

CITY OF RAPID CITY CONSTRUCTION CHANGE ORDER PER SETTLEMENT AGGREMENT DATED MAY 19, 2014.

JACKSON SPRINGS WATER TRANSMISSION MAINS

PROJECT NO. WTP09-1836 / CIP NO. 50780

DATE

ORIGINAL CONTRACT AMOUNT: \$3,538,182.24

CONTRACTOR: HIGHMARK INC.

LINE ITEM	DESCRIPTION	UNIT		CURRENT CONTRACT QUANTITY	UNIT PRICE	EXTENDED PRICE	ADJUSTED QUANTITY	ADJUSTED PRICE	NET CHANGE
	Total Final Contract Amount			1.00	\$3,538,182.24	\$3,538,182.24	1.00	\$3,538,182.24	\$0.00
	Change order per Settlement agreement dated May 19, 2014.				CHANGE ORDER UNIT PRICE (City) w/ markup				
	City Obligation of Settlement agreement:								
1A	MOBILIZATION	LS	60.0%	0.00	\$5,600.00	\$0.00	1.00	\$3,360.00	\$3,360.00
2A	INCIDENTAL WORK	LS	60.0%	0.00	\$3,920.00	\$0.00	1.00	\$2,352.00	\$2,352.00
3A	CONSTRUCTION STAKING	LS	60.0%	0.00	\$560.00	\$0.00	1.00	\$336.00	\$336.00
4A	IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM	LS	60.0%	0.00	\$74,701.10	\$0.00	1.00	\$44,820.66	\$44,820.66
5A	AC POWER DROP	LS	60.0%	0.00	\$11,928.00	\$0.00	1.00	\$7,156.80	\$7,156.80
6A	TEST STATION WITH REFERENCE ELECTRODE, COUPON AND PLASTIC MONITORING PIPE	LS	60.0%	0.00	\$1,320.00	\$0.00	1.00	\$792.00	\$792.00
7A	NO 2 AWG CONDUCTOR INSTALLATION IN CONDUIT	LF	60.0%	0.00	\$2.15	\$0.00	590.00	\$761.10	\$761.10
8A	OPEN CUT INSTALLATION OF 1" PVC CONDUIT	LF	60.0%	0.00	\$23.46	\$0.00	0.00	\$0.00	\$0.00
8A	DIRECTIONAL BORE INSTALLATION OF 1" PVC CONDUIT	LF	60.0%	0.00	\$20.91	\$0.00	590.00	\$7,402.14	\$7,402.14
9A	CONCRETE MARKERS	EA	60.0%	0.00	\$196.00	\$0.00	8.00	\$940.80	\$940.80
10A	SEDIMENT CONTROL WATTLES, 8 INCH	LF	60.0%	0.00	\$5.51	\$0.00	600.00	\$1,983.60	\$1,983.60
11A	STABILIZED CONSTRUCTION ENTRANCE	EA	60.0%	0.00	\$2,240.00	\$0.00	1.00	\$1,344.00	\$1,344.00
	TOTAL CITY							\$1,344.00	\$1,344.00
									\$71,249.10
	Highmark Obligation of Settlement agreement:				Contractor Unit Price without Markup				Highmark Obligation of Settlement agreement:
1B	MOBILIZATION	LS	40.0%	0.00	\$5,000.00	\$0.00	1.00	\$2,000.00	\$2,000.00
2B	INCIDENTAL WORK	LS	40.0%	0.00	\$3,500.00	\$0.00	1.00	\$1,400.00	\$1,400.00
3B	CONSTRUCTION STAKING	LS	40.0%	0.00	\$500.00	\$0.00	1.00	\$200.00	\$200.00
4B	IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM	LS	40.0%	0.00	\$64,397.50	\$0.00	1.00	\$25,759.00	\$25,759.00

LINE ITEM	DESCRIPTION	UNIT		CURRENT CONTRACT QUANTITY	UNIT PRICE	EXTENDED PRICE	ADJUSTED QUANTITY	ADJUSTED PRICE	NET CHANGE
5B	AC POWER DROP	LS	40.0%	0.00	\$10,650.00	\$0.00	1.00	\$4,260.00	\$4,260.00
6B	TEST STATION WITH REFERENCE ELECTRODE, COUPON AND PLASTIC MONITORING PIPE	LS	40.0%	0.00	\$1,200.00	\$0.00	1.00	\$480.00	\$480.00
7B	NO 2 AWG CONDUCTOR INSTALLATION IN CONDUIT	LF	40.0%	0.00	\$1.92	\$0.00	590.00	\$453.12	\$453.12
8B	OPEN CUT INSTALLATION OF 1" PVC CONDUIT	LF	40.0%	0.00	\$20.95	\$0.00	0.00	\$0.00	\$0.00
8B	DIRECTIONAL BORE INSTALLATION OF 1" PVC CONDUIT	LF	40.0%	0.00	\$17.00	\$0.00	590.00	\$4,012.00	\$4,012.00
9B	CONCRETE MARKERS	EA	40.0%	0.00	\$175.00	\$0.00	8.00	\$560.00	\$560.00
10B	SEDIMENT CONTROL WATTLES, 8 INCH	LF	40.0%	0.00	\$4.75	\$0.00	600.00	\$1,140.00	\$1,140.00
11B	STABILIZED CONSTRUCTION ENTRANCE	EA	40.0%	0.00	\$2,000.00	\$0.00	1.00	\$800.00	\$800.00
				TOTAL HIGHMARK					\$41,064.12
TOTAL						\$3,538,182.24		\$71,249.10	\$71,249.10

C.C.O. HISTORY INCREASE/(DECREASE)		PRIOR ADJUSTED CONTRACT PRICE :	\$3,538,182.24
<u>Change order per Settlement agreement dated May 19, 2014.</u>		NET INCREASE/(DECREASE):	\$71,249.10
\$71,249.10		ADJUSTED CONTRACT PRICE:	\$3,609,431.34
\$0.00		CHANGE TO DATE:	\$71,249.10
\$0.00			

CHANGE ORDER SHALL BE IN CONFORMANCE WITH THE REQUEST FOR PROPOSAL FOR IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM

Dale Schuelke _____ DATE *11/14/16*

CONTRACTOR: DALE SCHUELKE, Highmark Inc., PO Box 491, Black Hawk, SD 57718

D M M _____ DATE *12-31-15*

CONSULTANT: Dave Muck, P.E. - Ferber Engineering Co

Stacey Titus _____ DATE *12/31/15*

PROJECT MANAGER: STACEY TITUS, P.E.

Pauline Sumption _____ DATE *1-11-16*

CITY ENGINEER: DALE TECH, P.E. / L.S.

_____ DATE

MAYOR: STEVE ALLENDER _____ DATE

FINANCE: PAULINE SUMPTION _____ DATE

CONTRACT TIME CHANGE +/-: 0 NEW CONTRACT TIME: All Work Completed by MAY 22, 2016

City Staff recommends approval of this Change Order to Highmark, Inc., per Settlement agreement dated May 19, 2014, for an increase of \$71,249.10 based the unit pricing with the following appropriation:

Initial Funding							\$3,538,182.24
Fund Type	Water Revenue Bonds						
Department	0932						
Line Item	4381						
Fund	0602						
<u>Change order per Settlement agreement dated May 19, 2014.</u>	\$71,249.10						
Fund Type	Water Enterprise Fund						\$71,249.10
Department	0934						
Line Item	4381						
Fund	0602						

CITY OF RAPID CITY CONSTRUCTION CHANGE ORDER PER SETTLEMENT AGREEMENT DATED MAY 19, 2014.
JACKSON SPRINGS WATER TRANSMISSION MAINS
PROJECT NO. WTP09-1836 / CIP NO. 50780
DATE
ORIGINAL CONTRACT AMOUNT: \$3,538,182.24
CONTRACTOR: HIGHMARK INC.

LINE ITEM	DESCRIPTION	REASON FOR CHANGE
	Line items 1A - 12A	per settlement agreement City cost
	Line items 1B - 12B	per settlement agreement HIGHMARK cost
		See attached REQUEST FOR PROPOSAL FOR IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM

PREPARED BY: *Stacey P. Titus*
 Stacey Titus, P.E.

DATE: 12/31/15



CITY OF RAPID CITY
RAPID CITY, SOUTH DAKOTA

**JACKSON SPRINGS WATER TRANSMISSION MAINS (JSWTM)
PROJECT NO. WTP09-1836 / CIP NO. 50780**

**REQUEST FOR PROPOSAL
FOR
IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM**

**CITY OF RAPID CITY
PROJECT MANAGERS**

**MORGAN GAGLIANO, PE - DESIGN
KLARE SCHROEDER, PE - CONSTRUCTION**

CONSULTANT

**DAVID M. MUCK, PE/LS, CFM
FERBER ENGINEERING COMPANY**

APPROVED AS TO FORM
CITY ATTORNEY'S OFFICE

 Cade R. Cochran 1-11-16
Attorney Date

TABLE OF CONTENTS

<u>Section Title</u>	<u>Section No.</u>
Request for Proposal	1R
Information and Instructions to Contractor	2R
Insurance Requirements	3R
Contractor's Proposal	4R
Performance Bond	6R
Supplemental Specifications	7S
Submittals	01330
Record Documents	01780
Cathodic Protection Systems	13800
 <u>Appendices</u>	
Drilling Logs for Well No.1 and Well No. 2	Appendix A
Extracted Pages from 2009 Geotechnical Evaluation for Proposed Jackson Springs Water Treatment Plant	Appendix B
City of Rapid City Floodplain Development Permit (Copy)	Appendix C

SECTION 1R
REQUEST FOR PROPOSAL FOR THE FOLLOWING ITEMS

Notice is hereby given that a Proposal for furnishing materials, equipment, labor, and performing all the work for the construction of the

JSWTM – IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM
PROJECT NO. WTP09-1836 / CIP NO. 50780

in accordance with the specifications prepared by the Engineering Services Division shall be prepared and returned to the City of Rapid City Public Works Department, 300 Sixth Street, Rapid City, South Dakota 57701.

This Proposal Request has been prepared and is extended to the Contractor to fulfill the requirements stipulated in the Settlement Agreement (Agreement) between the City of Rapid City (City) and Highmark, Inc. (Contractor) with regard to Pennington County, South Dakota Civil Case #12-566. Due to the Agreement's acknowledgment of the release of warranty period and the release of bond on the original contract, the Contractor is required to provide bonds and a two year warranty on the installation of the Impressed Current Cathodic Protection System contained within the Plans and Specifications as contained within this proposal.

Sections 1R, 2R, 3R, 4R and 6R have been included within this Request for Proposal due either to modified contract provisions or are reiterated for clarity pertaining to this Proposal and subsequent Construction Contract Change Order. Provisions not provided herein, but which were included in the original project contract, remain valid for this Proposal and subsequent Construction Contract Change Order.

Additionally, Sections 01330 - Submittals, Sections 01780 – Record Drawings and Section 13800 – Cathodic Protection Systems detailed specifications are included herein. Section 01330 has been updated to include a submittal table specific to the work associated with this Request for Proposal. Section 01780 has been reissued for the benefit of the Contractor and his potential Subcontractors. Section 13800 provides detailed specifications for the installation of the impressed current cathodic protection system.

Construction Plans are provided with this Request for Proposal that are specific to the nature of the activities to be undertaken. As-constructed drawings for the Jackson Springs Water Transmission Mains have also been included for informational purposes. The Contractor is encouraged to refer to the original plans and contract documents for clarification, as necessary.

SECTION 2R
INFORMATION AND INSTRUCTIONS TO CONTRACTOR

{Provisions provided herein are modified or reiterated specifically for this Proposal and subsequent Construction Contract Change Order. Provisions not provided herein, but were part of the original contract, remain valid for the length of this Proposal and subsequent Construction Contract Change Order.}

2.3R TIME OF COMPLETION

The time of completion of the work is of vital importance, and the Contractor agrees to complete the work within the time stipulated in the Proposal. The overall completion date of the Proposal is **May 22, 2016**, and the work shall be completed within 60 days of the initiation of work on the Proposal.

2.4R MODIFICATION OF BIDS

No modification of the content of this Proposal document may be made without the knowledge and concurrence of both the Contractor and the City.

2.6R QUALIFICATIONS OF CONTRACTOR

The Contractor shall contract with a Qualified Cathodic Protection System subcontractor to complete work items pertaining to the installation of the Groundbed and Rectifier/Anode Terminal Box/CP Test Station including all equipment and appurtenances necessary for a complete and functioning system. These items include:

Groundbed Installation: Anode Bed Drilling, Collection of Resistivity Logs, Casing Installation, Anode Placement, Coke Breeze Installation, Anode Lead Wire Installation, Anode Bed Vent Piping, and any other items required for a complete and functional system

Rectifier/Anode Terminal Box/CP Test Station Installation: Installation of anode leads in Terminal Box, Installation of AC Power to rectifier, Electrical Connection of Terminal Box and Rectifier, Installation of negative conductor in conduit, Connection of CP to pipeline, Installation of reference electrode and cathodic protection test station, and any other items required for a complete and functional system

The following are Qualified Cathodic Protection System subcontractors deemed qualified by the City:

1. Goudy Engineering, Inc. / P.O. Box 18258 / Tucson, AZ 85731 / Office Phone: (520)298-1104 (Kevin Goudy)
2. Northland Corrosion Services, Ltd / P.O. Box 187 / Laurel, MT 59044 / Office Phone: (406)628-2213 (Rob Engh)
3. WBI Energy Corrosion Services / 552 Roxy Lane / Billings, MT 59105 / Office Phone: (406)248-6985 (John Davis)

2.9R BOND REQUIREMENTS

The Contractor shall provide a Surety Bond to the City, executed by a reliable and accredited Surety authorized to do business in the State of South Dakota, acceptable to the Council, signed by an "Attorney in Fact" of residence in South Dakota, and in an amount equal to the total of the change order amount contained within this Proposal as a guarantee of the full performance and completion of the contract and payment of all labor and all material bills. The bond shall be in the form provided.

A Warranty Bond, or other equivalent surety, in an amount equivalent to ten percent (10) of the change order amount contained within this Proposal shall be provided to the City to secure the warranty for a period of two years prior to final payment of this change order.

2.12R CONTRACT SPECIFICATIONS

Specifications to be followed under this contract are the City of Rapid City Standard Specifications for Public Works Construction (2007 Edition), as currently revised, and any Special Provisions, Special Conditions, and/or Detailed Specifications pertaining to this Request for Proposal.

2.13R EXAMINATION OF PROJECT SITE

The Contractor shall be responsible for examination of the site of the project. This includes the soil and water conditions to be encountered, improvements and private property to be protected, disposal sites for surplus material other than sites designated, and as to methods of ingress and egress to private properties and methods of handling traffic during construction of the work items as contained within this Proposal.

2.14R INSURANCE INFORMATION

Without limiting any of the other obligations or liabilities of the Contractor and until the work is completed and accepted by the Owner, the Contractor shall provide and maintain minimum insurance coverages in accordance with requirements as shown in Section 3 - Insurance Requirements.

The Contractor's insurance carrier or agent shall complete and deliver two (2) copies of the required insurance documents to the City in sufficient time to allow for review and approval by the City Attorney prior to the actual start of work by the Contractor. The City of Rapid City shall be listed as an additional insured and shall be given thirty (30) days written notice of cancellation or change to the policy. If work is to extend beyond the expiration date of coverages, the Contractor shall submit renewal forms for approval by the City Attorney.

2.15R BASIS OF PAYMENT

Method of payment for the work under the Proposal will be as outlined in Sections 2.15R, 2.16R and 2.17R. Method of payment under this contract will be:

Partial Payments Project

2.16R PAYMENT FOR MATERIALS ON SITE

Consideration of partial or full payments of materials on site (Section 2.15R) within this contract will be as indicated below:

No - Payments will not be considered

2.17R USE TAX LIABILITY

The Contractor shall be liable to pay the use tax on tangible personal property that is supplied by the City to the Contractor for performance of the Contractor. The value of said personal property is estimated to be **\$0.00**, which value shall be used for determining the Contractor's liability for tax. The Contractor shall be liable to pay all Federal, State, County, or local taxes required for labor and/or materials included in this Contract.

2.18R EXCISE TAX LIABILITY

The Contractor or Subcontractors shall be liable for payment of any state excise tax required for realty improvements under SDCL 10-46A. Pursuant to SDCL 5-18B-17 the City of Rapid City may not award a contract for the construction of a public improvement unless the City of Rapid City has verified that the Contractor has a South Dakota Contractor's Excise Tax License pursuant to SDCL Chapter 10-46A or 10-46B.

2.20R NON-DISCRIMINATION IN EMPLOYMENT

Contracts for work described in these Documents obligate the Contractor and Subcontractors to be non-discriminatory in their employment practices.

2.21R CITY OF RAPID CITY NONDISCRIMINATION POLICY STATEMENT

In compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the rehabilitation act of 1973, the age discrimination act of 1975, the Americans with disabilities act of 1990, and other nondiscrimination authorities it is the policy of

City of Rapid City
300 Sixth Street
Rapid City, SD 57701-5035

to provide benefits, services, and employment to all persons without regard to race, color, national origin, sex, disabilities/handicaps, age, or income status. No distinction is made among any persons in eligibility for the reception of benefits and services provided by or through the auspices of the City of Rapid City.

If you have any concerns regarding the provisions of services or employment on the basis of disability/handicap you may contact our ADA/Section 504 coordinator at telephone no. (605) 394-4110.

2.22R FEES, PERMITS AND TAXES

The Contractor shall obtain all applicable permits associated with the project. Building Permit Fees, Drainage Basin Fees, Erosion and Sediment Control Permit Fees, Air Quality Permit Fees, and Inspection and Permit Fees (as covered under Section 13.04.100 for excavations, driveways and patching etc.) shall be borne by the owner. All other fees, taxes and costs shall be borne by the Contractor.



CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

01/08/2016

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER First Western Insurance RC PO Box 3075 Rapid City, SD 57709 Kathy Johnson		CONTACT NAME: Kathy Johnson PHONE (A/C, No, Ext): 605-348-9800 FAX (A/C, No): 605-342-4579 E-MAIL ADDRESS:															
INSURED Highmark Inc Dale Schuelke PO Box 491 Black Hawk, SD 57718		<table border="1"> <thead> <tr> <th>INSURER(S) AFFORDING COVERAGE</th> <th>NAIC #</th> </tr> </thead> <tbody> <tr><td>INSURER A : Acuity</td><td></td></tr> <tr><td>INSURER B :</td><td></td></tr> <tr><td>INSURER C :</td><td></td></tr> <tr><td>INSURER D :</td><td></td></tr> <tr><td>INSURER E :</td><td></td></tr> <tr><td>INSURER F :</td><td></td></tr> </tbody> </table>		INSURER(S) AFFORDING COVERAGE	NAIC #	INSURER A : Acuity		INSURER B :		INSURER C :		INSURER D :		INSURER E :		INSURER F :	
INSURER(S) AFFORDING COVERAGE	NAIC #																
INSURER A : Acuity																	
INSURER B :																	
INSURER C :																	
INSURER D :																	
INSURER E :																	
INSURER F :																	

COVERAGES CERTIFICATE NUMBER: REVISION NUMBER:

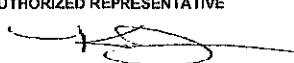
THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS
A	<input checked="" type="checkbox"/> COMMERCIAL GENERAL LIABILITY <input type="checkbox"/> CLAIMS-MADE <input checked="" type="checkbox"/> OCCUR	X		K19213	01/01/2016	01/01/2017	EACH OCCURRENCE \$ 1,000,000 DAMAGE TO RENTED PREMISES (Ea occurrence) \$ 250,000
A	<input checked="" type="checkbox"/> XCU GEN'L AGGREGATE LIMIT APPLIES PER: <input type="checkbox"/> POLICY <input type="checkbox"/> PRO-JECT <input type="checkbox"/> LOC OTHER:			K19213	01/01/2016	01/01/2017	MED EXP (Any one person) \$ 10,000 PERSONAL & ADV INJURY \$ 1,000,000 GENERAL AGGREGATE \$ 3,000,000 PRODUCTS - COMP/OP AGG \$ 3,000,000
	<input checked="" type="checkbox"/> AUTOMOBILE LIABILITY ANY AUTO ALL OWNED AUTOS HIRED AUTOS <input type="checkbox"/> SCHEDULED AUTOS <input type="checkbox"/> NON-OWNED AUTOS			K19213	01/01/2016	01/01/2017	COMBINED SINGLE LIMIT (Ea accident) \$ 1,000,000 BODILY INJURY (Per person) \$ BODILY INJURY (Per accident) \$ PROPERTY DAMAGE (Per accident) \$
A	<input type="checkbox"/> UMBRELLA LIAB <input type="checkbox"/> EXCESS LIAB DED <input type="checkbox"/> RETENTION \$			K19213	01/01/2016	01/01/2017	EACH OCCURRENCE \$ 5,000,000 AGGREGATE \$ 5,000,000
A	<input checked="" type="checkbox"/> WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below		N/A	K19213	01/01/2016	01/01/2017	PER STATUTE <input type="checkbox"/> OTH-ER <input type="checkbox"/> E.L. EACH ACCIDENT \$ 500,000 E.L. DISEASE - EA EMPLOYEE \$ 500,000 E.L. DISEASE - POLICY LIMIT \$ 500,000
A	Equipment			K19216	01/01/2016	01/01/2017	Equipment 500,000
A	Cargo			K19216	01/01/2016	01/01/2017	Cargo 25,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)

Project: Jackson Springs Water Transmission Mains
Project No: WTP09-1836/CIP No. 50780
30 day cancel notice included
Certificate holder is also an additional insured on the general liability coverage part.

CERTIFICATE HOLDER CANCELLATION

CITYRPC City of Rapid City 300 6th St. Rapid City, SD 57701	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS. AUTHORIZED REPRESENTATIVE 
---	---

**SECTION 4R
PROPOSAL FOR
FURNISHING LABOR AND MATERIALS
FOR THE CONSTRUCTION OF**

**JSWTM – IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM
PROJECT NO. WTP09-1836 / CIP NO. 50780**

SPECIAL CONDITIONS

1. All work covered within this proposal shall be in accordance with the Jackson Springs Water Transmission Mains, Project No. WTP09-1846/CIP No. 50780, Sections 1R, 2R, 3R, 4R, 6R, 7S, 01330, 01780, and 13800 of this Proposal document, and with the City of Rapid City Standard Specifications for Public Works Construction, 2007 Edition.
2. All Work shall be completed in accordance with the following calendar day completion schedule and milestone completion dates.
 - a. **All work shall be completed by May 22, 2016, and shall be completed within 60 consecutive calendar days once work begins.**
2. Proposal shall include sales tax and all other applicable taxes and fees.
3. A List of Subcontractors is provided in this section and shall be submitted with the Request for Proposal. The List shall include each Subcontractor's name, address, description of work and subcontract value. Additionally, a copy of each subcontract quote shall be attached to the List of Subcontractors at the time of submittal of the Request for Proposal.
4. Proposal quantities for unit price contract items are approximate and are being used to obtain the Proposal. Payment will be made for actual work completed in accordance with payment conditions explained in the specifications.
5. In the case of an error in extension of a unit price to an item total, the unit price shall govern, and the corrected item total used in evaluating the Proposal. In case of an error in summation of item totals for a total Proposal, the corrected summation will govern over the incorrect Proposal total shown.
6. Given the special nature of the work associated with this project, and given that this project is to be considered a Construction Change Order to the original construction contract for WTP09-1836 / CIP 50780, the Contractor is not required to complete 50% or more of the project, and therefore, can sublet a contract for the amount necessary to complete the work described.
7. Following review and acceptance of the Request for Proposal by the City Public Works Department, but prior to finalization by the City of Rapid City Common Council, the Contractor is required to provide a Performance Bond and a Payment Bond each for 100% of the

Proposal. Following Project Acceptance, a Warranty Bond will be required pursuant to Section 7.65 of the General Conditions of the Standard Specifications.

8. The Contractor will be responsible for full payment for materials, labor and equipment to complete the Project. Pay requests shall be submitted based upon the full amount; the City will reimburse the Contractor for their 60% of the work as indicated in the proposal forms and as stipulated in the Agreement. Retainage will be withheld per Section 7.59 of the General Conditions of the City of Rapid City Standard Specifications for Public Works Construction (2007) based on the amount within this Proposal and not the total Contract amount for the "Jackson Springs Water Transmission Mains Project No. WTP09-1836/CIP No. 50780".
9. Final payment or release of the retained percentage will not be made until Lien Waivers have been obtained by the Contractor from all subcontractors and submitted to the City per Section 7.30 of the General Conditions of the Standard Specifications
10. Weather days shall not be considered for completion date extensions.
- ~~11. Scull Construction Service, Inc. is currently completing the Canyon Lake Dam Reconstruction (City Project PW08-1743). The anticipated schedule of completion is June 30, 2015. If the Canyon Lake Dam Reconstruction project is not completed prior to the start of this Project, the Contractor is required to coordinate construction traffic, construction traffic control and staging areas with Scull Construction Service, Inc. The contact for Scull Construction Service, Inc., is Justin Busch, 605-390-2071.~~
12. Section 7.40 of the General Conditions of the City of Rapid City Standard Specifications for Public Works Construction (2007) shall be revised such that the Contractor shall perform, with his organization, work amounting to not less than ten (10) percent of the original total contract price instead of the standard fifty (50) percent.
13. Section 7.48 of the General Conditions of the City of Rapid City Standard Specifications for Public Works Construction (2007) shall be revised to allow Saturday, Sunday, Holiday, and Night work for the well drilling operation.
14. Remove Section 7.64 of the General Conditions of the City of Rapid City Standard Specifications for Public Works Construction (2007).
15. **If a project delay, beyond the control of the Contractor, is encountered then it shall be addressed in accordance with Section 7 of the Specifications.**
16. **Per Specification 7.70, Equipment and labor rates shall be furnished to the Engineer for the Contractor's forces and sub-contractor's forces at or prior to the Pre-Construction meeting.**
17. **In the event issues arise during the course of construction that are not addressed within the contract documents (specifications, drawings, etc.) then the Contractor may request consideration for Extra Work as defined and addressed per Section 7 of the specifications.**

18. In the event additional casing material, above and beyond the contract defined quantity, is required the Contractor shall be compensated at a rate of \$43.50 per vertical foot of casing furnished and installed. The use of additional casing material shall be per the direction of the Engineer.
19. In the event well drilling circulation is lost and "loss circulation materials" are required then the furnishing of and installation of loss circulation materials shall be paid for by the Owner at the rate of the cost of the loss circulation materials plus 15%. The use of "loss circulation materials" shall be per the direction of the Engineer.
20. In the event an artesian well is encountered, the Contractor and Owner agree that the presence of an artesian well shall be considered, "Extra Work" as defined and addressed in Section 7 of the specifications.

LIST OF SUBCONTRACTORS FOR

**JSWTM – IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM
PROJECT NO. WTP09-1836 / CIP NO. 50780**

List name, business address, description of subcontract work and dollar value of subcontract for each Subcontractor that will be used. Contractor shall list all Subcontractors to be used the project. In addition, for each Subcontractor listed, the Contractor shall provide a copy the Subcontractor's bid or proposal to complete their portion of the work under the Proposal. This information is required with the submission of the proposal.

<u>Name and Address of Subcontractor</u>	<u>Description of Subcontract Work</u>	<u>\$ Value</u>
<u>BEKA Corporation</u> <u>Box 472</u> <u>Rapid City, SD 57709</u>	<u>Bore</u>	<u>\$ 7830.⁰⁰</u>
<u>WBI Energy Corrosion Services</u> <u>PO Box 50988</u> <u>Billings, MT 59105</u>	<u>Deep Well Installations</u>	<u>\$51,020.⁰⁰</u>
<u>Muellenberg Electric, Inc</u> <u>PO Box 4128</u> <u>Rapid City, SD 57709</u>	<u>AC Service for Cathodic Protection System</u>	<u>\$ 5935.⁰⁰</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____

If more Subcontractors need to be listed this sheet can be reproduced or additional pages can be added.

REQUEST FOR PROPOSAL
 JSWTM IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM
 WTPO8-1836 / CIP 50780

BID ITEM	DESCRIPTION	UNIT	CITY OF RAPID CITY COST RESPONSIBILITY ¹ (Pay Items)			CONTRACTOR COST RESPONSIBILITY ¹ (Highmark's Responsibility (Non-Pay Items))		
			ESTIMATED QUANTITY	UNIT COST	EXTENDED COST	ESTIMATED QUANTITY	UNIT COST	EXTENDED COST
1	Mobilization	LS	0.6 (1)	3360.00	3,360.00	0.4 (1)	2000.00	2,000.00
2	Incidental Work	LS	0.6 (1)	2352.00	2,352.00	0.4 (1)	1400.00	1,400.00
3	Construction Staking	LS	0.6 (1)	336.00	336.00	0.4 (1)	200.00	200.00
4	Impressed Current Cathodic Protection System	LS	0.6 (1)	44820.66	44,820.66	0.4 (1)	25759.00	25,759.00
5	AC Power Drop	LS	0.6 (1)	7156.80	7,156.80	0.4 (1)	4260.00	4,260.00
6	Test Station with Reference Electrode, Coupon and Plastic Monitoring Pipe	LS	0.6 (1)	792.00	792.00	0.4 (1)	480.00	480.00
7	No. 2 AWG Conductor Installation in Conduit	LF	0.6 (590)	1.29	761.10	0.4 (590)	0.77	453.12
8	Open Cut Installation of 1" PVC Conduit	LF	0.6 (590)	14.08	8,304.24 8,304.24	0.4 (590)	8.38	4,944.20
8	Directional Bore Installation of 1" PVC Conduit	LF	0.6 (590)	12.55	7,402.14	0.4 (590)	6.80	4,012.00
9	Concrete Markers	EA	0.6 (8)	117.60	940.80	0.4 (8)	70.00	560.00
10	Sediment Control Wattles, 8-inch	LF	0.6 (600)	3.31	1,983.60	0.4 (600)	1.90	1,140.00
11	Stabilized Construction Entrance	EA	0.6 (1)	1344.00	1,344.00	0.4 (1)	800.00	800.00

PROJECT TOTAL

~~79,555.50~~

79,553.94

46,008.32

NOTES: RESPONSIBILITY under the terms of the agreement entered into between the City and Highmark, Inc., Highmark, Inc., is responsible for initial payment of materials, subcontract work and all other costs associated with the construction of the Project. The City will reimburse Highmark, Inc. at the agreement stipulated percentage of 60% for work completed.
 Item 8 is intentionally listed twice; Pricing on both direct bury and directional boring of 1" conduit is requested. The City will select whichever installation method is believed to be in the best interest of the City. The unused item will be removed from the contract by Construction Change Order following completion of the work.

NOTE: Revisions reflect Change Order prices.

