplates
- 2.2.13.1 Laminated plastic, 1/16-inch thick with white surface and black core.
- 2.2.13.2 Manufacturer's standard equipment nameplates may be used instead of those specified herein, if they display the required information, and are equivalent in quality and legibility. They need not be of the same material, or have the same form of imprinting.
- 2.2.13.3 Nameplate Features
- a. Blanks: Select sizes appropriate for required characters and legends. Smooth edges and bevel 1/32-inch at 45 degrees.

b. Characters: Use 3/16 to 5/16-inch characters for equipment names, and 3/32 to 3/16-inch characters for other information. Engrave sharp and clear. Refer to Section 13440 Figure 1.

c. Legends: Provide the following information, unless otherwise specified on the Drawings. For equipment names use the generic/functional designations shown on the Drawings.

1) Equipment name.

2) Equipment number.

2.2.13.4 Make sheet steel nameplates for equipment items that do not have surfaces suitable for attachment of plastic nameplates. Make nameplates when cylindrical surfaces of adequate size are available. When not, make nametags. Provide the information required above.

2.3 EQUIPMENT

2.3.1 Electrical equipment shall be PCB free.

2.3.2 Equipment enclosures: NEMA ICS 6 Types 1, 3R, 4 and 12 as shown on the Drawings.

2.3.3 Mini-Power Panel: Rated as shown on the drawings, with manufacturer's standard full capacity taps and insulation, in accordance with NFPA 70 and UL 1062. Surface mounted as shown on the Drawings.

2.3.3.1 Provide with main circuit breaker.

2.3.3.2 Branch circuit breakers: FS W-C-375B molded case manufacturer's type, with thermal magnetic trips. Number, rating, and arrangement are shown on the Drawings.

a. Permanently number branch circuits. Number tabs shall not be attached to, or be part of, circuit breaker.

b. Branch circuit breaker positions marked "space": Bussed for future circuit breakers. Provide removable single pole filler plates for spaces shown on drawings.

c. Provide a directory card holder and card for branch circuit load identification.

2.3.4 Combination Motor Controllers: NEMA ICS 2, horsepower rated, with 2 NO and 2 NC auxiliary contacts, in NEMA ICS 6 Type 3R enclosure. Bimetallic or melting alloy type overload elements are acceptable. Overload relay reset in cover. FS W-C-375 thermal magnetic trip or instantaneous motor circuit protector type circuit breakers. Size as shown on the Drawings.

2.3.5 Motor Load Fuses: NEMA FU 1, and be the following types.

2.3.5.1 250 V rated: Buss, Fusetron, Catalog No. FRN.

- 2.3.5.2 600 V rated; Buss, Fusetron, Catalog No. FRS.
- 2.3.6 Disconnect Switches: NEMA KS 1, fusible heavy duty type HD, horsepower rated for 600 V ac as noted on the Drawings. Fuses shall be NEMA FU 1 cartridge type, dual element, UL 198D, Class K5.
- 2.3.6.1 Process Building Service Disconnect shall be 3-pole with ground lug and solid neutral assembly in NEMA ICS 6 Type 4 enclosure.
- 2.3.7 Terminal Cabinet: All weather, NEMA ICS 6 Type 4, size and model as shown on the Drawings.
- 2.3.8 Vaults/Handholes: As shown on the Drawings.
- 2.3.9 Terminal Blocks
- 2.3.9.1 For instrumentation/control wiring: As shown on the Drawings or an approved substitute.
- 2.3.9.2 For No. 10 AWG power conductors and smaller: Either 1-piece or factory assembled sectional double terminal, barrier type, with binder screw terminals. Terminal ampacities shall be equal to or greater than conductor ampacities; Marathon or Buchanan.
- 2.3.9.3 For No. 8 AWG conductors and larger: Either 1-piece or factory assembled sectional barrier type with box lug terminals having pressure plate between screw and conductor. Size terminals for conductors to be connected.
- 2.3.9.4 Provide covers to cover live parts of terminations for circuits of 150 V or more to ground. Provide with means for ready inspection and full width marking areas.
- 2.3.10 Lighting Fixtures: Furnish with parts and fittings necessary to install in accordance with manufacturer's instructions.
- 2.3.10.1 Fixtures of each type described shall be from 1 manufacturer, and identical in finish and appearance.
- 2.3.10.2 Fixture types:
 - a. Indoor: Industrial type fluorescent fixture with 40 W lamps, rapid start ballast, and gasketed acrylic prismatic lens suitable for use in wet or corrosive atmospheres as shown on the Drawings.
 - b. Outdoor: Low Pressure Sodium, 120 V, with bracket mounting, as shown on the Drawings.
- 2.3.10.3 Fluorescent fixture ballasts: ANSI C82.1, IEEE 587 Category A, 47 CFR 18 Subpart C; high power factor, high performance Class P, with automatic resetting thermal protection and rapid start, rated for the voltage shown on the Drawings or in this Section and suitable for fixture temperature environments. ~~Electronic ballast is for use with T8 series lamps.~~

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- 2.3.10.4 Where 2 or more units are combined for continuous row installation, furnish necessary accessories to complete installation.
- 2.3.11 Receptacles: NEMA WD 1 Designation 5-15R, duplex, ivory, GFCI, rated 15 A, 120 V, 3-wire, grounding type, with screw terminals arranged for side wiring. Self-grounding receptacles may be used.
- 2.3.12 Toggle Switches: FS W-S-896, weatherproof, rated 20 A, 277 V, with conventional handles, and screw terminals arranged for side wiring, Perfect Line Model No. SW20-1 (Wesco No. 78-5055-20062).
- 2.3.13 Receptacle Plates: Vertical device mount cover, for GFI single receptacle, Red Dot Model No. CCGV (Wesco No. 04-2269-35022).

