Table of Contents

1.0 PURPOSE AND SCOPE ................................................................. 3
  1.1 Purpose ................................................................. 3
  1.2 Scope ........................................................................... 3

2.0 INFORMATION ........................................................................ 3
  2.1 Terms and Definitions ......................................................... 3

3.0 PRECAUTIONS AND LIMITATIONS ........................................... 4
  3.1 Personnel Safety ............................................................... 4
  3.2 Equipment Safety ............................................................. 4
  3.3 Radiation and Contamination Control ................................. 4
  3.4 Environmental Compliance ............................................... 4

4.0 PREREQUISITES .................................................................... 5
  4.1 Special Tools, Equipment, and Supplies ............................... 5
Cathodic Protection System Testing

4.2 Performance Documents ........................................................................................................... 6
4.3 Field Preparation ....................................................................................................................... 6

5.0 PROCEDURE ............................................................................................................................... 7
5.1 Test Instructions for Cathodic Protection System ................................................................. 7
5.2 Verify Operating Rectifiers ................................................................................................. 8
5.3 Install Temporary Current Interrupter and Check Operation .............................................. 10
5.4 Test Rectifier Polarization .................................................................................................... 12
5.5 Remove Current Interrupter Assemblies from the Rectifiers ............................................. 13
5.6 Restoration ............................................................................................................................. 14
5.7 Acceptance Criteria ............................................................................................................... 14
5.8 Review .................................................................................................................................. 15
5.9 Records .................................................................................................................................. 15

Figure 1 – Cathodic Protection Rectifiers Circuitry ........................................................................ 16
Figure 2 – Test Equipment Configurations .................................................................................. 17
Figure 3 - Cathodic Protection Test Station Example Configurations .......................................... 18
Figure 4 – Electrical Reference Test Station Example Configuration ......................................... 19
Figure 5 – Actual AP Farm ER Test Station* ............................................................................ 20
1.0 PURPOSE AND SCOPE

1.1 Purpose

This procedure provides instructions for installing temporary test equipment into the Cathodic Protection rectifier(s) and for performing voltage (pipe to soil) and amperage measurements of Cathodic Protection systems and rectifiers.

1.2 Scope

This procedure applies to the following:
- Test stations protecting double shell tank piping shown on H-14-0315XX series drawings.

2.0 INFORMATION

2.1 Terms and Definitions
- PRE - Copper-copper Sulfate Portable Reference Electrode.
3.0 PRECAUTIONS AND LIMITATIONS

3.1 Personnel Safety

3.1.1 During the performance of this procedure, comply with the DOE-0336, Hanford Site Lockout/Tagout Procedure.

3.1.2 Contact with exposed and energized circuit elements in the rectifier panel and oil tub could result in an electrical shock.

3.1.3 Hazards identified for performance of this procedure have been determined to fall under the scope of the General Hazards Analysis (GHA). No JHA Checklist is required.

3.1.4 Refer to DOE-0359, Hanford Site Electrical Safety Program as guidance for electrical safety practices. An Electrical Risk Assessment form will be required prior to performing exposed electrical work and for Lockout/Tagout installation and removal.

3.1.5 Prior to opening the cathodic test boxes in AW Farm, contact IH for directions on opening underground boxes due to the potential of ammonia in the boxes.

3.1.6 Contact IH for appropriate sample plan.

3.2 Equipment Safety

CAUTION - Do not use Allegro MX for measurements taken in Section 5.2.

3.3 Radiation and Contamination Control

3.3.1 Work in radiological areas will be performed using a radiological work permit following review by Radiological Control per ALARA work planning procedure TFC-ESHQ-RP_RWP-C-03.

3.4 Environmental Compliance

3.4.1 Per WAC 173-303-640 and TFC-ESHQ-ENV-FS-C-01, Environmental Notification, Environmental must be notified if Cathodic Protection System testing cannot be completed or if testing failure occurs.