*S.P.T.
12/29/15*

*4.5R
S.P.T.
12/29/15*

SECTION 6R
PERFORMANCE BOND

BOND # 54-205941

KNOW ALL MEN BY THESE PRESENTS, that we,
Highmark Inc, PO Box 491 Black Hawk, SD 57718 as Principal,
and United Fire and Casualty Company a SURETY
COMPANY with General Offices in Cedar Rapids Iowa, a
Corporation organized under the laws of the State of Iowa, and authorized to
transact business in the State of South Dakota as Surety, are held and firmly bound unto the CITY OF
RAPID CITY, SOUTH DAKOTA, in the penal sum of
Seventy one thousand two hundred forty nine dollars & ten cents (\$ 71,249.10), lawful money of the
United States, in payment of which sum well and truly to be made, the said Principal and Surety bind
themselves, their successors, and assigns, jointly and severally, firmly by these presents.

Signed, sealed, and delivered this 4th day of January 2016, ~~2009~~

WHEREAS, said Principal has entered into a written contract with the Obligee dated
21st December 2009, ~~2009~~ for

**JACKSON SPRINGS WATER TRANSMISSION MAINS
PROJECT NO. WTP09-1836 / CIP NO. 50780**

and shall be in accordance with the detailed plans and specifications for this Construction Change Order for the JSWTM – IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM on file in the offices of the City Finance Officer of said City. A copy of the original construction contract is attached hereto and made a part hereof.

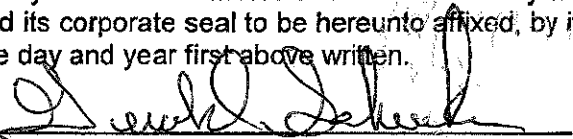
NOW, THEREFORE, if said Principal shall, in all particulars, well, truly, and faithfully perform and abide by said contract and each and every covenant, condition, and part thereof and shall carry out all obligations resting upon said Principal by the terms of said contract, specifications, and detailed plans; and if the said Principal shall pay to said City all sums due or which may become due by the terms of said contract, as well as by reason of any violations thereof by said Principal; and if said Principal shall promptly pay, or cause to be paid, all labor bills, including the hire, rental, or lease of equipment or machinery and the operators thereof used on the work and all bills for materials, lubricants, oils, and gasoline used in or consumed in the construction of such work and for all labor performed in such work, whether by subcontract or otherwise; and if said Principal shall protect and save harmless said City from all loss, damages, and expense to life or property suffered or sustained by any person, firm, or corporation, caused by said Principal or its agents, servants, or employees in the construction of said work; or by or in consequence of any negligence, carelessness, or misconduct in guarding and protecting the same, or from any act or omission of the said Principal or his agents, servants, or employees; and if the said Principal shall protect and save harmless said City from all suits and claims of infringement or alleged infringement of patent rights or processes; and if, for and during a period of two (2) years from and immediately following the completion of said Contract and the acceptance thereof by said City, the said Principal shall pay, or cause to be paid, to said City all damage, loss, and expense which may occur to the said City by reason of defective materials used or by reason of defective workmanship done in the furnishing of materials for and the construction of the said work

and compliance with S.D.C.L. 5-21-3 and S.D.C.L. 10-46-5, if applicable; and if said Principal shall save and hold harmless said City from all damages, loss, and expense occasioned by any failure whatsoever of the said Principal, then this obligation shall be null and void; otherwise to be and remain in full force and effect in law.

If the Principal shall fail or neglect to pay any person, firm, or corporation for labor bills, including the hire, rental, or lease of equipment or machinery, and the operators thereof, used on the work or materials employed or used by said Principal in carrying forward, performing, and completing said Contract within thirty (30) days after the same becomes due and payable, such persons, firms, or corporations entitled to such pay may sue and recover on this bond form said sureties or either of them the amount so due and unpaid them.

And the said surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the Contract or to the work to be performed thereunder, or the specifications accompanying the same shall in any way affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, alteration, or addition by the terms of the Contract or to the work or to the specifications.

IN TESTIMONY WHEREOF, the said Principal has caused these presents to be executed in its name and its corporate seal to be hereunto affixed by its duly authorized officers and the said Surety has caused these presents to be executed in its name and its corporate seal to be hereunto affixed, by its attorney-in-fact duly authorized thereunto so to do, the day and year first above written.



BY: Gerold Schuelke - President

Highmark Inc - Principal

United Fire and Casualty

SURETY COMPANY

BY: 
ATTORNEY-IN-FACT
Jodie K Fisk



(Accompany this Bond with Attorney-in-fact's authority from the company.)

This Bond and surety approved this _____ day of _____, 2015.



UNITED FIRE & CASUALTY COMPANY, CEDAR RAPIDS, IA
 UNITED FIRE & INDEMNITY COMPANY, WEBSTER, TX
 FINANCIAL PACIFIC INSURANCE COMPANY, ROCKLIN, CA
CERTIFIED COPY OF POWER OF ATTORNEY
 (original on file at Home Office of Company - See Certification)

Inquiries: Surety Department
 118 Second Ave SE
 Cedar Rapids, IA 52401

KNOW ALL PERSONS BY THESE PRESENTS, that UNITED FIRE & CASUALTY COMPANY, a corporation duly organized and existing under the laws of the State of Iowa, UNITED FIRE & INDEMNITY COMPANY, a corporation duly organized and existing under the laws of the State of Texas, and FINANCIAL PACIFIC INSURANCE COMPANY, a corporation duly organized and existing under the laws of the State of California (herein collectively called the Companies), and having their corporate headquarters in Cedar Rapids, State of Iowa, does make, constitute and appoint STEPHANIE HANSEN, OR KATHLEEN A. JOHNSON, OR JODIE K. FISK, OR ALICE ANN HERMAN, OR PERRY BORELLA, OR LESTIA J. MCLAUGHLIN, OR AMY BORELLA, OR MELISSA DOUGAN, OR DONNA FOSTER, ALL INDIVIDUALLY OF RAPID CITY SD

their true and lawful Attorney(s)-in-Fact with power and authority hereby conferred to sign, seal and execute in its behalf all lawful bonds, undertakings and other obligatory instruments of similar nature provided that no single obligation shall exceed \$10,000,000.00 and to bind the Companies thereby as fully and to the same extent as if such instruments were signed by the duly authorized officers of the Companies and all of the acts of said Attorney, pursuant to the authority hereby given and hereby ratified and confirmed.

The Authority hereby granted shall expire the 24th day of January, 2018 unless sooner revoked by UNITED FIRE & CASUALTY COMPANY, UNITED FIRE & INDEMNITY COMPANY, AND FINANCIAL PACIFIC INSURANCE COMPANY.

This Power of Attorney is made and executed pursuant to and by authority of the following bylaw duly adopted on May 15, 2013, by the Boards of Directors of UNITED FIRE & CASUALTY COMPANY, UNITED FIRE & INDEMNITY COMPANY, and FINANCIAL PACIFIC INSURANCE COMPANY.

"Article VI - Surety Bonds and Undertakings"

Section 2, Appointment of Attorney-in-Fact. "The President or any Vice President, or any other officer of the Companies may, from time to time, appoint by written certificates attorneys-in-fact to act in behalf of the Companies in the execution of policies of insurance, bonds, undertakings and other obligatory instruments of like nature. The signature of any officer authorized hereby, and the Corporate seal, may be affixed by facsimile to any power of attorney or special power of attorney or certification of either authorized hereby; such signature and seal, when so used, being adopted by the Companies as the original signature of such officer and the original seal of the Companies, to be valid and binding upon the Companies with the same force and effect as though manually affixed. Such attorneys-in-fact, subject to the limitations set forth in their respective certificates of authority shall have full power to bind the Companies by their signature and execution of any such instruments and to attach the seal of the Companies thereto. The President or any Vice President, the Board of Directors or any other officer of the Companies may at any time revoke all power and authority previously given to any attorney-in-fact.

IN WITNESS WHEREOF, the COMPANIES have each caused these presents to be signed by its vice president and its corporate seal to be hereto affixed this 24th day of January, 2016

UNITED FIRE & CASUALTY COMPANY
 UNITED FIRE & INDEMNITY COMPANY
 FINANCIAL PACIFIC INSURANCE COMPANY

By: *Dennis J. Richman* Vice President



State of Iowa, County of Linn, ss:
 On: 24th day of January, 2016, before me personally came Dennis J. Richmann

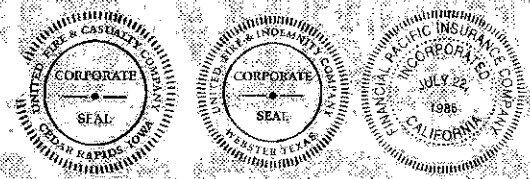
to me known, who being by me duly sworn, did depose and say, that he resides in Cedar Rapids, State of Iowa; that he is a Vice President of UNITED FIRE & CASUALTY COMPANY, a Vice President of UNITED FIRE & INDEMNITY COMPANY, and a Vice President of FINANCIAL PACIFIC INSURANCE COMPANY the corporations described in and which executed the above instrument, that he knows the seal of said corporations, that the seal affixed to the said instrument is such corporate seal, that it was so affixed pursuant to authority given by the Board of Directors of said corporations and that he signed his name thereto pursuant to like authority, and acknowledges same to be the act and deed of said corporations



Mary A. Bertsch
 Notary Public
 My commission expires: 10/26/2016

I, David A. Lange, Secretary of UNITED FIRE & CASUALTY COMPANY and Assistant Secretary of UNITED FIRE & INDEMNITY COMPANY, and Assistant Secretary of FINANCIAL PACIFIC INSURANCE COMPANY, do hereby certify that I have compared the foregoing copy of the Power of Attorney and affidavit, and the copy of the Section of the bylaws and resolutions of said Corporations as set forth in said Power of Attorney, with the ORIGINALS ON FILE IN THE HOME OFFICE OF SAID CORPORATIONS, and that the same are correct transcripts thereof, and of the whole of the said originals, and that the said Power of Attorney has not been revoked and is now in full force and effect.

In testimony whereof I have herewith subscribed my name and affixed the corporate seal of the said Corporations this 4TH day of JANUARY, 2016



By: *David A. Lange*

Secretary, UF&C
 Assistant Secretary, UF&I/EPIC

SECTION 7S
SUPPLEMENTAL CONDITIONS

These Supplemental Conditions amend or supplement appropriate provisions of the Contract Documents as indicated in the following paragraphs. All provisions in the Contract Documents which are not so amended or supplemented remain in full force and effect.

ARTICLE 1 - DEFINITIONS

- 1.01 The following terms have the meanings indicated below, which are applicable to both singular and plural thereof:
- A. "FEC" - Ferber Engineering Company, Inc. at 729 East Watertown St., Rapid City SD 57701.
 - B. "Resident Project Representative" - the authorized representative of FEC who is assigned to the construction Site or any part thereof.

ARTICLE 2 -FEC'S STATUS DURING CONSTRUCTION

2.01 **OWNER'S REPRESENTATIVE:**

- A. FEC will be Owner's representative during the construction period. The duties and responsibilities and the limitations of FEC's authority as Owner's representative during construction are set forth in the Contract Documents and shall not be extended without written consent of Owner and FEC.

2.02 **VISITS TO SITE:**

- A. FEC will make visits to the Site at intervals appropriate to the various stages of construction to observe the progress and quality of the executed Work and to determine, in general, if the Work is proceeding in accordance with the Contract Documents. FEC's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform to the Contract Documents. On the basis of such visits and on-site observations as an experienced and qualified design professional, FEC will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defects and deficiencies in the Work.

2.03 LIMITATIONS ON FEC'S RESPONSIBILITIES:

- A. Neither FEC's authority to act under this ARTICLE 2 or elsewhere in the Contract Documents nor any decision made by FEC in good faith either to exercise or not exercise such authority shall give rise to any duty or responsibility of FEC to Contractor, any Subcontractor, any Supplier, or any other person or organization performing any of the Work, or to any surety for any of them.
- B. Whenever in the Contract Documents the terms "as directed", "as required", "as allowed", "as approved", or terms of like effect or import are used, or the adjectives "reasonable", "suitable", "acceptable", "proper", or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review, or judgment of FEC as to the Work, it is intended that such requirement, direction, review or judgment will be solely to evaluate the Work for compliance with the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to FEC any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Paragraphs 2.03C or 2.03D.
- C. FEC and Owner will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. FEC and Owner will not be responsible for Contractor's failure to perform or furnish the Work in accordance with the Contract Documents.
- D. FEC and Owner will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other person or organization performing or furnishing any of the Work.
- E. The presence or absence of FEC or his representative will not act to relieve Contractor of any responsibility or of any guarantee of his performance. Neither will observation by FEC or his representative in any way be understood to relieve Contractor of any responsibility for proper supervision of the Work at all times.
- F. The limitations upon authority and responsibility set forth in this Paragraph 2.03 shall also apply to FEC, Resident Project Representative, and assistants.

ARTICLE 3 – OWNERSHIP AND REUSE OF DOCUMENTS

- 3.01 All Contract Documents and copies thereof furnished by FEC shall remain its property. With the exception of those copies signed in connection with the execution of the Agreement, all Contract Documents shall be returned to FEC on request upon completion of the Work.
- 3.02 Neither Contractor nor any Subcontractor or Supplier or other person or organization performing or furnishing any of the Work under a direct or indirect contract with Owner shall have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of FEC; and they shall not reuse any of the documents on extensions of the Project or any other project without written consent of Owner and FEC and specific written verification or adaptation by FEC.

ARTICLE 4 – INDEMNIFICATION

- 4.01 PERSONAL INJURY AND PROPERTY DAMAGE:
- A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless FEC and Owner, their consultants, agents, and employees from and against all claims, damages, losses and expenses, direct, indirect, or consequential (including but not limited to fees and charges of engineers, architects, attorneys and other professionals, and court and arbitration costs) arising out of or resulting from the performance of the Work, provided that any such claim, damage, loss, or expense:
1. Is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including the loss of use resulting therefrom, and
 2. Is caused in whole or in part by any negligent act or omission of Contractor, any Subcontractor, any person, or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder or arises by or is imposed by Laws and Regulations regardless of the negligence of any such party.

SECTION 7S – SUPPLEMENTAL CONDITIONS: continued

- B. In any and all claims against FEC and Owner, their consultants, agents, or employees by any employee of Contractor, any Subcontractor, any person, or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 4.01.A.1 shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor or other person or organization under workers' or workmen's compensation acts, disability benefit acts, or other employee benefit acts.

- C. If necessary for enforcement of any indemnification and hold harmless requirement herein, or if applicable law requires the Contractor to obtain specified limits of insurance to insure any indemnity obligation; then Contractor shall obtain such applicable coverage, the cost to be recovered and included in the Contract Price, and any indemnity attributable to the negligence of any indemnified party shall be limited to such insurance.

4.02 PATENT FEES AND ROYALTIES:

Contractor shall indemnify and hold harmless Owner, FEC, and anyone directly or indirectly employed by either of them from and against all claims, damages, losses, and expenses (including attorneys' fees and court and arbitration costs) arising out of any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents, and shall defend all such claims in connection with any alleged infringement of such rights.

END OF SECTION 7S.

**SECTION 01330
SUBMITTALS**

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes definitions, descriptions, transmittal, and review of Submittals.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 01780: - RECORD DOCUMENTS.

1.02 GENERAL INFORMATION:

- A. Definitions:
 - 1. Shop Drawings, Product Data, and Samples are technical Submittals prepared by Contractor, Subcontractor, Manufacturer or Supplier and submitted by Contractor to Engineer as a basis for approval of the use of Materials proposed for incorporation in the Work or needed to describe installation, operation, maintenance, or technical properties, as specified in each Division of the Specifications.
 - a. Shop Drawings include custom-prepared data of all types including drawings, diagrams, performance curves, material schedules, templates, instructions, and similar information not in standard printed form applicable to other projects.
 - b. Product Data includes standard printed information on materials, products, and systems; not custom-prepared for this Project, other than the designation of selections from available choices.
 - 2. Informational Submittals are those Technical Reports, Administrative Submittals, Certificates and Guarantees not defined as Shop Drawings or Product Data.
 - a. Technical Reports include laboratory reports, tests, technical procedures, technical records, and Contractor's design analysis.

SECTION 01330 - SUBMITTALS: continued

- b. Administrative Submittals are those nontechnical Submittals required by the Contract Documents or deemed necessary for administrative records. These Submittals include maintenance agreements, bonds, Project photographs, physical work records, statements of applicability, copies of industry standards, Project record data, schedules, security/protection/safety data, and similar type Submittals.
 - c. Certificates and Guarantees are those Submittals on Materials where a written certificate or guarantee from the Manufacturer or Supplier is called for in the Specifications.
3. Refer to ARTICLES 1.03 and 1.04 of this Part for detailed lists of Submittals and specific requirements.

B. Quality Requirements:

1. Submittals such as Shop Drawings and Product Data shall be of suitable quality for legibility and reproduction purposes. Every line, character, and letter shall be clearly legible. Drawings such as reproducibles shall be useable for further reproduction to yield legible hard copy.
2. Documents submitted to Engineer that do not conform to specified requirements shall be subject to rejection by Engineer, and upon request by Engineer, Contractor shall resubmit conforming documents. If conforming Submittals cannot be obtained, such documents shall be retraced, redrawn, or photographically restored as may be necessary to meet such requirements. Contractor's (or its Subcontractor's) failure to initially satisfy the legibility quality requirements will not relieve Contractor (or its Subcontractors) from meeting the required schedule for Submittals.

C. Language and Dimensions:

1. All words and dimensional units shall be in the English language.

D. Submittal Completeness:

1. Submittals shall be complete with respect to dimensions, design criteria, materials of construction, and other information specified to enable Engineer to review the information effectively.

SECTION 01330 - SUBMITTALS: continued

2. Where standard drawings are furnished, which cover a number of variations of the general class of Materials, each drawing shall be annotated to indicate exactly which parts of the drawing apply to the Materials being furnished. Use hatch marks to indicate variations that do not apply to the Submittal. The use of "highlighting markers" will not be an acceptable means of annotating Submittals. Annotation shall also include proper identification of the Submittal permanently attached to the drawing.

E. Form of Submittals:

1. Submittals and other Project documents shall be transmitted in hardcopy format in the quantity stipulated in the General Notes of the Plans and/or in the submittal schedule herein attached.
2. Contractor Submittals shall be accompanied with a completed transmittal letter. Submittals that are not accompanied with an approved transmittal letter will not be accepted and will be returned to Contractor.
3. All Contractor transmittal letters submitted to Engineer shall be in the form supplied and shall contain as a minimum the following information:
 - a. Contractor's Name;
 - b. Owner's Project number;
 - c. Owner's Contract number;
 - d. Filename;
 - e. Description of the information contained in the specific Submittal;
 - f. Revision number;
 - g. Submittal type;
 - h. Date of Submittal.
4. Nonconforming Submittals are subject to rejection by Engineer.

1.03 TECHNICAL SUBMITTALS:

- A. Items shall include, but not be limited to, the following:
1. Manufacturer's specifications.
 2. Catalogs, or parts thereof, of manufactured Materials.
 3. Shop fabrication and erection drawings.
 4. Bills of material and spare parts list.
 5. Instruction books and operating manuals.
 6. Material lists or schedules.
 7. Concrete mix design information.
 8. All drawings, catalogs or parts thereof, manufacturer's specifications and data, samples, instructions, and other information specified or necessary:
 - a. For Engineer to determine that Materials conform to the design and comply with intent of the Contract Documents.
 - b. For proper installation, operation, and maintenance of Materials which Engineer will review for general content but not for basic details.
- B. Submittal Schedule:
1. A Submittal Schedule of all Submittals specified or necessary for Engineer's approval of the use of Materials proposed for incorporation in the Work or needed for proper installation, operation, or maintenance is attached here within.
 - a. If Engineer deems that additional materials require submittals that are not on the list, these items may be added by the Engineer
 - b. Schedule submission of all Submittals to permit review, fabrication, and delivery in time so as to not cause a delay in the Work of Contractor or its Subcontractors or any other contractors as described in the Contract Documents.
 - c. This Submittal Schedule will be utilized throughout the Project by the Contractor, the Engineer, and the Owner.

SECTION 01330 - SUBMITTALS: continued

2. The Schedule shall indicate the anticipated dates of original submission for each item and Engineer's approval thereof, and shall be based upon at least one resubmission of each item.
3. Schedule all Submittals (Shop Drawings, Product Data, and Samples) required prior to fabrication or manufacture. Schedule Submittals pertaining to storage, installation, and operation at the Site for Engineer's approval prior to delivery of the Materials.
4. Resubmit Submittals the number of times required for Engineer's "No Exception Taken." However, any need for resubmittals in excess of the number set forth in the accepted schedule, or any other delay in obtaining approval of Submittals, will not be grounds for extension of the Contract Times, provided Engineer completes its reviews within the times specified.
5. Where a Submittal is required by the Contract Documents or the accepted Submittal Schedule, any related Work performed prior to Engineer's review and approval of the pertaining Submittal will be at the sole expense and responsibility of Contractor.

C. Transmittal of Submittals:

1. All Submittals (Shop Drawings or Product Data) for Materials furnished by Contractor, Subcontractors, Manufacturers and Suppliers shall be submitted to Engineer by Contractor, at least ten (10) working days prior to incorporating the items into the work, unless otherwise specified within the contract documents.
2. After checking and verifying all field measurements, transmit all Submittals to Engineer for approval as follows:
 - a. Mark each Submittal by Project name and number, Contract title and number, and applicable Specification Section and Article number. Include in the letter of transmittal the Drawing number and title, sheet number (if applicable), revision number, and electronic filename (if applicable). Unidentifiable Submittals will be returned for proper identification.

SECTION 01330 - SUBMITTALS: continued

- b. Check and approve Submittals of Subcontractors, Suppliers, and Manufacturers prior to transmitting them to Engineer. Contractor's submission shall constitute a representation to Owner and Engineer that Contractor approves Submittals and has determined and verified all design criteria, quantities, dimensions, field construction and installation criteria, materials, catalog numbers, compliance with Laws and Regulations, and similar data, and Contractor assumes full responsibility for doing so; and Contractor has coordinated each Submittal with the requirements of the Work and the Contract Documents.
 - c. At the time of each submission, call to the attention of Engineer in the letter of transmittal any deviations from requirements of the Contract Documents.
 - d. Make all modifications noted or indicated by Engineer and return the required number of revised Submittals until approved. Direct specific attention in writing, or on revised Submittals, to changes other than the modifications called for by Engineer on previous Submittals. After paper copy Submittals have been approved, submit copies thereof for final distribution. Previously approved Submittals transmitted for final distribution will not be further reviewed and are not to be revised. If errors are discovered during manufacture or fabrication, correct the Submittal and resubmit for review.
 - e. Following completion of the Work and prior to final payment, furnish record documents and approved Samples and Shop Drawings necessary to indicate "as constructed" conditions, including field modifications, in the number of copies specified. All such copies shall be clearly marked "PROJECT RECORD."
 - (1) Submit a final record copy of the Master Field Drawing list which shall indicate the final revision status of each drawing on the list.
 - f. Keep a copy or sample of each Submittal in good order at the Site.
3. Quantity Requirements:
- a. Refer to General Notes of the Plans.
 - b. When all Submittals have been updated to "as-constructed" conditions, transmit to Engineer and to Owner.

SECTION 01330 - SUBMITTALS: continued

- c. Owner may copy and use for internal operations and staff training purposes any and all document Submittals required by this Contract and approved for final distribution, whether or not such documents are copyrighted, at no additional cost to Owner.

D. Engineer's Review:

1. Engineer will review and take appropriate action on Submittals in accordance with the accepted Submittal Schedule. Engineer's review and approval will be only to determine if the items of Materials covered by the Submittals will, after installation or incorporation in the Work, conform to information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
2. Engineer's review and approval will not extend to design data reflected in Submittals which is within the special expertise of Contractor or Contractor's Subcontractors or Suppliers. Review and approval of a component item as such will not indicate approval of the assembly in which the item functions.
3. Engineer's review and approval of Shop Drawings, Product Data, or Samples will not relieve Contractor of responsibility for any deviation from requirements of the Contract Documents unless Contractor has in writing called Engineer's attention to such deviation at the time of submission, and Engineer has given written concurrence in and approval of the specific deviation. Approval by Engineer shall not relieve Contractor from responsibility for errors or omissions in Submittals.

E. Submittal Action Stamp:

1. Engineer's review action stamp, appropriately completed, will appear on all Submittals of Contractor when returned by Engineer. Review status designations listed on Engineer's action stamp are defined as follows:

A – NO EXCEPTION TAKEN: Signifies Material represented by the Submittal conforms with the design concept and complies with the intent of the Contract Documents and is approved for incorporation in the Work. Contractor is to proceed with fabrication or procurement of the items and with related Work. Copies of the Submittal are to be transmitted to Engineer for final distribution.

SECTION 01330 - SUBMITTALS: continued

B – MAKE CORRECTIONS NOTED: Signifies Material represented by the Submittal conforms with the design concept and complies with the intent of the Contract Documents and is approved for incorporation in the Work in accordance with Engineer's notations. Contractor is to proceed with fabrication or procurement of the items and with related Work in accordance with Engineer's notations and is to submit a revised Submittal responsive to notations marked on the returned Submittal or written in the letter of transmittal.

C – REVISE AND RESUBMIT: Signifies Material represented by the Submittal appears to conform with the design concept and comply with the intent of the Contract Documents but information is either insufficient in detail or contains discrepancies which prevent Engineer from completing its review. Contractor is to resubmit revised information responsive to Engineer's annotations on the returned Submittal or written in the letter of transmittal. Fabrication or procurement of items represented by the Submittal and related Work is not to proceed until the Submittal is approved.

D - REJECTED: Signifies Material represented by the Submittal does not conform with the design concept or comply with the intent of the Contract Documents and is disapproved for use in the Work. Contractor is to provide Submittals responsive to the Contract Documents.

E – SUBMIT SPECIFIED ITEM: Signifies Item(s) within Submittal are lacking detail and additional information for a specific item is required. Contractor is to submit such additional information to permit layout and related activities to proceed.

1.04 INFORMATIONAL SUBMITTALS:

A. Informational Submittals are comprised of Technical Reports, Administrative Submittals and Guarantees which relate to the Work, but do not require Engineer approval prior to proceeding with the Work. Informational Submittals shall include, but not be limited to:

1. Shipping or packing lists.
2. Job progress schedules.
3. Equipment and Material delivery schedules.
4. Progress photographs.
5. Warranties and guarantees.

B. Transmittal of Informational Submittals:

1. All Informational Submittals furnished by Subcontractors, Manufacturers and Suppliers shall be submitted to Engineer by Contractor unless otherwise specified.
 - a. Identify each Informational Submittal by Project name and number, Contract title and number, and Specification Section and Article number marked thereon or in letter of transmittal. Unidentifiable Submittals will be returned for proper identification.
 - b. At the time of each submission, call to the attention of Engineer in the letter of transmittal any deviations from requirements of the Contract Documents.
2. Test Reports:
 - a. Responsibilities of Contractor, Owner, and Engineer regarding tests and inspections of Equipment and Materials and completed Work are set forth elsewhere in these Contract Documents.
 - b. The party specified responsible for testing or inspection shall in each case, unless otherwise specified, arrange for the testing laboratory or reporting agency to distribute test reports as follows:

SECTION 01330 - SUBMITTALS: continued

- (1) Owner: One copy.
- (2) Engineer: One copy.
- (3) Resident Project Representative: One copy.
- (4) Contractor: One copy.

C. Engineer's Review:

1. Engineer will review Informational Submittals for indications of Work or Material deficiencies.
2. Engineer will respond to Contractor on those Informational Submittals which indicate Work or Material deficiency.
3. Submittal Schedule Master Copy will be maintained by Engineer and will be a specific item addressed during each progress meeting.

END OF SECTION

SUBMITTAL SCHEDULE		PROJ. TITLE: JACKSON SPRINGS WATER TRANSMISSION MAINS - IMPRESSED CURRENT CP SYSTEM							PROJ. NO: 09-1836		CIP # 50780			
		TO BE COMPLETED BY DESIGNER OF RECORD									CONTRACTOR COMPLETES	TO BE COMPLETED BY PROJECT INSPECTOR		
ITEM NUMBER	ITEM AND CONTRACT REFERENCE	NO. OF COPIES REQUIRED / RECEIVED *								REQUIRED SUBMISSION DATE	SUBMITTAL NUMBER	DATE RECEIVED	DATE RETURNED TO CONTRACTOR / STATUS	REMARKS
		SHOP DRAWINGS	PRODUCT DATA	COLOR SELECTION	SAMPLES	CERT. OF COMPLIANCE	DESIGN CALCS	TEST RESULTS	O&M MANUALS					
1	RECTIFIER (SECTION 13800)		4			4			4	4				
2	AC POWER SUPPLY EQUIPMENT (SECTION 13800)		4							4				
3	RECTIFIER INSTALLATION HARDWARE, CONDUIT, ENTRANCE SWITCH (SECTION 13800)		4							4				
4	RECTIFIER MOUNTING RACK (SECTION 13800)		4							4				
5	CP CABLES AND TEST WIRES (SECTION 13800)		4							4				
6	CP TEST STATIONS AND SHUNTS (SECTION 13800)		4							4				
7	CORROSION MONITORING EQUIPMENT (SECTION 13800)		4							4				
8	EXOTHERMIC WELD MATERIALS (SECTION 13800)		4							4				
9	WIRE CONNECTIONS AND TERMINALS (SECTION 13800)		4							4				
10	JUNCTION BOXES AND MOUNTING HARDWARE (SECTION 13800)		4							4				

* THE ENGINEER SHALL RETAIN THREE COPIES AND RETURN THE REMAINDER TO THE CONTRACTOR.

SUBMITTAL SCHEDULE		PROJ. TITLE: JACKSON SPRINGS WATER TRANSMISSION MAINS - IMPRESSED CURRENT CP SYSTEM							PROJ. NO: 09-1836		CIP # 50780			
		TO BE COMPLETED BY DESIGNER OF RECORD								CONTRACTOR COMPLETES	TO BE COMPLETED BY PROJECT INSPECTOR			
ITEM NUMBER	ITEM AND CONTRACT REFERENCE	NO. OF COPIES REQUIRED / RECEIVED *								REQUIRED SUBMISSION DATE	SUBMITTAL NUMBER	DATE RECEIVED	DATE RETURNED TO CONTRACTOR / STATUS	REMARKS
		SHOP DRAWINGS	PRODUCT DATA	COLOR SELECTION	SAMPLES	CERT. OF COMPLIANCE	DESIGN CALCS	TEST RESULTS	O&M MANUALS					
11	GROUND BED TERMINATION MATERIALS (SECTION 13800)		4						4					
12	CONCRETE MIX DESIGN AND REINFORCING STEEL (SECTION 13800)		4				4		4					
14	IMPRESSED CURRENT ANODE, ANODE WIRE, AND CENTRALIZER (SECTION 13800)		4			4			4					
15	COKE BREEZE (SECTION 13800)		4						4					
16	COMPRESSION CONNECTOR SPLICES AND SPLICE MATERIALS (SECTION 13800)		4						4					
17	CASING PIPE (SECTION 13800)		4						4					
18	WELL SEAL (SECTION 13800)		4						4					
19	VENT PIPE (PVC AND STEEL) (SECTION 13800)		4						4					
20	CASING PIPE WALL LEAD WIRE PROTECTION (GROMET) (SECTION 13800)		4						4					
21	SEALING MATERIAL (SECTION 13800)		4						4					

* THE ENGINEER SHALL RETAIN THREE COPIES AND RETURN THE REMAINDER TO THE CONTRACTOR.