PART 3 - EXECUTION

3.1 PREPARATION

- 3.1.1 Field Measurements: Scale dimensions on Drawings show desired and approximate locations of equipment. Actual locations, distances, and levels shall be governed by field conditions.
- 3.1.2 Contractor shall prepare installation procedures for installation of SC₁ equipment in accordance with ASME NQA-1. These installation procedures shall be reviewed and approved by the design engineering group. See Section 01400 for witness and hold points.

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3.2 INSTALLATION

3.2.1 General

- 3.2.1.1 Perform work in accordance with NFPA 70.
- 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 attaching to structural steel. When clamping is impracticable, obtain approval from the Construction Engineer before drilling, punching, cutting, or welding to building structural steel members for support attachments.
 - b. Fasten equipment to concrete or masonry with expansion anchors.
 - c. Fasten equipment to metal wall panels with weld studs, bolts, or self-tapping metal screws.
- 3.2.1.3 Locate equipment, boxes, and conduit approximately where shown in relation to equipment served.
- 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 Drawings.

- 3.2.1.6 Attach nameplates on or near equipment, with metal screws. RTV sealant Page 216 may be used when screws are not practical.
- 3.2.1.7 Use appropriate calibrated special tools when installing devices for which special installation tools are recommended by the manufacturers.
- 3.2.1.8 Expansion anchors: See Section 05055.
- 3.2.2 Grounding Systems
- 3.2.2.1 Underground conductors, electrodes, and connections: Install in accordance with the Drawings. Make joints connecting copper and galvanized steel conductors above grade and in dry locations. Connections may be made with exothermic welds or Burndy Hyground connectors.
- 3.2.2.2 System and equipment grounding: Solidly ground neutral conductor of 3-wire, 1-phase and 4-wire, 3-phase, wye-connected distribution systems. Ground equipment in accordance with the Drawings and NFPA 70.
- 3.2.2.3 Static grounding: Ground steel building columns and skid frame to the grid, as shown on the Drawings. Ground metal siding as noted on the Drawings.
- 3.2.3 Conduit
- 3.2.3.1 For excavation and backfill of soil, see Section 02225.
- 3.2.3.2 Use rigid steel where subject to mechanical damage, or installed in concrete floors and walls, exposed to weather, or 4 feet maximum above floors. Electrical metallic tubing may be used elsewhere.
- 3.2.3.3 Install 14-gage galvanized steel pull wire or 1/8-inch polyethylene rope in spare conduits.
- 3.2.3.4 Install concealed conduits as directly as possible and with bend radii as long as possible. Install exposed conduit parallel with or at right angles to building and skid lines. Where conditions permit, maintain continuous exposed horizontal runs along walls at 9 feet minimum above floor level or grade.
- 3.2.3.5 Permanently label conduits at both ends with numbers shown on the Drawings. For short (10 foot maximum length) conduits, place one label at the center only.
- 3.2.3.6 Make elbows, offsets, and bends uniform and symmetrical. Bend conduit with approved bending devices.
- 3.2.3.7 Cut conduit ends square, ream, 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.
- 3.2.3.8 Use galvanized steel locknuts and insulated bushings for attachment to enclosures except threaded hubs or sealing type locknuts shall be used outdoors or where moisture is present. Threadless fittings are not

permitted for rigid conduit. Use Erickson type couplings where required. Do not use running threads.

- 3.2.3.9 Install without moisture traps wherever possible. Where practicable, provide drain holes in pullboxes or fittings at low points in raceway systems and remove burrs from drilled holes.
- 3.2.3.10 Flexible conduit:
- a. Use to make connections to motors and other equipment subject to vibration. Use liquidtight flexible metal conduit where conduit and fittings are installed outdoors or exposed to moisture or chemical fumes indoors.
 - b. Use in 4 foot maximum lengths for other equipment, with approval of the Construction Engineer.
 - c. Use for flush and recessed lighting fixtures in lengths of up to 6 feet.
- 3.2.3.11 Set up joints in conduit installed in concrete, underground, or exposed to weather, with high temperature, antiseize, conductive thread lubricant and sealant.
- 3.2.3.12 Install exposed conduit stubbing up through floor 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. Verify stub-up locations with final equipment arrangements.
- 3.2.3.13 Wrap conduit passing from concrete to air or to direct earth burial with conduit protection tape from 3 inches in concrete to 12 inches minimum in earth, or 3 inches in air.
- 3.2.3.14 Seal openings around conduit at concrete or block fire walls and floor penetrations. Use fire barrier sealing compound for openings to 1/4-inch maximum, and grout for larger openings. Make seals waterproof, and finish sealant flush with surrounding wall surfaces.
- 3.2.3.15 Seal openings around conduit at exterior wall penetrations and penetrations of walls which form boundaries between adjoining ventilation zones, using specified sealant. Make seals waterproof, and finish sealant flush with surrounding wall surfaces.
- 3.2.3.16 Use hangers with 3/8-inch rods for 2-inch and smaller conduit, and hangers with 1/2-inch rods for 2-1/2-inch and larger conduit. If conduit is suspended on rods more than 2 feet long, rigidly brace to prevent horizontal motion or swaying.
- 3.2.3.17 Apply sealing compound after installation of conductors, at boxes, in conduits that penetrate walls or floors.