3.4.2 If working with Radiological or potentially radiologically contaminated equipment, ensure a Pre-Job Rad survey is performed. If working on contaminated equipment, a Post-Job Rad survey is required.
4.0 PREREQUISITES

4.1 Special Tools, Equipment, and Supplies

4.1.1 The following testing equipment and supplies may be needed to perform this procedure during the annual surveys:

- Model 40A CRONOS Current Interrupter
- Calibrated Digital Multi-meter, with HZ function
- Calibrated Amp Probe
- Allegro MX Field PC.
- Calibrated Copper-copper sulfate Portable Reference Electrode (PRE)
- Water (as needed)
- Nitrile gloves
- FR clothing
- Voltage rated gloves
- 3.6V, D-cell, 19AH Lithium battery for 40A CRONOs Current Interrupter (2/unit)
- Other tools, equipment and supplies as identified by Shift Manager/OE/FWS/User.
4.2 Performance Documents

4.2.1 The following documents may be required during the performance of this procedure for the annual survey and may be required during specialty surveys:
- TO-100-052, Perform Waste Generation, Segregation, Accumulation and Clean-up
- GHS-SDS and/or MSDS # 040721 (Copper-copper Sulfate)
- GHS-SDS and/or MSDS # 032646 (Tall oil ENVIRO-T-200 ground sealant)
- Bill of Material for reference electrode
- Waste Planning Checklist for one-time-use reference electrode
- A-6001-159, Lifted/Landed Lead Record
- Reference electrode documentation
- DOE-0336, Hanford Site Lockout/Tagout Procedure
- Allegro MX Field PC User Manual

4.3 Field Preparation

Special Instructions
Replace batteries in 40A CRONOS Current Interrupters prior to starting annual Survey.

The following conditions must be met before the procedure Steps may commence:

4.3.1 USING the 40A CRONOS User Manual SET one (1) of the 40A CRONOs Current Interrupter(s) as follows:
- 1.0 Second OFF
- 3.0 Seconds ON.

4.3.1.1 USING the 40A CRONOS User Manual SYNCHRONIZE all the 40A CRONOS Current Interrupters to the 1.0 Second OFF and 3.0 Second ON cycle.

4.3.2 PROGRAM all 40A CRONOs Current Interrupters as follows:
- OPERATE during the day shift only (On at 08:00 to 16:00 hrs.)
- TURN-OFF during all other hours (OFF at 16:00 to 08:00 hrs.).

4.3.3 RECORD Test Equipment number and expiration date of Multi-meter(s) and Ammeter(s) on Data Sheet.
5.0 PROCEDURE

Special Instructions
Testing can be performed in any logical order at the discretion of the FWS and/or Engineer. Record those directions in the Work Record or Shift Log.

Prior to opening the cathodic test boxes in AW Farm, contact IH for directions on opening underground boxes due to the potential of ammonia in the boxes.

5.1 Test Instructions for Cathodic Protection System

5.1.1 RECORD the Operational Parameters of the rectifiers.

5.1.2 CLEAN/INSPECT Rectifiers, gaskets and associated components AND RECORD the As-Found and As-Left condition in the Comments Section of the Data Sheet.

5.1.3 IF any missing or incorrect Labels are identified, DOCUMENT in the Comments Section of the Data Sheet.

5.1.3.1 IF any missing/incorrect Labels are identified, FABRICATE those labels AND INSTALL labels to their proper location during the performance of this Procedure.
Cathodic Protection System Testing

5.2 Verify Operating Rectifiers

**CAUTION**

Do not use Allegro MX for measurements taken in Section 5.2.

NOTE - The DC output lugs of AP241-CATH-RECT-100 and AP241-CATH-RECT-101 are located in oil tub enclosure. For all other rectifiers, DC output lugs are located at bottom of front rectifier panel, see Figure 1.

5.2.1 **USE** M&TE multi-meter and amp probe for all measurements taken in this Section.

5.2.2 **RECORD** the operability of each rectifier (ON or OFF) on Data Sheet.

5.2.3 **IF** a rectifier is found in “OFF” position, **PERFORM** Step 5.2.3.1 through 5.2.3.3, otherwise proceed to Step 5.2.4.

5.2.3.1 **NOTIFY** FWS/System Engineer.

5.2.3.2 **TROUBLESHOOT/CORRECT** minor deficiencies as directed by FWS/Engineering.

5.2.3.3 **RECORD** the actions in the Comments Section of the Data Sheet.

5.2.4 **RECORD** tap settings on Data Sheet.

5.2.5 **CHECK** value on applicable Data Sheet for maximum allowable DC millivolts.

5.2.6 **MEASURE AND RECORD** DC millivolts across total output shunt on Data Sheet.