SUBMITTAL SCHEDULE										PROJ. TITLE: JACKSON SPRINGS WATER TRANSMISSION MAINS - IMPRESSED CURRENT CP SYSTEM		PROJ. NO: 09-1836		CIP # 50780	
I T E M N U M B E R	ITEM AND CONTRACT REFERENCE	TO BE COMPLETED BY DESIGNER OF RECORD								CONTRACTOR COMPLETES		TO BE COMPLETED BY PROJECT INSPECTOR			
		NO. OF COPIES REQUIRED / RECEIVED *								REQUIRED SUBMISSION DATE	SUBMITTAL NUMBER	DATE RECEIVED	DATE RETURNED TO CONTRACTOR / STATUS	REMARKS	
SHOP DRAWINGS	PRODUCT DATA	COLOR SELECTION	SAMPLES	CERT. OF COMPLIANCE	DESIGN CALCS	TEST RESULTS	O&M MANUALS	DOCUMENTS							
22	RECTIFIER INSTALLATION AND O&M MANUALS (SECTION 13800)		4					4	4						
23	DEEP ANODE HOLE LOG PLAN (SECTION 13800)								4						
24	LAB TESTS FOR ANODES (SECTION 13800)								4						
25	WORK SCHEDULE (SECTION 13800)								4						
26	CP CONTRACTOR'S CREDENTIALS, IF REQUESTED (SECTION 13800)								4						
27	FIELD TEST REPORTS (SECTION 13800)								4						
28	RECORD DRAWINGS (SECTION 01780 & 13800)								4						

* THE ENGINEER SHALL RETAIN THREE COPIES AND RETURN THE REMAINDER TO THE CONTRACTOR.

THIS PAGE INTENTIONALLY LEFT BLANK.

SECTION 01780
RECORD DOCUMENTS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes administrative and procedural requirements for Record Documents to be maintained by the Contractor during the Project.
- B. Related Work Specified Elsewhere:
 - 1. Standard Specifications, SECTION 7
 - 2. SECTION 01330 - Submittals.

1.02 RECORD DOCUMENT SUBMITTALS:

- A. General: Do not use Record Documents for construction purposes. Protect Record Documents from deterioration and loss in a secure, fire-resistant location. Provide access to Record Documents for Engineer's reference during normal working hours.
- B. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark which drawing is most capable of showing conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
 - 1. Record information concurrently with construction progress.
 - 2. Mark record sets with red erasable pencil. Use other colors to distinguish between variations in separate categories of the Work. Mark each document "PROJECT RECORD" in neat, large, printed letters.
 - 3. Mark new information that is important to Owner but was not shown on Contract Drawings or Shop Drawings.
 - 4. Note related Change Order numbers where applicable.
 - 5. Organize Record Drawing sheets into manageable sets. Bind sets with durable-paper cover sheets; print suitable titles, dates, and other identification on the cover of each set.

SECTION 01780 – RECORD DOCUMENTS: continued

6. Upon completion of the Work, submit Record Drawings to Engineer for Owner's records.
 7. Include the following:
 - a. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - b. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of construction.
 - c. Where Submittals are used for mark-up, record a cross-reference at corresponding location on Drawings.
 - d. Field changes of dimension and detail.
 - e. Changes made by Change Order or other Modifications.
 - f. Details not on original Contract Drawings.
- C. Record Specifications: Maintain one complete copy of the Project Manual including Addenda. Include with the Project Manual one copy of other written construction documents, such as Change Orders and Modifications issued in printed form during construction.
1. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and Modifications.
 2. Give particular attention to substitutions and selection of options and information on concealed construction that cannot otherwise be readily discerned later by direct observation.
 3. Note related Record Drawing information and Product Data.
 4. Upon completion of the Work, submit record Specifications to Engineer for Owner's records.
 5. Include the following:
 - a. Manufacturer, trade name, catalog number, and Supplier of each product and item of Equipment actually installed, particularly optional and substitute items.
 - b. Changes made by Addendum, Change Order, or other Modifications.
 - c. Related Submittals.
- D. Record Product Data: Maintain one copy of each Product Data Submittal. Note related Change Orders and markup of Record Drawings and Specifications.

SECTION 01780 – RECORD DOCUMENTS: continued

1. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the Site and from the manufacturer's installation instructions and recommendations.
 2. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily discerned later by direct observation.
 3. Upon completion of markup, submit complete set of record product data to Engineer for Owner's records.
- E. Record Samples Submitted: Immediately prior to Substantial Completion, Contractor shall meet with Engineer and Owner's personnel at the Project Site to determine which Samples are to be transmitted to Owner for record purposes. Comply with Owner's instructions regarding packaging, identification, and delivery to Owner.
- F. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record keeping and Submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records, and place in good order. Identify miscellaneous records properly and bind or file, ready for continued use and reference. Submit to Engineer for Owner's records.

THIS PAGE INTENTIONALLY LEFT BLANK.

SECTION 13800
JACKSON SPRINGS WATER TRANSMISSION MAINS
CATHODIC PROTECTION SYSTEMS

1 PART 1 GENERAL

1.01 WORK INCLUDED

- A. This section covers the work necessary to furnish and install the following type(s) of an impressed current cathodic protection station and monitoring systems for the existing Jackson Springs 20-inch steel water pipeline, complete.
- B. The impressed current cathodic protection system shall consist of one cathodic protection station consisting of a rectifier with two remote surface semi-deep anode type impressed current groundbeds in Canyon Lake Park.
- C. The remote semi-deep anode impressed current groundbed shall consist of two semi-deep anode groundbeds with individual anodes and lead wires. Two semi-deep anodes shall be placed in the same right-of-way area approximately 50 feet apart. Each of the semi-deep anode groundbeds shall be approximately 125 feet deep, 8-inch diameter with four (4) anodes each. The top 45 feet shall be cased and sealed. The groundbed shall have a concrete pad over each drilled hole.
- D. The rectifier, anode junction box, vent pipe and AC service meter shall be installed on a rectifier mounting rack next to an existing AC service panel. The rectifier negative cable and a test station/bond box shall be installed at the 20-inch Jackson Springs Water Transmission Mains steel pipeline.

1.02 RELATED WORK

- A. City of Rapid City Standard Specifications for Public Works, 2007 Edition
- B. Section 7S – Supplemental Conditions
- C. Section 01330 – Submittals
- D. Section 01780 – Record Documents

1.03 GENERAL

- A. Coordinate all work specified herein with the original Jackson Springs Transmission Main Contract Documents, General Requirements and related sections which contain information and requirements that apply to the work specified herein, and as modified by the specifications provided herein.
- B. The Contractor shall be responsible for coordination of one call, connection to the pipelines, and AC power installations. The Contractor shall oversee rectifier and groundbed installation and complete the remaining items necessary to provide a fully functional cathodic protection system including the specified functional testing of the completed CPS station and providing record drawings. This shall include but not be limited to furnishing all materials, equipment and labor to

complete wire connections to the pipelines, test wires and cable, rectifier, grounded, test stations, junction box installations as specified in this section.

- C. Materials and workmanship as specified in this section shall be coordinated and completed in conjunction with other applicable sections. Coordinate all work specified herein with other crafts and related sections.
- D. The Contractor shall make a careful examination of the nature and location of the project, the Contract Documents, and the applicable permits and regulation requirements before submitting a bid. Bid submission shall act as conclusive evidence that the Contractor has investigated and is fully aware of the Contract Document requirements, local conditions and difficulties to be encountered and of the character, quality, and quantities of the work to be performed.

1.04 REFERENCE STANDARDS

- A. General: The latest revision of the following minimum standards shall apply to the cathodic protection design, materials, and installation except where more stringent standards are applicable.
 - 1. American National Standards Institute (ANSI):
 - a) C34.2, Practice and Requirements for Semiconductor Power Rectifiers.
 - b) C80.1, Rigid Steel Conduit-Zinc Coated.
 - c) C80.6 Intermediate Conduit (IMC) – Zinc Coated.
 - 2. American Society for Testing and Materials (ASTM):
 - a) A-518, High Silicon Cast Iron Anodes.
 - b) B418, Standard Specification for Cast and Wrought Galvanic Zinc Anodes.
 - c) C94, Standard Specification for Ready-Mixed Concrete.
 - 3. American Wood Preservers Association (AWPA):
 - a) AWPA Standard U1 for Lumber and Timber.
 - 4. National Association of Corrosion Engineers International (NACE):
 - a) Standard Practice SP0169, Control of External Corrosion on Underground or Submerged Metallic Piping Systems.
 - 5. National Electrical Manufacturers Association (NEMA):

- a) I-10, Type R and 4X Enclosures.
 - b) MR-20, Cathodic Protection Rectifier Units.
 - c) TC 2-83, Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
 - d) WC 3-80, Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (R 1986).
 - e) WC 5-73, Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (R 1985).
 - f) WC 7-88, Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
6. National Fire Protection Association (NFPA):
- a) National Electrical Code (NEC), NFPA 70.
7. Occupational Safety and Health Administration (OSHA).
8. Underwriter's Laboratories, Inc. (U.L.):
- a) UL 6, Rigid Metallic Conduit.
 - b) UL 83, Thermoplastic Insulated Wire and Cable.
 - c) UL 467, Grounding and Bonding Equipment.
 - d) UL 486A, Wire Connectors and Soldering Lugs for Use With Copper Conductors.
 - e) UL 489, Molded Case Circuit Breakers and Circuit Breaker Enclosures.
 - f) UL 506, Specialty Transformers.
 - g) UL 510, Insulating Tape.
 - h) UL 514, Outlet Boxes and Fittings.

1.05 DEFINITIONS

- A. **American Wire Gauge (AWG):** American Wire Gauge (AWG) is a United States (U.S.) standard set of wire conductor sizes. The “gauge” is used to describe the wire diameter which is related to the resistance per foot of the wire and the current carrying capacity of the wire conductor. Larger gauges relate to smaller diameter wire sizes which have a higher resistance per foot and lower current carrying capacity than the smaller numbered gauge sizes.
- B. **Active Column:** Active column of a deep anode groundbed shall be that portion of the groundbed, which discharges current, and shall consist of the anodes and coke breeze.
- C. **Anode:** The electrode or metallic surface location where DC current is discharged into a surrounding electrolyte and corrosion (oxidation with a loss of electrons) occurs in a corrosion cell. The opposite of a cathode.
- D. **Appurtenances or Fittings:** Items including but not limited to valves, fittings, elbows, tees, glands, angles, bends, blow offs, restrained joints, flanges, couplings, spool pieces, miscellaneous piping, tapping saddles, blow-offs, or hydrants, including metallic glands, etc.
- E. **Cathode:** The electrode or metallic surface location where DC current is received or collected from a surrounding electrolyte and protection (reduction with a gain of electrons) occurs in a corrosion cell. The opposite of an anode.
- F. **Cathodic Protection, (Cathodic Protect, Cathodically Protected etc.):** An electrical method of reducing or eliminating corrosion by making previous anodic areas on a structure surface, a cathode by creating a DC current flow to the structure by use of a cathodic protection system.
- G. **Cathodic Protection System:** Two common cathodic protection methods are galvanic anodes and impressed current cathodic protection systems. A galvanic anode system consists of galvanic anode materials (usually magnesium or zinc) that naturally corrodes or sacrifices itself and does not require an outside power source. An impressed current type system utilizes an outside power source usually a rectifier (that converts AC to DC current) and forces (impresses) current from a number of anodes (or groundbed) through the environment to the structure to be protected.
- H. **Cathodic Protection Station (CPS):** An impressed current cathodic protection installation location consisting of a rectifier and groundbed or anode string. The groundbed types can consist of electrically remote surface or deep anode type groundbeds or a distributed type groundbed.
- I. **Deep or Semi-Deep Anode Groundbed:** A cathodic protection impressed current groundbed that is installed in a drilled hole at a prescribed depth and electrically remote distance from the structure being cathodically protected to achieve electrical remoteness. Typically anodes and coke breeze are installed in

the lower portion (active column) and a highly resistant or sealing material is installed in the top section of the drilled hole (inactive column). For the purpose of this specification, deep anode and semi-deep anode groundbeds are used interchangeably.

- J. **Engineer:** The individual or entity named as such in the Agreement and their respective consultants or Subcontractors (corrosion consultant, cathodic protection tester, surveyor, soil tester, weld inspector, coating inspector, etc.) or others acting as representatives of the Engineer and/or Owner.
- K. **Exothermic (Thermite) Welds:** A metallurgical method of making electrical connections based on an exothermic reaction, which turns a mixture of copper oxide and aluminum into molten copper using specially designed graphite molds, with steel or cast iron (ductile iron) charges and wire sleeves.
- L. **Ferrous or Metallic Pipe:** Ferrous metal structures or pipe shall be defined as any pipe or structure made of steel or iron alloys and pipe or structure containing steel or iron as a principal structural material (such as steel, ductile iron, and cast iron), except ASTM C361 reinforced concrete pipe.
- M. **Foreign-Owned:** Any buried pipe or cable not specifically owned or operated by the Owner.
- N. **Functional and Performance Testing:** Tests necessary to demonstrate that installed equipment and systems function as specified and operate in the manner intended. Functional testing is a prerequisite to performance testing for equipment and systems specified to have a performance test.
- O. **Inactive Column:** Inactive column of a deep anode groundbed shall be that portion of the groundbed which does not discharge current, and shall consist of the gravel fill, casing, and grout or concrete seal which is above the active column.
- P. **Leads, Test Wires, Bond Wires, Joint Bond, Pipe Connecting Wires, Cable:** Insulated stranded copper conductor; the same as wire.
- Q. **Manufacturer's Representative:** Employee of manufacturer who is factory trained and knowledgeable in technical aspects of their products and systems.
- R. **Plastic Reference Pipe:** Plastic conduit or pipe placed in soil next to structure to allow a portable reference electrode to be inserted into for structure-to-reference electrode potential measurements.
- S. **Potential: Structure-to-Reference Electrode Potential (also Pipe-to-Soil Potential):** Common method to determine corrosion protection levels by measuring the difference in voltage (potential) between the subject metallic structure and the electrolyte in which it is buried or submerged, as measured to

the standard specified reference electrode (usually a copper/copper sulfate reference electrode) placed in contact with an electrolyte (soil, water, etc.).

- T. **Raceways:** Conduit, plastic or metal pipe, or electrical metallic conduit (EMT) for casing of electrical or cathodic protection cables.
- U. **Rectifier:** An electrical device which provides a direct current (DC) source for an impressed current type cathodic protection groundbed. Typically a rectifier converts alternating current (AC) into DC current through a process known as rectification with either silicon diodes or selenium stacks.

1.06 SUBMITTALS DURING CONSTRUCTION

- A. Provide catalog cuts and other information for all proposed products proposed for use that shows compliance of those materials with these Specifications. Contractor submittals shall be made in accordance with Section 01300 Submittals of these Specifications.
- B. Provide catalog cuts and other information for all materials to be used for Engineer's and/or other representatives of the Owner's approval prior to start of construction.
- C. Submit information in similar numerical order as the specification section numbering, (if materials are included in one submittal for that section of the specification).
- D. Submit required information on a system-by-system basis with items clearly marked for specific products or models to be used. Indiscriminate submittal of manufacturer's literature only is not acceptable. The proposed model, size, and type shall be clearly marked, submission of the product data sheet only with no clarification on model, size and type of products to be provided will require resubmission.
- E. Submittal information shall clearly show manufacturer name and model number of specified item to be provided, not just supplier name. If only a supplier name is provided, then entire submittal shall be rejected and a new submittal will be required. Materials provided to the job site with only the supplier name shall be relabeled with original manufacturer's name, model number, etc., or be returned and replaced at Engineer's and/or designated representative's discretion at no additional cost to the Owner.
- F. Minimum rectifier, junction box and ac power installation submittals shall consist of but not be limited to the following:
 - 1. Rectifier (Type, Model, Case Size, Spare Parts, Etc.).
 - 2. AC Power Supply Equipment.

3. Rectifier Installation Hardware, Conduit, Entrance Switch, etc.
 4. Rectifier Mounting Equipment for Type of Mount
 - a) Rectifier Mounting Rack
 5. Cathodic Protection Cables, Test Wires.
 6. Test Stations.
 7. Shunts.
 8. Corrosion Monitoring Equipment (Reference Electrodes, Coupons, On/Off Switches, Plastid Monitoring Pipe, Etc.).
 9. Exothermic Weld Materials.
 10. Wire Connection Coatings.
 11. Wire Termination Materials.
 12. Junction Boxes.
 13. Test Station and Junction Box Mounting Hardware and Supports.
 14. Groundbed Termination Materials.
 15. Concrete Pads and Reinforcement.
 16. Guard Rail Assembly and/or Steel Marker Posts (Bollards).
- G. Minimum groundbed material submittals shall consist of but not be limited to the following:
1. Impressed Current Anode.
 2. Anode Lead Wire (Size, Insulation Type).
 3. Anode Centralizers (if required).
 4. Coke Breeze.
 5. Compression Connector Splices.
 6. Splice Materials.
- H. Minimum additional material submittals for deep anode groundbed installations shall consist of but not be limited to the following:

1. Casing Pipe.
2. Well Seal.
3. Belowgrade Vent Pipe (Active Column Area and Inactive Column Area).
4. Abovegrade Vent Pipe.
5. Casing Pipe Wall Lead Wire Protection (Gromet).
6. Sealing Material.

I. In addition, the following specific information shall be provided:

1. Manufacturer information shall be submitted for all corrosion protection materials to be used and shall include manufacturer's name, model number, and rated electrical capacity of equipment (if appropriate); installation instructions; and detailed descriptions of the construction materials.
2. Two copies of installation instructions and operation and maintenance manuals for each rectifier unit including wiring schematics and bench performance data during full capacity output tests for each rectifier.
3. Contractor proposed method to log deep anode hole including type of equipment (make and model), current source (volts) and procedure including test reporting data sheet.
4. Independent Laboratory Analysis Certification of Compliance for Anodes.
5. Schedule: Contractor shall provide proposed impressed current system construction schedule including a minimum advance notice of starting date as required in this specification section.
 - a) Contractor shall include in the work progress schedule the proposed construction starting date, progress reporting procedures, sequence and schedule for each portion of work, and completion date for all phases of work specified in this section. Cathodic protection system shall be fully operational upon completion of the work.
 - b) Provide a minimum of a three week (21 calendar days) written notice to Engineer and/or Owner designated representatives prior to actual start date of construction. General reference to project schedule does not meet this requirement. Notice period date shall start when signed written notice is received and approved by Engineer and/or Owner and their designated representatives.

- c) Schedule start of work so that so that travel and/or set up can be on Monday with the actual installation start on Tuesday or Wednesday of that week with full operations scheduled for the full week to allow Engineer and/or Owner representatives' specified observations to be completed during that same trip.
- d) Work start-up shall not be scheduled during weeks with holidays (New Year's Day, Memorial Day, July 4th, Labor Day, Thanksgiving, and Christmas).
- e) All equipment, materials, labor and test instruments shall be on-site and available to allow full production to start immediately following the start-up meeting during the same field trip to allow the required observation of actual production procedures by Engineer and Owner's technical representatives to meet minimum specified observation production requirements. If full production does not start during that field trip and a second trip is required, then the Contractor is responsible for additional costs of Engineer and Owner's designated representatives to return to site to observe Contractor full production procedures, quality control testing and record keeping.
- f) The intent of the advance notice and timing of initial field meeting and observation visits is not to impede production. Rather the scheduling requirement is needed for proper planning and travel arrangements. The intent of the field visits and observations is to assist in addressing and resolving any technical issues that may arise at the start of installation.

J. Quality Assurance Submittals:

- 1. Cathodic Protection Contractor's proposed project field superintendent or foreman's name and experience with a minimum of five (5) verifiable impressed current cathodic protection projects in the last five (5) years with Owner, Contractor, and Design Engineer representative in charge names and contact phone number for each project, if requested by the Owner or Engineer.
- 2. Manufacturer's Certificates of Compliance for materials where specified.
- 3. Field Test Reports:
 - a) Functional testing results shall be submitted to the Engineer and/or designated representative immediately upon completion of the tests.

- b) Contractor shall maintain record Drawings of the installation and construction of the cathodic protection stations. Record Drawings shall accurately show location and type of anodes, wires, and groundbed terminations including conduits, AC service drop, rectifier, pipe connections, test stations, and junction boxes.
- c) Submit deep anode groundbed as-built information as part of as-built information. Deep anode drilling and anode resistance information shall include but not be limited to:
 - 1) Driller's log.
 - 2) Initial well resistance log from bottom of casing to bottom of drilled hole at five-foot (5') intervals.
 - 3) Final anode placement, coke breeze, casing, and seal depths.
 - 4) Anode resistance data summary before and after backfilling with coke breeze.
 - 5) Any necessary State reports.

K. Contract Closeout Submittals:

- 1. Special guarantees and warranties as specified in this section.
- 2. Record Drawings and Reports.
- 3. The impressed current cathodic protection system shall be fully operational and a functional test performed and submitted prior to acceptance of and issuing substantial completion of the cathodic protection systems for the project.
- 4. Submit record Drawings and field test report information to Engineer at end of project as one condition to be received and accepted by Engineer prior to application for final payment.

L. Refer to this specification section in its entirety for additional submittal items that may not be listed here as this is not an all-inclusive list.

1.07 QUALITY ASSURANCE

A. Cathodic Protection (CP) Contractor's Competency:

- 1. Contractor's Competency: Contractor shall have a minimum of five (5) years (or more if specified for special construction) of practical experience in the type of work called for in this specification, and shall have

knowledge about soil conditions in the local area. Contractor may be required to show proof and furnish a list of references substantiating this requirement to the satisfaction of the Engineer or Owner and/or their designated representatives.

2. Cathodic Protection Contactor proposed project field superintendent or foreman shall have a minimum of five (5) years experience in installation of impressed current anode groundbeds of comparable size and complexity as these locations as part of their regular work. Contractor shall provide verifiable references with Owner, Contractor, and Design Engineer representative in charge names and contact phone numbers and addresses for a minimum of five (5) similar impressed current cathodic protection projects completed in the last five (5) years for Engineer's and Owner's and/or their designated representatives review and approval.
 3. Should the Contractor attempt to meet these requirements by subcontracting their work and the CP Contractor or the proposed project foreman not meet these requirements, the Engineer, Owner or their designated representatives has the right to request another CP Subcontractor or project foreman at no additional cost to the Owner.
- B. The Contractor shall provide at all times a thoroughly experienced and competent field superintendent or foreman, who will be present to supervise construction at the site. This person shall have the authority to represent the Contractor and shall be the point of contact with the Owner and Engineer and their designated representative.
- C. The Contractor shall make a careful examination of the nature and location of the project, the Contract Documents, qualification and quality control requirements and the applicable permits and regulatory requirements before submitting a bid. Bid submission shall act as conclusive evidence that the Contractor is fully aware of the contract documents, regulatory, qualification and quality control requirements and will not file suit with the Owner, Engineer, or their designated representatives over the Contractor qualification, quality control requirements or their enforcement.
- D. The Contractor acknowledges in all cases the burden of proof to show adequate project experience, qualifications, and quality control is the responsibility of the Contractor. By submission of a bid, the Contractor agrees that they accept Owner, Engineer, and their designated representative's decision as final and will not file suit against the Owner, Engineer or their designated representative's based on their decision.
- E. Functional testing shall be completed by the Contractor only in the Engineer's and/or Owner's designated representative's presence on the installed cathodic protection and corrosion protection items.

- F. The final testing shall be completed by the Engineer and/or Owner or their designated representatives.
- G. At Engineer's and/or Owner's or their designated representative's option, they may randomly select one of each type of anodes supplied, for Contractor to obtain independent laboratory analysis or to conduct physical field verification testing on. Cost of these test(s) shall be borne by the Contractor.

1.08 OBSERVATION OF WORK

- A. Provide access to all areas of the project site or the product manufacturer's facilities for Engineer and/or Owner and their designated representatives, and product manufacturer's representatives at all times during installation, testing and to observe finished work.
- B. All materials and installations shall be subject to observation for suitability as the Engineer and/or Owner or their designated representatives may elect, prior to, during, or after incorporation into the work. Observation or testing by the Engineer and/or Owner or their designated representatives or the waiver of observation or testing of any particular portion of the work shall not be construed to relieve the Contractor of their responsibility to correctly perform the work and testing required in accordance with these specifications and the product manufacturer's recommendations.
- C. The Contractor is in charge of and solely responsible for all of the quality control and final inspections required. Observation of or spot testing by the Engineer and/or Owner or their designated representatives or by the product manufacturer does not meet the quality control inspection requirement or relieve the Contractor from doing the quality control testing required by the product manufacturer, this specification, or the Contractor's quality control program.
- D. The Engineer and/or Owner or their designated representatives reserves the right to reject all work that does not meet the minimum requirement of this specification. This may be done either during or after completion of the work, during subsequent observations or testing, warranty inspection testing, or at anytime when discovered during the warranty period.

1.09 RECORD DRAWINGS

- A. The Contractor shall maintain an accurate record of the construction and provide a marked-up (red-line on project plan set) drawing of all construction modifications and installed location of corrosion control items as specified. This shall include but not be limited to:

1. Survey-grade location of rectifier, test and cathodic protection cables and surface markers, reference electrodes, AC power installation, conduits, and test stations, etc.
 2. Actual deep anode drilled hole size and depth and installed location of coke breeze, vent pipe, surface casing, down hole seals, anode header wires and anode junction box.
- B. At completion of project, the Contractor shall provide a list of materials and a copy of the record Drawings of the cathodic protection installations to the Engineer for preparation of Record Drawings in accordance with Section 01780 – Record Drawings.

1.10 WARRANTY

- A. The Contractor, and through the Contractor the CP Subcontractor and product manufacturers shall jointly and severally warrant to the Owner and guarantee the work under this section against defective workmanship and materials for a period of two (2) years or longer if required by the General Conditions commencing on the date of final acceptance of the work.
- B. Functional and final testing and warranty inspection(s) of the corrosion protection systems shall be made at the end of the work and within the warranty period, respectively. The Contractor, CP Subcontractor, and/or product manufacturer representatives at their option may be present during the final testing or warranty inspections by the Engineer and/or Owner or their designated representatives.
1. Any construction defects identified by the Engineer and/or Owner or their designated representatives during energizing and testing or during warranty inspections shall be located and corrected by the Contractor at his sole expense including additional engineering, inspection, and retesting time and expenses.
 2. Any defects in the corrosion protection system discovered at or during the functional, final, and/or warranty inspection(s) shall immediately be repaired and retested in a timely manner (repairs starting within 30 calendar days and completed, tested, and approved within 60 calendar days of notice) by the Contractor. All repairs shall be in accordance with the written product manufacturer's instructions as reviewed and approved by the Engineer and/or Owner or their designated representatives. Provide the Engineer and Owner with a minimum of fourteen (14) calendar days of advance notice before beginning repairs.
 3. For all repairs, the Contractor shall provide an extended warranty (equal to the original warranty period length) or longer if required by the General Conditions commencing on the date of final acceptance of the repair work.

4. All repairs or any damage to other work caused by such defects or repairing of the defects including additional engineering or consulting time, full-time observation during repairs, and retesting or re-warranty inspections shall be at sole cost to Contractor.

2 PART 2 PRODUCTS

2.01 GENERAL

- A. Unless otherwise indicated, provide all first-quality, new materials, free from defects, in first class condition suitable for the intended use. Provide materials intended for this type of service in accordance with this specification and the referenced standards.
- B. The materials and equipment provided under these specifications shall be new and the standard product of manufacturers regularly engaged for a minimum of three (3) years on a full time basis in the manufacturer of such products and shall be the manufacturer's latest standard design that complies with this specification section requirements.
- C. All materials and equipment shall show evidence of Underwriter Laboratories (U.L.) approval where U.L. standards exist and product listings are available. All materials, equipment, and installations shall conform to the latest version of the National Electrical Code (NEC), and all applicable federal, state, and local laws, codes, and regulations.
- D. Whenever the requirements of the Specifications or Drawings exceed those of the codes or manufacturer's instructions, the requirements of the Specifications or Drawings shall prevail. Where a larger size, higher quality, or better grade of material is required, the most stringent requirement shall apply.
- E. Like items of materials provided hereunder shall be the end product of one manufacturer in order to achieve standardization for appearance, maintenance, and replacement.
- F. The Contractor shall be responsible for all such material furnished by them and shall replace, at their own expense, all such material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include the furnishing of all materials and labor required for the replacement of installed material discovered defective prior to the final acceptance of the work or during the warranty period.
- G. The Contractor shall be responsible for the safe storage of materials furnished by them or to them and accepted by them and intended for the work.
- H. The use of a manufacturer's name and model or catalog number is solely for the purpose of establishing the standard of quality and general configuration desired.

Products of other manufacturers of equal standard and quality will be considered in accordance with the General Conditions.

1. The Contractor acknowledges that in all cases the burden of proof to show that the material offered for substitution is equal in function, performance, and life to that listed in this Specification section shall rest with the Contractor, and unless the proof is adequate and satisfactory to the Owner, Engineer or their designated representatives, the substitution will not be approved.
2. By submission of an alternate material submittal, the Contractor agrees that they will accept that the Owner, Engineer and their representative's decision is final and that the Contractor will not file suit against the Owner, Engineer or their designated representative's based on their final decision.

2.02 MATERIAL SUPPLIERS

- A. Suppliers listed below can usually supply the types of materials specified in this section. Alternate suppliers will be considered, subject to approval of the Engineer and/or designated representative. Address given is that of their offices in the Western United States; contact these offices for information regarding the location of their representative nearest the project site:
 1. Farwest Corrosion Control, Denver, CO (888-532-7937).
 2. Goudy Engineering, Tucson, AZ (520-298-1104).
 3. MESA Products, Inc., Tulsa, OK (918-627-3188).
 4. Northland Corrosion Services, Laurel, MT (406-628-2213).
 5. WBI Energy Corrosion Services (formerly Total Corrosion Services, TCS), Billings, MT (406-248-6985).

2.03 RECTIFIER

- A. General: Rectifiers shall meet the requirements of NEMA Standard MR-20 "Cathodic Protection Rectifier Units" in addition to these specifications. Rectifiers shall be air cooled, manually controlled, and shall be designed to operate continuously at full rated output at an ambient temperature of -58° F to 113 F (-50° C to 45° C).

