

Attachment J-C26.1

High Voltage Electrical Distribution Systems Work

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SOW Item No. C26-02
HV Substation Transformer 5 Year PGM

Follow all NASA safety procedures required for working with high voltage electrical equipment and utilize the "buddy system" for all maintenance operations.

- __1. Request and follow switching and isolation order from power dispatcher.
- __2. Perform power factor test for 6.9kV primary transformers or higher.
- __3. Perform megger test for all transformers.
- __4. Perform transformer turns ratio (TTR) test for all transformers.
- __5. Perform the following oil tests on transformer main tank and oil filled compartments:
 - a) Standard oil screen to include:
 - 1. Dielectric (ASTM D877, D1816)
 - 2. Acid neutralization (ASTM D974)
 - 3. Specific gravity (ASTM 1298)
 - 4. Interfacial tension (ASTM D971 or D2285)
 - 5. Color (ASTM D1500)
 - 6. Visual condition (ASTM D1524)
 - 7. PPM of water (ASTM 1533)
 - b) Dissolved gas analysis (DGA) (ASTM D-3612).
 - c) Dissipation or power factor (ASTM D-924).

Note: report low oil levels for SR to add as needed.

- __6. Clean and report oil leaks.
- __7. Inspect, maintain and clean bushings.
- __8. Inspect and maintain connections in HV and LV compartments. (not required for oil filled compartments).
- __9. Inspect and maintain gauges, record maximum temperature and reset vane.
- __10. Inspect and maintain oil sample valve, lower drain valve, and upper fill valve.
- __11. Inspect and maintain potheads / cable heads, and conduit connections.
- __12. Inspect and maintain heaters and controllers.
- __13. Inspect and maintain pressure relief devices.
- __14. Inspect, maintain and record/verify no-load tap changer position.
- __15. Inspect and maintain transformer grounds.
- __16. Touch up chipped paint and corroded areas with primer and paint.
- __17. Confirm names of transformer and cables with HV and LV one-line diagrams.
- __18. Inspect and maintain anchors of apparatus to pad where applicable.
- __19. Inspect, clean and maintain surge arrestors and associated wiring.
- __20. Verify operation of cooling fans and pumps, lubricate as required.
- __21. Fill out maintenance report/record.

SOW Item No. C26-03
HV Substation Transformer Radiator Cleaning Annual PM

This is for Sub K 138 kV Transformer K5, K6, K7, K8, K9, and K10.

Follow all NASA safety procedures required for working with high voltage electrical equipment and utilize the “buddy system” for all maintenance operations.

- __1. Request and follow switching and isolation order from power dispatcher.
- __2. Record pressure/vacuum reading.
- __3. Record temperature reading.
- __4. Immediately report any repair concerns such as oil leaks, excessive dirt, corrosion, etc. To COTR.
- __5. Touch up chipped paint as required.
- __6. Clean all oil coiling radiators including between fins to remove airborne debris.
- __7. Fill out maintenance report/record.

SOW Item No. C26-04
HV Substation Transformer Oil Sample 2-1/2 Year PT&I

Follow all NASA safety procedures required for working with high voltage electrical equipment and utilize the “buddy system” for all maintenance operations.

- __1. Request and follow switching and isolation order from power dispatcher.
- __2. Perform the following oil tests on transformer main tank and oil filled compartments:
 - a) Standard oil screen to include:
 - 1. Dielectric (ASTM D877, D1816)
 - 2. Acid neutralization (ASTM D974)
 - 3. Specific gravity (ASTM 1298)
 - 4. Interfacial tension (ASTM D971 or D2285)
 - 5. Color (ASTM D1500)
 - 6. Visual condition (ASTM D1524)
 - 7. PPM of water (ASTM 1533)
 - 8. Dissolved gas analysis (GDA) (ASTM D-3612)
 - 9. Dissipation or power factor (ASTM d-924).

Note: report low oil levels for SR to add as needed.