- 3.2.3.18 Where routing is parallel with hot water or steam pipes, maintain 6 inches minimum clearance from pipe covering. Where not run parallel with pipe, it is acceptable to run closer than 6 inches, providing conduit does not touch pipe covering.
- 3.2.3.19 Encase conduit installed below on-grade floor slab with 3 inches minimum of concrete on all sides, or use PVC coated rigid steel.
- 3.2.4 Metal Raceway Other Than Conduit: Install complete with necessary fittings, connectors and parts, in accordance the manufacturer's instructions.
- 3.2.5 Underground Conduit
 - 3.2.5.1 For excavation and backfill of soil, see Section 02225.
 - 3.2.5.2 Use rigid steel in sand bed as shown on the Drawings.
 - 3.2.5.3 For single conduit runs, use rigid steel conduit.
 - 3.2.5.4 Install underground conduits in accordance with the Drawings and route without drains where possible.
 - 3.2.5.5 Where drains or risers are required, install in accordance with the Drawings. Seal conduit at both ends with sealing compound.
- 3.2.6 Boxes, Enclosures, and Wiring Devices
 - 3.2.6.1 Install boxes firmly in position and plumb.
 - 3.2.6.2 Install extension ring with blank cover on flush mounted junction boxes where box serves permanently installed equipment.
 - 3.2.6.3 Flush mount junction boxes served by concealed conduit.
 - 3.2.6.4 Install dust covers on junction, pull, and outlet boxes, and other types of wiring outlets at initial installation. Replace with permanent covers or devices after wires are installed.
- 3.2.7 Conductors
 - 3.2.7.1 Do not bend cables installed in wireways to less than manufacturer's recommended minimum bending radii. Bind power and control circuits separately with nylon cable ties, at 18-inch intervals. Lay cables in wireways in straight parallel lines, and avoid crossing.
 - 3.2.7.2 Identify conductors, by wire numbers shown on the Drawings, with wiremarkers. Attach wiremarkers at termination points within 2 inches of wire terminations. Marker nomenclature shall be visible without moving wires or markers.
 - 3.2.7.3 Paint or pressure-sensitive colored 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 the following table, for branch and feeder circuits up to and including equipment connections. Use colored tape to properly code existing conductors in which the color does not comply.

Conductor Origin	Conductor	Insulation Color
480Y/277 V, 3-phase systems, transformers, panels, switchboards, etc.	Phase A Phase B Phase C Neutral Equipment ground	Red Yellow Blue White or Gray Green (or bare)
120/240 V, single-phase transformers, panels, switchboards, etc.	Hot Number 1 Hot Number 2 Neutral Equipment ground	Black Brown White or Gray Green (or bare)

- 3.2.7.4 Use lubricant recommended by the cable manufacturer, or wire pulling compound specified, when pulling wire and cable through conduit.
- 3.2.7.5 Do not install or handle wires with thermoplastic insulation or jacket when ambient temperature is 15°F or below.
- 3.2.7.6 Install and mark direct buried cable in accordance with the Drawings.
- 3.2.7.7 Wiring between devices and terminal boards shall be neatly trained and supported. No more than two wires shall connect to a single terminal point.
- 3.2.7.8 Power wiring and terminal boards shall be sized in accordance with NEMA ICS 2. Control wiring shall be No. 14 AWG minimum. Hinged wiring where used, shall be extra flexible, 90 °C flame-retardant, switchboard or machine tool wire, Type SIS, in accordance with NEMA WC 7.
- 3.2.8 Splices, Taps, and Cable Terminations
- 3.2.8.1 Make splices and taps in building wire with solderless connectors specified in 2.2.1. Use connectors in accordance with the manufacturer's instructions.
- 3.2.8.2 Use plastic insulating tape for uninsulated splices and taps. Apply tape to thickness at least equal to conductor insulation. Where bolted splice or connection presents irregular surface, apply insulating putty to joints before taping.
- 3.2.8.3 Use crimp-on type ring or spade lugs with turned up legs for wire terminations of stranded conductors to binder screw or stud type terminals. Lugs shall have insulated sleeves.

- 3.2.8.4 Strip wires for use with pressure plate terminal strips so that no more than 1/8-inch of bare conductor is exposed after insertion beneath plate.
- 3.2.9 Lighting Fixtures: Mount fixtures as shown on the Drawings. Use fixture stud if lighting fixture is suspended from outlet box. Only keyless fittings may use box cover fastening screws for support.
- 3.2.10 Motor Control Centers
- 3.2.10.1 Check bus phasing before making cable connections. Connect cable and bus conductors with phase sequence as follows when observed from front.

A Phase - Front	Left	Top
B Phase - Center	Center	Center
C Phase - Rear	Right	Bottom

- 3.2.11 Variable Speed Drives
- 3.2.11.1 Install in accordance with equipment manufacturer's instructions and this Section.
- 3.2.11.2 Anchor both front and back to the Electrical Equipment Skid floor with two anchors minimum, as shown on the Drawings. Ensure floor decking is secured to framing under equipment.
- 3.2.12 Electrical Equipment Skid
- 3.2.12.1 Anchor the skid/shelter to the concrete pad as shown on the Drawings.
- 3.2.12.2 Install equipment wiring as shown on the Drawings.
- 3.2.13 Seismic Shutdown System Equipment: Assemble system components on seismic concrete foundations as per manufacturer's instructions. Install interconnect conduit and vendor-supplied cabling. Anchor the cabinets as shown on the Drawings and in accordance with the manufacturer's written procedure.
- 3.2.14 Sluicer Skid, Exhaust Skid and Chiller Skid: Connect power and control wiring in accordance with the Drawings, this Section, and the manufacturer's instructions.
- 3.2.15 Heating Coil SCR Control Panel: Install in accordance with the Drawings, this Section, and the manufacturer's instructions.
- 3.2.16 Motor Operated Equipment: Connect air compressor, fans, pumps, winch, etc in accordance with the Drawings, this Section, and manufacturer's instructions. Install wiring to devices which do not appear on the Drawings, but are included in installation shown on the manufacturer's drawings.

3.3 FIELD QUALITY CONTROL

3.3.1 For SC₁ components: SC₁ equipment and materials shall be stored, handled and installed in accordance with written procedures that satisfy ASME NQA-1 requirements; see Section 3.1.2.

3.3.2 Testing

3.3.2.1 Furnish equipment and instruments required to perform testing.

3.3.2.2 Use instruments which bear calibration stamps showing dates of calibration and expiration dates of stamps. Calibration and accuracy of instruments shall be certified by an independent testing laboratory having standards traceable to the National Institute of Standards and Technology.