- B. Supply rectifier with a dual AC input of 120/240 volts, single-phase, 60-Hz and a suitably sized magnetic-type circuit breaker on front of rectifier panel. The rectifier shall be capable of operation at 110% of rated input/output without damage to the rectifier components.
- C. Rectifying Elements: The rectifier shall be a single-phase bridge type with a silicon diode or selenium stack. The rectifier stack shall be protected from overvoltage surge with selenium surge plates and overcurrent with current-limiting devices. Suitably sized heat sinks shall be provided to maintain rectifying element and case temperatures below maximum temperature recommended by manufacturer. Lightning protection devices shall be provided on both the AC put and DC output of rectifier. Rectifier shall be provided with an efficiency filter.
- D. Transformer: The rectifier transformer shall be a separate and secondary type with a 95 percent minimum efficiency meeting the requirements of NEMA, UL, and CSA. All transformer insulation shall be rated for a minimum temperature of 266° F (130° C) with actual hottest spot temperature at rated conditions not to exceed 212° F (100° C).
- E. Manually Controlled Rectifiers:
1. Rectifier output shall be manually controlled with either a minimum of 20 evenly divided transformer fine and course tap settings. Course and fine taps shall be arranged in consecutive order.
 2. Rectifier output shall be manually controlled with either a minimum of 18 evenly divided transformer fine and course tap settings or a variable transformer adjustment.
- F. Meters: Supply the rectifier with combination DC voltage and current meter and external panel mounted shunt, Holloway type, in series with the ammeter. Shunt voltage and amperage rating shall be clearly identified on externally mounted shunt. The meters shall have individual switches so that the meter is not in the circuit continuously. The meters shall be accurate to within two- percent (2%) of the actual voltage and current output and shall be D'Varsonal jeweled movement type meters for standard type rectifiers. Meters shall be tested and calibrated at the factory. Meters will be tested in the field for accuracy. Inaccurate meters shall be replaced by the manufacturer. Meter shall be able to measure maximum rectifier output.
- G. Panel Board: Rectifier meters, shunt, ac circuit breaker, taps, AC and DC fuses or push button breakers, and DC output terminals shall be mounted on a non-metallic rectifier panel board. Rectifier panel board shall be constructed of sufficient thickness to withstand shipping and operational stresses and be located at front of rectifier to allow access for testing and adjustment. Rectifier DC terminals shall be solderless lug type. Tap studs, tap bars, nuts, and washers shall

be suitably sized brass, bronze, or nickel- or tin-plated copper. Polarity of rectifier DC terminals, fine and course transformer tap numbering, meters, breakers, and fuses or breakers shall be clearly engraved or identified with a permanent marking system on rectifier panel. Stick on labels or tape are not acceptable.

- H. Convenience AC Outlet: Provide 115 Volt AC convenience outlet on rectifier.
- I. Rectifier Case: Transformer, ac circuit breaker, rectifier stacks, lightning arrestors, DC output meters, and all wiring connections shall be housed in a minimum 11-gauge thick steel cabinet suitable for pole/wall/mounting rack or pad mounting:
 - 1. Air-cooled enclosure shall meet the requirements of NEMA 3R. Cabinet shall provide suitable ventilation for adequate cooling of the rectifier by natural air convection. A grounding lug shall be provided on the outside of the cabinet. Cabinet shall protect the interior components from weather, vandalism, and nest building insects.
 - 2. Steel cabinet shall be hot-dipped galvanized or coated inside and out with a three-coat baked enamel coating system with manufacturer's standard color, or be an anodized aluminum type cabinet.
 - 3. Rectifier case access shall be provided with hinged and removable doors on the front and both sides to allow access. Cabinet shall be held closed with stainless steel latches and provided with a hasp for padlocking.
 - 4. For air cooled standard type rectifiers up to 30 amp DC output, provide one size **larger** case size than standard for that rectifier rating to aid in cooling and access for testing and maintenance. For 31 amp DC output size rectifiers or larger, provide with standard size case.
- J. Identification: A permanent means of identification such as a rectifier engraved nameplate shall be mounted on the interior side of the rectifier door. The nameplate shall list manufacturer name and phone number, rectifier model number, year manufactured, serial number, and AC and DC electrical input and output electrical ratings. Nameplates with only supplier's name and phone number in place of actual rectifier manufacturer's name and phone number will not be accepted and will require replacement by the Contractor at no additional cost to the Owner.
- K. Operation and Maintenance Manuals:
 - 1. Supply rectifier operation and maintenance manuals for each type of rectifier provided for the project. The rectifier manual shall include an electrical schematic of the rectifier, parts list with replacement part numbers, and troubleshooting procedures.

2. Supply three (3) complete rectifier manuals with full scale bench tests for each rectifier manufacturer and size and type of rectifier provided.
- L. Spare Parts: Provide the following spare parts for each rectifier:
1. Complete set of spare fuses (minimum of four each) or two (2) push button breakers (one AC and one DC, minimum of two) for each size provided depending on rectifier type and AC and DC protection utilized.
 2. One (1) each AC input lightning arrestor.
 3. One (1) each DC output lightning arrestor.
- M. Special Provisions to be provided for each standard type unit shall include but not be limited to the following items as specified above:
1. AC and DC lightning protection.
 2. Efficiency Filter.
 3. Meter On/Off switch.
 4. Minimum tap adjustments of 20 steps or more.
 5. Access provided by removable doors in front and both sides.
 6. 115 Volt AC convenience outlet.
 7. One size larger case as specified above.
- N. Acceptable standard type rectifier manufacturer and models are:
1. Universal Rectifier Standard Air Cooled Model ASAI 40 volt 20 amp AACFHM RPQ (P= minimum 20 steps, Q= Larger Rectifier Case Size) available from Universal Rectifier, Rosenberg, Texas. (www.universalrectifiers.com).

2.04 AC POWER SERVICE

- A. Combination Meter Base Socket/Breaker: Combination meter base socket and breaker shall be 240-volt, single- phase, three-wire, 100-ampere, with 1-inch hubs per local power utility requirements.
- B. Ground Rod: Ground rods shall be 5/8-inch by 8-feet long copper clad steel.
- C. Ground Wire and Clamp: Ground wire shall be bare No. 6 AWG solid copper wire with a high copper content alloy or bronze bolt-on ground rod clamp.

- D. The AC wire to supply power to the rectifier shall be single conductor, soft drawn copper, minimum No. 10 AWG or larger as sized per the National Electric Code to match the maximum rated rectifier power requirement.
- E. AC Conduit and Fittings:
 - 1. All buried AC wires shall be installed in rigid Schedule 80 PVC conduit and fittings. All conduit and fittings shall be U.L. approved. PVC conduit shall meet NEMA TC-2, Type EPC-80-PVC standards and fittings shall meet NEMA TC-6 standards. PVC conduit shall transition below-grade to tape wrapped rigid galvanized steel conduit per local utility company regulations.
 - 2. All abovegrade AC wires shall be installed in rigid hot dipped galvanized steel conduit, or flexible liquid-tight steel conduit, per local codes and as indicated on the Drawings.

2.05 RECTIFIER MOUNTING

A. Rectifier Mounting Rack

- 1. Mounting rack shall be constructed of the materials and to the dimensions shown on the Drawings. The mounting rack shall be galvanized or coated with the epoxy coating system specified.

2.06 WIRES

- A. General: All cathodic protection wires, joint bond wires, bonding cables, leads, and cables provided shall be insulated STRANDED copper wire. Wire size, type, and insulation type as specified in this section. Wire shall conform to applicable requirements of NEMA WC 3-80, WC 5-73, and WC 7-88.
- B. No. 2 AWG, No. 4 AWG, No. 6 AWG, and No. 8 AWG cathodic protection cables shall be single-conductor, stranded copper wire with 600-volt high molecular weight polyethylene (HMWPE) insulation. Insulation shall be 7/64-inch (110 mils) minimum thickness in accordance with ASTM D 1248, Class C, Grade 5.
- C. Anode leads shall be as listed under "Anodes" this specification section.
- D. Minimum No. 12 AWG wire for test and No. 14 AWG reference electrode lead wires shall be single-conductor, stranded copper with 600-volt, TW, THWN, THHN or HMWPE insulation.
- E. Wire Identification:
 - 1. Wire insulation color shall indicate the function of each wire and shall be as shown on the Drawings and as follows:

- a) Water Pipeline– Blue Insulation
 - b) Reference electrode wires: Yellow Insulation.
2. Cathodic Protection Impressed Current CP Cables:
- a) Rectifier Positive CP Cables:
 - 1) Rectifier Positive Groundbed Cable -- Black Insulation with 1 Strip of Red Tape.
 - 2) Semi-Deep Anode Groundbeds
 - A) Semi-Deep Anode No. 1 – Black with 1 Strip of Red Tape and 1 Strip of Purple Tape.
 - B) Semi-Deep Anode No. 2 – Black with 1 Strip of Red Tape and 1 Strip of Gray Tape.
 - 3) Individual Deep Anode Leads - Black Insulation -anodes numbered consecutively with bottom (deepest) anode as No. 1.
 - b) Rectifier Negative CP Cable:
 - 1) Pipe or Structure Lead – Black Insulation with 1 Strip of Blue Tape.
- F. Stranded Cathodic Protection Cable and Wire Diameter Sizes:

BARE AND INSULATED WIRE NOMINAL DIAMETER							
Stranded Copper Wire Gauge Size (AWG)	Bare Conductor (Wire) Diameter Inches	HMWPE INSULATION		TYPE TW INSULATION		TYPE THHN/THWN-2 INSULATION	
		Insulation Thickness Inches	Nominal Diameter Inches with Insulation	Insulation Thickness Inches	Nominal Diameter Inches with Insulation	Insulation Thickness Inches	Nominal Diameter Inches with Insulation
No. 12 AWG	0.0726	0.110	0.293	0.030	0.130	0.015	0.120
No. 10 AWG	0.0915	0.110	0.311	0.030	0.150	0.015	0.140
No. 8 AWG	0.146	0.110	0.370	Different types of insulation may have different insulation coating thicknesses, which will influence total nominal wire diameter. Consult wire manufacturer for actual wire diameter and insulation thickness. Size conduit and runs per NEC requirements based on number of conductors, wire size, and insulated wire diameter.			
No. 6 AWG	0.184	0.110	0.408				
No. 4 AWG	0.232	0.110	0.456				
No. 2 AWG	0.283	0.110	0.510				

2.07 IMPRESSED CURRENT ANODES

A. General:

1. The anode size and weight may differ slightly because of variations in casting and mold shapes, but shall be the manufacturer's standard and should approximate the following specified sizes.
2. The impressed current anodes shall be recommended by anode manufacturer as suitable for soil burial conditions in the type of grounded installations specified for this project.
3. The anodes shall be center connected type. Connection of lead wire to the anode shall be factory assembled with the manufacturer's standard type center connection (lead wire soldered to a threaded brass connector or seated expandable lead ferrule).
4. The connection, lead wire and anode shall be visually and physically inspected for damage when the connection is completed. Anode to lead wire connection shall be tested randomly per the manufacturer's quality control program. This shall include both electrical resistance and pull-out tests of the completed connection. Any visual or physical damage to the anode, connection or lead wire or if not passing the manufacturer's quality

control testing shall be cause for complete replacement of the anode and lead wire.

5. After the necessary quality control checks have been completed, the connection shall be electrically sealed with manufacturer's standard insulation epoxy encapsulated potting compound (NOVOID C or equal). The anode shall be allowed to cool to ambient temperature and the sealing compound to cure. After the sealing potting compound is sufficiently cured, the anode shall be then capped with a two-part epoxy (Hexcel 7CC2) anode cap or a heat shrinkable polyethylene (Thermofit) anode cap or approved equal. Anode surface shall be cleaned and prepared and the anode cap installed according to the cap manufacturer's directions. Epoxy anode cap material shall be mixed and poured in one continuous operation. Epoxy anode caps shall be allowed to cure for a minimum of 12-hours and then visually inspected before moving. The epoxy anode cap or heat shrink anode cap shall provide a waterproof tight bond to the anode and lead wire. Any visual or physical damage to the anode cap shall be cause for rejection and total replacement.

B. High Silicon Chromium Cast Iron Anodes:

1. Impressed current cast iron anode material shall be a modified high-silicon chromium cast iron anode conforming to ASTM-518 Grade 3 and the following chemical composition requirements:
 - a) Silicon (Si): 14.20 to 14.75 percent.
 - b) Manganese (Mn): 1.50 percent maximum.
 - c) Carbon (C): 0.70 to 1.10 percent.
 - d) Chromium (Cr): 3.25 to 5.0 percent nominal.
 - e) Copper (Cu): 0.50 percent maximum.
 - f) Molybdenum (Mo): 0.50 percent maximum.
 - g) Iron: Remainder.
2. Tubular Cast Iron Anodes:
 - a) The anode connection shall be 1.5 times stronger than the wire (1,000 pounds minimum pull-out) and have a maximum resistance of 0.001 ohms.
 - b) Tubular anodes shall be chill or spin cast type, with expanded anode wall of 0.2" diameter in center connection location,

retention grooves for improved epoxy/sealants adhesion and reliability, and consistent weight and size.

3. Heavy Wall Center Tap Tubular Anode Sizes:
 - a) Cast iron anode size shall be 2.7-inches diameter by 84-inches long tubular shape with a minimum weight of 70 pounds. Acceptable center connected high silicon cast iron heavy wall tubular anodes are:
 - 1) Anotec Centertec Z Series Type 2684 Z.
 - 2) Or approved equal.

C. Anode Leads:

1. Anode Lead Wire: Anodes shall be supplied with a No. 8 AWG stranded copper lead wire with insulation as specified in this section.
2. Anode Lead Wire Insulation: Anode lead wire insulation shall be:
 - a) High Molecular Weight Polyethylene (HMWPE) 600-volt, 7/64-inch (110-mils) minimum thickness, in accordance with ASTM D 1248, Class C, Grade 5.
3. Anode Wire Length: The anode lead wires shall be of sufficient length to extend splice-free from anode connection to the anode header wire or anode junction box as shown on the Drawings. The Contractor shall determine the length required prior to ordering of the anodes:
 - a) Deep or Semi-Deep Anode Groundbed Lead Wire Lengths - The anode lead wires shall be factory cut to the proper length to extend splice free from the anode to the anode junction box location as shown on the Drawings. The wire shall be coiled on plastic or wooden reels resulting in a minimum wire coil diameter of five-inches (5") or more. Individual anode leads of different lengths shall be numbered and the wire length marked on the wire insulation or on a tear off tag at the free end of the anode lead wire.
4. Packaging and Shipping: Coil anode wires and secure, and package anode in crates as required to prevent damage during shipment. Exercise care to insure that the wire is not damaged during shipment or that the anodes or lead connection at the anode end is not physically stressed. Anode or wire that shows visual or physical evidence of damage shall be cause for replacement of the complete anode.

- D. **Compliance Statement:** Furnish an independent laboratory analysis certifying that the anode supplied is in compliance with the requirements of this specification section.
- E. **Field Verification:** At Engineer's or Owner's or their designated representative's option, an anode may be selected at random for Contractor to conduct an independent laboratory analysis to demonstrate material supplied meets the requirements of this Specification. Cost of the testing shall be borne by the Contractor.

2.08 ANODE CENTRALIZERS

- A. Anode centralizers for semi-deep anode groundbed shall be either a metal or plastic assembly that can be securely attached to the anode without damaging or impairing the function of anode or anode wire. Anode centralizer size and type provided shall be such that they will center the vertical anode in the drilled hole and provide easy field adjustment. Centralizer assembly shall consist of a minimum of three (3) vanes approximately 120 degrees apart to keep the anode centered in hole. Anode centralizer assembly shall not block the hole or impair installation of the anode, anode lead wire, vent pipe, or coke breeze.
- B. Acceptable anode centralizers are:
 - 1. Farwest CENTRA Series Centralizers, from Farwest Corrosion, Denver, Colorado.
 - 2. Mesa CEN Series Centralizers, from MESA Products, Tulsa, OK.
 - 3. Goudy Anode Centering Device ($\frac{3}{4}$ " x 13" Spring Steel with Two Stainless Steel Clamps), Tucson, AZ.
 - 4. Or approved equal.

2.09 COKE BREEZE

- A. **Coke Breeze:** Provide sufficient coke breeze to backfill completely around the anodes as shown on the Drawings with allowances for extra volume due to cave-ins, wash outs, wet locations, and different excavation or installation methods.
- B. Coke breeze for backfill of groundbeds shall be low resistance (less than approximately 0.10 ohm-cm); electrically conductive, calcined petroleum type approved for direct burial if required by the appropriate state and federal agencies.
- C. Coke breeze can be provided in bulk or bag shipping. In either case the coke breeze shall be shipped and stored in a manner to keep it dry in order to minimize it from freezing solid. If bagged, the coke breeze shall be provided and shipped in

waterproof bags. Bags shall be UV resistant or protected with colored tarps from long term UV exposure.

D. Deep and Semi-Deep Type Groundbeds:

1. Coke breeze for deep and semi-deep type groundbeds shall meet the following minimum composition:

DEEP AND SEMI-DEEP GROUND BED COKE BREEZE	
Element	Content
Volatile Matter	0.55 percent maximum
Ash	0.41 percent maximum
Sulfur	5.8 percent maximum
Moisture	0.1 percent maximum
Particle Size	Less than 1 mm
Bulk Density	60 pounds per cubic foot minimum
Fixed Carbon (Carbon & Sulfur)	98.0 percent minimum

2. Coke breeze for deep and semi-deep anode type groundbeds shall be suitable for pumping. Acceptable calcined coke breeze materials for deep anode groundbeds are:
 - a) LORESCO DW-1, SC-2, or SC-3 available from Cathodic Engineering Equipment Company, Hattiesburg, MS.
 - b) Asbury 251-P from Farwest Corrosion, Denver, Colorado.
 - c) Great Lakes Carbon Coke No. 60, from MESA Products, Tulsa, OK.
 - d) Or approved equal.

2.10 DEEP ANODE CASING

- A. Well casing shall be new standard weight steel or plastic casing in an undamaged condition. Nominal wall thickness for 6-inch or larger diameter steel casing shall be a minimum of one-quarter inch (1/4") thick. Steel pipe joints shall be welded. Plastic casing shall be Schedule 40 and meet or exceed ASTM Standard F-480. Plastic casing joints shall be bell and spigot type and solvent welded (glued). All casing shall be in new condition, durable, and watertight. Casing material shall be nontoxic and resistant to water and soil corrosiveness. Casing shall meet local

well drilling standards and be able to withstand installation, grouting, and operating stresses.

2.11 DEEP ANODE SEALING MATERIAL

- A. The sealing material for the deep anode groundbed shall consist of an impermeable material, such as cement grout, bentonite-gelatinous mud or grout or puddling clay as required to meet local and state drilling code requirements.
1. Cement grout shall be composed of not more than two (2) parts by weight of sand and one (1) part of cement (Type I/II or V) with 5 to 7 gallons of clean water (per 94 pound bag of cement). Quick-setting cement, retardants to setting, and other additives, including hydrated lime to make the mix more fluid (up to 10 percent of volume of cement), and bentonite (up to 5 percent) to make the mix more fluid and to reduce shrinkage, may be used if allowed by state and local well drilling regulations.
 2. Bentonite sealer shall be high swelling, chemically un-altered bentonite clay intended for plugging and sealing drilled holes. Acceptable bentonite sealers are:
 - a) PermaPlug from Cathodic Engineering Equipment Co., Inc., Hattiesburg, MS.
 - b) Enviroplug from Mesa Products, Tulsa, OK.
 - c) Or approved equal.
 3. Puddling clay shall consist of a mixture of bentonite, other expansive clays, fine-grained material and water, in a ratio of not less than seven (7) pounds of bentonite or expansive clay per gallon of water. Fine grain materials shall be composed of particles with a grain size that can pass through a sieve with openings measuring 0.0078 inches (0.2 millimeter {mm}) dimension but are retained on a sieve with openings measuring 0.0023 inches 0.06 mm. Puddling clay shall be composed of not less than 50 percent expansive clay with the maximum size of the remaining portion not exceeding that of coarse sand. Coarse sand shall be composed of particles with a grain size that can pass through a sieve with openings measuring 0.039 inches (1.0 mm) but are retained on a sieve with openings measuring 0.024 inches (0.6 mm).

2.12 DEEP ANODE SEAL

- A. Deep anode seal shall be a two-piece, cast iron well seal with a rubber packer to form a watertight seal. Seals shall permit conduit and vent pipe penetrations through the seal with the rubber packing sealing the annular space watertight. Seal shall be lockable type or a lockable deep anode cap provided if required by the state or local well drilling regulations. Seals shall be as manufactured by:
 - 1. Campbell Manufacturing, Inc., Bechtelsville, PA.
 - 2. Berkeley Pump Company, Berkeley, CA.
 - 3. Jacuzzi Brothers Inc., Little Rock, AR.
 - 4. Or approved equal.
- B. Locking Lid
 - 1. Locking lid shall be fabricated with an anchoring system into the concrete pad, hinge and hasp for a lock as required to allow deep anode to be locked if a lockable deep anode seal is not provided and a lockable deep anode cap is required by the state or local well drilling regulations. Fabricated locking lid shall be provided with the same surface preparation and type of coating system as provided for the above grade deep anode surface vent pipe.

2.13 DEEP ANODE DOWNHOLE VENT PIPE

- A. Downhole vent pipe for deep anode groundbeds shall be heavy duty Schedule 40 PVC one-inch (1") diameter minimum conforming to ASTM D-1785, Type 1, Grade 1. Vent pipe joints shall be solvent welded (glued) bell and spigot type. The vent pipe material shall be resistant to chlorine. Vent pipe shall extend from the bottom to the top of the drilled hole.
- B. Vent pipe in the inactive column area shall be solid.
- C. Vent pipe in the active column area shall be perforated in a continuous manner such that the perforated sections are adjacent to the anodes for the entire active anode column length upon installation. Vent pipe shall be either drilled and provided with a geotextile fabric sock or factory slotted. The bottom of the vent pipe shall be sealed with a glued solid plastic end cap or plug:
 - 1. Drilled vent pipe holes shall be 3/8-inch diameter, penetrate the pipe at four quadrants around the circumference at each drilled location, and equally spaced at 4-inches apart throughout each perforated 2-foot section. Pipe shall be wrapped in geotextile fabric sock to prevent intrusion of fine-grained coke breeze into vent pipe. Fabric (Nilex filter sock or approved equal) shall be non-deteriorating geo-textile material of sufficient durability and attachment to the pipe to resist tearing and

damage during installation. Geotextile sock shall be securely fastened to drilled plastic pipe by means of four complete wraps of high quality duct tape at each end of 20-foot pipe section.

2. Slotted vent pipe shall have factory cut vertical slits approximately 0.006-inch (0.15 cm) wide and 1.5-inches (3.81cm) long cut in a parallel pattern to the longitudinal centerline of the plastic pipe. Slot spacing shall be 1-inch (2.54cm) from preceding slit at approximately 6-inch (15.24cm) centerline to centerline separation distance. Slotted vent pipe does not require use of a geotextile sock. Acceptable factory slotted vent pipe configurations are Loresco All Vent or approved equal.

2.14 DEEP ANODE SURFACE VENT PIPE

- A. Deep anode surface vent pipe shall be fabricated of two-inch (2") diameter steel pipe with 180-degree gooseneck. The vent pipe shall be installed and terminated at top of the hole as shown on the Drawings. The steel surface vent pipe shall be connected to plastic vent pipes with the appropriate type and size of plastic-to-steel coupling. The abovegrade end of the steel vent pipe shall be threaded and a threaded screened bushing or a drilled plastic or steel end cap installed to prevent entry into or blockage of the vent pipe by foreign objects or insects. The end cap shall be predrilled with a minimum of six evenly spaced 1/8-inch-diameter holes.
- B. The entire assembly shall be sandblasted to near white grade (SSPC-SP-10) and coated with a three coat epoxy/polyurethane enamel system at 8 to 10 mils minimum total film thickness dry (MDFT). Three coat system shall consist of rust inhibitive epoxy primer (2.5 to 3 MDFT), one coat of epoxy (3 to 4 MDFT), and one to two finish coats of polyurethane enamel coating as required to hide mid-coat (3 to 4 MDFT). Finish coat color shall be as shown on the Drawings.

2.15 JUNCTION BOXES (LOCKABLE TYPE)

- A. General
 1. Lockable type junction boxes shall be post or wall mounted or flush installed in an electrical pull box as shown on the Drawings.
 2. The junction box shall be the standard product of a recognized manufacturer.
 3. The junction box shall be supplied with one-piece oil resistant gasket to be mounted inside door to form a seal. The junction box shall be provided with a lockable hinged door. This shall consist of a stainless steel continuous hinge and a locking lid and hasp for a padlock.

4. Junction box shall have multiple hubs suitable for thread mounting on the bottom of the junction box consisting of either a double hub with two 1 ¼" or larger rigid threaded galvanized steel conduit or a single two-inch (2") or larger rigid galvanized steel conduits depending on the number and size of wires. Side knockouts shall be a minimum of 1" or larger. Knockouts and hubs for outdoor exposure conditions shall not be located on top of the box. Sufficient knockouts and conduits shall be provided to allow the number and size of wires specified or shown.
5. Acceptable junction box enclosures are:
 - a) Stahlin Brothers Inc., Belding, MI.
 - b) Hoffman Engineering Company, Anoka, MN.
 - c) Or approved equal.
6. The box shall be provided with a separate panel board for attachment of the number of terminals specified with a shorting strap or a buss bar with a terminal strip or terminal block with medium-duty solderless compression type terminals connectors that will accommodate the number of wires and wire sizes (gauge) as specified and shown on the Drawings with all the necessary mounting hardware. The junction box panel shall be a minimum 3/16 to 1/4-inch micarta or cross-laminated phenolic sheet. Flat and lock washers, terminal nuts, and studs shall be 1/4-inch. All hardware shall be Series 300 stainless steel, nickel plated brass or bronze.
7. Junction box shall be provided with sufficient terminals for attachment of all rectifier, cross bond, pipe, test, coupon, tracer or reference electrode leads as shown or specified for that location.
8. Minimum inside box dimensions shall be according to the number of wires and wire sizes (gauge) as shown on the Drawings according to the specific type of junction box specified below.
9. Mounting: The enclosure shall be provided with rugged supports to allow it to be securely mounted as shown on the Drawings.
 - a) Wood: – Junction box shall be provided with all rigid conduit support and all mounting hardware (galvanized two-hole conduit straps, wood screws or bolts, conduit bushing, etc.) as necessary to provide a rigid support to the rectifier pole or wood post.
 - b) Wall, Unistrut or Mounting Rack – Junction box shall be provided with all rigid conduit support and mounting hardware

galvanized two-hole conduit straps, unistrut, bolts, washers and nuts, conduit bushing, etc.) as necessary to provide a rigid support to the wall, unistrut, or mounting rack.

- c) Electrical Pull Box Vault – Junction box shall fit loosely inside electrical pull box vault and be provided with long wire leads to reach a minimum 18-inches out of the electrical pull box.

B. Deep or Semi-Deep Anode Junction Box:

1. Anode terminal box for deep or semi-deep anode groundbeds shall be a NEMA 4X type junction box for outdoor exposure.
2. Junction box shall be provided with necessary mounting equipment as necessary for on a mounting rack as shown on the Drawings.
3. Acceptable anode terminal junction boxes depending on manufacturer can be 16-gauge galvanized or coated steel, stainless steel or 14-gauge aluminum, molded fiberglass, or polycarbonate. Coated steel boxes shall be coated with either a baked enamel or heat-cured 100 percent solids thermosetting epoxy coating.
4. The anode junction box shall be provided with sufficient copper shorting straps and/or 0.01-ohm shunts to electrically bond each anode lead terminal to the rectifier positive lead buss bar as shown on the Drawings. The minimum number of shunts and compression type connectors shall match the number of anodes provided for each groundbed location.
5. The deep or semi-deep anode terminal junction box shall have as a minimum the following features:

DEEP ANODE TERMINAL JUNCTION BOX		
Item No.	Item	Minimum Requirements
1	Junction Box Enclosure Type	16 Gauge Coated Steel or 14 Gauge Fiberglass Box
2	Enclosure Rating	NEMA 3R or 4X
3	Minimum Number of Circuits (Anode Leads Not Including Rectifier Positive Header Wire)	10
4	Shunt Type and Max. Rating	0.01-ohm Holloway Type RS shunt (6 amp capacity)
5	Rectifier Positive Header Cable Wire Size and Minimum Lug Size for ¼-Inch Stud Size	No. 2 AWG with Burndy KPA-25 Lug or ILSCO SLU-125 Lug or approved equal
6	Anode Lead Wire Size and Minimum Lug Size for ¼-Inch Stud Size	No. 8 AWG Burndy KA-4C Lug, ILSCO SLU-70, or approved equal.
7	Special Features	Lockable Hinged Door
8	Minimum Conduit Size, Number and Location (Conduit Size Dependent on Number of Anode Wires)	Two Conduits Both Bottom Mount For Up To 10 Anodes
9		Minimum 1 ¼-Inch Conduits
9	Minimum Box Size (Depending on Number of Anodes)	Up To 10 Anodes
10	Minimum Box Height	16-Inches
11	Minimum Box Depth	6-Inches
12	Minimum Box Width	12-Inches

C. Test Station/Pipe Bond Junction Box:

1. Combination test station pipe bond junction box for shall be a NEMA 4X type junction box for outdoor exposure.
2. Junction box shall be provided with a concrete electrical pull box as shown on the Drawings.
3. Acceptable junction boxes shall be 14-gauge molded fiberglass or polycarbonate.

4. The minimum junction box shall be 10-inches by 12-inch size with 10 terminal locations. The junction box shall be provided with sufficient copper shorting straps and terminals to electrically bond the rectifier negative to the pipeline as shown on the Drawings. The minimum number of compression type connectors shall match the number of bond, test and reference leads provided for each test station/junction box location as shown on the Drawings.

D. Acceptable custom made junction boxes are available from:

1. Farwest Corrosion, Denver, CO.
2. Integrated Rectifier Technologies (IRT) Edmonton, Calgary, Canada.
3. Mesa Products, Tulsa, OK.
4. Universal Rectifiers Inc., Rosenberg, TX.
5. Or approved equal.

2.16 MISCELLANEOUS REFERENCE MONITORING EQUIPMENT AND MATERIALS

A. Prepackaged Copper/Copper Sulfate Reference Electrodes:

1. General: Stationary reference electrode for buried piping locations shall be a copper/copper sulfate reference electrode. Reference electrode minimum dimensions shall be approximately 1 1/2-inches in diameter by 6-inches long. Reference electrode shall be suitable for long term installation and designed for a 15-year minimum life expectancy with an accuracy of plus or minus 5-millivolts.
2. Electrode manufacturer shall warrant electrode for 15-year design life and provide both labor and material replacement, if electrode becomes unstable by more than 20 millivolts during design life.
3. Electrodes shall be supplied prepackaged in a permeable cloth bag containing manufacturer's special low-resistivity backfill mixture formulated to retain moisture and maintain electrode stability. Outside dimensions of electrode package shall be approximately 6-inches in diameter by 14-inches long.
4. Supply electrode with a lead wire attached and electrically insulated with the manufacturer's standard connection. The connection shall be stronger than the wire.
5. Lead wire shall be single conductor No. 14 AWG or larger stranded copper wire insulated as specified under WIRE, this section. Lead wire shall be of sufficient length (minimum 50') or longer as required to reach

splice free from reference electrode to test station, (some locations may be offset from pipeline). Lead wire shall be coiled and bound.