- __3. Inspect and record transformer gauges.
- __4. Verify operation of cooling fans and pumps.
- __5. Confirm names of transformers and cables with HV and LV one-line diagrams.
- __6. Fill out maintenance report/record.

SOW Item No. C26-05
HV 2.4 kV Dry Transformer 5 Year PGM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

- __1. Provide thermography of transformer and P.D.S.
- __2. Request and follow switching and isolation order from power dispatcher observing and recording the operation of the transformer PDS for proper alignment of main and arcing contacts and mechanism movement.
- __3. Clean and vacuum transformer and compartment.
- __4. Inspect and maintain all HV and LV connections.
- __5. Inspect and maintain gauges, record maximum temperature and reset vane.
- __6. Inspect and maintain transformer grounds.
- __7. Touch up chipped paint and corroded areas with primer and paint.
- __8. Clean HV and LV compartments where applicable and only where these compartments are de-energized.
- __9. Perform megger test.
- __10. Perform transformer turns ratio (TTR) test. Inspect and maintain anchors of apparatus.
- __11. Inspect and maintain secondary mains where located within the transformer enclosure or adjacent compartment.
- __12. Confirm names of transformers and cables with HV and LV one-line documents.
- __13. Fill out maintenance report/record.

SOW Item No. C26-06
HV 2.4 kV Dry Transformer 2 1/2 Year PT&I

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

- 1. Provide thermography of transformer and P.D.S.
- 2. Inspect and maintain transformer grounds.
- 3. Inspect and record transformer gauges.
- 4. Confirm names of transformers and cables with HV and LV one-line documents.
- 5. Fill out maintenance report/record.

SOW Item No. C26-07
HV Unit-Sub/Building 2.4 kV Oil Filled Transformer 5 Year PGM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC safety manual.

- __1. Notify power dispatcher of intent to perform PM.
- __2. Perform a standard oil screen to include:
 - a. Dielectric (ASTM D877, D1816)
 - b. Acid neutralization (ASTM D974)
 - c. Specific gravity (ASTM 1298)
 - d. Interfacial tension (ASTM D971 or ASTM D2285)
 - e. Color (ASTM D1500)
 - f. Visual condition (ASTM D1524)
 - g. PPM of water (ASTM 1533 required on 25kV or higher voltages and on all silicone filled unit).
 - h. Dissolved gas analysis (GDA) (ASTM D-3612)
- __3. Visually inspect HV and LV compartments.
- __4. Perform megger test.
- __5. Perform transformer turns ratio (TTR) test.
- __6. Record pressure/vacuum reading.
- __7. Record temperature reading.
- __8. Utilize thermography to check for loose connections or other hot spots.
- __9. Immediately report any repair concerns such as oil leaks, excessive dirt, corrosion, etc. to COTR.
- __10. Touch up chipped paint as required.
- __11. Confirm names of transformer and cables with HV and LV one-line diagrams.
- __12. Fill out maintenance report/record.

SOW Item No. C26-08
HV Unit-Sub/Building 2.4 kV Oil Filled Transformer 2 1/2 Year PT&I

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC safety manual.

- __1. Notify power dispatcher of intent to perform PM.
- __2. Perform a standard oil screen to include:
 - a. Dielectric (ASTM D877, D1816)
 - b. Acid neutralization (ASTM D974)
 - c. Specific gravity (ASTM 1298)
 - d. Interfacial tension (ASTM D971 or ASTM D2285)
 - e. Color (ASTM D1500)
 - f. Visual condition (ASTM D1524)
 - g. PPM of water (ASTM 1533 required on 25kV or higher voltages and on all silicone filled unit).
 - h. Dissolved gas analysis (GDA) (ASTM D-3612)
- __3. Inspect and record transformer gauges.
- __4. Confirm names of transformers and cables with HV and LV one-line documents.
- __5. Fill out maintenance report/record.