3.3.2.3 Test the equipment grounding system for ground continuity, and measure the ground resistance. Test the equipment and wiring for continuity and unintentional grounds. Verify proper phase sequence and voltage at equipment served before attempts are made to operate equipment. Notify the Quality Control Inspector before start of tests. Record the results.

a. Megger conductors rated 600 V and used for services, feeders or branch circuits over 150 V to ground, phase-to-phase, and phase-to-ground. Minimum acceptable value of insulation resistance is 200 megohms. The megger manufacturer's instruction booklet, furnished with megger, shall be used for conducting tests. Disconnect devices not capable of withstanding voltage or current of megger test, such as indicating instruments, relays and lamps, before test is made. Voltage output of megger shall be 1000 V dc nominal.

b. ~~Test wiring operating at less than 150 V to ground for continuity and unintentional ground. Resistance shall not exceed 1 ohm on continuity checks. Test wiring operating at less than 150 V to ground for continuity and unintentional ground. Resistance shall not exceed 1 ohm for continuity checks of wiring larger than #16 AWG and 3 ohms for wiring #16 AWG and smaller. Wiring used for 4-20 mA loops and for annunciation may be up to 5 ohms in resistance.~~ ECN-418
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3.3.2.4 Motors: Check for correct rotation.

3.3.3 Reconnect devices disconnected during testing.

CATHODIC PROTECTION

PART 1 - GENERAL

1.1 REFERENCES

- 1.1.1 Following documents and others referenced therein form part of Contract to extent designated in this Section.
- 1.1.1.1 American National Standards Institute (ANSI)
- C135.30-1988 Zinc Coated Ferrous Ground Rods for Overhead or Underground Line Construction
- 1.1.1.2 American Society for Testing and Materials (ASTM)
- C 177-85 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
- C 518-91 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
- D 1621-73(1979) Test Method for Compressive Properties of Rigid Cellular Plastics
- D 1622-93 Test Method for Apparent Density of Rigid Cellular Plastics
- D 2842-69(1990) Test Method for Water Absorption of Rigid Cellular Plastics
- D 2856-87 Test Method for Open Cell Content of Rigid Cellular Plastics by the Air Pycnometer
- D 3487-88 Mineral Insulating Oil Used in Electrical Apparatus
- 1.1.1.3 American Welding Society (AWS)
- A5.8-1992 Specification For Fillet Metals For Brazing and Braze Welding

1.1.1.4 Federal Specifications (FS)

TT-S-00230C
AMD 2

Sealing Compound: Elastomeric
Type, Single Component (For Caulking,
Sealing, And Glazing In Buildings And
Other Structures)

1.1.1.5 National Electrical Manufacturers Association (NEMA)

FU 1-1986

Low Voltage Cartridge Fuses

ICS 6-1993

Industrial Control and Systems
Enclosures

KS 1-1990

Enclosed Switches

RN 1-1989

Polyvinyl-Chloride (PVC) Externally
Coated Galvanized Rigid Steel Conduit
and Intermediate Metal Conduit

WC 5-1992

Thermoplastic-Insulated Wire and Cable
for the Transmission and Distribution
of Electrical Energy

1.1.1.6 National Fire Protection Association (NFPA)

70-1993

National Electrical Code

1.1.1.7 Revised Code of Washington (RCW)

Title 19

Business Regulations - Miscellaneous

Chapter 19.28

Electricians and Electrical
Installations

1.1.1.8 Underwriters Laboratories (UL)

6-1993

Rigid Metal Conduit

83-1994

Thermoplastic-Insulated Wires and
Cables

198E-1988

Class R Fuses

360-1994

Liquid-Tight Flexible Steel Conduit

467-1993

Grounding and Bonding Equipment

486A-1992

Wire Connectors and Soldering Lugs for
Use with Copper Conductors

486C-1992

Splicing Wire Connectors

510-1994

Polyvinyl Chloride, Polyethylene and
Rubber Insulating Tape

514B-1993

Fittings for Conduit and Outlet Boxes Page 226

651-1989

Schedule 40 and 80 Rigid PVC Conduit

5th edition Rev thru 12-4-89

1.1.1.9 Washington Administrative Code (WAC)

Title 296

Department of Labor and Industries

Chapter 296-46

Safety Standards - Installing Electric Wires and Equipment - Administrative Rules

1.2 SUBMITTALS

1.2.1 See Section 01300 for submittal procedures.

1.2.2 Approval Required

1.2.2.1 Approval data: Before delivery, submit information listed in Approval Data List in this Section.

~~1.2.2.2 Test station sketches: Before installation, submit a field sketch of each test station. Show existing pipe configuration exposed by excavation and proposed new pipe configuration, pipe test conductor connections, pipe bonding jumper locations, and reference electrode location.~~

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1.2.3 Approval Not Required

1.2.3.1 Vendor information: Before installation, submit information listed in Vendor Information List in this Section.

1.2.3.2 Electrical contractor's license: Before installation, submit a copy of license required by RCW 19.28 and WAC 296-46-940.

1.2.3.3 Acceptance test report: Within 10 days after testing, submit completed ATP.

1.3 QUALITY ASSURANCE

1.3.1 Electrical/Electronic Product Acceptability: Provide labeling and documentation in accordance with Section 01400.

1.3.2 Deliverable Documentation: Following documents and records, required by this Section, shall be delivered to Construction Document Control in accordance with Section 01720.

<u>Document</u>	<u>Paragraph</u>
Test Results	3.3.1.2
Pipe Exothermic Weld Documents	3.3.2.1
Functional Test of Reference Electrodes	3.3.2.2

1.4 PERMITS

1.4.1 Obtain from ICF KH and conspicuously post following permits before starting work under this Section.

a. Core Drilling/Tie-In Permit (Form WHC A-5600-118): Required for each element of work involving core drilling or utility tie-in. Notify ICF KH 14 days before need.

b. Hot Work Permit (Form KEH 2235.00): Required for each location in which work involves welding, cutting, grinding, soldering, heating, spark generation or open flame. Notify ICF KH 3 days before need.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 See Section 01610 for general requirements.