5.2.7 **MEASURE** DC volts across DC output (See Figure 1) **AND**

**RECORD** the value on Data Sheet.
5.2 - Verify Operating Rectifiers (Cont.)

5.2.8 MEASURE the following AND 
RECORD values on the associated Data Sheet.

5.2.8.1 RECORD AC input voltage(s).

5.2.8.2 RECORD AC input amperage(s).

5.2.8.3 RECORD Frequency across output.

5.2.9 RECORD any discrepancies in the comments section of the data sheet AND 
NOTIFY FWS/System Engineer.
5.3 **Install Temporary Current Interrupter and Check Operation**

**Special Instructions**
Lockout/Tagout for the installation of a temporary current interrupter for all the rectifiers is required.

5.3.1 **PERFORM** Lock and Tag or Authorized Worker Lockout/Tagout per DOE-0336, Hanford Site Lockout/Tagout Procedure as directed by Shift Manager/OE.

5.3.2 **PERFORM** “Safe to Work” check.

5.3.3 **RECORD** Serial Number of Current Interrupter assembly on Data Sheet.

**NOTE** - The current interrupter assembly installations of this procedure are temporary in nature. The installations do not require permanent attachment to the rectifier body.

5.3.4 **INSTALL** a temporary Current Interrupter into rectifier circuitry at the DC output at tap board.

5.3.5 **RECORD** Lifted Lead(s) in Comment Section of Data Sheet.

5.3.6 **ISOLATE** (i.e. tape) newly exposed energized surfaces.

5.3.7 **REMOVE** Lock and Tag or Authorized Worker Lockout/Tagout per DOE-0336, Hanford Site Lockout/Tagout Procedure.
5.3 - Install Temporary Current Interrupter and Check Operation (Cont.)

5.3.8 **ENERGIZE** rectifier.

5.3.9 **USING** a multi-meter at the DC output of the rectifier **ENSURE** the Current Interrupter is cycling as follows:
- 1.0 Seconds OFF
- 3.0 Seconds ON

5.3.10 **RECORD** any discrepancies in the comments section of the data sheet **AND** **NOTIFY** FWS/System Engineer.
5.4  Test Rectifier Polarization

**Special Instructions**

Use Allegro MX Field PC for Section 5.4. Use of other test equipment only allowed with the prior approval of the Cathodic Engineer.

**NOTE** -  If the test station is located in an area that is paved with asphalt, the best contact for the electrode is in the test station enclosure.

-  PRE should be kept in a climate controlled building when not in use.

5.4.1  **ENSURE** PRE is making good contact with ground as follows:

5.4.1.1  **CLEAR** electrode placement area of rocks or coverings.

5.4.1.2  **POUR** a small amount of water on cleared ground in the designated “Donut” for that Test Station.

5.4.1.3  **SET** electrode on moist ground inside “Donut”.

5.4.2  **CONNECT** Common (-) test lead of Allegro MX to PRE.

5.4.3  **CONNECT** the POS (+) lead of Allegro MX to the first terminal in the test station.

5.4.4  **ENSURE** Allegro unit / test equipment is set to milli-volts DC.

**NOTE** -  It is necessary to collect survey data for each and every Terminal listed in the Allegro MX field PC.

5.4.5  **MEASURE** the instant ON/OFF voltage on all Listed Terminal points in each test station using the PRE AND **RECORD** the ON and OFF voltage readings for each Terminal in Allegro MX field PC.

5.4.5.1  **RECORD** temperature in Allegro MX field PC.

5.4.6  **MOVE** PRE, wires, and Allegro MX to next test station and rinse PRE.

5.4.7  **REPEAT** Steps 5.4.2 through 5.4.6 through for each remaining test stations / listed terminals.
5.5 Remove Current Interrupter Assemblies from the Rectifiers

5.5.1 REMOVE the temporary installed current interrupter(s) per Steps 5.5.1.1 through 5.5.1.5.

5.5.1.1 PERFORM Lock and Tag or Authorized Worker Lockout/Tagout per DOE-0336, Hanford Site Lockout/Tagout Procedure as directed by Shift Manager/OE.