SOW Item No. C26-09
HV Oil/SF6 Circuit Breaker Biennial PGM

Follow all NASA safety procedures required for working with high voltage electrical equipment and utilize the “buddy system” for all maintenance operations.

Service each circuit breaker listed above as follows.

- __1. Request and follow switching and isolation order from power dispatcher.
- __2. Record the reading of the operations counter.
- __3. Check electrical and/or mechanical integrity of the circuit breaker control cabinet and operator.
- __4. Clean the circuit breaker control cabinet where applicable.
- __5. Clean, inspect and lubricate the mechanism.
- __6. Confirm names of circuit breakers with HV and LV one-line diagrams.
- __7. Fill out maintenance report/record.

SOW Item No. C26-10
HV Oil/SF6 Circuit Breaker 4 Year PGM

Follow all NASA safety procedures required for working with high voltage electrical equipment and utilize the “buddy system” for all maintenance operations.

NOTE: To be accomplished in conjunction with HV Oil/SF6 Circuit Breaker Biennial Year PGM

Service each circuit breaker listed above as follows:

1. Request and follow switching and isolation order from power dispatcher.
2. Record the reading of the operations counter.
3. Check electrical and/or mechanical integrity of the circuit breaker control cabinet and operator.
4. Clean the circuit breaker control cabinet where applicable.
5. Clean, inspect and lubricate the mechanism.
6. Test oil per specification (ASTM D923), for oil circuit breakers.
7. Clean and wax bushings.
8. Perform time travel analysis for all circuit breakers.
9. Perform a contact resistance test.
10. Complete megger test on each breaker pole following NETA MTS.
11. Confirm names of circuit breakers with HV and LV one-line diagrams.
12. Fill out maintenance report/record.

SOW Item No. C26-11
HV Air/Vacuum Circuit Breaker Biennial PGM

Follow all NASA safety procedures required for working with high voltage electrical equipment and utilize the “buddy system” for all maintenance operations.

Service each circuit breaker listed above as follows.

- __1. Request and follow switching and isolation order from power dispatcher.
- __2. Record the reading of the operations counter.
- __3. Check electrical and/or mechanical integrity of the circuit breaker control cabinet and operator.
- __4. Clean the circuit breaker control cabinet where applicable.
- __5. Clean, inspect and lubricate the mechanism.
- __6. Confirm names of circuit breakers with HV and LV one-line diagrams.
- __7. Fill out maintenance report/record.

SOW Item No. C26-12
HV Air/Vacuum Circuit Breaker 4 Year PGM

Follow all NASA safety procedures required for working with high voltage electrical equipment and utilize the “buddy system” for all maintenance operations.

Note: To be accomplished in conjunction with HV Air/Vacuum Circuit Breaker Biennial PM.

Service each circuit breaker listed above as follows:

- __1. Request and follow switching and isolation order from power dispatcher.
- __2. Record the reading of the operations counter.
- __3. Check electrical and/or mechanical integrity of the circuit breaker control cabinet and operator.
- __4. Clean the circuit breaker control cabinet where applicable.
- __5. Clean, inspect and lubricate the mechanism.
- __6. Test oil per specification (ASTM D923), for oil circuit breakers.
- __7. Clean and wax bushings.
- __8. Perform time travel analysis for all circuit breakers.
- __9. Perform a contact resistance test.
- __10. Complete megger test on each breaker pole following NETA MTS.
- __11. Confirm names of circuit breakers with HV and LV one-line diagrams.
- __12. Fill out maintenance report/record.

SOW Item No. C26-13
HV Substation 138 kV Disconnect Switch 4 Year PGM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC safety manual.

- __1. Request and follow switching and isolation order from power dispatcher.
- __2. Observe performance of the disconnect switch during operation and report any abnormalities.
- __3. Confirm names of disconnect switches with HV and LV one line diagrams.
- __4. Clean, inspect and lubricate the mechanism.
- __5. Check / inspect electrical contacts for wear and alignment (adjust as required).
- __6. Inspect, clean and wax the insulators.
- __7. Lubricate moving components. Caution: Do not use a conductive lubricant on the disconnect switch mechanism.
- __8. Fill out maintenance report/record

SOW Item No. C26-14
HV Substation 34.5 kV Disconnect Switch 4 Year PGM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC safety manual.