PART 2 - PRODUCTS

2.1 SUBSTITUTES

2.1.1 See Section 01630 for substitution approvals.

2.2 MATERIALS

2.2.1 Conductors

2.2.1.1 Alternating current (ac): UL 83, stranded copper, 600 V rating, Type THHN/THWN insulation. Size specified on Drawings.

2.2.1.2 Direct current (dc): NEMA WC 5, stranded copper, 600 V rating, high molecular weight low density polyethylene, Type "CP." Size specified on Drawings.

2.2.1.3 Grounding: Bare solid copper, No. 6 AWG.

2.2.2 Conduit and Fittings

2.2.2.1 Outdoor above ground: UL 6 or UL 360.

2.2.2.2 Underground, power: UL 6, PVC coated in accordance with NEMA RN 1, Type A-40, factory applied.

2.2.2.3 Underground, test station: UL 651, Schedule 40.

2.2.2.4 Liquid-tight flexible steel conduit and fittings: UL 360.

2.2.2.5 Fittings for rigid steel conduit: UL 514B.

2.2.3 Connectors

2.2.3.1 Compression splice connector: UL 486C, for use with cable splice or cable tap, size as required.

2.2.3.2 Pipe Ground Clamp Connector: UL 467, bronze, size as required.

- 2.2.3.3 Terminal lug: UL 486A crimp type with ring or spade lug with turned up Page 228 tips, nylon or vinyl insulated.
- 2.2.4 Exothermic Fusion Weld Molds, Weld Metal and Conductor Sleeve
- 2.2.4.1 For existing pipe: Use either of following "Cadweld" weld molds by Erico Products or approved substitute. Base mold on pipe size and conductor size. Weld metal shall be either low emission type recommended by weld mold manufacturer with igniters and filters or standard type, "Cadweld" No. CA15. Sleeve for use with No. 8 AWG conductor shall be "Cadweld" No. CAB-133-1L.
- Low emission type mold with Electric Starter, Part No. XLB971A1.
 - Standard type mold.
- 2.2.4.2 For new pipe: Use either of following "Cadweld" weld molds by Erico Products or approved substitute. Base mold on pipe size and conductor size. Weld metal shall be either low emission type, "Cadweld" XL No. 90, with igniters and filters or standard type, "Cadweld" No. 150. Sleeve for use with No. 8 AWG conductor shall be "Cadweld" No. CAB-133-1L.
- Low emission type mold with Electric Starter, Part No. XLLMCEG1H.
 - Standard type mold, "Cadweld" No. LMC, suffix based on conductor size.
- 2.2.4.3 Ensure manufacturer's installation and inspection procedures are provided with product. Procedures for "Cadweld" items are contained in Erico Products "Installers and Inspectors Guide" (A-7D-01, 1985).
- 2.2.5 Rigid Polyurethane Insulation: Sprayed foam-in-place 2-component system with minimum apparent overall density of 2.4 lb/ft³ in accordance with ASTM D 1622, approximately 95% closed cells in accordance with ASTM D 2856, water absorption approximately 0.05 lb/ft² of surface area in accordance with ASTM D 2842, "k" Factor of approximately 0.15 Btu·in/h·ft²·°F at 75 °F after aging 10 days at 140 °F in accordance with ASTM C 518 or ASTM C 177, and minimum compressive strength of 45 lb/in² parallel to rise and 27 lb/in² perpendicular to rise when tested in accordance with ASTM D 1621. Polythane Systems, Incorporated urethane foam PSI-S200-25 systems; or Polymer Development Laboratories, Inc 110 system, 3 lb/ft³ density; or Burtin Urethane Corporation "Buc 114," 3 lb/ft³ density; or Universal Foam Systems, Inc., 2.8 lb/ft³ density.
- 2.2.6 Ground Rod: ANSI C135.30, galvanized steel, 5/8 inch by 8 foot minimum.
- 2.2.7 Marker, Identification, For Cable: Metal auger, flush with grade type, 17-inch long by 6-inch circular top with raised words "CATHODIC PROTECTION." AB Chance Co., Catalog No. C554 with installation tool, Catalog No. CWFA, or approved substitute.
- 2.2.8 Marker, Location, For Underground Cable and Conduit: See Section 02225.

2.2.9 Equipment Nameplates

2.2.9.1 Laminated plastic, 1/16-inch thick with white surface and black core.

2.2.9.2 Manufacturer's standard equipment nameplates may be used instead of those specified herein, if they display the required information, and are equivalent in quality and legibility. They need not be of the same material, or have the same form of imprinting.

2.2.9.3 Nameplate Features

a. Blanks: Select sizes appropriate for required characters and legends. Smooth edges and bevel 1/32-inch at 45 degrees.

b. Characters: Use 1/8 to 5/16-inch characters for equipment names, and 3/32 to 3/16-inch characters for other information. Engrave sharp and clear. See Section 13440, Figure 1, for examples.

c. Legends: Provide the following information, unless otherwise specified on the Drawings. For equipment names use the generic/functional designations shown on Drawings.

- 1) Equipment name.
- 2) Manufacturer's identification.
- 3) Manufacturer's model or assembly number.
- 4) Serial number.

2.2.9.4 Make sheet steel nameplates for equipment items that do not have surfaces suitable for attachment of plastic nameplates. Make nameplates when cylindrical surfaces of adequate size are available. When not, make nametags. Provide the information required above.

2.2.10 Nameplate, Survey Marker: Brass, 2-inch diameter, 5/8- by 2-1/2-inch shank, No. 2132 Surveyors Service Co. or approved substitute.

2.2.11 Oil for Rectifier: ASTM D 3487, Type II.

2.2.12 Sealant: FS TT-S-00230, clear RTV silicone.

2.2.13 Duct Sealing Compound: Material of CONTRACTOR's choice.

2.2.14 Splice Kit, Conductor: Epoxy potting compound for encapsulating electrical wire splices buried underground, 3M Company, Scotchcast, Catalog No. 82-B1 or 90-B1 or approved substitute.

