

Cathodic Protection Equipment, Underground Distribution						
Component Classification Categories						
Criticality or Critical	I	X			Normal Application	
	II		X		Where Remote Monitoring Exists	
	III			X	For Bond Ties in Gas or Petroleum applications	
Duty Cycle	Heavy Load	N/A	N/A	N/A		
	Normal Load	N/A	N/A	N/A		
Service Condition	In Service	N/A	N/A	N/A		
	Spare	N/A	N/A	N/A		
Condition Monitoring Tasks		Task Frequencies			Failure Codes	Comments
Rectifier Inspection		3M	1Y	N/A	1a	Monitoring allows for remote alarm for malfunction.
Galvanic Anode Current Reading		2Y	2Y	N/A	1b	
Monitor Cable Sheath Voltage		3Y	3Y	N/A	2a, 3a	
Impressed Current CP System		2Y	2Y	N/A	1a-c, 2a, 3a	
Time Directed Tasks		Task Frequencies			Failure Codes	Comments
Reverse Current Switch Inspection		6M	6M	N/A	2b	
Failure Finding		Task Frequencies			Failure Codes	Comments
Bondtie Monitoring		2Y	N/A	1Y	1d	
Condition Directed Tasks		Task Frequencies			Failure Codes	Comments
None		N/A	N/A	N/A		

FAILURE MODE

- 1.Fails to Provide DC Current

- 2. Fails to Maintain Mechanical Integrity
- 2. Fails to Maintain Mechanical Integrity
- 2. Fails to Maintain Mechanical Integrity

- 3. Fails to Meet Protective Condition
- 3. Fails to Meet Protective Condition

FAILURE CAUSES

- 1a. Rectifier Failure
- 1a. Rectifier Failure
- 1b. Anode Depleted
- 1b. Anode Depleted
- 1c. Header Cable Failure
- 1d. Bondtie Failure

- 2a. Cable Sheath Corrosion
- 2a. Cable Sheath Corrosion
- 2b. Reverse Current Switch Malfunction

- 3a. Exposed Joint and/or Cable Sheath Corrosion
- 3a. Exposed Joint and/or Cable Sheath Corrosion

MAINTENANCE TASKS

- Rectifier Inspection
- Impressed Current CP System Survey
- Galvanic Anode Current Reading
- Impressed Current CP System Survey
- Impressed Current CP System Survey
- Bondtie Monitoring

- Monitor Cable Sheath Voltage
- Impressed Current CP System Survey
- Reverse Current Switch Inspection

- Monitor Cable Sheath Voltage
- Impressed Current CP System Survey

TASK**DEFINITION**

Bondtie Monitoring	Monitor bondtie.
Galvanic Anode Current Readings	Record individual anode current at anode bed and compare with previous readings.
Impressed Current CP System Survey	Test and calibrate each of the CP system components (rectifier, anode output and structure return current). Compare data with previous readings.
Monitor Cable Sheath Voltage	Record cable sheath bonding wire-to-reference cell voltage readings in manholes. Compare with previous readings.
Rectifier Inspection	Record rectifier volts and amps output and the rectifier tapping.
Reverse Current Switch Inspection	Calibrate the reverse current switch controller. Visually inspect the reverse current switch contacts.

Cathodic Protection Equipment, Underground Distribution Template Summary

The Preventive Maintenance program is documented via Performance Centered Maintenance (PCM) templates. Templates have been developed that address all transmission, substation, and distribution equipment that is owned, and / or, maintained by EED. Each template documents the program tasks, frequencies, failure modes, and maintenance basis for the associated equipment. Tasks and associated frequencies are designed to address known failure modes of the equipment covered by the template. In general, the tasks included in the PCM templates are the result of good industry practices, industry experience, and manufacturer recommendations.

References:

Internal reports and operating experience

Boundary Definition

The boundary of Distribution Cathodic Protection systems are defined as all equipment required to ensure corrosion protection including:

- Rectifiers
 - Anode Beds
 - Reverse Current Switches
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Failure Experiences

Failures are subject to ACE/RCI investigation. Findings/recommended corrective actions are incorporated into the template as required.

Vendor Recommendations

N/A

Disposition of Vendor Recommendations

N/A

Basis For Template Tasks

Bondtie Monitoring: Determines if conditions prevail that create stray current discharges from other utilities or even to self from nearby CP systems, which are not electrically integral to location of discharge. A bondtie is provided to provide a metallic path to originating stray current source. A bondtie however impacts the current output substantially of a CP system (requiring higher output) therefore a balance between discharge and CP capacity needs to be maintained.

Galvanic Anode Current Reading: This will indicate need for anode replacement.

Impressed Current CP System Survey: Ensure the system is delivering the required corrosion protection.

Monitor Cable Sheath Voltage: Reading provide indication of corrosion activity in manhole.

Rectifier Inspection: Ensure the rectifier is working properly and has no burned or damaged internal components. Changes in readings should be investigated. Changes in these readings indicate a problem with the protection system.

Reverse Current Switch Inspection: Verify control unit functionality and ensure the mechanical integrity of the unit.

Revision 0		Date 12/29/2006
Writer	Larry Griess (Strategic Programs)	
Reviewer(s)		
Approver(s)	Kathy McHugh (FAM Maintenance Planning)	
Reason Written	To document the maintenance program tasks, frequencies, failure modes, and maintenance basis	

Revision 1		Date 11/30/2010
Writer	Chris Stefanski	
Reviewer(s)	Ken Wendt (Mgr. Material Condition)	
Approver(s)	Bill Fluhler , Bill Gannon, Nitin Patel, Jim Crane, Bill Sullivan	
Reason Written	Added note to ensure template changes are communicated to affected work groups.	

Revision 2		Date 06/10/2010
Writer	Rodolfo Patriarca	
Reviewer(s)	Youssef Tabib, Ken Wendt, Chris Stefanski	
Approver(s)	Bill Fluhler	
Reason Written	To document the maintenance program tasks and frequencies. Removed "Standard C5202 - Pipeline Crossing Monitoring" task.	

Revision 3		Date 06/18/2014
Writer	Suneetha Parupalli (Material Condition)	
Reviewer(s)	Youssef Tabib (Sr. Engineer), Ken Wendt (Mgr. Material Condition)	
Approver(s)	Michael Moy (UFAM)	
Reason Written	3 year review, reformat document, No content change	

Revision 4		Date 06/23/2017
Writer	Rodolfo Patriarca (Material Condition)	
Reviewer(s)	Youssef Tabib (Sr. Engineer)	
Approver(s)	Michael Moy (UFAM)	
Reason Written	UFAM Periodic Review, No content changes made	

Revision 5		Date 06/25/2020
Writer	Jimi Conway (Material Condition)	
Reviewer(s)	Youssef Tabib (Sr. Engineer), Anthony Grazioso (Material Condition)	
Approver(s)	Michael Moy (UFAM)	

Reason Written

3-year periodic review. Revised to add Criticality II for remote-monitoring enabled rectifiers. The remote monitoring allows for automated reporting of recitifier functionality and only requires a 1 yr minimum frequency for inspection. Re-ordered criticality for formatting clarity (Normal Application is now Criticality I). Revised wording for Criticality III to remove "Nearby Corrosion Interference Equipment" and updated criticality for "bond tie locations in gas/petroluem applications" for 1Y frequency.