- __1. Request and follow switching and isolation order from power dispatcher.
- __2. Observe performance of the disconnect switch during operation and report any abnormalities.
- __3. Confirm names of disconnect switches with HV and LV one line diagrams.
- __4. Clean, inspect and lubricate the mechanism.
- __5. Check / inspect electrical contacts for wear and alignment.(adjust as required)
- __6. Inspect, clean and wax the insulators.
- __7. Lubricate moving components. Caution: Do not use a conductive lubricant on the disconnect switch mechanism.
- __8. Fill out maintenance report/record.

SOW Item No. C26-15
HV Substation 2.4 kV Disconnect Switch 5 Year PGM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC safety manual.

- __1. Request and follow switching and isolation order from power dispatcher.
- __2. Observe performance of the disconnect switch during operation and record findings.
- __3. Clean, inspect and lubricate the mechanism.
- __4. Check / inspect electrical contacts for wear and alignment.
- __5. Inspect and clean the insulators.
- __6. Grease the bearings.
- __7. Confirm names of disconnect switches with HV and LV one line diagrams.
- __8. Fill out maintenance report/record.

SOW Item No. C26-16
HV Substation Battery Quarterly PM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

Hydrogen is liberated from all wet electrolyte type batteries during the charging period. Therefore, adequate ventilation by dilution or mechanical means shall be provided to avoid an explosive mixture. A "No Smoking" sign shall be posted in immediate battery areas. In addition protective equipment shall be worn to prevent contact with battery acid.

- __1. Contact power dispatch before initiating work.
- __2. Perform equalizing charge; after completion take hydrometer readings of all cells and record results.
- __3. Check and record bus voltage.
- __4. Check and record charge and discharge currents.
- __5. Check cell level and add water if necessary.
- __6. Check filler cap vent holes for plugs.
- __7. Inspect electrode plates for color, particles, damage, or swelling.
- __8. Inspect bottom of cell for residue.
- __9. Read and record cell voltages 10-20 minutes after starting equalizing charge.
- __10. Clean off cell tops with a soda solution.
- __11. Check condition of terminals and straps; perform battery impedance test.
- __12. Perform a visual inspection looking for signs of corrosion.
- __13. Perform thermography on all batteries and electrical connections.
- __14. Inspect and recorder charger cabinet settings and condition.
- __15. Note and record all findings.

Fill out maintenance report/record.

SOW Item No. C26-17
HV Substation Battery and Charger Annual PM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

Hydrogen is liberated from all wet electrolyte type batteries during the charging period. Therefore, adequate ventilation by dilution or mechanical means shall be provided to avoid an explosive mixture. A "No Smoking" sign shall be posted in immediate battery areas. In addition protective equipment shall be worn to prevent contact with battery acid.

To be accomplished in conjunction with HV Substation Battery Quarterly PM

1. Contact power dispatch before initiating work.
2. Record charger output voltage.
3. Record charger output current.
4. Wipe and/or blow out dirt and foreign material from charging unit interior (air not more than 25 psi).
5. Perform a visual inspection of the charging unit looking for signs of corrosion.
6. Record electrolyte levels.
7. Visually inspect each cell/unit.
8. Visually inspect each connection.
9. Measure and record ambient temperature within battery room.
10. Measure and record the specific gravity of each cell.
11. Measure and record the voltage of each cell.
12. Measure and record the system voltage.
13. Measure and record the electrolyte temperature of one cell on each end of each rack & row.
14. Record the date of cleaning and inspection.
15. Fill out maintenance report/record.