6. Package cloth bag with reference electrode in and shipped and stored in waterproof plastic or heavy paper bag of sufficient mil thickness to protect the electrode, wire, backfill, and cloth bag.
7. Acceptable CU/CUSO₄ reference electrodes are:
 - a) Borin Reference Electrodes, Model STEALTH 2 Cu/CuSO₄ from Borin Manufacturing, Bel Air, CA.
 - b) Farwest FWCC Series SP-150 from Farwest Corrosion, Denver, CO.
 - c) GMC STAPERM Model CU-1-UG from GMC Corrosion Electrical, Ontario, CA.
 - d) EDI Model UL CUG LongLife Reference Electrode from Electrochemical Devices, Inc., Albion, RI.
 - e) Or approved equal.

2.17 PLASTIC REFERENCE MONITORING PIPE

- A. Plastic Reference Monitoring Pipe: A three-inch (3") minimum diameter Schedule 40 PVC plastic pipe shall be provided at test stations as shown on the Drawings or listed on the test station schedule:
 1. Plastic reference monitoring pipe at post test stations or at abovegrade termination locations shall be provided with a threaded pipe cap.
 2. Plastic reference monitoring pipe at flush test stations shall be provided with a slip fit cap.

2.18 CONCRETE ELECTRICAL PULL BOX OR JUNCTION BOX VAULT:

- A. Electrical pull box for flush type junction box with concrete pad shall be H-20 traffic rated pull box vault, suitable for burial conditions and with a locking lid. Pull box vault shall be sized so as to allow bond or groundbed wires, test wires, plastic monitoring pipe, conduit, test station and junction box inside pull box or vault box.
- B. Minimum size shall be 30-inch long, 17 3/4-inch wide, 17-inch deep sized precast concrete or polymer plastic concrete hand hole vault box with no floor.
- C. Vault box lid shall be rated for traffic lids and identified with "CP Test" marking.

D. Acceptable CP vault boxes are available from:

1. Associated Plastics.

E. Or approved equal.

2.19 CONDUIT, LOCKNUTS, AND STRAPS

A. The minimum conduit size shall be 1-inch diameter unless otherwise indicated on Drawings or specified.

B. Use conduits, couplings, elbows, nipples, and other fittings meeting the requirements of NEMA TC and TC 3, Federal Specification W-C-1094, UL, NEC, and ASTM specified tests for the intended use:

1. Use intermediate metal conduit, including couplings, elbows, nipples, and other fittings, hot-dipped galvanized and meeting the requirements of UL and the NEC. Do not use setscrew type couplings, elbows, and nipples unless approved by the Engineer.
2. Do not use setscrew type couplings, elbows, and nipples unless approved by the Engineer.
3. Heavy wall rigid PVC conduit shall be Schedule 40, UL listed for concrete-encasement, underground direct burial, concealed and direct sunlight exposed use. Use conduits, couplings, elbows, nipples, and other fittings meeting the requirements of NEMA TC and TC 3, Federal Specification W-C-1094, UL, NEC, and ASTM specified tests for the intended use.
4. Flexible metal conduit shall be UL listed, liquid-tight flexible metal conduit consisting of galvanized steel flexible conduit covered with an extruded PVC jacket and terminated with nylon bushings or bushings with steel or malleable iron body and insulated throat and sealing O-ring.
5. Locknuts, two-hole straps, and other miscellaneous hardware shall be galvanized steel. Galvanized items shall be hot-dipped galvanized in accordance with ASTM A153.
6. Galvanized hardware shall not be used underground or in immersion service without a top coating.
7. Conduit bushings shall be threaded plastic or plastic-throated galvanized steel fittings with a threaded plastic end cap.

2.20 THERMITE WELD MATERIALS

- A. Electrical connection of copper wire or copper strap to metallic (steel, ductile iron, and cast iron) fittings, pipe, and structures shall be by the thermite weld, (exothermic) method. The thermite weld materials shall be UL listed to ANSI/UL 467 "Grounding and Bonding Equipment".
- B. The thermite weld metal shall consist of a mixture of copper oxide and aluminum material ignited by magnesium starting powder with a spark or by an electronic type ignition. Thermite weld materials shall be designed for connection of copper to steel or ductile iron and cast iron surfaces. The materials and exothermic process shall provide a completed permanent type connection that will not loosen or develop high resistant connection points and have a resistance equal to or lower than the strap or wire, be durable, be corrosion resistant, and have a high adhesion connection to both the surface and strap or wire.
- C. Supply the proper size and type of wire sleeves, cartridges, and welder molds as required for each type of connection and pipe material in accordance with the thermite weld manufacturer's written recommendations. Material and equipment shall be from the same manufacturer and utilized throughout the entire project. Weld materials from different manufacturers shall not be interchanged.
- D. The individual thermite weld metal charges shall be sealed in a moisture-resistant plastic container (tube or cartridge) with tight fitting caps with the separate steel disks or in a prepackaged sealed container. The starting (ignition) material shall be packed in the bottom of the tube with the weld material on top or for the electrical ignition type intermixed as required. The individual plastic containers shall be packed in sealed boxes so as to protect the individual containers and keep their contents dry. The size (weight in grams) and type of the charge shall be clearly marked on the plastic package and individual sealed containers.
- E. Provide type of charges required for each pipe, fitting, or structure base material.
- F. Provide steel charges for steel materials. Charge (cartridge) size shall be minimum of 15 grams and maximum of 25-grams for steel materials.
 1. Standard type steel charges:
 - a) Cadweld F-33 (Green Top).
 - b) ThermOweld P Standard Powder.
 - c) Or approved equal.
 2. Electronic ignition type steel charges:
 - a) Cadweld Plus CA15PLUS33 with black top or CA25PLUS33 with red top.

- b) ThermOweld EZ Lite Remote with suitably sized thermOweld P Standard Powder Charges.
 - c) Or approved equal.
- G. Welder molds shall be graphite molds sized for each type and size of charge and pipe size and type to be used as recommended by the exothermic weld manufacturer. Each mold shall have permanent identification showing manufacturer name, mold part number, wire and pipe size, and weld metal type and size:
 - 1. Ceramic "One-Shot" molds will not be acceptable.
 - 2. Vertical type connections require special welders and materials as recommended by the exothermic weld manufacturer.
- H. For horizontal type connections to smaller pipe and fitting sizes, different molds to match the different pipe curvature are required according to the manufacturer's recommendations. These molds for small pipe sizes are identified by each pipe size (PS):
- I. Electronic Ignition - Cadweld Plus Exothermic or ThermOwelds EZ Lite Remote:- Connections with prepackaged containers with electronic type ignition can be substituted for standard cadweld spark type ignition connections provided that equal or better low resistance, durability, adhesion, and performance characteristics are proven. Electronic type ignition materials shall be able to be used in standard graphite molds for wire and strap type connections for each structure type and size. Manufacturer shall provide a reference table with corresponding molds and charge sizes and types. Spark type and electronic ignition type materials from different manufacturers shall not be intermixed.
- J. Cleaning or grinding wheels shall be self-cleaning and leave no resin or residue on surface to be welded to:
 - 1. Wheels shall be type as recommended by the exothermic weld manufacturer (vitrified type-grinding wheels, organic cleaning wheels, or approved equal).
 - 2. The use of resin, rubber, or shellac-impregnated type grinding wheels are not recommended by the exothermic weld material manufacturers and shall not be used.
- K. Mold cleaner shall be type and size recommended by weld manufacturer for each type of graphite weld mold being used.
- L. Adapter Sleeves:

1. Install adapter sleeves for all No. 12 AWG and No. 10 AWG sized wires. Provide sleeve type as recommended by thermite weld manufacturer and attach in the field.
2. Install adapter sleeves for all No. 4 AWG and No. 2 AWG sized wires. Either premade factory sleeved wires or wires with sleeves made in the field with the appropriate sized sleeves and hammer die are acceptable:
 - a) Factory formed sleeves shall be beveled to allow molten thermite weld material to directly contact wire.
 - b) Field formed sleeves shall be attached with the appropriate sized and type of hammer die and method as recommended by the thermite weld manufacturer. Wire conductor for field installed adapter sleeves shall extend 1/4 inch beyond end of the sleeve to allow molten thermite weld material to directly contact wire.

M. Thermite weld materials are available as specified from:

1. Burndy – Formerly Continental Industries, Inc. (thermOweld – 800-558-1373), Tulsa, OK.
2. Erico Products Inc. (Cadweld - 800-248-9353) Cleveland, OH.
3. Or approved equal.

N. Acceptable Materials:

1. Thermite weld materials for **STRANDED** copper wire test leads and joint bonds with factory and field formed sleeves and copper bond straps are given below for reference:

EXOTHERMIC WELD SLEEVED WIRE MATERIALS				
Stranded Test Lead Or Bond Wire Size	CADWELD®		thermOweld®	
	Sleeve Model No.	Hammer Die Model No.	Sleeve Model No.	Hammer Die Model No.
No. 12 AWG	CAB-133-1H	Crimped	38-0200-00	Crimped
No. 10 AWG	CAB-133-1H	Crimped	38-0201-00	Crimped
No. 4 AWG	CAS-20-F	CAD-11	38-0204-00	38-4859-00
No. 2 AWG	CAS-09-F	CAD-09	38-0203-00	38-0310-00

Horizontal Type Exothermic Weld Connections Sleeve, Weld Mold, Maximum Charge Size and Type for Pipe and Fitting Diameters $\geq 10''$						
STEEL TYPE CONNECTIONS						
Wire Size	CADWELD®			thermOweld®		
	Sleeve No.	Mold No.	Max. Charge Size & Type	Sleeve No.	Mold No. And Type	Max. Charge Size & Type
No. 12 AWG	CAB-133-1H	CAHAA-1G	CA15 F-33	38-0200-00	M-100 or M-102, CS32 Type	15 P
No. 4 AWG	CAS-20-F	CAFSA-1L	CA25 F-33	38-0204-00	M-7345, CS48 Type	25 P
No. 2 AWG	CAS-09-F	CAFSA-1V	CA25 F-33	38-0203-00	M-129, CS48 Type	25 P

Notes:

- Utilize molds for sleeved wire per specifications. Mold sizes for small diameter pipe and fittings shall be adjusted based on actual pipe type and pipe diameter per exothermic manufacturer's recommendations.
- Steel Mold P.S. = Pipe size reference at end of mold number per each pipe size for steel up to 3 ½-inch diameter pipe size up to 9-inch. The same steel welder mold for flat surfaces can be used for all steel pipe or fitting sizes ten-inch (10") or larger.

2.21 WIRE CONNECTION COATINGS

- A. **Primerless Weld Caps:** Thermite weld caps shall consist of a minimum four-inch by four-inch (4" x 4") size prefabricated weld cap filled with elastomeric mastic coating and a layer of protective adhesive with an integrated primer.
- Primerless thermite weld cap materials for No. 8 AWG and smaller size wire connections shall be:
 - Handy Cap IP available from Chase Tapecoat/Royston Laboratories.
 - ThermOcap "PC" Primed Cap from thermOweld.
 - Or approved equal.
 - Larger sized primerless thermite weld caps shall be utilized for No. 6 and larger size wire, coated bond straps, and Pin Weld type connections shall be:
 - Handy Cap XL IP (extra large) available from Chase Tapecoat/Royston Laboratories.
 - Or approved equal.
- B. **One Hundred Percent (100%) Repair Coating:**

1. Locations where thermite weld caps are not suitable for use due to physical constraints (i.e. too small of flat area for thermite weld cap such as on sleeve-type coupling rings, mechanical joint follower gland rings, or bolted restraint joint rings, etc.) will require an 100-percent fast cure epoxy, polyurethane, or polyurea type pipe repair coatings.
2. Field repair material shall be fast cure, high build, low temperature, moisture tolerant, one-hundred percent (100%) material that can be distributed in a two component repair cartridge tubes with a dispensing gun. Repair coating shall be compatible with original pipe or fitting coating and exhibit minimum 2,000 psi adhesion values. Acceptable field epoxy repair type coating are:
 - a) Denso North America Protal 7125 Repair Cartridge.
 - b) Canusa CPS High Build Epoxy Coating HBE-95 WG (winter grade).
 - c) Or approved equal.

2.22 WIRE CONNECTECTORS

A. Compression Connectors:

1. Compression connectors for No. 8 AWG and larger wire sizes for in-line, multi-splices, and tap splices shall be "C" taps made of conductive wrought copper, sized to fit the wires being spliced and rated for 600 Volt applications, (except for the No. 12 AWG size wire connectors).
2. Compression connectors shall be applied with the crimp tool and die recommended by the manufacturer for the wire and tap connector size.
3. Typical copper compression Type "C" connectors, die sizes and hand mechanical crimping tool models for various stranded copper wire sizes are given below for reference, contact compression connector manufacturer for exact models required:

TYPE "C" COMPRESSION TYPE CONNECTORS							
STRANDED COPPER WIRE SIZE		COMPRESSION CONNECTOR MANUFACTURERS					
		BURNDY			THOMAS AND BETTS		
RUN or MAIN	TAP or BRANC H	YC-C Copper Crimpit	Die Index Model	Crimper Model	C Tap Connector Color Code	Die Code	Crimper Model
12-Sol – 10 Stranded	12-Sol – 10 Stranded	YC10C10 **	W 238	MD6			

8 AWG	8 AWG	YC8C8	W 162	MD6	Gray or Brown	29 or 33	TBM5-S
4 AWG	8 AWG	YC4C8	BG	MD6	Brown	33	TBM5-S
4 AWG	4 AWG	YC4C4	BG	MD6	Pink	42	TBM5-S
2 AWG	4 AWG	YC2C4	W-C	MD6	Pink	42	TBM5-S
2 AWG	2 AWG	YC2C2	W-C	MD6	Orange	50	TBM5-S
* - Not UL Listed, Can be Used on Test Wires or Anode Leads, Etc.							

4. Acceptable Type "YC" wire compression connectors as manufactured by:

- a) Burndy Co.
- b) Thomas and Betts.
- c) Or approved equal.

B. Inline "butt" type wire splice connectors or wire nuts are NOT acceptable.

C. Split bolts are acceptable only if silver soldered after a physical connection is made and both the wires are equal to or smaller than No. 10 AWG size.

D. Silver Brazing Alloy:

1. Brazing Alloy with minimum 15 percent silver content, 1185 to 1300 degrees F melting range.
2. Provide suitable silver brazing alloy and flux recommended by manufacturer for materials being connected (i.e. copper to stainless steel, copper to steel, and/or copper to copper, etc.).

2.23 WIRE SPLICE INSULATION KITS

A. General

1. Splices shall be made with suitably sized copper compression connectors and insulated with either a hand tape system, with a specially formulated splicing kit, or with an epoxy splice kit depending on wire size.
2. Smaller wires (equal to or smaller than No. 8 AWG) can be repaired with tape, or insulated with a specially fabricated splicing kit, or made with an approved epoxy insulated splice kits.
3. Insulation damage or splices to large cathodic protection cables (No. 4 AWG or larger) shall only be made with an approved epoxy type splice kit.

B. Epoxy Splice Kits:

5. General: Epoxy splice kit shall be type suitable for abovegrade and buried applications and rated for non-shielded cables up to 5 kV and multi-conductor cables through 1,000 volts.
6. Splice kit shall consist of snap together plastic mold sized to fit around splice, funnels, tape for sealing ends of mold, and two-part epoxy resin in a single pouch for mixing. Epoxy resin shall be electrical insulating, low viscosity type that will harden (cure) quickly with time.
7. Wye splice insulating kit for insulation repair or wye type splices shall be:
 - a) 3M Company Scotchcast Series 90-B1.
 - b) Plymouth Bishop Plycast Straight Splicing Kit 2636.
 - c) Or approved equal.
8. In-Line splice insulating kit for insulation repair or splices shall be:
 - d) 3M Company Scotchcast Series 82.
 - e) Plymouth Bishop Plycast Straight Splicing Kit 2638.
 - f) Or approved equal.

2.24 ELECTRICAL SPLICING TAPES AND SEALERS:

- A. Electrical splicing tapes and sealer for wire splices and insulation repair shall be UL and CSA approved, cold and weather resistant, highly elastic, with a high dielectric strength and highly resistant to sun, water, oil, acids, alkalies, and corrosive chemicals. Tapes and electrical sealers shall be suitable for moist or wet environments.
- B. Acceptable electrical splicing tapes and sealers include the following types:
 1. Rubber High Voltage Electrical Tape: Linerless 30 mil rubber high voltage splicing tape suitable for splicing cables through 69kV.
 - a) Scotch Professional Grade Linerless Rubber Splicing Tape 130C as manufactured by 3M Products.
 - b) Plymouth L969 Plyvolt Linerless EPR High Voltage Tape as manufactured by Plymouth Bishop.
 - c) Or approved equal.
 2. High Voltage Vinyl Electrical Tape: All weather, minimum 7 mil thick, vinyl electrical tape suitable for cable splices up to 600 volts:

- a) Scotch Super 33+ or Scotch Super 88 Vinyl Electrical Tape as manufactured by 3M Products.
 - b) Plymouth Premium 111 Black Vinyl Plastic Electrical Tape as manufactured by Plymouth Bishop.
 - c) Or approved equal.
3. Filler Tapes: Low voltage rubber filler tapes or putties that can be wrapped, stretched or molded around irregular shapes for quick, smooth insulation build-up to insulate connections up to 600 volts for topcoating with vinyl electrical tapes:
- a) Scotchfill Insulating Putty as manufactured by 3M Products.
 - b) Plymouth 125 Electrical Filler Tape as manufactured by Plymouth Bishop.
 - c) Or approved equal.
4. Electrical Coating Sealer: Electrical coating for sealing tape insulation on splices in severe conditions, suitable for direct burial, direct water immersion, and above grade applications, acceptable products are:
- a) Scotchkote Electrical Coating as manufactured by 3M Company.
 - b) Or approved equal.
- C. Terminal and Connection Coating and Electrical Sealers:
1. Electrical Insulating Spray: Electrical insulating spray for sealing tape insulation on splices, or on terminals to minimize external corrosion. Acceptable insulating spray materials are:
 - a) Scotch 1601 Insulating Spray as manufactured by 3M Company.
 - b) Royston Protective Coating Product Data No. 614 from Royston Laboratories.
 - c) Or approved equal.
 2. Oxidation Inhibiting Compound: - Oxidation inhibiting compound shall be non-water soluble, non-petroleum based and suitable for aluminum, copper, steel and rubber and polyethylene type insulating materials. Acceptable products are:
 - a) Penetrox A-13 available from Burndy Products.

- b) Contax Inhibiting Compound Type CTB available from Thomas and Betts (T&B).
- c) Or approved equal.

2.25 WIRE TERMINAL CONNECTORS

- A. Wire Connector Terminals: A ring tongue terminal or single hole solderless lug type connector shall be installed on the end of all stranded wire before connecting it to test station, terminal box, or junction box terminal studs:
- B. Ring Tongue Wire Terminals
 - 1. Wire connector terminals: One-piece heavy duty one hole non-insulated tin-plated copper crimp-on ring tongue wire terminals shall be sized to fit wire and stud size and be suitable for use with copper conductors.
 - 2. Wire forked end type terminals are **NOT** acceptable.
 - 3. Acceptable ring tongue wire terminals for ¼-inch stud sizes are listed below:

STRANDED COPPER WIRE RING TONGUE TERMINAL CONNECTORS					
Stranded Cable Size (AWG)	Bolt or Stud Size	MANUFACTURER AND MODEL			
		Anderson	Blackburn	Burndy	T and B
No. 14 to 20	1/4"	----	----	YAV14 Box	Series 54100 Model C10-14
No. 10 to 12	1/4"	----	----	YAV10 Box	Series 54100 Model C10-14
No. 8	1/4"	----	CTL8-14	YA8C-L Box	54130
No. 6	1/4"	VHCS-6-14	CTL6-14	YA6C-L Box	54105
No. 4	1/4"	VHCS-4-14	CTL4-14	YA4C-L Box	54106
No. 2	1/4"	VHCS-2-14	CTL2-14	YA2C-L2 Box	54107

4. Acceptable wire single hole solderless lugs are available from:

- a) Anderson.
- b) Blackburn.
- c) Burndy.
- d) Thomas and Betts (T & B).
- e) Or approved equal).

C. Lug-it Connectors: Single hole seamless copper Lug-it type connector rated shall be UL listed for 600 volt service with off-set tongue suitable for wire size being terminated.

1. Acceptable No. 4 AWG and No. 2 AWG wire single hole solderless lugs are:

- a) Burndy L125.
- b) Thomas and Betts BTCO208-B2.
- c) Or approved equal).

D. Lug Connectors:

1. Lugs for connection of CP wires to junction box buss bar shall consist of an arched pressure plate bar and V-bottom collar type connection that provides a secure permanent type grip to end of wire.
2. Lug shall be made from seamless copper, be UL E6207 listed and CSA certified, rated to 600 volts and able to be installed with a screwdriver or allen wrench sized to fit ¼-inch stud size for the cable sizes specified or shown on the Drawings.
3. Acceptable lugs are:
 - a) Burndy Series KA or KPA.
 - b) ILSCO Series SLU.
 - c) Or approved equal.

- E. Electrical Connectors: Hardware used in electrical connections including bolts, studs, nuts, washers, and lock-washers shall be tin or nickel plated copper, brass, bronze, or 300 series stainless steel for electrical conductivity and atmospheric corrosion resistance.

2.26 STAMPED BRASS OR ALUMINUM MARKING TAGS

- A. Rectifier, junction box and test station locations shall be identified with stamped brass or aluminum marking tags. . Minimum tag size shall be two-inch (2") diameter. Stamped letters and numbers shall be 1/8-inch minimum size.
- B. Deep or semi-deep anode lead wires shall be identified with stamped brass or aluminum marking tags in junction box as shown on the Drawings. Minimum tag size shall be one-inch (1") diameter. Stamped letters and numbers shall be 1/8-inch minimum size.
- C. Acceptable marking tags are available from:
 1. Calpico, Inc. South San Francisco, CA.
 2. Western Electromarker, Edmonton, Alberta, Canada.
 3. Or approved equal.

2.27 CABLE WARNING SIGNS

- A. Fiberglass outdoor electrical hazard (yellow) warning sign, minimum standard size 8-inch by 8-inch or 7-inch by 10-inch size with 1/16-inch (0.0625) minimum thickness. Large lettered wording: "DANGER: CABLE BURIED HERE" shall

be provided in bold black letters. Sign shall be suitable for outdoor industrial exposure and be guaranteed to not chip, fade, rust, shatter or peel for a minimum of 15-years. Acceptable cable warning signs are available from:

1. Brady Signmark.
2. Seton.
3. Carsonite.
4. Or approved equal.

2.28 PLASTIC CONDUIT SHEATHING

- A. Plastic conduit for cathodic protection cable sheathing (for buried cables) shall be one-inch (1") minimum diameter Schedule 40 polyethylene (PE) or polyvinyl chloride (PVC) plastic pipe.

2.29 WARNING TAPE

- A. Warning tape shall be heavy-gauge, 4 mil minimum thickness, plastic tape for use in trenches.
- B. Warning tape shall be non-traceable type. Warning tape shall be resistant to corrosive soil and intended for extended direct burial service.
- C. Tape shall meet A.P.W.A. national color code and shall be imprinted with an appropriate legend to define the type of utility. Tape shall be labeled with bold black letters for full length of tape.
 1. Warning tape for buried cathodic protection cables and conduits shall be yellow and labeled "CAUTION: CABLES BURIED BELOW" and a minimum of 3-inch width.
- D. Acceptable products are available from:
 1. Allen Systems, Inc.
 2. Griffolyn Co.
 3. ITT Blackburn.
 4. Pro-Line by Pro-Pak Industries, Inc.
 5. Terra Tape from Reef Industries.
 6. Or approved equal.

2.30 DISK TYPE MARKERS

A. Disk type markers shall consist of a one piece minimum 3 1/2" diameter cast bronze utility marker disk with a concrete anchoring shaft. The marker disk shall meet Corps of Engineers Type 1 disk requirements. Marker disk shall have stamped standard utility warning. The marker disk shall be designed for inserting into concrete.

1. Stamped printing and graphics style and information included shall be submitted to and selected by Owner.
2. Lettering shall be sized to fit onto the 3 1/2" diameter bronze disk. Wording shall be as follows:

CALL BEFORE YOU DIG

CITY OF RAPID CITY

(605) 394-4163

SDONECALL OR 811

B. Acceptable bronze type disk type markers are:

1. Bernsten Concrete Utility Warning Markers (Part No. C35FB-U-3 1/2" Flat Concrete Utility Marker (Bronze) available from Berntsen (800-356-7388).
2. Orbital Concrete Markers (Part No. WFS-ES-0037) available from William Frick and Company (847-918-3700).
3. Orbital Bronze Concrete Markers (RCO2 Model) available from Rhino (RJM Company) (800-620-4773).
4. Or approved equal.

2.31 CONCRETE REINFORCEMENT MATERIALS

A. Reinforcement for concrete slabs (rectifier concrete pad, deep anode pad, junction box pads, flush mounted test station or junction box collars, etc.) shall be welded wire fabric, rebar or fibrous concrete reinforcement material as shown on the Drawings.

B. Welded Wire Fabric

1. Wire mesh reinforcing shall be wide spaced, standard, flat sheets, structural welded wire fabric meeting ASTM A497-89. Provide bolsters, chairs, spacers and other devices for spacing, supporting and fastening

wire reinforcement in place. Wire fabric shall be W12 by W12 size with 6-inch by 6-inch spacing for 12-inch slab thickness as manufactured by:

- a) Davis Walker Corporation.
- b) Cross Wire Cloth and Manufacturing Company.
- c) Or approved equal.

C. Fibrous Concrete Reinforcement Material

1. Fibrous concrete reinforcement material shall be specifically manufactured of optimum gradation for use as a concrete secondary reinforcement meeting ASTM C 1116. Fiber length shall be per manufacturer's recommendations for each type of application and minimum concrete strength requirements per applicable codes. Fibrous concrete reinforcement material shall be one-hundred percent (100%) virgin polypropylene fibrillated fiber containing no reprocessed materials. Minimum volume per cubic yard shall be 0.1% (1.5 pounds).

- a) FORTA Corporation, Grove City, PA.
- b) Nycon Corporation, Fairless Hills, PA.
- c) Propex (Fibermesh Company) Chattanooga, TN.
- d) Or approved equal.

D. Rebar – No. 4 Hoop Size Rebar

2.32 CONCRETE

A. Concrete used on this project shall be Class M-6 per Section 56 of the Standard Specifications.

3 PART 3 EXECUTION

3.01 GENERAL

- A. All materials and equipment associated with the cathodic protection and corrosion protection systems as shown and specified herein shall be furnished and installed by the Contractor.
- B. The Contractor shall provide at his sole expense and pay for all permits, fees, labor, equipment, and materials necessary for installation of the cathodic protection system as specified herein.
- C. Contractor shall provide and maintain all necessary barriers, guards, watchmen, lights, traffic control, etc., that is necessary for safe execution of the work and to comply with local, state or federal agencies, or permit and/or easement requirements.
- D. Contractor shall obtain and pay for all necessary electrical and/or construction permits and arrange for inspection as required by local, state, or federal agencies.
- E. Contractor shall fill out and submit all information required for deep anode type installations to the appropriate state agency including but not limited to driller's log information.
- F. The installation of the facility herein specified and described shall conform as set forth herein and on the Drawings, the material manufacturer's instructions, and the current edition of the applicable portions of national, state and local law, codes, and regulations. Contractor shall follow the conditions of applicable easement and permits obtained for this project.
- G. The cathodic protection installation and location shall be as shown on the Drawings, except when the Drawings and national, state or local codes are contradictory. In such cases, the requirements of the codes shall prevail. Code compliance is mandatory. If the Drawings are in conflict with local, state or national regulations or codes, the Contractor shall notify the Engineer and/or Owner or their designated representatives, who will then determine if and what changes are appropriate.
- H. Whenever the requirements of the Specifications or Drawings exceed those of the codes or manufacturer's instructions, the requirements of the Specifications or Drawings shall prevail. Where a larger size or better grade of material or higher standard of workmanship is required, the most stringent requirement shall prevail.
- I. All work shall present a neat and finished appearance. Any changes in the design or method of installation of an item as specified shall be reviewed by the Engineer and/or Owner or their designated representatives, prior to installation.

- J. The Drawings show the general arrangement of the design only and should not be scaled for exact locations except where dimensions are provided. Field conditions and other structures and utilities will dictate exact final locations.
- K. The Drawings indicate the extent and general arrangement of the groundbeds, rectifier, wires, conduits, and associated items. However, discrepancies and omissions in the locations and quantities of utilities and structures shown may exist. Contractor shall inspect project site and shall review the location of buried utilities, structures, and pipelines in project area with the Engineer, Owner or their designated representatives and other respective owners prior to construction.
- L. The Contractor shall be responsible for contacting and coordination of appropriate location service companies and/or foreign pipeline or utility companies representatives for location of their structures prior to beginning excavation. The Contractor shall be responsible for the protection of existing structures and utilities and the proper routing of cable and location of groundbeds, equipment, and connections.
- M. In the event of any conflicts in the Drawings or Specifications, the Engineer shall be consulted. If departures from the Drawings are deemed necessary by the Contractor, details of such departures and the reasons therefor shall be submitted to the Engineer and/or Owner or their designated representatives for review as soon as practical, but not later than fourteen (14) calendar days before installation.
- N. Work shall be conducted only during time frame and calendar days as allowed by the Engineer and Owner standard construction procedures and per the Contract Documents and this specification section.
- O. Weather/Environmental Conditions:
1. Work shall be accomplished only during daylight hours (sun up to sun down).
 2. Installation of the corrosion protection system components, such as splices, bonds, and wire installation shall be allowed only when ambient temperature is above ten degrees Fahrenheit (10°F) (-12° C) and rising to minimize damage to cathodic protection materials and wire insulation.
 3. Care shall be taken with plastic pipe materials (casing, vent pipe, conduit, etc.) to not cause damage or cracking during cold weather.
 4. Materials can be stored in covered and heated storage units to maintain minimum temperatures above restricted temperature limits.
- P. General: Rectifier, test station and junction box installations, trenching, assembly of anodes, anode and coke breeze placement, wire connections, pipe excavation,

backfilling and compaction shall be done in a continuous operation and shall be observed by Engineer, and/or Owner or their designated representative(s).

- Q. Do not thermite (exothermic) weld, pin braze, silver braze, cut, grind, weld or utilize open flame or torches in areas of flammable vapors or air borne particles, where a fire or explosion could result.
- R. Install and work around abovegrade and buried AC powerlines and oil and gas pipelines with extreme care, follow minimum separation distances, safety, and work procedural requirements per Owner, Contractor Safety Program and foreign company requirements and regulations. Take special precautions during times of high lightning activity, especially next to powerlines, elevated equipment or drill rigs.
- S. Installations shall be completed according to the National Electrical Code (NEC), local or state regulations and as specified in this section.

3.02 CATHODIC PROTECTION MATERIAL STORAGE AND HANDLING

- A. Store materials in secure, protected location in accordance with material manufacturer's recommendations.
- B. Store all cathodic protection materials off the ground in a manner to provide protection from detrimental effects of the weather in a safe manner. Protect against weather, condensation, and mechanical damage. In addition, protect coke breeze bags from direct sunlight with colored tarps or store under cover. Materials shall be handled with care to prevent damage. Prepackaged corrosion control items shall be handled with care to prevent loss of backfill material.
- C. Do not allow reference electrodes to freeze. Store in protected area, off the ground. Utilize before shelf life has expired.
- D. Wire shall not be sharply bent or tightly coiled to minimize possibility of damage to the wire insulation during manufacture, shipment, or installation.
- E. Equipment or materials that display visual or physical damage from shipping, storage or during the course of installation shall be replaced. Immediately remove from the project site all damaged cathodic protection materials.