5.5.1.2 PERFORM “Safe to Work” check.

5.5.1.3 RESTORE the rectifier to original configuration.

5.5.1.4 DOCUMENT leads landed as completed in Comment Section of Data Sheet.

5.5.1.5 REMOVE Lock and Tag or Authorized Worker Lockout/Tagout per DOE-0336, Hanford Site Lockout/Tagout Procedure.

5.5.2 RETURN to original configuration AND ENERGIZE rectifier.
5.6 Restoration

5.6.1 IF any problems were encountered during the performance of this Data Collection, INFORM FWS.

5.6.2 IF not already removed, REMOVE all Test Equipment and current interrupter assemblies.

5.6.3 RECORD Test Equipment information and calibration status on Data Sheet.

5.6.4 NOTIFY FWS that Cathodic System Testing is complete.

5.7 Acceptance Criteria

NOTE - WAC 173-303-640 Section (6) (c) (i) references NACE Standard RP0285-95 Item 21030 as guidelines in maintaining and inspecting cathodic protection systems. NACE Section 4.2.1.2 (a negative polarized potential of at least 850 mV relative to a saturated copper/copper sulfate reference electrode) and Section 4.2.1.3 (a minimum of 100 mV of cathodic polarization) are the two standards of adequate cathodic protection described in the Criteria of Protection that follows.

- The multi-meter displays values in the "reference electrode-to-pipe" convention. The Criteria of Protection that is stated below reflects this convention.

- Static potentials (free corrosion potentials) are referenced in the following Criteria of Protection as values derived from the "reference electrode-to-pipe" convention.

Criteria of Protection

A system is considered to be protected if it has:

- An "OFF" potential measurement (as displayed by the multi-meter) equal to or more positive than 0.85 volts. The measurement is referenced against the PRE to Term

OR

- An "OFF" potential measurement (as displayed by the multi-meter) that is at least 100 millivolts more positive than a "Static" potential measurement. Both the "OFF" potential measurement and the "Static" potential measurement are referenced against the PRE to Term.
5.8  Review

5.8.1  INFORM FWS testing is complete.

5.8.1.1  OBTAIN PCS Report from Cathodic Engineer AND INSERT into the work order package.

5.8.2  FWS REVIEW AND ENSURE the following:

- All required data has been collected and is present on PCS Report
- Comments sections are filled out appropriately
- Work requests needed as a result of this procedure are identified and generated (i.e. rodent infestation clean-up)
- Work request number(s) of any work documents generated as a result of this procedure, are recorded in the Comments field of the Allegro MX field PC
- Environmental/Engineering has been notified of failed test, or incomplete testing.

5.9  Records

This procedure is performed within a work package, as such, the procedure in its entirety will be maintained as a record per the Work Control process.

The record custodian identified in the Company Level Record Inventory and Disposition Schedule (RIDS) is responsible for record retention in accordance with TFC-BSM-IRM_DC-C-02.
Figure 1 – Cathodic Protection Rectifiers Circuitry

Note: This sketch is to be used as a reference in the installation of a pulse generator and transformer into the electrical circuit of the following rectifiers:

<table>
<thead>
<tr>
<th>Rectifiers (480 Volt 3 phase)</th>
<th>Rectifier (208 Volt 3 phase)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 2, AV241-CATH-RECT-101 &amp; -102, AN241-CATH-RECT-102, 14, 15, 16, No. 18, &amp; AM241-CATH+RECT-100</td>
<td></td>
</tr>
</tbody>
</table>
Figure 2 – Test Equipment Configurations
Cathodic Protection System Testing

Figure 3 - Cathodic Protection Test Station Example Configurations

TEST STATION TERMINAL IDENTIFICATION DIAGRAM

TYPE I

TEST STATION TERMINAL IDENTIFICATION DIAGRAM

TYPE II

TEST STATION TERMINAL IDENTIFICATION DIAGRAM

TYPE III
**Figure 4 – Electrical Reference Test Station Example Configuration**

<table>
<thead>
<tr>
<th>Terminal ID*</th>
<th>Electrode/Sensor Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Test Lead to Pipe</td>
</tr>
<tr>
<td>B</td>
<td>Test Lead to Pipe</td>
</tr>
<tr>
<td>C**</td>
<td>Reference Cell</td>
</tr>
<tr>
<td>D</td>
<td>ER Sensor Outside Pipeline Coating</td>
</tr>
<tr>
<td>E</td>
<td>ER Sensor Attached to Pipe</td>
</tr>
<tr>
<td>F</td>
<td>ER Sensor Attached to Pipe</td>
</tr>
<tr>
<td>G**</td>
<td>Reference ER Sensor Outside Pipeline Coating</td>
</tr>
</tbody>
</table>

* Terminals are labeled in ER sensor test stations with sensor information instead of letters.

** Not all ER test stations contain Terminals C and G. Terminals C and G are shared when possible, and are contained in the highest numbered Test Station in a given electrical enclosure.
Figure 5 – Actual AP Farm ER Test Station*

*This image is representative of the AP farm test station only.