2.2.15 Tape, Electrical Insulating

2.2.15.1 Plastic: UL 510, plastic 3/4 inch wide.

2.2.15.2 Rubber: UL 510, self-vulcanizing, 3/4 inch wide.

- 2.2.16 Touch-up Compound for PVC Conduit Coating: Material of CONTRACTOR'S choice.
- 2.2.17 Wiremarker: Tubular plastic, imprinted or typed with indelible ink, or plastic tag typed with indelible ink, fastened securely to wire with plastic wire tie.
- 2.2.1.8 *Liquid epoxy coating, Scotch Kote 312 by 3M Company or approved substitute.* ECN-121
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- 2.3 EQUIPMENT
- 2.3.1 Anodes: High silicon, chromium iron, 2-3/16 by 24 inch with No. 8 AWG stranded copper lead wire having high molecular weight, polyethylene (HMW PE) insulation in accordance with NEMA WC 5. Lead length 20 feet. Anodes prepackaged in 8- by 48-inch minimum steel canister with coke breeze backfill. Durichlor 51 Anode Company, Type TAB or approved substitute.
- 2.3.2 Disconnect Switch: NEMA KS 1, heavy-duty type, fusible, 240 V ac, 30 A rating, 2-pole with NEMA ICS 6 Type 3R enclosure. Fuses shall be in accordance with NEMA FU 1, cartridge type, dual element, UL 198E, Class RK5. Provide with one 15 A fuse and slug for neutral fuse clip.
- 2.3.3 Test station, high impact plastic housing, 9 terminal removable plastic terminal board, removable green cover, 7-3/4 inches in diameter, 5 inches high, Street Fink CP Test Station, manufactured by Cott Manufacturing Company or an approved substitute.
- 2.3.4 Anode Distribution Box: 12 by 12 by 6 inches (minimum dimensions) with 32 solderless pressure type terminals, Goodall Model No. T-32-A; or 20 by 16 by 6 inch with 30 shunts, Anode Junction Box, Farwest Corrosion Control, or an approved substitute.
- 2.3.5 Permanent Underground Reference Electrode: Saturated gelled copper-copper sulfate with cotton bag and backfill mix, 30-year design life, EI Electrochemical Devices, Incorporated, EDI Model UL-CUG-LW020 or an approved substitute. Provide with 20 feet of No. 8 14 AWG or larger HMW/PE insulated lead wire. ECN-486
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- 2.3.8 Rectifier
- 2.3.8.1 General requirements: Rectifier and associated equipment shall operate and deliver rated capacity, without exceeding temperature limitations specified, when operating in following environment.
- a. Location: Outdoors in direct sunlight.
 - b. Ambient temperature range: -20 to 131 °F.
 - c. Relative humidity: 100%.
 - d. Dust: Exposure to dust particulate (sandstorm).
 - e. Precipitation: Driving rainstorm.
 - f. Snow: Accumulation of sleet or snow.

2.3.8.2 Design requirements:

- a. Rating
 - 1) Line input voltage: 120 V ac.
 - 2) Line frequency: 60 Hz.
 - 3) Number of phases: Single-phase.
 - 4) Output voltage: 24 V dc.
 - 5) Output current: 12 A.
- b. Oil-immersed type.
- c. Suitable for mounting on concrete slab.
- d. Transformer: Separate primary and secondary windings fully rated for maximum capacity. Electrostatic shield between primary and secondary windings.
- e. Silicon stacks: Connected in full wave bridge circuit configuration, and rated a minimum of 800-peak inverse volts. Provide voltage surge protection with ac and dc lightning arresters and metal varistors across secondary lines to stack, and across dc output of rectifier. Provide heat sinks sized to keep diode junction and case temperatures below temperatures that could cause failure.
- f. Efficiency filter: Incorporate in rectifier to increase efficiency of unit.
- g. Enclosure: NEMA ICS 6, Type 4.
- h. Current carrying pressure connections, such as terminal studs and current shunt connections, shall have thin layer of conductive grease applied to contact surfaces to prevent oxidation.

2.3.8.3 Construction requirements:

- a. Construct to permit transformer, stacks and other internal components to be immersed in oil. Inside of enclosure shall be accessible through cover mounted on top. Attach cover to cabinet by hinges and provide with quick-release clamps and padlock clasp or other means of locking cabinet. Provide stop to limit swing of lid when opened. Provide positive, oil-resistant, compressible sealing lid gasket. Cork and sponge materials are not acceptable. Gasket joints shall not have gaps.
- b. Provide panel for mounting terminals, circuit breakers, shunts, etc. Board inside panel shall be micarta or similar insulating material, supported on 4 edges.

c. Enclosure and appurtenances: Approved for use in specified environmental conditions. Materials and methods used in construction and fabrication of rectifier shall be in accordance with NEMA requirements for specified service. Internal components and connections of rectifier shall be immersed in 3 inches of oil, minimum.

d. Enclosure shall be steel, provided with oil drain plug. Oil level shall be clearly marked.

e. Finish enclosure inside and outside with 1 coat of epoxy red oxide primer and 2 coats of gray baked enamel.

f. Provide engraved, manufacturer's standard nameplates on rectifier. Nameplate information shall include specified rating data.

2.3.8.4 Instrumentation:

a. Combination digital volt-ammeter or separate digital voltmeter and ammeter, rectangular. Scale shall be linear, and range from 0 to 125% minimum of rated voltage and current.

b. Meter circuit shall have momentary-off-momentary disconnect switch which may be closed by operator when readings are being taken.

c. Ammeter shunt: Size in accordance with ampere rating of rectifier.

2.3.8.5 Voltage and current control

a. Output voltage manually controlled. Transformer taps shall have tap-changing devices for manual operation to permit 18 equal steps minimum of adjustment.

b. Power supply pulse generator for instant-off potential measurements, 115 V ac, 60 A rating. MC Miller Company, Catalog No. WFA005 or approved substitute (mount in rectifier control panel).

