



Description	This procedure is designed to check for proper operation of cathodic protection rectifiers.	
Regulatory Applicability	<input checked="" type="checkbox"/> Transmission Pipelines <input checked="" type="checkbox"/> Regulated Gathering Pipelines <input checked="" type="checkbox"/> Distribution Pipelines	
Frequency	Six times per calendar year at intervals not to exceed 2 ½ months. Starting in January 2022 Rectifier inspections can be completed remotely however at least once per calendar year not to exceed fifteen months the rectifier must be physically inspected in person.	
Reference	49 CFR 192.465	<i>External Corrosion Control: Monitoring</i>
Forms / Record Retention	F-192.709 WTG 1200 WTG 1201	<i>Repair Work Order / Life of Pipeline System Rectifier Inspection Form / Life of Pipeline System Interference Bond Data Sheet / Life of Pipeline System</i>
Related Specifications	None	
OQ Covered Task	0101 <i>Inspect Rectifier and Obtain Readings</i> 0111 <i>Maintain Rectifier</i>	
	(In order to perform the tasks listed above; personnel must be qualified in accordance with West Texas Gas's Operator Qualification program or directly supervised by a qualified individual.)	



Procedure Steps

NOTE: Refer to procedure P-192.483 for needed remedial actions. Remedial action must be taken promptly.

Inspect Rectifier

Remote Inspections: Amperage and voltage levels must be reviewed and recorded to ensure proper cathodic protection is being maintained during remote inspection.

Physical Inspections:

Note: No Rectifier should be touched until the case is checked for AC voltage with an approved voltage detection instrument. Rectifier chassis ground operability should be verified.

1. Read volts across rectifier terminals with appropriate voltage meter. Record on Form WTG 1200 or a comparable digital spreadsheet that gathers all pertinent information, or cathodic data gathering software.
2. Read amps utilizing an appropriate multi-meter or amp meter in conjunction with the main rectifier shunt. If amps on panel meter do not agree with amps determined by shunt, adjust the panel meter. If the unit is equipped with a multi circuit negative bond box then all shunts should be read and recorded.
3. Record tap positions, coarse and fine. Also check oil level if applicable.
4. Write a work order (Form F-192.709), if any step above shows rectifier is not working properly.

Adjust Calibrate Rectifier

1. Turn rectifier "off" with external switch or the provided switch/breaker.
2. Increase the fine tap setting in progressive steps. Turn rectifier back "on" after each step, and take pipe-to-soil potential off nearest test station reading again. Continue fine adjustment step-wise until desired pipe-to-soil has been achieved.
3. If the fine tap setting reaches its highest setting and desired pipe-to-soil potential has not yet been achieved, turn rectifier "off" again. Set fine tap to the lowest setting and increase the coarse tap setting by 1. Turn rectifier back "on" and recheck pipe-to-soil pipeline voltage. Repeat step-wise fine tap adjustments per step 2 until desired pipeline voltage is obtained.
4. Record final new tap settings, and voltage and amperage outputs. Read amperage across permanent shunt utilizing a high impedance multimeter. The multimeter setting shall be in the millivolt position. Take reading on millivolt meter, keeping in mind some shunts have correction factors which should be taken into consideration to determine true amperage reading.



Troubleshoot/Repair Rectifier and Bond Connections

1. Complete the following on primary AC breaker:
 - a) With power on, ensure the voltage is being supplied to the rectifier by confirming AC voltage on the line side of the rectifier's circuit breaker.
 - b) With the rectifier's circuit breaker closed, ensure the voltage is being supplied to the rectifier by confirming AC voltage on the load side of the rectifier's circuit breaker.

NOTE: AC voltage should be the same on the supplied and load sides of the circuit breaker.