SOW Item No. C26-18
HV Capacitor Annual PT&I

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

- __1. Request and follow switching and isolation order from power dispatcher.
- __2. Visual inspection
 - a. Cabinets
 - b. Capacitors
 - c. Capacitor bushings and connections
 - d. Bus insulators
 - e. Fuses
 - f. Fans
- __3. Verify operation of cooling fans.
- __4. Record all results/observations.
- __5. Confirm names of HV capacitors with HV and LV one line diagrams.
- __6. Fill out maintenance report/record.

SOW Item No. C26-19
HV Capacitor Triennial PGM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

To be accomplished in conjunction with HV Capacitor Annual PM.

- __1. Tighten connections and clean capacitors.
- __2. For the disconnect switch observe performance during operation; clean, inspect, and lubricate the mechanism; check, inspect electrical contacts for wear and alignment; inspect and clean the insulators; grease the bearings.
- __3. Lubricate cooling fans as required
- __4. Remove failed capacitors.
- __5. Record all results/observations.
- __6. Fill out maintenance report/record. Add to or update electronic database of equipment. This database to be accessible by NASA.

SOW Item No. C26-20**HV System Electro-mechanical Protective Relays Substations Triennial PGM**

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

For each electro-mechanical relay, perform the following:

- __1. Contact power dispatch before initiating work.
- __2. Test relay per manufacturer's specifications.
- __3. Perform inspection of the mechanism. Clean and lubricate as needed.
- __4. Calibrate the relay for proper response.
- __5. Record all settings, findings and conditions associated with the relay, 'as found' and 'as left'. This database to be accessible by NASA.
- __6. Clean and inspect the case, cover glass and gasket.
- __7. Confirm names of system protective relays with HV and LV one line diagrams.
- __8. Fill out maintenance report/record.
- __9. Add to or update electronic database of equipment. This relay database to be fully accessible by NASA. This includes relay type, model number, and setting.

SOW Item No. C26-21
HV System Electro-mechanical Building Protective Relays Triennial PGM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

For each solid state relay, perform the following:

- __1. Contact power dispatch before initiating work.
- __2. Test relay per manufacturer's specifications.
- __3. Calibrate the relay for proper response.
- __4. Record all settings, findings and conditions associated with the relay, 'as found' and 'as left'.
- __5. Confirm names of system protective relays with HV and LV one line diagrams.
- __6. Fill out maintenance report/record.
- __7. Add to or update electronic database of equipment. This relay database to be fully accessible by NASA. This includes relay type, model number, and setting.

SOW Item No. C26-22
HV System Solid State Protective Relays Substations (Verification) Triennial
PGM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

For each solid state relay, perform the following:

- __1. Contact power dispatch before initiating work.
- __2. Verify relay settings.
- __3. Record all settings, findings and conditions associated with the relay, 'as found' and 'as left'.
- __4. Confirm names of system protective relays with HV and LV one line diagrams.
- __5. Fill out maintenance report/record.
- __6. Add to or update electronic database of equipment. This relay database to be fully accessible by NASA. This includes relay type, model number, and setting.

SOW Item No. C26-23
HV System Solid State Protective Relays Substations (Calibration) 6 Year
PGM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

For each solid-state relay, perform the following:

- __1. Contact power dispatch before initiating work.
- __2. Test relay per manufacturer's specifications.
- __3. Calibrate the relay for proper response.
- __4. Record all settings, findings and conditions associated with the relay, 'as found' and 'as left'.
- __5. Confirm names of system protective relays with HV and LV one line diagrams.
- __6. Fill out maintenance report/record.
- __7. Add to or update electronic database of equipment. by NASA. This relay database to be fully accessible by NASA. This includes relay type, model number, and setting.

SOW Item No. C26-24
HV System Solid State Protective Relays Building (Verification) Triennial
PGM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

For each solid-state, perform the following:

- __1. Contact power dispatch before initiating work.
- __2. Verify relay settings.
- __3. Record all settings, findings and conditions associated with the relay, 'as found' and 'as left'.
- __4. Confirm names of system protective relays with HV and LV one line diagrams.
- __5. Fill out maintenance report/record.
- __6. Add to or update electronic database of equipment. This relay database to be fully accessible by NASA. This includes relay type, model number, and setting.