2.3.8.6 Protection: Furnish with following protective devices and equipment.

a. ac thermal magnetic input circuit breaker: Mounted within control panel to provide ~~short circuit and overload protection~~ a minimum of short-circuit protection.

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b. ac fuse: Installed in transformer primary circuit. Fuse shall be accessible from front of panel.

c. dc valve-type arrester: For 150 V maximum line-to-ground fault voltage.

d. ac input surge (lightning) arresters.

e. Ground lug: Installed on cabinet so cabinet may be connected to grounding system. Size ground lug for No. 6 AWG copper ground cable.

2.3.8.7 Output terminals:

- a. Two negative and 4 positive stud-type terminals with nut and washer, mounted on front of control panel, appropriately marked.
- b. External shunts on output (positive and negative) circuits indicated above. Output shunts of same rating as ammeter external shunt.

PART 3 - EXECUTION

3.1 PREPARATION

3.1.1 Field Measurements: Scale dimensions on Drawings show desired and approximate location 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, Specifications, and Drawings.

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

3.2.1.3 Refer to Section 02225 where excavation or backfill of soil is required.

3.2.2 Rectifier: Attach to pad with concrete expansion anchor bolts as shown on Drawings.

3.2.2.1 Terminate ac wiring on rectifier input terminals, and dc wiring on rectifier output terminals.

3.2.2.2 Fill rectifier with specified oil to level shown on rectifier case.

3.2.3 Anodes: Install *vertical anodes* to depth of 7 feet, (\pm) 6 inches ~~or as~~ ECN-150 ~~shown on Drawings and horizontal anodes to depth of 4 feet (\pm) 6 inches.~~ ECN-150

3.2.3.1 Use subsurface radar scanning machine to locate underground structures before augering. Hand auger holes for anodes that are located above or within 4 feet from underground tanks or structures. Power auger may be used for other anodes. Maximum auger size, 12 inches.

3.2.3.2 Lower anodes to bottom of holes by rope, and center within holes. Do not use lead wires to lower anodes. If temporary casings have been used, slowly withdraw casings while backfilling.

3.2.3.3 Backfill around anodes by sluicing with water.

3.2.3.4 Repair damaged anode lead wire insulation by encapsulation with epoxy resin using conductor splice kit.

3.2.3.5 Connect anode lead conductor to terminals in anode distribution box using compression type terminal lug.

- 3.2.4 Test Station: Install where shown on Drawings. Stamp or engrave survey marker nameplate, using 3/16 inch minimum letters, TEST STATION T (numbers shown on Drawings).
- 3.2.4.1 Identify each terminal in test station with a nameplate. Engrave with pipe designation or words "Reference Electrode." Character height 1/8 inch. Secure nameplates to terminal board with specified sealant.
- 3.2.4.2 Place test station in 6-inch PVC conduit and seal, as shown on Drawings.
- 3.2.5 Anode Distribution Box: Install as shown on Drawings and terminate anode feeder and anode loop cables on large bus and anode lead cables on individual terminals. Engrave nameplate, using 3/16-inch letters, ANODE DISTRIBUTION BOX ADB (number shown on Drawings). Fasten nameplate to front cover of box with rivets or machine screws and nuts.
- 3.2.6 Permanent Underground Reference Electrode: Before installing, perform functional test of reference electrodes in accordance with this Section.
- 3.2.6.1 Follow manufacturer's installation instructions. Do not allow reference electrode to freeze.
- 3.2.6.2 Install reference electrode horizontally, 6 to 12 inches below outer surface of pipe. For configuration of parallel pipes, install in center of configuration, and not adjacent to or touching any pipelines. Construction Engineer will assist in positioning reference electrodes if required.
- 3.2.6.3 Bring lead wire to top of hole for termination in test station and install wiremarker with words: REFERENCE ELECTRODE.
- 3.2.6.4 Repair damaged lead wire insulation using conductor splice kit.
- 3.2.6.5 Backfill in accordance with Section 02225.
- 3.2.7 Pipe Test Conductors, Bonding Jumpers, and Negative Return Cable
- 3.2.7.1 Existing pipes:
- a. Before connecting conductors, obtain verification of each pipe's usage from Construction Engineer and obtain approval for method of connection. Wire brush and file pipe at each connection location to bright metal surface free of oil and dirt. If connection is made by exothermic welding, enlarge window in coating to accommodate exothermic weld mold. Make exothermic welds of conductors to metal pipe only in accordance with approved manufacturer's instructions. If connection is made by ground clamp, coat clamp with same materials and installation methods as exothermic welds. Using No. 4 AWG copper wire and exothermic welds, install bonding jumpers across mechanical pipe joints (such as threaded couplings or bell and spigot connections). Extend bonds to a point 30 feet from nearest anode.
 - b. Inspect exothermic welds in accordance with manufacturer's instructions. If weld fails, make another weld at least 12 inches from previous weld attempt and inspect.

c. ~~At pipe connection, apply specified sealant on exposed copper wire, weld material and bared pipe. Overlap sealant on copper wire insulation, on pipe coating or on bared pipe a minimum of 1 inch. Smooth sealant by hand. At pipe connection, apply liquid epoxy coating on exposed copper wire, weld material and bared pipe. Overlap coating on pipe coating or on bared pipe a minimum of 1 inch. Wrap exposed copper conductors with self-vulcanizing tape and plastic tape.~~

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d. Conductor size specified on Drawings.

e. Repair damaged pipe test conductor insulation with 2 half-lapped layers of self-vulcanizing tape and 2 half-lapped layers of plastic tape.

f. Make repairs of foam insulation on pipe with sprayed polyurethane as follows.

1) Install in accordance with manufacturer's recommended procedure.

2) Side-wall retainer may be used to assure uniform width and height of sprayed insulation. Obtain approval of retainer wall installation and materials from Construction Engineer.