3.03 AC POWER SERVICE

- A. Provide all materials, labor and equipment required to install the AC power service from the power utility company connection to the rectifier. Minimum services shall be 120/240 volt, 100 amp class, 3 wire, single phase. All equipment shall be listed by an OSHA approved Nationally Recognized Testing Laboratory (NRTL) where such listing is available.

- B. Installation of the AC service meter and AC wire installation from meter to rectifier shall be provided by a Contractor furnished licensed electrician as shown on the Drawings. All equipment shall be installed in accordance with local electrical utility requirements and shall meet or exceed local and National Electrical Codes (NEC).
- C. The CONTRACTOR shall arrange for and coordinate and pay for all necessary local building and code inspections required.
- D. The AC service meter location shall be installed directly adjacent to the cathodic protection station on the rectifier mounting rack as shown on the Drawings. The AC power to the AC service meter shall be installed by Black Hills Power to the new AC service meter base provided by the Contractor. The local utility shall approve the AC meter installation and make the final AC power connection. Contractor is responsible for the installation of cabling between the transformer and the new service meter. Black Hills Power will connect power to both the transformer and the new service meter.
- E. Dual Rectifier AC Input: Install dual AC input to the rectifier from the AC service meter to the rectifier with four wires. Two black wires shall be hot and connected to each side of the breaker. One white wire and one green wire to the neutral or ground strip in the junction box. Terminate the wires at the rectifier so as to provide the lowest specified rectifier dual input AC voltage. Connect the green wire to the rectifier case for the case ground. For example, if the rectifier is a dual 120/240 VAC rated, then connect one of the black wires and the white wire to the rectifier AC input terminals. The other black wire is not used and a wire nut and tape should be put on the end. If for example 240 VAC input is specified then connect the two black wires to the rectifier AC input terminals and the white wire is not used and a wire nut and tape is put on its' end. In both examples, the green wire still goes to the rectifier case for the case ground. Always confirm that the rectifier dual input AC tap bar is correct for the dual input wiring used.
- F. Minimum wire size shall be No. 10 AWG or larger per NEMA current guidelines.
- G. Rectifier Grounding:
 - 1. Separate grounding (ground rods, ground grid, counterpoise or a connection to the existing building or transformer ground) shall be provided and comply with applicable codes and ordinances to meet or exceed local ground to earth resistance required values.
 - 2. The grounding system shall conform to installation and material requirements of UL 467 and NFPA 70 and these specifications.
 - 3. The grounding system shall consist of a minimum of two or more ground rods or building grounds. The AC power supply equipment shall be grounded per applicable codes with one or more ground rods or grounding

system components (ground grid, counterpoise, building ground, etc.). A separate ground rod or building ground shall also be provided and connected directly into the exterior lug on the rectifier case as shown on the Drawings.

4. The Contractor shall measure and provide sufficient grounding for the rectifier to meet a maximum 5-ohm resistance to earth value as recommended by rectifier manufacturers. Additional ground rods or counterpoise or connection to building ground grid shall be provided and connected to the rectifier case so as to meet or be lower than the maximum 5-ohm resistance as measured by the "fall of potential" method.

3.04 RECTIFIER INSTALLATION

- A. Provide the rectifier, rectifier mounting hardware, mounting (rectifier pole, mounting rack, pad mount or wall mount), entrance switch, and all electrical hardware necessary for the rectifier installation in accordance with the specifications as shown on the Drawings.
- B. The rectifier installation shall conform to NEC electrical codes, all local utility company requirements, permitting agencies, and all applicable codes and standards.
- C. The general rectifier installation and location shall be as shown on the Drawings. The rectifier shall be mounted so as to allow unobstructed access to and full opening of the rectifier front and side access doors for testing, maintenance, and repair. Location adjustments may not be made without prior approval of the Engineer.
- D. The rectifier location shall be offset from the pipeline as shown on the Drawings and mounted on a rectifier mounting rack. The test wires, reference electrode and negative bond wire shall be installed in conduit as shown on the Drawings.
- E. The rectifier mounting rack shall be straight and plum and installed at the minimum depth shown on the Drawings or required by the local utility, whichever one is the most stringent (deepest). Thoroughly compact the soil under the rectifier mounting rack and provide a concrete pad.
- F. The rectifier shall be securely mounted to the mounting rack as shown on the Drawings. The top rectifier mount bolt shall penetrate completely through the mounting rack and be provided with large steel washers on each side of the mounting rack. The rectifier shall be flush to the mounting rack. The rectifier shall be level and conduits installed plumb.
- G. Rectifier cables and bond cables shall be installed in rigid galvanized steel conduit abovegrade in exterior (outside) locations and attached to rectifier

mounting rack with double hole conduit straps. Buried sections of metallic conduit shall be taped.

- H. All metallic conduits shall be terminated with plastic throated conduit bushings and plastic threaded end cap including the AC connections into the entrance switch and rectifier.
- I. The rectifier shall be provided with a rectifier nameplate that lists the rectifier manufactured and rated AC and DC information. The nameplate shall be mounted in a visible location on the exterior side of the front rectifier door and either on the interior side of the rectifier door or on the rectifier front panel. The nameplate shall list the actual rectifier manufacturer not the supplier.
- J. The rectifier shall also be identified with a stamped identification tag permanently attached in a visible location on the inside of the rectifier housing. The tag shall be stamped with the rectifier number and pipeline stationing of the rectifier location.
- K. Rectifier lead from the rectifier negative terminal shall be installed in conduit to the junction box and attached directly as shown on the Drawings. Rectifier lead from the rectifier positive terminal should be installed in conduit to the anode terminal box as shown on the Drawings:
 - 1. Test leads and rectifier leads from negative rectifier terminal shall be installed to the pipelines or structures being protected and attached by the thermite weld or pin brazing method to the pipe or structure.
 - 2. The positive and negative rectifier cables shall not be installed in the same conduit.
 - 3. The groundbed and structure leads shall be clearly identified in the rectifier case and boxes. The negative (structure) lead shall be identified with colored tape or color coded insulation to match wire color code shown under "Wire Insulation" in this specification section.

3.05 DEEP OR SEMI-DEEP ANODE GROUND BED INSTALLATION

A. General:

1. Drilling, electrical logging of the hole, lowering of anodes, coke breeze placement, and backfilling shall be done in a continuous operation and shall be observed by the Engineer and/or other representatives of the Owner.
2. Drilling of the groundbed and waste disposal shall be in accordance with the methods and procedures of the best recognized drilling practices and shall comply with the rules and regulations of the state, county, city, or other governing bodies having jurisdiction. All holes shall be constructed and all casings set round, straight, and plumb. Deep anode groundbed holes shall be sealed as specified herein or as required by local well drilling regulations. The most stringent requirements shall apply.
3. Contractor may over drill hole and install and seal surface casing in the inactive column at his own option and risk.
4. If the deep anode groundbed is installed with steel casing in the active column.
 - a) The steel casing shall be disconnected at the inactive/active column elevation and the surface steel casing pulled back a minimum of twenty-feet (20') above the active column (including coke breeze depth).
 - b) A plastic casing shall be installed around the surface steel casing for a minimum of forty-feet (40') at the top.
5. The Contractor shall take all necessary precautions to avoid contamination of the aquifer with contaminated water, gasoline, drilling fluids and additives, or other deleterious substances during construction, through the opening, or by seepage through the ground surface.
6. For deep anode groundbeds, the driller shall maintain a log describing the depth and type of geological formations encountered during drilling. Copies of the log shall be submitted to the Engineer, Owner and appropriate authorities.
7. The Contractor shall take all necessary precautions to avoid entrance of foreign matter into hole, movement of soil strata, or collapsing of the hole at all times during the progress of the work. Should movement of soil strata or collapse of the drilled hole interfere with proper completion of the groundbed installation, the Contractor shall recover the wire and anode

strings and ream or redrill the hole or install a completely new deep anode groundbed installation next to original hole location.

B. Drilling:

1. The deep anode hole shall be drilled to the minimal nominal diameter and depth as shown on the Drawings. The Contractor shall over drill the hole depth as required to compensate for any soil sloughing off of the hole walls or cave ins during anode installation such that the depth of the bottom anode and the top of the active column is not less than the minimum distances below ground surface as shown on the Drawings.
2. Drilling fluid utilized shall be non-hazardous, bentonite based, water well type drilling gel or mud. Drilling mud shall be certified by National Sanitation Foundation as non-hazardous.
3. Drill the deep anode ground beds at the approximate locations shown on the Drawings. The exact location will depend on the locations of structures and utilities encountered in the field and must be determined in the field with the Engineer and Owner prior to start of construction.
4. The Contractor shall over drill hole and install surface casing as shown on the Drawings. Casing, other than the surface casing, shall not be installed or left in the hole unless in the driller's estimation it is necessary for successful completion of the hole. Surface casing shall be set prior to completion of the first 50 feet of hole. Should steel casing be installed, it shall be cut below the surface and jacked up to a point 50 feet, minimum, above the top of the active column. Cutting and jacking operations may be completed before or after installation of the anode assembly at the Contractor's option. At Contractor's option, plastic casing may be installed in the inactive column area, but shall not extend into the active column area.
5. The Contractor shall seal the annular space around the surface casing and the soil in accordance with State requirements and the local well drilling regulations. The sealing material shall be placed under pressure in the annular space between the casing and soil as required by drilling regulations. Sealing material shall be allowed to reach initial set before any additional work on the drilled hole that may disturb the seal.
6. The Contractor shall seal hole to prevent downhole movement of surface water and intermixing of different aquifers. Where separate aquifers are encountered, a bentonite seal shall be installed between the different aquifers. Bentonite seal thickness shall be a minimum of 3-feet thick, seal thickness shall be increased by Contractor as required to maintain separation of aquifers under high pressure or artesian conditions. If

different aquifers are encountered in active anode area, separate vent pipes shall be installed in areas between different aquifers.

7. The Contractor shall contain and be responsible for disposal of all drilling mud and cuttings in a legal manner:
 - a) The use of re-circulating mud tanks is required.

C. Deep Anode Bed Loading Preparation:

1. Contractor shall give the Engineer and/or other representatives of the Owner a minimum of 8-hours notice prior to final anode hole preparation and anode/coke breeze placement.
2. Final preparation of the anode hole, electrical logging, lowering of anodes and vent pipe, coke breeze backfill, and placement of seals shall only be completed during daylight hours and observed by Engineer and/or other representatives of the Owner. Contractor shall schedule work accordingly.
3. When the anode hole has been drilled to the specified depth, clean water shall be circulated in the hole to clear the deep anode hole of drilling mud and cuttings. Recirculate with clean water sufficiently to allow settling of the anodes and coke breeze without causing danger of anode hole collapse or wall sloughing.
4. Contractor shall schedule work to only begin anode bed loading preparations (flushing, electrical logging, anode and coke breeze placement, etc.) early enough in the day to insure completion during daylight and normal working hours. Flushing and anode loading shall not begin after 2:00 pm unless prior approval has been obtained from the Engineer or their designated representative.

D. Electrical Logging:

1. Contractor shall flush the hole and electrically log the hole in presence of the Engineer and/or a representative of the Owner to determine downhole soil layer electrical characteristics for optimum anode elevation.
 - a) An acceptable method of electrically logging is to make a resistance-to-earth reading as a test electrode (either a short section of weighted pipe, a test anode or the first anode) is lowered down the hole.
 - b) Testing will require suitable meter(s); a test electrode (a short section of weighted pipe, a test electrode; connection to a low resistance ground; a wire reel with appropriate type, size, and a

long enough length of wire to reach the bottom of the hole; and a method to determine the depth of the weighted test electrode below the surface.

- c) The current source shall be a minimum 12-volt car battery equipped with an exterior shunt to measure the current flow during the test through a shunt.
 - d) Use of a soil resistivity meter is not an acceptable method to log the drilled hole.
 - e) Resistance readings and depth from the bottom of the surface casing to bottom of the hole shall be recorded continuously or at 5-foot increments for entire hole depth.
 - f) If logged with a test anode or short piece of pipe, the test anode or short piece of pipe shall be removed from the hole prior to inserting the first anode and vent pipe.
2. Contractor shall provide Engineer and/or a representative of the Owner with proposed electrical logging test procedure and equipment list for Engineer's and/or a representative of the Owner's review and approval prior to start of drilling operations.
 3. Based on the results of the electrical log data and the driller's log of soil formations, the Engineer and/or a representative of the Owner may modify the anode spacing and drilling depth. The Contractor shall be compensated for additional drilled depth over the maximum hole depth specified herein on the unit cost basis stated in the summary of work section.

E. Lowering of Anodes:

1. Lowering of the anodes shall be done after drilling and Engineer's and/or Owner's representative's review of the driller's log and electrical logging of the hole are completed. Actual lowering of the anodes and backfilling of the hole with coke breeze shall be coordinated with and observed by the Engineer and/or a representative of the Owner.
2. Installation of the anode assembly and coke breeze shall be delayed until the next day if it cannot be completed during daylight of the same day as the completion of the drilling and electrical logging. If installation of the anode assembly is delayed more than four (4) hours from completion of the drilling operations, the drill stem and bit shall be reinserted and run back to the bottom of the hole. Sufficient bit rotation and circulation shall be maintained to ensure that the drilled hole is adequately prepared for the anode and coke breeze installation.

3. A minimum of one centralizer with three (3) ribs or flights shall be placed on each anode and adjusted to fit down the hole and not cause damage to the wire insulation while keeping the anode in the center of the drilled hole. The three centralizer ribs or flights shall be placed one hundred and twenty degrees (120°) apart. Care shall be taken to not damage the anode when attaching the centralizers and to leave any sharp edges or corners that may damage wire insulation. If metallic centralizers are used, the ends shall be taped to minimize possible damage to wire insulation.
4. If the hole is drilled with mud, the hole shall be flushed out with clean water in a continuous process either before or after the anodes and vent pipe are lowered, at the Contractor's option, until the return fluid is sufficiently clear to allow proper installation and settlement of coke breeze. The Engineer and/or Owner's representative shall inspect the return fluid before coke breeze installation shall be permitted to begin.
5. The hole shall remain full of water during installation of the anodes and coke breeze.
6. Anode leads and vent pipe shall be laid out in a manner so as to prevent damage, allow inspection, and to allow ease of downhole installation. Centralizers shall be attached to each of the anodes prior to lowering down the hole. The Engineer and/or Owner's representative shall inspect the individual anodes and lead wires for damage. Any visible physical damage to anode or lead wires shall be cause for rejection of that entire anode assembly.
7. Contractor shall measure anode lead wire length to verify and monitor actual anode depth and spacing in drilled hole by either of the following method at Contractor's option:
 - a) Measure anode lead length as the individual anode is lowered down the hole (with a wire measurer) to confirm actual anode elevation and spacing. Or
 - b) Pre-measure the anode length and compare it to the other anode lengths for reference. The Contractor shall lay out the anode leads, measure the actual anode wire length and pre-mark them at that time to demonstrate the actual wire lengths and show that the difference between the end of the wires are equal to the specified spacing. Once the anode lead length is verified, the difference between the anode wire end lengths can be used to monitor and set the anode depth and spacing.
8. Slotted or predrilled vent pipe shall be installed in the active column area and solid vent pipe shall be installed in the inactive column area.

- a) The vent pipe if predrilled shall be encased in the geotextile sock and the sock secured with four complete wraps of heavy duty filament tape on each end of the vent pipe. If slotted vent pipe is used it shall not require use of a geotextile sock.
9. For deep anode groundbeds, the first (deepest) anode shall be attached to the pre-drilled or slotted vent pipe. An additional weight shall be attached to the vent pipe if required. The bottom end of the vent pipe shall be sealed with a solid cap or plug glued to the vent pipe end.
10. The anode and vent pipe shall carefully be lowered to the bottom of the hole. Electrical logging of the hole may be completed at this time at the Contractor's option. The vent pipe individual ends shall be wiped clean and dry, and then primed/glued with a solvent type cement. The solvent type cement shall be designed and suitable for similar fast set, immersion service, and joining of PVC. The glued connection shall be cleaned, primed (if required), glued, inserted together, rotated, and allowed to sufficiently cure dry before the vent pipe is lowered.
11. The remaining anodes shall be lowered individually. The Contractor shall monitor individual anode depth and spacing by use of a wire measurer device or by known length of each anode lead wire. Bumping (physical touching the top anode with the next anode being lowered into the hole and then lifting the next anode into position) is not allowed as a measurement method.
12. When the anode is at the specified depth, it shall be suspended in the hole and securely tied off around a suspension bar or pipe with a sufficient diameter (2 ½" minimum diameter) to prevent sharp bending of the wires. The wires shall be tied off in order. The anodes shall remain securely fastened until the coke breeze backfill has been placed and has settled.
13. Care shall be taken to avoid damage to the anode assembly and wires from the casing or drill rig. If, during installation of the anodes, any anode is damaged or the wire insulation is cut, gouged, or scraped, the anode and wire will not be acceptable. No wire splices will be allowed except those shown on the Drawings and those approved by the Engineer.
14. Elevation and spacing of the anodes shall be as shown on the Drawings unless the Engineer and/or designated representative modifies the anode depth and spacing in the field based on the driller's geological log and electrical log. The Contractor may be required to modify the anode elevation according to the Engineer and/or designated representative's direction by installing a gravel layer below the first anode or over-drilling the hole. At Contractor's option, the hole may be flushed to allow installation and settlement of the gravel layer for the anode location adjustment.

F. Backfilling of Deep Anode Hole:

1. After the anode and vent pipe assembly is installed to the predetermined depth, a continuous coke breeze column area shall be placed around the anodes by pumping from the bottom of the hole to the top. The hole shall be left full of water for backfilling with coke breeze. The Contractor shall thoroughly mix with water to prepare a coke breeze slurry in accordance with the coke breeze manufacturer's written recommendations. The coke breeze slurry shall be pumped into the hole at high pressure through an additional plastic pipe supplied by the Contractor. The coke breeze plastic pipe shall be installed in the drilled hole before or after the first anode and vent pipe assembly is installed at Contractor's option, but before the remaining anodes are installed.
2. The coke breeze shall be pumped in an even and continuous manner around each anode from the bottom of the hole to the top as the coke breeze plastic pipe is slowly and carefully withdrawn. Take care to not allow the coke breeze plastic pipe to become stuck in the hole as the coke breeze settles out. Do not remove the coke breeze plastic pipe too fast to cause pumping from too high above the coke breeze level which may allow bridging of the coke breeze and cause possible voids in the coke breeze backfill column around the anodes. The pumping operation and removal of the coke breeze pipe shall be in a continuous operation when started. A sufficient amount of coke breeze shall be installed to cover the top anode as shown on the Drawings. Do not overfill the hole.
3. The Contractor shall conduct resistance measurements between an appropriate grounded structure or the pipeline and each of the individual anode leads as the coke breeze is pumped into the drilled hole. The individual anode resistance measurements shall start with the bottom anode first. When the resistance measurement indicates that the coke breeze level has covered the first anode (by becoming substantially lower than the initial anode resistance for that same anode), then the test leads shall be connected to the next higher anode lead wire and the resistance measurement repeated. The resistance testing shall be conducted consecutively for each of the anodes as the coke breeze is installed. The Contractor shall utilize the resistance measurements to monitor the coke breeze level in the drilled hole and detect any possible coke breeze bridging problems during the pumping process.
4. Physically test each anode lead, after the coke breeze has been placed and settled and the anodes have become substantially set (cannot move anode by pulling up on the lead wire). Then the electrical resistance of the individual anodes shall be measured by the Contractor while observed by the Engineer and/or a representative of the Owner, again after the coke breeze is settle, to verify that no bridging occurred. Bridging of the coke

breeze backfill resulting in a possible void in the coke breeze backfill column is indicated if the resistance of the anode(s) is substantially different than those either below or above the set of anodes in question and the initial readings were all similar.

5. The initial and final individual anode resistance-to-earth shall be measured, recorded, and submitted as part of the functional testing by the Contractor for each drilled location.
6. Care shall be taken during installation of the anodes and pumping of the coke breeze to not damage the anode assembly and to avoid plugging or filling of the vent pipe with coke breeze, bridging of the coke breeze, collapsing of the hole, and either over-filling or under-filling the hole. Plugging or filling of the vent pipe by entry of the coke breeze into the vent pipe is indicated if the return fluid coming out of the vent pipe as the coke breeze settles is not clear and contains coke breeze. If the hole collapses, coke breeze bridges, the vent pipe plugs or is full of coke breeze, the anode assembly is damaged, or the hole is under-filled or over-filled, the Contractor shall take necessary steps to resolve and correct the problem.
7. After the coke breeze is installed and has settled for a minimum of 24 hours and the anodes are set, the Contractor while observed by the Engineer and/or a representative of the Owner shall measure the depth to the top of the coke breeze column to assure that the top of the coke breeze column is at the specified elevation in order to maintain sufficient cover over the anodes and electrical isolation from the structure to be protected. If the hole is over-filled by more than 15 feet, the Contractor shall take corrective measures to provide the specified elevation by removing the coke breeze. If the hole is under-filled by more than five (5) feet, additional coke breeze shall be added by the Contractor to the specified elevation. This shall be completed by hand shoveling a saturated mixture of coke breeze and water to bring the coke breeze level up to the specified depth. Remeasure depth after placement of the additional coke breeze.
8. Upon acceptance of the top coke breeze elevation by the Engineer and/or designated representative, the sealing material shall be placed from the top of the coke breeze to a point either 12-inches below the finished elevation of the well seal or hole termination depth shown on the Drawings or as required by local, county, or state well drilling regulations. Upon acceptance of the coke breeze installation by the Engineer and/or designated representatives, an approved sealing material (either bentonite clay, puddling clay or cement grout) shall be used to seal the deep anode hole inactive column as required by local drilling regulations, state code and project specific details. Do not overfill hole and stop sealing material

at an elevation so as to allow completion of the vent pipe and wire termination as shown on the Drawings.

9. Placement of Top Seal: The Contractor shall measure the elevation of the inactive column seal while observed by the Engineer and/or a representative of the Owner. Method of seal placement shall force sealing material from bottom of space to be sealed to surface. The sealing material shall be placed in a manner that ensures entire filling of the space in one continuous operation. Vent pipe and lead wire termination through casing shall be completed prior to placement of the seal inside the top portion of the casing. The top portion of seal shall be placed after the vent pipe and wire terminations are completed.

G. Vent Pipe Termination:

1. The vent pipe shall be terminated next to the anode terminal box as shown on the Drawings. The abovegrade portion of the two-inch (2") vent pipe shall be a steel surface vent pipe as specified under PRODUCTS, this specification section.
2. Connect steel vent pipe to plastic downhole vent pipe with an appropriate plastic-to-steel coupling six-inches (6") minimum below grade. The vent pipe shall terminate a minimum of twenty-eight inches (28") and maximum of thirty-six inches (36") abovegrade as shown on the Drawings.
3. Install one hundred and eighty degree (180⁰) gooseneck on steel vent pipe and cap with a predrilled end cap or screened bushing as specified under PRODUCTS, this specification section.
4. Sandblast and coat the abovegrade steel vent pipe as specified under PRODUCTS, this specification section.
5. Place well cap in casing and tighten bolts to torque according to well cap manufacturer's recommendations. Provide a locking lid if required by the State and local regulations.
6. For offset junction box and vent pipe locations, terminate the vent pipe outside of the casing pipe as shown on the Drawings. Cut a smooth, round, hole in the side of surface casing for routing of the vent pipe to the offset termination. Grind or file all edges smooth. Provide and install a suitable type and size of rubber or plastic fitting (grommet) at the casing wall to protect the vent pipe from damage.

H. Anode Terminal Box:

1. An anode terminal box shall be installed at an offset location next to the rectifier as shown on the Drawings. Install box in a protected location that will allow access and opening of all doors for future testing and maintenance of both the rectifier and junction box.

I. Deep or Semi-Deep Anode Lead Wire Terminations:

1. Anode wires shall be terminated in the anode terminal box at the location as shown on the Drawings. Connect rectifier positive wire and anode lead wires together with the appropriate shunts and copper bus bars.
2. For deep anode groundbeds, the Contractor shall cut a smooth, round, hole in the side of surface casing for routing of anode lead wires as shown on the Drawings. Grind or file all edges smooth. Provide and install a suitable type and size of rubber or plastic fitting (grommet) at the casing wall to protect the anode lead wires from damage.
3. Label all wires in boxes with permanent nonferrous tags identifying the anode bed, anode number and rectifier lead. Connect numbered anode leads in consecutive order to anode terminal starting with the bottom anode as Number 1 at top left hand junction box terminal as shown on the Drawings.

3.06 CONDUITS, TEST STATIONS, AND JUNCTION BOXES

- A. Install sufficient wire to reach test station and/or junction box final locations. Leave extra slack in wire at structure location, bottom of conduit, and in box.
- B. Color-code wires per specifications before installation of wires in conduit or backfilling of the cathodic protection and test station wires.
- C. All wires installed abovegrade shall be installed in rigid hot-dipped galvanized steel conduit or flexible liquid-tight steel conduit and fittings.
- D. All conduit shall be secured with double hole conduit straps with wood screws on wood, bolts and expansion shields on concrete or brick, toggle bolts on hollow masonry units, and machine screws or welded, threaded studs on steelwork.
- E. Install junction and test station boxes in protected locations, which sufficient spacing and clearances necessary to allow access for future testing. Install boxes and conduits and securely fasten in accordance with National Electrical Code, as shown on the Drawings, and in accordance with these specifications.
- F. Mount all boxes and exposed conduit plumb and level. Install in a secure, substantial manner by attachment to the appropriate wood post, channel, service pole, building structure, or structural member. Fasten directly with wood screws

on wood, bolts, and expansion shields on concrete or brick, toggle bolts on hollow masonry units, and machine screws or welded, threaded studs on steelwork. Threaded studs driven in by a powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.

- G. Install cable warning signs on junction box mounting posts or pads and rectifier installation locations as shown on Drawings.
- H. Conduits entering cabinets, junction, or terminal boxes shall be secured with double galvanized locknuts, one on the inside and one on the outside of box and with bushings. Conduit shall be sized in accordance with the appropriate codes and shall be of such size and so installed that conductors may be drawn in without injury or excessive strain.
- I. In outdoor, underground, or buried locations, use watertight couplings, and connections. Open no more knockouts in box than required. Seal any unused openings. Install and equip boxes and fittings so as to prevent water from entering the conduit or box.
- J. Install insulated bushings and insulating throat connectors with plastic threaded end caps on the ends of all rigid metallic conduit that terminate in test stations, junction or terminal boxes, and rectifier cabinets and as shown on Drawings.
- K. Make all conduits watertight and free of obstructions. Ream all conduits, remove burrs, and clean conduit interior before introducing cables or pull wires.
- L. For plastic conduits, use factory made elbows for all bends 30 degrees or larger. Make no bends in flexible conduit that exceed allowable bending radius of the cable to be installed or that significantly restricts the conduit flexibility.
- M. Solvent weld plastic conduit joints with solvent recommended by the conduit manufacturer. Follow manufacturer's written instructions and provide watertight joints. Provide expansion joints as required or as recommended by the conduit manufacturer. Use acceptable plastic terminal adapters and female adapters when joining plastic conduit to metallic fittings or conduit.
- N. Flush Installations:
 - 1. Flush mounted test stations or junction boxes shall be located as shown on the Drawings. Where heavy traffic conditions exist, locate to the side of the street:
 - 2. Install a minimum 6-inch thick concrete collar either in a minimum 2-foot square pad or 3-foot diameter round concrete pad shape around flush mounted test station body as shown on Drawings. Shape as selected by Owner. Rotate flush mounted test station square type concrete slabs so that slab points toward traffic flow in roadways.

3. Install test station or junction box in electrical pull box in accordance with the pull box manufacturer instructions at locations as shown on the Drawings.
4. Install a minimum 6-inch thick collar of the minimum size for both post junction boxes or flush junction boxes with an electrical pull box as shown on the Drawings.
5. Compact under, and install flat support blocking or brick under electrical pull boxes, flush test stations or junction box bodies for support. Install supports and concrete collar around electrical pull box, test station or junction box so as to prevent settlement.
6. Concrete collar and electrical pull box, test station or junction box lid shall be set level and flush with the top of curb, sidewalk or roadway. Concrete collar and electrical pull box, test station or junction box lid shall be set level and ½ to 1-inch higher than finished grade in open dirt and lawn areas. Electrical pull box, test stations or junction boxes and collars that settle or are set too low or high shall be replaced at Contractor's sole cost.
7. Provide sufficient slack in test wires to allow terminal block, test station or junction box to extend a minimum 18-inches out of flush electrical pull box, test station body, or junction box.

3.07 CONDUCTOR INSTALLATION

A. Buried Conductors:

1. All cathodic protection cables and wires shall be buried at a minimum of 36-inches or the minimum burial depth below finished grade as shown on the Drawings for each specific location.
2. All rectifier leads and anode header wires shall be free of splices, except those splices shown on Drawings or observed and approved by Engineer and/or designated representative. Insulation on all wires shall be free of cut or abraded areas.
3. Care shall be taken to avoid damage to existing structures, pipelines, and utilities during the trenching process. All cathodic protection cable trenches shall be in the general location and route as shown on the Drawings. Contractor may modify location as approved by the Engineer as required to minimize possible damage to existing structures. Trench shall be of uniform depth and width, level, smooth, and free of any sharp objects. Hand trenching may be required in some areas to avoid damage to existing structures.

4. Complete all excavations and trenching regardless of the type, nature or condition of materials encountered as required to accomplish specified construction to lines and grades as shown.
5. Shore, sheet, and brace excavations and trenches as necessary to prevent caving during excavation in unstable material, or to protect adjacent structures, property, workers, and the public. All sheeting, shoring, and bracing of excavations and trenches shall conform to the safety requirements of the federal, state, or local public agency having jurisdiction. The most stringent of these requirements shall apply.
6. Contractor shall backfill and compact trenches and excavations as specified and required by the Owner standards and requirements for type of location being crossed. Place soil in lifts and compact as necessary to meet minimum compaction density required per type of installation.
7. Install cable(s) in plastic conduit sheathing for protection from burrowing animals as specified and shown on the Drawings.
8. Bury warning tape approximately twelve inches above all *direct bury* underground cathodic protection cable and conduit. Align parallel to and within two inches of the centerline of conduit or cable run.
9. The Contractor shall provide and maintain approved barricades and signs and any traffic control as required for protection of the public, equipment, personnel, and material.