SOW Item No. C26-25**HV System Solid State Protective Relays Building (Calibration) 6 Year PGM**

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

For each solid-state, perform the following:

- __1. Contact power dispatch before initiating work.
- __2. Test relay per manufacturer's specifications.
- __3. Calibrate the relay for proper response.
- __4. Record all settings, findings and conditions associated with the relay, 'as found' and 'as left'.
- __5. Confirm names of system protective relays with HV and LV one line diagrams.
- __6. Fill out maintenance report/record.
- __7. Add to or update electronic database of equipment. This relay database to be fully accessible by NASA. This includes relay type, model number, and setting.

SOW Item No. C26-26
HV Sectionalizing Box Annual PM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

Note: To be accomplished in conjunction with HV Systems Manholes with Sectionalizing Boxes Annual PT&I.

- __1. Call power dispatch before initiating work.
- __2. Check and record N2 pressure.
- __3. Charge sectionalizing box with gaseous nitrogen, where applicable.
- __4. Check for N2 leaks.
- __5. Perform general visual inspection of unit.
- __6. Fill out maintenance report/record.

SOW Item No. C26-27
HV Substation Quarterly PT&I

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

- __1. Contact power dispatch before initiating work.
- __2. Perform a visual inspection of the substation equipment (transformers, breakers, disconnects, buss, reactors, etc.). Noting any discrepancies and logging the discrepancies on the maintenance action form for review and further action. (Utilize binoculars for insulator/bushing inspection.)
- __3. Fill out maintenance report/record.

SOW Item No. C26-28
HV Substation Annual PM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

- __1. Contact power dispatch before initiating work.
- __2. Perform a visual inspection of the substation equipment (transformers, breakers, disconnects, buss, reactors, etc.) Noting any discrepancies and logging the discrepancies on the maintenance action form for review and further action. (Utilize binoculars for insulator/bushing inspection.)
- __3. Use the ultrasonic/corona leak detector for nitrogen leaks where applicable and corona throughout the yard.
- __4. Perform infra-red thermography inspection and record results.
- __5. Fill out maintenance report/record.

SOW Item No. C26-29
HV System Manholes With Sectionalizing Boxes Annual PM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

- 1. Call power dispatch before initiating work.
- 2. Make a visual assessment of the manhole cleanliness and drainage.
- 3. Make a visual inspection of cable conditions.
- 4. Make a visual inspection of cable supports.
- 5. Note any discrepancies on the maintenance action form for further review and action.
- 6. Fill out maintenance report/record

SOW Item No. C26-30
HV System Manholes Without Sectionalizing Boxes Triennial PM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

- 1. Call power dispatch before initiating work.
- 2. Make a visual assessment of the manhole cleanliness and drainage.
- 3. Make a visual inspection of cable conditions.
- 4. Make a visual inspection of cable supports.
- 5. Note any discrepancies on the maintenance action form for further review and action.
- 6. Fill out maintenance report/record.

SOW Item No. C26-31
HV Regulator Oil Sample 2 1/2 Year PT&I

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

To be accomplished in conjunction with HV Substation Transformer Oil Sample 2 1/2 Year PT&I (where applicable).

- __1. Contact power dispatch before initiating work.
- __2. Perform inspection:
Check for problems such as leaking oil. If any of the above are noted they should be scheduled for repair as soon as practical.
- __3. Observe operation:
Operation of the voltage regulators should be observed by checking the operations counter and reading the voltage levels at various locations along the circuit beyond the regulator.
- __4. Perform a standard oil screen to include:
 - a. Dielectric (ASTM D877, D1816)
 - b. Acid neutralization (ASTM D974)
 - c. Specific gravity (ASTM 1298)
 - d. Interfacial tension (ASTM D971 or D2285)
 - e. Color (ASTM D1500)
 - f. Visual condition (ASTM D1524)
 - g. PPM of water (ASTM 1533)
 - h. Dissolved gas analysis (GDA) (ASTM D-3612)
 - i. Dissipation or power factor (ASTM d-924).
- __5. Confirm names of HV regulators with HV and LV one line diagrams.
- __6. Fill out maintenance report/record.