3) Repair opening in flexible duct liner with plastic sheet material similar to existing.

g. Identify end of each conductor using specified wiremarker with typewritten or imprinted pipe number to which conductor is connected. Label pipe test conductors connected to unidentifiable pipes with pipe size followed by words "UNKNOWN."

h. Use terminal lugs for conductor terminations in test station.

i. Backfill in accordance with Section 02225.

3.2.7.2 New pipes

a. Wire brush each pipe conductor standoff bracket and file to bright metal surface, free of oil and dirt. Make exothermic weld of conductors to standoff bracket in accordance with approved manufacturer's instructions.

b. Inspect exothermic welds in accordance with manufacturer's instructions. If weld fails, make another weld at least 3 inches from previous weld attempt and inspect.

c. ~~Apply clear RTV silicone sealant on all exposed copper wire, weld material and bared conductor standoff bracket. Overlap sealant on copper wire insulation, on pipe coating or on bared surface a minimum of 1 inch. Smooth sealant by hand. Apply liquid epoxy coating on all exposed copper wire, weld material and bared conductor standoff bracket. Overlap coating on pipe coating or on bared surface a minimum of 1 inch. Wrap exposed copper conductors with self-vulcanizing tape and plastic tape.~~

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d. Conductor size specified on Drawings.

e. Repair damaged pipe test conductor insulation with 2 half-lapped layers of self-vulcanizing tape and 2 half-lapped layers of plastic tape. Page 236

- f. Identify end of each conductor using specified wiremarker with typewritten or imprinted pipe number to which conductor is connected.
- g. Use terminal lugs for conductor terminations in test station.
- h. Backfill in accordance with Section 02225.

3.2.7.3 Brazing to copper tubing

- a. Connect conductors to copper pipes by torch brazing.
- b. Torch brazing shall utilize a neutral flame adjustment. The brazing filler metal shall be Class B CuP-5 in accordance with AWS A5.8. Brazing temperatures shall be 1300 to 1500 °F and shall be controlled by a temperature-sensitive flux which shall be of the AWS Type 3A category. Base metal shall be cleaned with emery cloth abrasives prior to brazing. Flux shall be applied to parts immediately after cleaning and prior to assembly. Joint shall be assembled such that the stranded wire and the tube are in virtual contact. Assembled joint shall be heated to brazing temperature as indicated by flux flow. Filler metal is then fed into the joint. The filler metal shall not be heated directly with flame. Apply the flame on the base metal as necessary to guide the flow of brazing filler metal. After joint completion, completely remove flux residue by washing with hot water.
- c. Test integrity of connection by tapping side of brazed joint with a small hammer. If braze fails, braze again at approximately 3 inches from previous attempt.
- d. ~~Brazed connections shall be coated with specified sealant. Overlap sealant on copper wire and bared metal a minimum of 1 inch. Smooth sealant by hand. Brazed connections shall be coated with liquid epoxy coating. Overlap coating on copper wire and bared metal a minimum of 1 inch. Wrap exposed copper conductors with self-vulcanizing tape and plastic tape.~~ ECN-121
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3.2.8 Conductors: Install anode feeder, anode loop, anode lead, and negative return cables as follows.

3.2.8.1 Place in trenches prepared in accordance with Drawings.

3.2.8.2 Identify cables, using specified wiremarkers, at terminations except at inaccessible underground locations. Nomenclature shall be as shown on Drawings.

3.2.8.3 Terminate anode feeder and anode loop cables at rectifier positive output terminals and anode distribution box. Terminate negative return cables at rectifier negative output terminal, and on pipe where shown on Drawings. Use terminal lugs for conductor terminations at rectifier and anode distribution box.

3.2.8.4 Repair damaged cable insulation by using conductor splice kit.

3.2.8.5 Cover cable ends with plastic electrical tape until ready for termination.

3.2.8.6 Cable marker: Install as noted on Drawings.

3.2.9 Conduit: Install underground power conduits where shown on Drawings. Cut conduit square, ream and deburr. Repair damaged PVC coating on conduits with touch-up compound. Seal conduits that enter control panels or boxes with duct sealing compound.

3.3 FIELD QUALITY CONTROL

3.3.1 Continuity Testing

3.3.1.1 Furnish instruments and equipment required to conduct testing.

3.3.1.2 Test equipment and wiring for continuity (1 ohm or less) and unintentional grounds, and verify proper voltage at equipment served before attempt is made to operate equipment. Record results.

3.3.2 Exothermic Welds

3.3.2.1 Document exothermic welds of conductors to new and existing pipe. Include following:

- a. Pipe test conductor: Identification of each pipe and each associated test station to which conductor is connected.
- b. Bonding jumper: Identification of each pipe to which connected and general location of jumper.
- c. Negative return cables: Identification of pipe to which connected.
- d. Verification that weld complies with manufacturer's installation and inspection requirements.

3.3.2.2 Functional Test of Reference Electrodes

- a. Before functional test, conduct an accuracy test of 2 MC Miller Model RE-5 portable reference electrodes by placing end of 2 reference electrodes in a plastic bucket filled with tap water and using a digital voltmeter, measure voltage between electrodes. Verify that value is less than 20 mV.
- b. Place permanent reference electrodes being tested in a plastic bucket filled with tap water. Soak electrodes for at least 3 hours.
- c. Place end of 1 portable reference electrode that has been tested for accuracy in water in plastic bucket or touch end of portable reference electrode to outside bag of permanent reference electrode.
- d. Using a digital voltmeter, measure voltage between permanent reference electrode and portable reference electrode. Verify that value is less than 50 mV. If difference is equal to or greater than 50 mV, discard and replace permanent reference electrode with another and repeat test.
- e. Record voltage between permanent reference electrode and portable reference electrode on Data Sheet (Form KEH 2255) and submit completed form to Construction Engineer.

3.3.3 Acceptance Test

3.3.3.1 ICF KH will provide approved Acceptance Test Procedure (ATP)

3.3.3.2 Notify ICF KH before performing acceptance test.

3.3.3.3 Perform acceptance test in accordance with approved ATP.

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