B. Conductors in boxes:

1. Install and pull conductor according to National Electric Code and these specifications. Care shall be taken to not damage wire, insulation, or conduit during installation process. Route and maintain sufficient slack in cable(s) and wires to prevent conductor from being unduly stressed, damaged, or broken during installation or backfill operations.
2. Do not exceed the cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii. Where pulling compound is used, use only UL listed compound compatible with the cable outer insulation and the conduit type involved.
3. Wires shall be installed in a continuous length, with all wires free of splices, except those approved by the Engineer. Insulation on all wire shall be free of cut, damaged, or abraded areas. If field conditions dictate that a splice is required or wire is damaged, then splices or damage to the wire insulation may be repaired at the discretion of the Engineer. Major damage to the wire or insulation shall be cause for replacement. All splices and wire insulation repairs shall be observed and approved by the

Engineer and/or designated representative in accordance with this specification section.

4. Wire connections to anode terminal or junction box and test station terminals shall be with crimp-on spade lug or Lug-it terminals. Wire type and color code as specified under MATERIALS, this specification section, shall be maintained throughout this project.
 5. Arrange wiring neatly in rectifier, test station, and junction or terminal boxes; cut to proper length; remove surplus wire; and attach terminal or connect to junction box or rectifier terminal as specified. Install identification tag or color coding as specified.
- C. Cathodic protection cables, test and reference electrode wires shall be provided with sufficient slack and looped or coiled at the pipeline and boxes to prevent the wire from being unduly stressed or broken during backfilling operations.

3.08 WIRE SPLICES AND WIRE INSULATION REPAIR

- A. Wire splices shall be made with suitably sized Type C compression connectors as specified or mechanically secured and silver soldered. Install with suitable sized compression tools as recommended by compression connector manufacturer.
- B. Inline type butt connectors or wire nuts are **NOT** allowed. Split bolts are **NOT** allowed unless silver soldered and both wires are No. 10 AWG size wire or smaller.
- C. Minor insulation damage to small cathodic protection wires (equal to or smaller than No. 10 AWG) shall be repaired by spirally wrapping (minimum of 50 percent overlap) with two layers of high voltage rubber splicing tape and two layers of vinyl electrical tape coated with an approved electrical seal coat in accordance with the tape manufacturer's installation instructions, or with a specially fabricated splicing kit, or made with an approved epoxy insulated splice kit.
- D. Insulation damage or splices to large cathodic protection cables (No. 8 AWG or larger) shall only be made with an approved epoxy insulated splice kits.
- E. Epoxy Wire Splice Kits: Wire splice kits shall be installed as shown on the Drawings and according to the manufacturer's recommendations.
 1. Strip wire, roughen existing insulation, tape crimped connection, place mold, tape openings, level and fill with epoxy resin in accordance with manufacturer's instructions.

2. In cold weather, preheat splice kit resin to a minimum of 60 degrees F. prior to mixing. Thoroughly mix and pour into funnel, allow air to escape. Leave funnel in place as a reservoir.
 3. Monitor to assure that no epoxy leaks out from mold. All splices mold bodies shall be completely full, top-off, refill or replace as required. All splices shall be made waterproof, suitable for direct burial or immersion service.
 4. Allow adequate curing time for epoxy to harden prior to moving splice or placing splice in trench and backfilling.
- F. All wire splices and wire insulation repair locations shall be observed and approved by the Engineer and/or their designated representative.
- G. The pipeline station or GPS location shall be recorded by the Contractor and included in the record drawing information.

3.09 TEST STATION/JUNCTION BOX INSTALLATION

- A. Install a post or flush Type IR test station with two No. 12 AWG test wires to the pipeline installed in the combination test station/junction as shown on the Drawings.
- B. Mount the test station on the wood post or in an electrical pull box located next to the pipeline as shown on the Drawings. Install a reference electrode and plastic monitoring pipe and daylight the end of the plastic monitoring pipe next to the post test station in a protected location or inside the electrical pull box as shown on the Drawings.

3.10 STATIONARY REFERENCE ELECTRODE INSTALLATION

- A. Remove reference electrode and cloth bag from the shipping bag and place six inches from the pipe below the centerline of the pipe or structure in a horizontal position, perpendicular to the pipe or structure in accordance with manufacturer's directions.
- B. Presoak the reference electrode if recommended by the reference electrode manufacturer prior to burial. Do not hold or lower the reference electrode by the wire lead.
- C. Prepackaged reference electrode shall be backfilled with clean native soil. Do not allow reference electrode to freeze, place below frost line.
- D. Connect reference electrode lead to separate terminal than pipe lead in test station. Do not connect to pipe leads or directly to pipe. Terminate wire leads in test station as shown on Drawings.

3.11 PLASTIC MONITORING PIPE

- A. Place 3-inch diameter plastic reference monitoring pipe with a threaded pipe end cap next to test station for IR drop free potential measurements at locations as shown on the Drawings.
 - 1. Terminate plastic monitoring pipe abovegrade in a protected location next to the test station at height and distance shown on the Drawings.
 - 2. Terminate plastic monitoring pipe in the electrical pull box vault.
- B. Do not exceed the maximum bending radius of the plastic monitoring pipe, if required provide long bending radius fittings, so as to allow insertion of a portable reference electrode into the plastic monitoring pipe from the ground surface clear back to the end of the plastic monitoring pipe at the pipeline.

3.12 WIRE CONNECTIONS

- A. The electrical connection of copper wire to metallic pipe surfaces shall be by the thermite weld or pin brazing method. Prepare surface and make connections in accordance with the weld manufacturer's recommended procedures and these specifications, which ever one is more stringent.
- B. Provide adequate ventilation and safety equipment (gloves, safety glasses, etc.) and follow safety and training requirements as recommended by the weld material manufacturer. Avoid contact with hot materials. Remove or protect fire hazards in the area during the thermite welding, pin brazing or soldering operations.
- C. Assure that pipe wall thickness is of sufficient thickness that the thermite weld, pin brazing or silver solder process will not damage the pipe wall's integrity or damage the lining in any way.
- D. Complete thermite or pin brazing weld type connections at locations and in a manner that does not damage sealing materials, gaskets, plastic pipe, and/or coatings. Maintain minimum two inch (2") separation from pipe O-ring gasket in accordance with the pipe or fitting manufacturer recommendations.
- E. Thermite (Exothermic) Welds:
 - 1. The electrical quality and resistance of the connection is dependent on proper adhesion of the welded connection to the pipe or fitting surface. Observe proper thermite weld material selection, safety precautions, surface preparation, and welding procedures as recommended by the material manufacturer.
 - 2. Use steel type charges for all steel pipe and fitting thermite weld connections. Utilize correct sized mold (as shown on metal tag on graphite mold) based on wire and pipe or fitting size and type. Utilize

correct type and size of charges for each connection based on wire and pipe or fitting size and type. Cartridge charge type and size in grams is shown on box and charge tube.

3. The wire and cable to be thermite welded shall be clean, bright, and dry. Clean all wire that is contaminated with oil and grease in accordance with the thermite weld manufacturer's recommendations. Remove all corroded cable including the individual strands.
4. Before the connection is made, clean the surface to bare metal by making a two-inch (2") by two-inch (2") window in the coating, and then filing or grinding the surface with a grinding wheel to produce a bright (white) metal finish.
5. All power grinding shall be with a vitrified type-grinding wheel. The use of resin, rubber, or shellac-impregnated type grinding wheels is not recommended by the thermite weld manufacturer and will not be acceptable.
6. Contractor shall take appropriate actions for existing coatings with asbestos to minimize worker exposure and to contain, handle, and dispose of asbestos per regulations.
7. After the surface is cleaned to a smooth, white metal finish, lightly tap the pipe surface with a sharp tool (back of claw hammer or metal chisel edge, etc.) so as to produce dimples to improve surface profile and adhesion for the weld material.
8. In certain high humidity conditions, cold weather, or on cold or wet surfaces, preheating of the metal surface and/or molds may be required to improve successful connections and minimize porous welds.
9. Exothermic welding should be completed immediately following preparation of the metal surface before surface flash rusting or oxidation can occur.
10. Where specified wire sleeves shall be firmly attached to the end of the wire before thermite welding to the metal surface. Wire and sleeve shall be clean and dry. Wire shall extend 1/4-inch out of field formed sleeves. Factory formed sleeves shall be provided with end of sleeve beveled or angled so that wire is exposed to thermite weld material.
11. Utilize exothermic weld packing compound around mold as required on irregular or small weld surface areas to seal bottom of welder mold to prevent molten metal leakage.

12. Replace worn molds at intervals as recommended by the thermite weld manufacturer to minimize the possibility of molten metal leakage during the thermite welding process.
13. The mold and base metal shall be kept clean and dry. Avoid moisture and contaminants in mold and materials being welded as this may result in spewing of hot molten material.
14. Place a metal disk in the bottom of the graphite mold and then pour in the weld material or place the prepackaged weld material cartridge in mold. Be sure to squeeze the plastic cylinder to get all of the starting powder out. Close the mold body lid.
15. Place the graphite mold on the prepared pipe surface and install the wire in the slot at the bottom of the mold. Confirm that the mold and wire provide a proper fit and that the mold is in intimate contact on all sides with the surface being welded to. Hold the wire and mold steady and firm on the pipeline or fitting surface.
16. Ignite the weld material with the spark gun or electrical starter depending on type of charge. Lightly tap the mold body during the ignition fusion process. Carefully remove the graphite mold after the exothermic fusion process is completed approximately 15 to 20 seconds later.
17. Care should be taken during the thermite welding process, as the exothermic process produces a molten liquid metal that is extremely hot, 2,500° F (1,400° C) and will result in a local release of smoke. Do not watch the bright light (flash) or breathe the fumes from the thermite welding process.
18. Do NOT sharply hit or move the graphite mold body during the thermite weld process to minimize expelling the molten metal out of the graphite mold.
19. The graphite mold should not be touched or allowed to come in contact with the pipe coating or other flammable or meltable materials, as it is extremely hot. Carefully clean the slag out of the graphite mold body with the mold cleaner intended for that mold size and type.

F. Pin Brazing:

1. Weld connection shall be cleaned to bare white metal similar to that for thermite weld type connections.
2. Complete pin brazed connections in accordance with the pin brazing manufacturer's recommendations with a fully charged unit.

3. Load pin brazing gun with proper sized and type of pin and ferrule. Adjust height of gun as required based on wire size and connector. Only direct to metal type connections are allowed. No threaded bolts or nuts are allowed.
 4. Activate pin brazing unit to braze the cable and lug to the pipe or fitting surface.
- G. Coating damaged by welding or weld splatter shall be repaired per this specification section.
- H. All damage to pipe, coatings or linings, gaskets or O-rings etc., shall be repaired by the Contractor at his sole expense.
- P. Testing of Completed Thermite Weld or Pin Brazed Type Connections:
1. After the welded wire connection has cooled, remove slag, visually and physically test quality of connection by tapping with a hammer and lightly pulling on the wire.
 2. The completed thermite weld or pin brazed wire connection should visually present a good appearance of a well-formed connection with a minimum loss of weld material or splatter. All portions of the wire and sleeve shall be covered with the weld material. Remove and replace all visually or physically defective, porous, or poor welds.
- I. Each test and bond wire connection shall be visually and physically tested before coating according to this specification section.
- J. Remove and replace bonds or wire connections at all locations not passing visual or physical tests.
- K. Coat completed connection only after passing testing. Connection area shall be allowed to cool to "warm to touch" condition prior to application of wire connection coating or field repair coating.

3.13 WIRE CONNECTION REPAIR COATING

- A. General:
1. Clean weld area and install a prefabricated thermite weld cap or liquid epoxy repair coating per manufacturer's directions over each completed connection after testing.
 2. The pipe or structure factory-coating surface shall be properly prepared and clean and dry before application of the repair coating or thermite weld cap.

3. All exposed metallic surfaces not covered by the thermite weld cap shall be coated with an approved pipe coating repair coating or the 100-percent moisture cure liquid epoxy repair coating shall be utilized.
4. In cold weather, store thermite weld cap and coating repair materials in a heated location and keep warm until installation.

B. Prefabricated Thermite Weld Cap:

1. Type and size of prefabricated thermite weld cap shall be determined by type of connection and size of wires:
 - a) Utilize standard type prefabricated thermite weld caps with integrated primer on all No. 8 AWG and smaller wires.
 - b) Utilize extra-large type prefabricated thermite weld caps with integrated primer on all No. 6 AWG and larger wires, coated strap bonds, and at all pin brazing locations.
2. Prefabricated thermite weld cap shall be applied at connection according to manufacturer's directions. The filler material shall be placed over the thermite weld connection and worked around and under the wire and connection. Apply pressure to the prefabricated cadweld cap to assure good adhesion.
3. Completed prefabricated thermite weld cap assembly shall adhere tightly to pipe and wire connection with no voids or gaps. Inadequate adhesion is demonstrated if there are visible gaps or voids under the cap or if the cap can be easily removed from the pipe surface by pulling with fingertip pressure.
4. At all locations where inadequate adhesion is evident, remove and replace prefabricated thermite weld cap; or prime and apply either a minimum six-inch (6") by six-inch (6") square of field repair tape, a 55-mil thick Tapecoat Gray "Pads"; or heat shrink repair material over existing cadweld cap. Apply per tape coating or heat shrink manufacturer's directions.

C. Liquid Epoxy Connection Coating:

1. Coat completed and tested wire connection at pipe locations or as required for factory coating repairs with a liquid one hundred percent (100%) repair type coatings.
2. Complete surface preparation and apply one hundred percent (100%) solids, low temperature epoxy repair coating in accordance with coating manufacturer directions.

3. Total minimum dry film thickness shall be 20-mils, apply in multiple coats if required by manufacturer of specific coating utilized.
4. Allow coating to cure to sufficient degree to prevent damage to coating, prior to handling and backfilling. Strictly follow minimum cure time recommended by coating manufacturer based on surface and ambient temperatures.
5. Depending on the coating manufacturer and type of coating selected, for some epoxy coatings, the pipe or structure surface can be preheated and the repair coating force cured with low temperature heat. Consult and follow coating manufacturer's application instructions.

3.14 CONCRETE

- A. Place and finish concrete in accordance with Standard Specifications and these plans. Maintain concrete at temperatures and cure times within acceptable environmental parameters as required per ACI recommendations. Smooth and finish concrete in a workmanlike manner. Remove forms when concrete has cured adequately.
- B. Concrete Pads:
 1. Pour concrete pads, flush test station collars and guard post footers at locations as shown on the Drawings and/or listed in this specification section or on the test station schedule.
 2. Install concrete collars at all flush test stations, electrical CP pull boxes/vaults and junction boxes.
 3. Utilize fiber reinforced concrete or place rebar or wire mesh at the elevation from top of the slab as shown on the Drawings. Slope concrete away from hole at a rate of 1-inch to every 12 inches. Slope concrete pad or guard post footer away from all sides of post so that water will drain away from post. Fill posts with concrete and top with rounded grout plug.

3.15 STAMPED BRASS OR ALUMINUM MARKING TAGS

- A. Test station, rectifier and pipe junction box locations shall be located and identified by two-inch (2") diameter sized stamped brass or aluminum marking tags.
- B. Provide the type and number of location marking tags required for the number of test station, rectifier and pipe junction boxes installed on the project.
 1. Contractor shall provide unstamped tags to Engineer or Owner personnel, who will then stamp the tag with the appropriate identification stationing at the time of the final acceptance testing.

C. Deep or Semi-Deep Anode Junction Boxes

1. Individual deep or semi-deep anode lead wires shall be identified with minimum one-inch (1") diameter sized stamped brass or aluminum marker tags as shown on the Drawings. Deepest anode shall be marked as No. 1.
2. For semi-deep groundbeds terminated in a common anode junction box, the anodes from each semi-deep groundbed shall be terminated in a column on opposite sides of the junction box as shown on the Drawings.
3. Field etching with an electrical engraver is not acceptable. The letters and numbers shall be deeply stamped into the tags for long term visibility.

3.16 WARNING TAPE

- A. Bury warning tape above all underground direct bury cathodic protection cable, conduit, and/or all pipelines. Warning tape shall be placed approximately 12-inches above pipe and structures being identified or at specified depths as required in other sections of this contract document or shown on the details. Align parallel to and within 2 inches of the centerline of conduit, cable, or pipe run.

3.17 PIPELINE AND UTILITY DISK TYPE MARKERS

- A. Install pipeline and utility disk type markers at locations along the conduit run according to Owner Standards and the following:
1. Install pipeline reference marker posts at locations as shown on the Drawings and as marked in the field. This should consist of but not be limited to specified locations along the length of the conduit run, not exceeding a two hundred-foot (200') maximum spacing and at fenceline crossings and all cathodic protection test station locations.
 2. Install directly over the conduit run or next to test stations in accordance with utility post manufacturer's recommendations.
- B. The marker disk shall be stamped with the utility warning wording and installed in a concrete pad in accordance with the marker disk manufacturer as shown on the Drawings.

3.18 CONDUIT BORES

- A. The Contractor shall direction drill (bore) under all pavement and concrete lined drainage ditches. At their discretion they may either bore under sidewalks or cut a three-foot wide trench and excavate. Both boring and excavations and backfilling (including compaction) at these locations shall meet minimum City of Rapid City Standards.

- B. Install bore pipe in accordance with Owner standards and requirements per recognized and approved directional drilling procedures. Installation shall meet requirements of the structure owner or utility (sidewalk, parking lot, train tracks, roadway, pipeline, telephone or power cables, building, etc.) being bored under.
- C. Take care to not cause any wash outs or damage to other structures or utilities during boring operations or installation of bore pipe. Correct any voids or damage caused back to the original condition to the satisfaction of the Engineer, Owner and/or structure or utility owner in accordance with City requirements. Install cathodic protection cables in bore pipe and mark location of both ends of bore pipe.

3.19 SURFACE RESTORATION AND SEEDING

- A. Surface restoration and erosion control measures shall be completed by the Contractor in accordance with the Jackson Springs Water Transmission Main Contract Documents and City of Rapid City Standards to minimize erosion on disturbed areas and restore vegetation.

3.20 PRESERVATION, RESTORATION, AND CLEANUP

- A. Confine operations to construction easements, work areas described. Protect existing structures and utilities and keep project site neat and orderly at all times. The project sites shall be restored to a condition equivalent to their original condition before construction started and to the satisfaction of the Engineer, Owner and/or land owner.
- B. The drilling site shall be kept neat and orderly under all circumstances. All excess equipment and cuttings shall be removed daily when required by the prevailing conditions at the drilling site. The Contractor shall provide containment for and removal of all excess materials and water, tailings, mud, and waste products from the project site, and disposal of at an approved disposal site in accordance with local and state regulations.
- C. Prevent contamination of the project area. Do not dump or spill oil, fuel, solvents, coatings, rubbish, or other similar materials on the ground or in or near any stream or wetland area. Use caution to prevent stream or groundwater contamination. All excess equipment and material shall be removed daily when required by the prevailing conditions at the construction site. The Contractor shall provide containment for and remove all excess materials, and waste products from the project site as necessary to meet local and state regulations, local road and highway requirements and permit or easement conditions. Leave project sites free of rubbish or excess materials of any kind. Contractor shall be liable for containment and cleanup of any contamination of any aquifer, stream, or soil.
- D. Surface restoration and erosion control measures shall be completed by the Contractor to meet local, state, and federal requirements.

- E. **Cleaning and Touch-up Painting:** Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove all materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish. Galvanized equipment damage shall be coated with a 3-mil dry-film thick coating of a gray organic zinc-rich primer. If extensive damage is done to equipment paint surfaces, refinish the entire equipment in a manner that provides a finish equal to or better than the factory finish, that meets the requirements of the Specifications, and that is acceptable to the Engineer.

3.21 FUNCTIONAL AND PERFORMANCE TESTING

- A. The installation shall not be considered complete until all AC and DC wiring is complete and the rectifier is capable of operating at full rated DC load. The Contractor shall leave the AC to and all rectifier(s) turned OFF at all times during the installation of the cathodic protection groundbed(s).
- B. It shall be the responsibility of the Contractor to keep the AC power, entrance switches, and rectifier enclosures secured with padlocks and safely turned OFF, until functional and operation tests are performed by the Contractor and observed and approved by the Engineer and/or their designated representative. At that time the Contractor shall take his padlock off the enclosures and the Engineer and/or designated representative or Owner shall replace them with the Owner's padlocks.
- C. **Functional Testing Schedule:** When construction of the cathodic protection station is completed, the Contractor shall notify and provide a minimum of three weeks (21 calendar days) advance notice to the Engineer and/or Owner's representative that the installation is ready to be turned on and functional testing performed, unless the Engineer is already scheduled to be or already is onsite doing construction observations (services during construction). At such a time as the Engineer and/or Owner's representative may indicate, the Contractor, in the presence of the Engineer and/or Owner's representative shall conduct as a minimum the following functional testing:
 - D. **Rectifier and Groundbed Functional Testing:** The Contractor shall energize the completed cathodic protection system and conduct an operating test to demonstrate that the equipment is installed correctly and operating properly for initial approval. Functional testing shall consist of demonstrating operation of rectifier from zero to 100-percent of rated capacity. Tests shall also be made across terminal and junction box shunts to confirm that all portions of the groundbed are functioning correctly.
- E. **Test Stations and Junction Boxes:**

1. Test each test station or junction box wire for continuity, correct termination, and proper connection and color code to the designated structure:
 - a) Test each pipe bond or test wire for continuity with potential measurements to a copper/copper sulfate reference electrode and with an ohm-meter between wires prior to connecting together on the terminal board.
 - b) The pipe bond and test wires should read close to the same voltage (potential to the copper/copper sulfate reference electrode with the meter set on DC volts) and have a low resistance reading with the meter set on ohms, if the bond wires and test leads are correctly installed.
2. Test coupon test lead continuity and wiring with potential and ohm-meter testing for both test coupons to confirm that double coupon leads to same coupon are color-coded and terminated correctly. Test to confirm that one (protected) coupon is connected to the cathodic protected structure through the on/off switch and that the other (static or freely corroding) coupon is isolated and not connected to the cathodic protected structure or other (protected) coupon.
3. Test the buried reference electrode test leads and potentials to confirm correct operation. The buried copper sulfate reference electrode and the portable copper/copper sulfate reference electrode should read approximately the same (within 25 to 50 millivolts of each other). If the reference electrode does not provide equal or near equal potential measurements to a portable copper/copper sulfate reference electrode (convert if required depending on buried reference electrode type), then saturate the buried reference electrode by pouring water down the plastic monitoring pipe. Retest the buried reference electrode again several days later after the buried reference electrode is moist.
4. Do not connect reference electrodes to pipe test lead terminals.

F. The Contractor shall make sufficient functional tests throughout the network of protected pipe and fittings to determine proper installation of the cathodic protection and corrosion protection monitoring systems. Any construction defects identified during functional or final testing shall be located and corrected by the Contractor at his sole expense.

3.22 FINAL TESTING

A. Final Cathodic Protection System Energizing and Testing

1. After the cathodic protection station has been constructed and individual functional testing completed, a final test shall be conducted by the Engineer and/or Owner's representative to determine if the entire cathodic protection system operates properly. At the Contractor's option, he/she may be present during this testing.
 2. The Engineer and/or designated representative will make all necessary adjustments in the output of the system, and make sufficient tests throughout the network of protected structures or piping to ensure proper installation of the cathodic protection system.
- B. Any construction defects or incomplete work identified by the Engineer or designated representative during functional or final testing or during warranty inspections shall be located and corrected by the Contractor at his sole expense including additional engineering, retesting, and inspection time.
- C. Any defects in the cathodic protection system discovered shall immediately be repaired and retested in a timely manner (warranty work shall be completed within 60 calendar days of notice) by the Contractor in accordance with this specification and the written product manufacturer's instructions as reviewed and approved by the Engineer and/or designated representative. Provide the Engineer and/or designated representative with a minimum of fourteen (14) calendar days' advance notice before beginning warranty repairs.

4 PART 4 PAYMENT

4.01 GENERAL

- A. Payment for the work in this section will be included as part of applicable unit prices stated in the summary of work section.

END OF SECTION

©RUSTNOT 2014. Reproduction in whole or in part without the written consent of RUSTNOT is prohibited.

* * * * *



**Ferber
Engineering
Company, Inc.**

- Civil Engineering
 - Water Resources
 - Transportation
 - Land Surveying
 - GIS

APPENDIX A

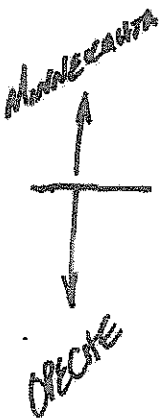
**DRILLING LOGS FOR
WELL NO. 1 AND WELL NO. 2**

Artesian Well, #1

LOG

Municipal Tourist Park

Feet	Description
0-25	Alluvium- no sample, This is Driller's report
25-31	Gravel- no sample. Driller's report.
31-58	Gravel and red shale (Spearfish #0 ?) No sample. Driller's report. Driller reports striking the Minnekahta L.S. at 58 feet, casing set in Minnekahta at 65 feet. First outtings obtained after casing was set
58-65	Minnekahta limestone, no sample. Driller's report.
65-72	Sample- Buff to pink to purplish limestone. Some red sandy particles that may have come down from Spearfish formation. Some white quartz grains (from overlaying gravel?). Some clean white calcite grains with typical cleavage. Many rounded bluish black grains (contamination from gravel higher in hole?). Minnekahta limestone.
72-78	Sample- Buff colored Minnekahta l.s., some red sandy shale particles, apparently contamination from Spearfish Also bits of dark colored schist and white quartz, probably contamination from gravel or alluvium above.
78-84	Sample- Buff colored, slightly pinkish Minnekahta l.s. Some contamination of red sand and black to gray schist fragments as in above samples.
84-90	Sample- Buff to pink to purplish limestone. Typical Minnekahta. Very little contamination from overlaying beds. These cuttings considerably larger than in previous samples.
90-96	Sample- Distinctly purple-pink limestone, some buff colored fragments. Minnekahta.
96-102	Sample- Essentially like previous sample. Minnekahta.
102-111	Sample- Buff to purplish limestone. Minnekahta, like previous sample
111-116	Sample- Brownish red when wet, paler brownish pink when dried. Cuttings consist of reddish clay with a large proportion of limestone fragments, some gypsum. Somewhere in this range is apparently the change from Minnekahta l.s. to Opeche shale.
116-122	Sample- Brick red when wet. Pale purplish red when dry. Somewhat sandy, highly Calcareous shale, with many limestone fragments. Whether the limestone belongs here or has been brought down by drill from overlaying Minnekahta is not certain. Opeche shale.



L O G

- Feet
122-126 Sample- Dark maroon color when wet, pale maroon when dry. Shale somewhat sandy, highly calcareous. Some limestone fragments, possibly carried down from above.
- 126-130 Sample- Much like preceding sample in color, a little less calcareous, (by acid test). Some gypsum.
- (120-130) Sample- Brick red shale, some gypsum.
- 130-134 Sample- Shale with gypsum. Dark maroon wet, brick red dry.
- 130-150 Sample- Red sandstone, dark brick red when wet, paler brick red dry. Considerable gypsum.
- 140-150 Sample- Like above sample but with much gypsum.
- 150-155 Sample- Smooth plastic red clay, not sandy, very slightly calcareous. Deep maroon wet, deep brick red dry.
- 155-160 Like previous sample
- 150-160 Sample- Is this correctly labeled? Red sand with gypsum. Very like 130-150
- 160-165 Sample- Plastic clay, deep maroon color when wet, deep brick red dry. Not sandy but quite calcareous as shown by brisk effervescence with dilute H Cl.
- 165-170 Sample- Same as above
- 170-195 Sample- Same as above
- 195-220 Sample- Same as above
- 220-270 No sample supplies by driller. He says Opeche shale as above samples.
- 280-285 Sample- Sand, in bulk sample reddish pink when wet, pale pink dry. Slight momentary effervescence in dilute H Cl, indicating small amount of calcareous cement. Under binocular microscope appears to be practically pure quartz sand, grains rounded to subangular. Some grains stained on outside with pinkish brown coating from oxide, probably, which gives the color to the bulk sample. No "heavy" minerals as shown by immersion in tetrabromethane. Very probably Innelsa formation.
- 285-300 Sample- Fine sand. In bulk sample deep pink wet, pale salmon pink dry. Highly calcareous with brisk and continued effervescence with H Cl. Hole sample under binocular shows fine grained quartz sand coated with probably C.CO₃. After treatment with H Cl dilute, insol residue under microscope clear quartz grains and some grains of limonite. No heavy minerals.

Continuity layer (Opeche)



L O O

- Feet
- 300-320- No sample furnished by driller.
- 320-330 Sample- Buff to pale brown dolomite limestone, somewhat argillaceous and siliceous. Some fragments of brick red shale.
- 330-340 Sample- Like preceeding sample.
- 340-345 Sample- Deep brick red wet, paler shade dry. Chiefly clay, some fine sand and considerable limestone in fragments and in fine clay.
- 345-350 Sample- Like preceeding sample, perhaps a little less clay and a little more lime.
- 350-355 Sample- Like preceeding sample.
- 355-370 Sample-, Essentially like preceeding sample.
- 370-380 Sample- Clay, dark maroon wet, brick red dry. Considerable gypsum and CaCO₃ in clay.
- 380-390 Sample- Brick red sand, quite argillaceous and calcareous.
- 390-400 Sample- Shale (clay) deep maroon wet, brick red dry. Lime carbonate crusts on some pieces. Is this indigenous or dyronitic since sample was taken?
- 400-410 Sample- Like preceeding sample.
- 410-420 Sample- Like preceeding sample.
- 420-430 Sample- Sand, Pink when wet, paler creamy pink dry. Calcareous with brisk effervescence in H Cl. Binocular shows it to consist of medium size quartz grains coated with lime carbonate.
- 430-440 Sample- Like preceeding
- 440-450 Sample- Sand. Pale pinkish cream wet, pinkish white dry. Binocular shows little carbonate coating on quartz grains but a sample dropped into H Cl effervesces vigorously for a moment. Somewhat coarser grained than preceeding sample.
- 450-460 Sample- Like preceeding
- 460-470 Sample- Much like preceeding, but somewhat more calcareous and with more shale fragments.

City of Rapid City

Deep Well No. 2, NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 9, T. 1 N., R. 7 E.