2. Complete the following on primary AC fuses:
 - a) Remove fuse or fuses.
 - b) Check fuse or fuses for continuity with ohmmeter.
3. Complete the following on Transformer:
 - a) With the unit on, check the transformer secondary by reading AC voltage between the center studs of the tap setting terminals.
 - b) Voltage may be checked between any of the secondary taps.
 - c) The entire secondary winding can be measured between the highest coarse tap and the highest fine tap.
 - d) If the circuit breaker trips, indicating a short circuit, the transformer may be isolated from the DC circuit by removing either coarse or fine adjust link.
 - e) If the circuit breaker continues to trip, look for visible shorts between the transformer leads.
 - f) If the circuit breaker does not trip, the short is not in the transformer, but in the DC circuit.
4. Complete the following on secondary AC fuses:
 - a) Remove secondary AC fuses located in the circuit between the center studs of the tap setting terminals and the bridge connections on the stack.
 - b) Check fuse and fuses for continuity with ohmmeter.

5. Complete the following on Stack:

CAUTION – To check diodes in a stack, turn off at the unit breaker.

- a) Remove either the fine or coarse tap link bar.
- b) Remove either the positive or negative DC output lead.
- c) Connect one ohmmeter lead to either the coarse or fine tap center stud and the other lead to the positive terminal. Reverse the leads and check again.
- d) Move the lead from the positive terminal to the negative terminal. Reverse the leads and check again.
- e) Remove the other lead from whichever tap center stud it is connected to. Place it on the other tap center stud and repeat the checks at the negative and positive output terminals.



- f) Each diode should have a low resistance value in the forward direction and a very high or infinite resistance measured in the reverse direction. If a diode has a low or high resistance in both directions, replace and retest the stack.
6. Complete the following on DC fuses:
 - a) Remove fuse or fuses.
 - b) Replace defective fuse or fuses with proper size fuse.
7. Does rectifier need adjusting?
 - a) No – Continue with step 9.
 - b) Yes – Seek assistance from appropriate personnel for additional investigation and corrective actions before making any adjustments.
8. Examine rectifier for any abnormal defects.
9. Record all required information.

Repair or Replace Defective Rectifier Components

1. Complete the following on primary AC breaker:
 - a) Disconnect wires from supply to breaker.
 - b) Disconnect wires from breaker to rectifier.
 - c) Replace defective breaker with new breaker.
 - d) Connect wires from breaker to rectifier.
 - e) Connect wires from AC supply to breaker.
2. Complete the following on primary AC fuses:
 - a) Remove fuse or fuses.
 - b) Replace defective fuse or fuses with proper size fuse.
3. Complete the following on transformer:
 - a) Disconnect wires from rectifier AC breaker to transformer.
 - b) Disconnect wires from transformer to coarse and fine tap panels.
 - c) Replace defective transformer with new transformer.
 - d) Connect wires from transformer to coarse and fine tap panel.
 - e) Connect wires from transformer to AC rectifier breaker.
4. Complete the following on stack:
 - a) Disconnect wires from fine and coarse tap panel to stack.
 - b) Disconnect wires from stack to positive and negative DC output terminals.
 - c) (If stack is selenium) Remove stack and replace with new stack.



- d) (if stack is silicon) Remove defective diodes and replace with new diodes.
- e) Connect wires from stack to positive and negative DC output terminals.
- f) Connect wires from fine and coarse tap panel to stack.
5. Complete the following on DC fuses:
 - a) Remove fuse or fuses.
 - b) Replace defective fuse or fuses with proper size fuse.
6. Examine rectifier for any abnormal defects.
7. Does rectifier need adjusting?
 - a) NO – Continue with step 8.
 - b) YES – Seek assistance from appropriate personnel for additional investigation and corrective actions before making any adjustments.
8. Record all required information.
9. Complete the following on Bonds:
 - a) Measure the pipe to soil potential at the major bond for both the company pipeline and the foreign structure.
 - b) Measure and record the current flow and direction of the flow through the bond. If no current flow exists, check all circuit connections including but not limited to cable connections (including connections to the structure) and shunt connections.
 - c) All critical bonds shall be read and recorded every 2 months not to exceed 2 1/2 months or 6 times per year on WTG FORM 1201, or a cathodic data gathering software. All noncritical bonds shall be read and recorded annually. Not to exceed 15 months.