Drilled by Norbeck June-August, 1936

Summary of sample descriptions by J. P. Gries when restudied 10/29/42

- 0 - 4 silt, red-brown, micaceous; including schist fragments
20 gravel Top of Minnekahta formation @ 20 feet
22 limestone, finely crystalline, white to light brown
24 fissure filling, quartz, mica schist, sand, red clay
34 limestone, finely crystalline, white to light brown
70 limestone, gray to brown, dense to medium crystalline
110 shale and siltstone, lavender. Top of Opeche @ 70 feet
120 sandstone, orange, plus anhydrite and gypsum, white
205 shale, brick red, some silty
290 sandstone, white to orange, fine to medium, some in some cemented with calcite. Top of Kimmelusa @ 205 feet
300 sandstone, limestone and gypsum mixed
330 anhydrite with streaks of sandstone and possibly some red shale
350 dolomite, white to pink, finely crystalline, with streaks of sandy dolomite or dolomitic sandstone in upper part
360 sandstone, dolomitic, with some admixed anhydrite
420 sandstone, white to orange, incoherent to compact
430 dolomite, pink to gray, possibly some sandstone streaks
460 sandstone, white to orange, compact, well cemented
470 dolomite, pink to gray, possibly some sand streaks
475 sandstone and sandy dolomite
480 anhydrite, white
503 dolomite, as above, possible some sandstone
510 anhydrite ?
520 shale, bright brick red, some silty, tough
540 shale, same, not so bright
550 sandstone, fine, white to orange, incoherent
560 sandstone, dolomitic limestone and anhydrite mixed
590 sandstone, fine, nearly white, some rounded, some calcareous
616 dolomite, pink, possibly some sandstone
667 sandstone, fine, white to orange, cemented, some nearly limestone
683 dolomite, some streaks of anhydrite, sandstone, and possibly red shale
735 sandstone, fine, white to orange, + cemented, some anhydrite near top
770 dolomite or dolomitic limestone, light brown to pink; some streaks are sandy; maybe some anhydrite
848 dolomite, calcareous, with streak of sandstone
870 dolomite, light brown, may be some sandstone or anhydrite
902 dolomite, finely crystalline, nearly white, Madison formation @ 870

Minnekahta Limestone
Opeche
CONFIRMED
MINNEKAHTA
KIMMELUSA

7
7

SCHEDULED

1-7-90

1-7-4023

Location	Sample No.			
	Well #1	Well #2	Well #3	Well #4
Depth (feet)	1460	957	902	900
Use	Public Supply			
Water-bearing formation				
Temperature (°F)				
Silica (SiO ₂)				
Total Iron (Fe)	0.1	0.18	0.1	0.1
Calcium (Ca)	56.1	89.2	55.3	60.1
Magnesium (Mg)	17.6	32.8	19.6	21.0
Sodium (Na)	7.4	6.8	5.5	6.5
Potassium (K)				
Bicarbonates (HCO ₃)	222	200	222	222
Carbonate (CO ₃)				
Sulfate (SO ₄)	33.3	17.1	24.7	46.4
Chloride (Cl)	2.4	2.4	1.1	2.4
Fluoride (F)	0.32	0.32	0.3	0.3
Nitrate (NO ₃)	0.3	0.2	0.2	0.2
Boron (B)				
DISSOLVED SOLIDS	237	444	222	257
Residue on evaporation at 180°C				
Sum				
HARDNESS AS CaCO ₃	213	258	219	237
Calcium, magnesium				
Noncarbonate				
Percent sodium				
Specific conductance (micromhos at 25°C)				
pH	7.77	7.5	7.77	7.75
SAR				
Total Fe				
Turb.				

Name & Address of owner

Rapid City, S. Dak

POC:

Appearance

Drilled by

Yield

Source S. Dak. Dept. Health, Public Water Supply Data (1954)

Date of collection

10/54 10/54 10/54 10/54

Date installed

1935 1936 1937 1940

Well diameter (inches)

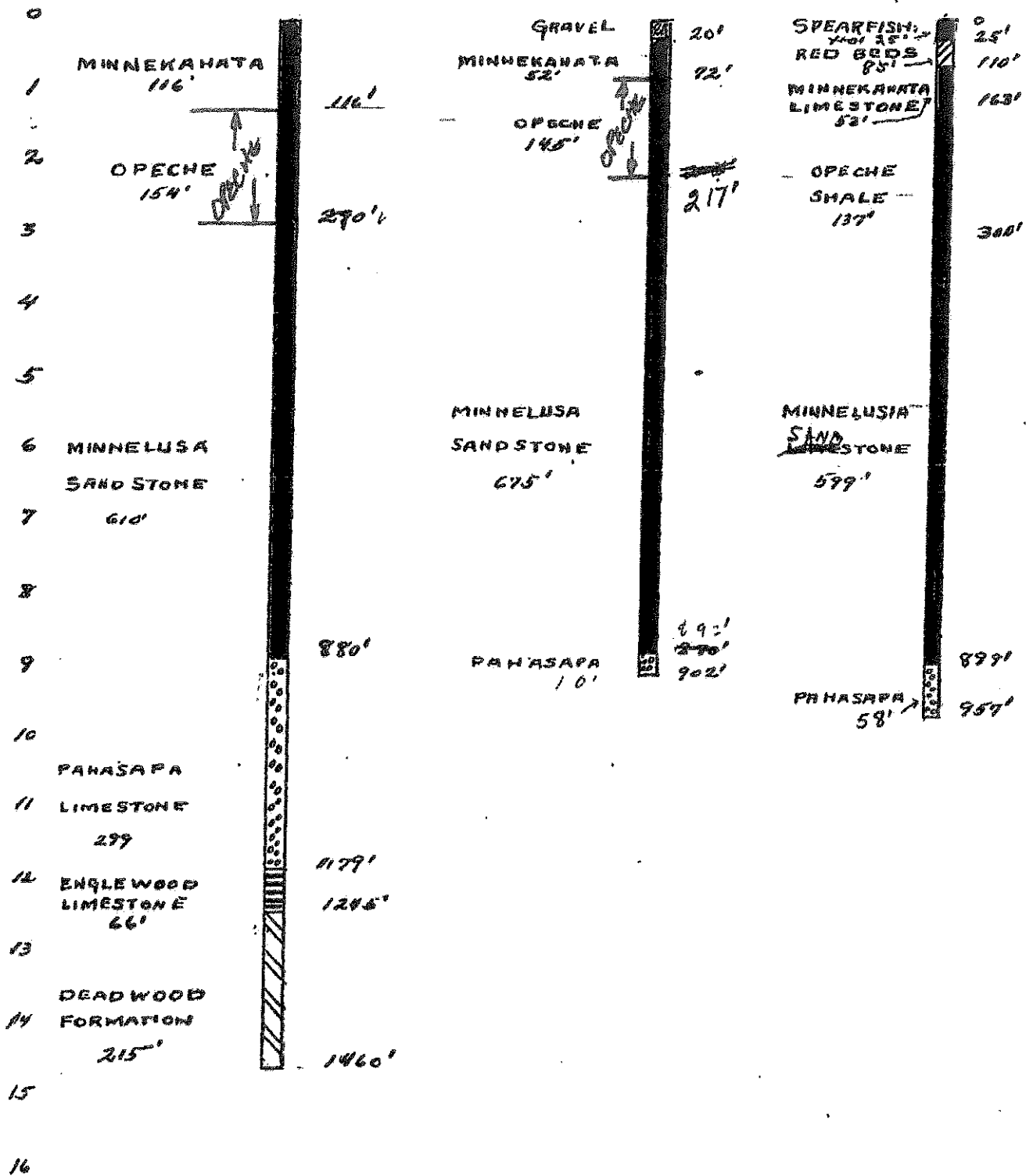
8 8 8 10

↑
MADISON

WELL No. 1

WELL No. 2

WELL No. 3



11-14-1949
B.F.W.

THIS PAGE INTENTIONALLY LEFT BLANK.



**Ferber
Engineering
Company, Inc.**

- Civil Engineering
 - Water Resources
 - Transportation
 - Land Surveying
 - GIS

APPENDIX B

Extracted Pages from
2009 Geotechnical Evaluation for
Proposed Jackson Springs
Water Treatment Plant

THIS PAGE INTENTIONALLY LEFT BLANK.

GEOTECHNICAL EVALUATION

FOR
**PROPOSED JACKSON SPRINGS WATER TREATMENT
PLANT**

RAPID CITY, SOUTH DAKOTA

March 10, 2009

PREPARED FOR:

Burns & McDonnell Engineering Company
Attn: Mr. Anthony Besson, P.E.
9785 Maroon Circle, Suite 400
Centennial, CO 80112

PAGES SPECIFIC TO THE JSWTM - IMPRESSED
CURRENT CATHODIC PROTECTION SYSTEM PROJECT
AREA HAVE BEEN INCLUDED HEREIN. FOR COMPLETE
GEOTECHNICAL REPORT FOR THE JACKSON SPRINGS
WATER TREATMENT PLANT PROJECT, REFER TO
APPENDIX C OF THE DETAILED SPECIFICATIONS FOR
THE ORIGINAL JACKSON SPRINGS WATER TREATMENT
PLANT PROJECT.



FMG, INC. 3700 Sturgis Road, Rapid City, South Dakota 57702-0317 605/342-4105
FAX 605/342-4222

SCALE: 1" = 400'

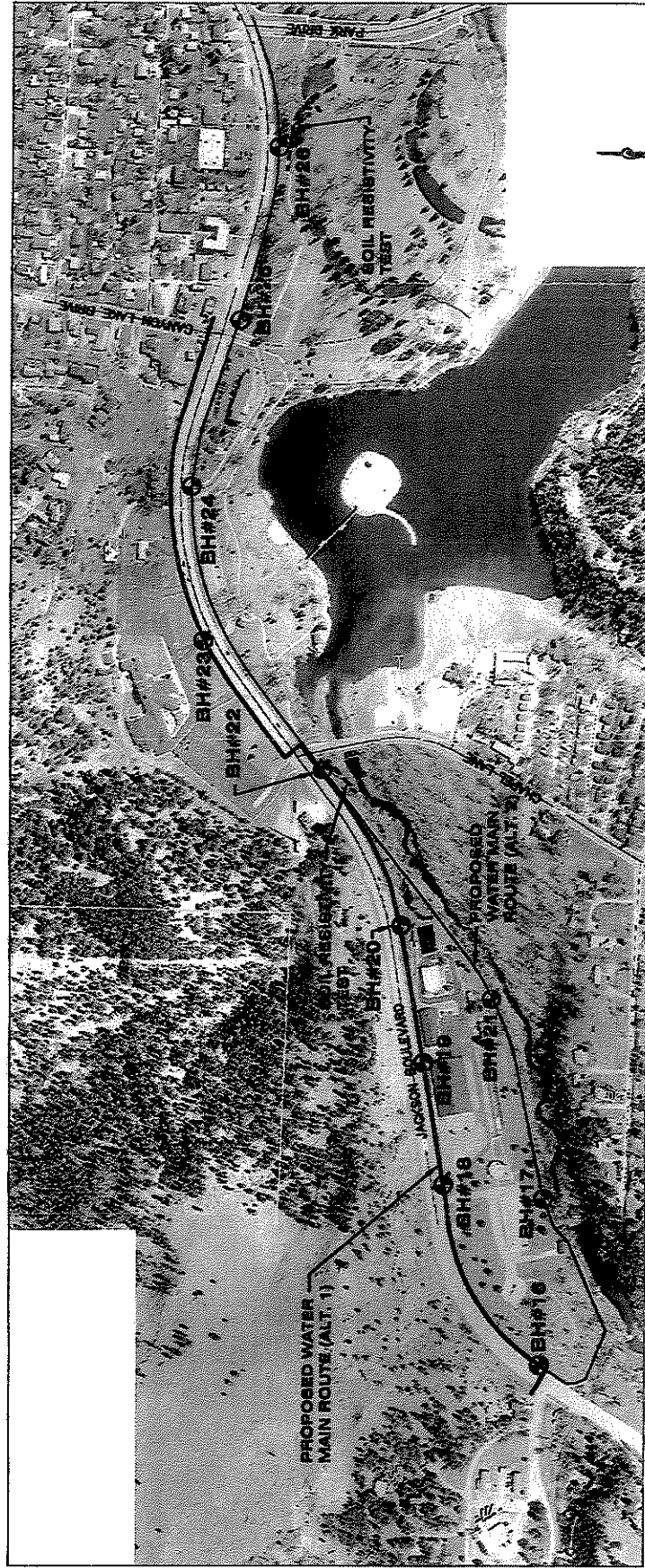


Figure Number: **2**

Borehole
LOCATION
PLAN

Revised / Date

**JACKSON SPRINGS
WATER TREATMENT PLANT**
RAPID CITY, SD

PROJECT NO. 0000000000

Drawn By	0000
Checked By	0000
Approved By	0000
Date	0000
Scale	0000
Sheet No.	0000
Total Sheets	0000



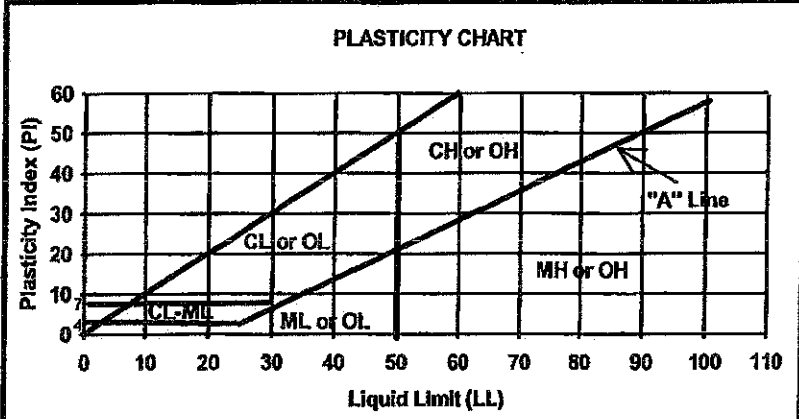
F M G, Inc.
2300 Sangha Road
Rapid City, SD 57702-0217
(605) 342-4100 FAX (605) 342-4222
www.fmginc.com

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
ASTM Designation: D 2487-90 and D 2488-90 (Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names ^A				Soil Classification	Group Symbol Name	
COARSE-GRAINED SOILS More than 50% retained on the No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3^E$ $Cu < 4$ and/or $1 > Cc > 3^E$	GW Well-Graded Gravel ^F GP Poorly Graded Gravel ^F		
		Gravels with Fines More than 12% fines ^C	Fines classify as ML or MH Fines classify as CL or CH	GM Silty Gravel ^{F,G,H} GC Clayey Gravel ^{F,G,H}		
		Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3^E$ $Cu < 6$ and/or $1 > Cc > 3^E$	SW Well-Graded Sand ^F SP Poorly Graded Sand ^F	
		Sands with Fines More than 12% fines ^D	Fines classify as ML or MH Fines classify as CL or CH	SM Silty Sand ^{G,H,I} SC Clayey Sand ^{G,H,I}		
	FINE-GRAINED SOILS 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic soils	$PI > 7$ and on or above "A" line ^J $PI < 4$ or plots below "A" line ^J	CL Lean Clay ^{K,L,M} ML Silt ^{K,L,M}	
			organic soils	Liquid limit-oven dried -----<.75	OL Organic Clay ^{K,L,M,N}	
soils			Liquid limit-not dried	OL Organic Silt ^{K,L,M,O}		
	Silts and Clays Liquid limit 50 or more	Inorganic soils	PI plots on or above "A" line PI plots below "A" line	CH Fat Clay ^{K,L,M} MH Elastic Silt ^{K,L,M}		
organic soils		Liquid limit-oven dried -----<.75	OH Organic Clay ^{K,L,M,P}			
soils		Liquid limit-not dried	OH Organic Silt ^{K,L,M,Q}			
HIGHLY ORGANIC SOILS		Primarily organic matter, dark in color, and organic odor		PT Peat		

- A. Based on the material passing the 3-in. (75-mm) sieve.
- B. If field sample contained cobbles or boulders, or both, add "with cobbles and boulders, or both" to group name.
- C. Gravels with 5% to 12% fines require dual symbols:
 GW-GM well-graded gravel with silt
 GW-GC well-graded gravel with clay
 GP-GM poorly graded gravel with silt
 GP-GC poorly graded gravel with clay
- D. Sands with 5% to 12% fines require dual symbols:
 SW-SM well-graded sand with silt
 SW-SC well-graded sand with clay
 SP-SM poorly graded sand with silt
 SP-SC poorly graded sand with clay
- E. $Cu = D_{60}/D_{10}$ $Cc = (D_{30})^2/D_{10}D_{60}$
- F. If soil contains $\geq 15\%$ sand, add "with sand" to group name.

- G. If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM
- H. If fines are organic, add "with organic fines" to group name.
- I. If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.
- J. If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
- K. If soil contains 15% to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
- L. If soil contains $\geq 30\%$ plus No. 200, predominantly sand, add "sandy" to group name.
- M. If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.
- N. $PI \geq 4$ and plots on or above "A" line.
- O. $PI < 4$ or plots below "A" line.
- P. PI plots on or above "A" line.
- Q. PI plots below "A" line.



Equation of "A" - line: Horizontal at $PI = 4$ to $LL = 25.5$, then $PI = 0.73(LL - 25)$ (Chart is for general graphic presentation purposes only)

- Figure 3

PROJECT: **Jackson Springs WTP**

LOCATION: Rapid City, SD


PROJECT #: 090005

DATE STARTED: 2/3/09 COMP.: 2/3/09

CONTRACTOR: FMG, Inc. w/ Mobile 57

DRILL METHOD: Hollow Stem Auger

**GEOLOGIC LOG
OF
BOREHOLE 25**



3700 STURGIS ROAD
RAPID CITY, SOUTH DAKOTA 57702

BORING LOCATION: Water Main
Near Canyon Lk Dr & Jackson Blv

GROUND ELEVATION: 3368

DATUM: City of RC GIS


BORING DIAMETER: 5 Inches

COLLAPSE DEPTH: _____

FILL DEPTH: No Fill Obsv

ELEVATION / DEPTH	WATER	GEOLOGY GRAPHIC	SAMPLE TYPE,#	USCS	DESCRIPTION	NM (%)	DD (pcf)	LL (%)	PI (%)	QU (psf)	phi	Swell (%) (ksf)
0		Alluvium										
3365			P25A SPT Soil Sample 2/4/2 N=6	SM-ML	Silt with Sand to Silty Sand, Red, Wet, No to Low Plasticity, Soft to Loose.							
5			S25A Shelby Tube Soil Sample 5-6.5Ft P25B SPT Soil Sample 1/2/4 N=6	CL-ML	Silty Lean Clay, Red to Brown, Wet, Low Plasticity, Soft.							
10			P25C SPT Soil Sample 2/3/4 N=7	GW-SW	Well Graded Sand and Gravel, Reddish Brown, Wet to Saturated, No Plasticity, Dense to Very Dense, Subrounded Gravel.							
3355			S25B Shelby Tube Soil Sample 10-11.5Ft P25D SPT Soil Sample 1/1/4 N=6									
15		P25E SPT Soil Sample 10/12/10 N=22										
3350	2/5/09		P25F SPT Soil Sample 10/15/15 N=30									
20												
3345												
25												
3340												
30												
3335												
35												
3330												
					- End of Borehole at 21.5Ft. No groundwater encountered during drilling.							

SEE ATTACHED KEY FOR ABBREVIATIONS, NOTES & DESCRIPTIONS

PROJECT: Jackson Springs WTP	GEOLOGIC LOG OF BOREHOLE 26  <small>3700 STURGIS ROAD RAPID CITY, SOUTH DAKOTA 57702</small>	BORING LOCATION: Water Main Near Park Dr & Jackson Blvd
LOCATION: Rapid City, SD		GROUND ELEVATION: 3352
PROJECT #: 090005		DATUM: City of RC GIS
DATE STARTED: 2/3/09 COMP.: 2/3/09		BORING DIAMETER: 5 Inches
CONTRACTOR: FMG, Inc. w/ Mobile 57		COLLAPSE DEPTH:
DRILL METHOD: Hollow Stem Auger		FILL DEPTH: No Fill Obsv

ELEVATION / DEPTH	WATER	GEOLOGY GRAPHIC	SAMPLE TYPE,#	USCS	DESCRIPTION	NM (%)	DD (pcf)	LL (%)	PI (%)	QU (psf)	phi	Swell (%) (ksf)
0		Alluvium										
3350				SM	Silty Sand with Gravel, Yellowish Brown, Moist, No Plasticity, Loose.							
5			P26A SPT Soil Sample 2/2/1 N=3	SM	Silly Sand, Brown.	9.6		NV	NP			
3345			P26B SPT Soil Sample 3/4/5 N=9									
10			P26C SPT Soil Sample 7/5/8 N=13	SC	Clayey Sand with Gravel, Pale Brown, Dry, No Plasticity, Dense.							
3340												
15	2/3/09		P26D SPT Soil Sample 5/7/10 N=17	GW-SW	Well Graded Sand and Gravel, Reddish Brown, Wet to Saturated, No Plasticity, Dense to Very Dense, Subrounded Gravel.							
3335												
20			P26E SPT Soil Sample 10/15/14 N=29									
3330												
25												
3325												
30												
3320												
35												
					- End of Borehole at 21.5FL Groundwater encountered during drilling at 16FL, but was not present during a re-check 24+hrs after completion of drilling.							

SEE ATTACHED KEY FOR ABBREVIATIONS, NOTES & DESCRIPTIONS

FIGURE 29 sheet 1 of 1

KEY TO SYMBOLS

Symbol Description

Symbol Description

Strata symbols



Silty sand



Well graded sand



Well graded sand with silt



Lean Clay



Well graded gravel with clay



Clayey sand



Silty Lean Clay



Poorly graded sand



Well graded gravel with silt



Well graded gravel and sand



Clayey gravel



Poorly graded gravel with silt



Interbedded Silty Sand and Sandy Lean Clay



Sandy Silt to Silty Sand

Misc. Symbols



Boring continues



Groundwater Level During Drilling



24+hr Groundwater Level



Depth to caving

Soil Samplers



Bulk Sample



Standard Penetration Test (SPT)

Notes:

1. The exploratory borings were drilled on the dates presented on the boring logs. Please refer to the attached Soils Classification System Chart for more detailed explanations of the soils and their properties.
2. The Geologic Logs of the Boreholes and related information depict only the conditions and materials encountered at the specific boring location and at the particular time designated on the Logs. Soil conditions at other locations will likely vary from those indicated at each specific boring or sample location. The given depths of material changes & the sample depths shown are approximate. Variations may occur.
3. These logs are subject to the limitations, conclusions, and recommendations in this report.
4. The numbers adjacent to the SPT sample symbols are the blows/interval and represent the number of blows required to drive the 1" I.D. split spoon sampler the given distance into the soil with a 140# automatic hammer that drops 30". The SPT test is performed for a length of 18". The "N" value for each given SPT is the number of blows required to drive the 1" I.D. sampler into the last 12 inches of soil.
5. The Results of some tests conducted on samples recovered are reported on the Borehole Logs. Abbreviations used are:

NM = Natural Moisture Content of the Soil (in percent).

DD = Dry Density of the Soil (in Pounds per Cubic Foot).

LL = Atterberg Liquid Limit of the Soil (in percent).

PI = Atterberg Plasticity Index of the soil (in percent)

phi = Internal Angle of Friction (in degrees)

QU = Unconfined Compressive Strength (in Pounds per Square Foot).

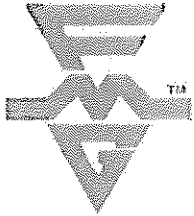
Swell = (%) Percent Swell Against 100psf Surcharge; (ksf) Maximum Swell Pressure Generated by Material.

KEY TO SYMBOLS

Symbol Description

Soil Samplers

■ Shelby Tube



FMG, INC. 3700 Sturgis Road, Rapid City, South Dakota 57702-0317

605/342-4105
FAX 605/342-4222

July 23, 2009

Ferber Engineering Company, Inc.
Mr. Dave Muck, P.E.
729 E. Watertown Street
Rapid City, SD 57701

Re: Jackson Springs Water Treatment Plant
Field Soil Resistivity Surveys
Water Transmission Mains Alignment

Dear Mr. Muck:

As requested, we have performed seven field soil electrical resistivity surveys along the proposed water transmission mains alignment for the referenced project. The surveys were performed in the general locations you have requested, and in general accordance with ASTM G57 using the Wenner Four-Electrode Mode.

The results and locations of the resistivity surveys are presented on the attached figures. The indicated soil resistivity represents the average electrical resistivity of the soils to the depth indicated, in each case 6 feet. The indicated corrosivity ratings are based on Table 1 of the draft of the City of Rapid City "Corrosion Control Design Manual", 2008.

We trust this information is sufficient. If you have any questions or need anything additional, please don't hesitate to contact us. *Thank you for the opportunity to be of service.*

Respectfully submitted,

FMG, Inc.

Alex Fisher, P.E.

Enclosures

c: FMG File # 090011.16
L:\Project\Geotech Reports\090011.16FerberResistivity

Civil Engineering
Geotechnical Engineering
Materials Testing Laboratory
Land Surveying
Environmental Services
Water Resources



FMG Inc.
 3700 Sturgis Road
 Rapid City, SD 57702
 605-342-4105

**Field Measurement of Soil Resistivity
 Using the Wenner Four-Electrode Method**
ASTM G 57

Project Number:	90011.16	Date Performed:	23-Jul-09
Client:	Ferber Engineering Co.	Performed By:	BS
Project Name:	Jackson Springs WTP	Reviewed By:	AF
Sample Location:	As Noted, See Attached Figure 2	Type of Utility:	Water Main

Test Location	Depth (ft)	Initial Meter Reading	Meter Reading Multiplier	Final Reading (ohms)	Soil Resistivity (ohms-cm)	Risk Assessment or Soil Corrosivity Zone	Corrosivity Rating
#1, West of Hatchery Entrance	6	8.2	0.1	0.82	942	1	Extremely Corrosive
#2, Near FEC CP-10, West of Chapel Lane	6	3.6	10	36	41364	5	Mildly Corrosive
#3, West End of West Canyon Lake Park Parking Lot	6	4.2	1	4.2	4826	3	Corrosive
#4, South of Int of Canyon Lake Dr and Jackson Blvd	6	3.1	1	3.1	3562	3	Corrosive
#5, East of North Central Canyon Lake Park Parking Lot	6	2.5	1	2.5	2873	2	Very Corrosive
#6, West of East Canyon Lake Park Parking Lot 6	6	9.6	1	9.6	11030	5	Mildly Corrosive
#7, East Side of Canyon Lake Drive, Across From Canyon Lake Liquor	6	1.1	10	11	12639	5	Mildly Corrosive

Figure 1



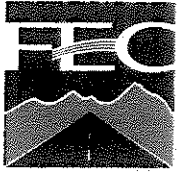
Ferber Engineering, Inc.
 2775 Highway 10, Rapid City, SD 57701
 (605) 342-2200



JACKSON SPRINGS WATER TREATMENT PLANT
 WATER TRANSMISSION MAINS
 RAPID CITY, SD

FIGURE 1
 Proposed
 Location
 of 42" and
 36" Water
 Mains





**Ferber
Engineering
Company, Inc.**

- Civil Engineering
 - Water Resources
 - Transportation
 - Land Surveying
 - GIS

APPENDIX C

City of Rapid City
Floodplain Development Permit

THIS PAGE INTENTIONALLY LEFT BLANK.

**BUILDING PERMIT
CITY OF RAPID CITY**

300 SIXTH STREET - RAPID CITY, SD 57701 (605) 394-4120
For Inspections (605) 394-4157

PERMIT TYPE: SITE PERMITS
PERMIT SUBTYPE: 705 FLOOD PLAIN
PERMIT DESCRIPTION: JACKSON SPRINGS WTP09-1836

Permit Number: CIBP14-5391
DATE ISSUED:

Printed: 12/19/2014 10:27 am

PROPERTY INFORMATION	CONTRACTOR INFORMATION
<p>PROPERTY ADDRESS: 2902 PARK DR OWNER : CITY OF RAPID CITY</p> <p>ADDRESS: RAPID CITY, SD 57701-5034 TEL:</p> <p>BLOCK: TRACT 1-2 AND LOT A-B OF TRACT 3 (ALSO IN 1N-7E SEC 8)</p> <p>SECTION-TOWNSHIP-RANGE: 9-1N-7E</p> <p>SUBDIVISION: RAPID CITY GREENWAY TRACT</p> <p>PIN NO.:37-09-301-001 TAX ID NO.:23960</p> <p>ZONING: LOT SIZE: 77.80</p> <p>INSIDE RAPID CITY OUTSIDE HISTORIC DIST.</p> <p>DRAINAGE BASIN: 319,3 FLOODWAY: ,FLOODWAY</p> <p>FLOOD DFIRM: 0.2 PCT ANNUAL CHANCE FLOOD HAZARD,AE,X</p> <p>DWELLINGS UNITS: 0</p> <p>OCCUPANCY LOAD:</p> <p>OCCUPANCY GROUP:</p> <p>CONSTRUCTION TYPE:</p> <p>NUMBER OF STORIES:</p> <p>BATHROOMS:</p> <p>BEDROOMS:</p> <p>STRUCTURE SQ/FT 0</p> <p>FUNDING SOURCE: Public</p>	<p>TEL</p>
	FEE INFORMATION
	ESTIMATED COST \$1,000
	TOTAL FEE
APPLICANT INFORMATION	
<p>FERBER ENGINEERING CO., INC. 729 E WATERTOWN STREET RAPID CITY, SD 57701 (605)343-3311</p>	
<p>_____ SIGNATURE OF APPLICANT</p>	<p>_____ APPROVED BY</p>
<p>_____ DATE</p>	<p>_____ DATE</p>

INSPECTIONS REQUIRED

Phone 394-4157

Please provide your Permit #, site address, Type of Inspection needed, your name and phone#.

It is the duty of the person doing the work to notify this office when the work or construction is ready for inspection. Twenty-four (24) hours advance notice is required when scheduling ALL inspections.

Inspections listed in the order they are typically called for:

1. **Footings** – When forms are set, steel tied and in place and proper clearances maintained from soils.
2. **Foundation Walls** – When forms are set, steel tied and in place and proper clearances maintained.
3. **Foundation Drain** – When foundation drain is in place and proper clearances provided.
4. **Electrical** – When temporary service is set – Prior to energizing temporary or electrical sign.
5. **Structural Concrete Slab or Under-floor Inspection**
 - a. General Construction
 - b. Plumbing – Under slab piping
 - c. Fire Sprinkler Underground – Pipe in place before covering.
 - d. Mechanical – Under slab ducting
 - e. Electrical – Under slab equipment
6. **Preliminary Framing**
7. **Mid roof inspections when new ice shield, underlayment and flashing is installed.**
8. **Rough-In Inspections – Must be completed prior to insulating or sheetrocking.**
 - a. Plumbing – All water, sewer & vents in place.
 - b. Mechanical – All duct work in place.
 - c. Electrical – All electrical wires pulled.
 - d. Gas – All gas lines in place.
 - e. Framing – When the roof, framing, fire blocking, fire stops and bracing are in place; all pipes, chimneys, vents, rough electrical, plumbing, heating pipes, and ducts are installed. All penetrations through floors and ceiling are sealed. Windows and stairways must be in place.
 - f. **Fire Alarm – Conduit, J-box, and panel in place and wires pulled.**
 - g. **Fire Sprinkler – Pipe is hung, heads in place, and riser built.**
 - h. **Commercial Hood – Piping and tanks in place.**
 - i. **Special Protection Systems – Piping and tanks in place.**
9. **Electrical – Permanent Service connected - Prior to energizing permanent service.**
10. **Final Inspections – Individual inspections to be scheduled through the Inspection Coordinator.**
 - a. General Construction – After finish grading and building is completed and ready for occupancy.
 - b. Plumbing
 - c. Mechanical
 - d. Electrical
 - e. Gas
 - f. **Fire Building – (Access, Address, Knox Box, Fire Extinguisher, Site, etc.)**
 - g. **Fire Alarm – (Any Fire alarm work)**
 - h. **Fire Sprinkler – (Any Fire sprinkler work)**
 - i. **Commercial Hood – (Any Ansul type system work)**
 - j. **Special Protection Systems – (FM 200,etc.)**

NEW

NEW

Please call 394-4157 to schedule an inspection