SOW Item No. C26-32
HV Regulator 5 Year PGM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

To be accomplished in conjunction with HV Substation Transformer 5 year PGM (where applicable).

- __1. Contact power dispatch before initiating work.
- __2. Perform inspection:
Check for problems such as leaking oil, damaged insulators, and loose connections. If any of the above are noted they should be scheduled for repair as soon as practical.
- __3. Perform megger.
- __4. Observe operation:
Operation of the voltage regulators should be observed by checking the operations counter and reading the voltage levels at various locations along the circuit beyond the regulator.
- __5. Record all voltage settings and voltage deviations for entry into the maintenance history file.
- __6. Perform a standard oil screen to include:
 - a. Dielectric (ASTM D877, D1816)
 - b. Acid neutralization (ASTM D974)
 - c. Specific gravity (ASTM 1298)
 - d. Interfacial tension (ASTM D971 or D2285)
 - e. Color (ASTM D1500)
 - f. Visual condition (ASTM D1524)
 - g. PPM of water (ASTM 1533)
 - h. Dissolved gas analysis (GDA) (ASTM D-3612)
 - i. Dissipation or power factor (ASTM d-924).
- __7. Confirm names of HV regulators with HV and LV one line diagrams.
- __8. Fill out maintenance report/record.

SOW Item No. C26-33
HV Load Tap Changers 2 1/2 Year PT&I

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

To be accomplished in conjunction with HV substation transformer oil sample 2 1/2 year PT&I (where applicable).

- __1. Contact power dispatch before initiating work.
- __2. Check for problems such as leaking oil. If any of the above are noted they should be scheduled for repair as soon as practical.
- __3. Observe operation:
operation of the LTC should be observed by checking the operations counter and reading the voltage levels at various locations along the circuit beyond the LTC.
- __4. Perform the following oil tests on transformer LTC tank and oil filled compartment:
 - a. Dielectric (ASTM D877, D1816)
 - b. Acid neutralization (ASTM D974)
 - c. Specific gravity (ASTM 1298)
 - d. Interfacial tension (ASTM D971 or D2285)
 - e. Color (ASTM D1500)
 - f. Visual condition (ASTM D1524)
 - g. PPM of water (ASTM 1533)
 - h. Dissolved gas analysis (GDA) (ASTM D-3612)
 - i. Dissipation or power factor (ASTM d-924).

Note: report low oil levels for SR to add as needed.

- __5. Confirm names of HV regulators with HV and LV one line diagrams.
- __6. Fill out maintenance report/record.

SOW Item No. C26-34
HV Load Tap Changers 5 Year PGM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

To be accomplished in conjunction with HV Substation Transformer 5 Year PGM (where applicable).

- __1. Contact power dispatch before initiating work.
- __2. Perform the following oil tests on transformer LTC tank and oil filled compartment:
 - a. Dielectric (ASTM D877, D1816)
 - b. Acid neutralization (ASTM D974)
 - c. Specific gravity (ASTM 1298)
 - d. Interfacial tension (ASTM D971 or D2285)
 - e. Color (ASTM D1500)
 - f. Visual condition (ASTM D1524)
 - g. PPM of water (ASTM 1533)
 - h. Dissolved gas analysis (GDA) (ASTM D-3612)
 - i. Dissipation or power factor (ASTM d-924).

Note: report low oil levels for SR to add as needed.

- __3. Perform megger.
- __4. Lubricate tap changer motor bearings (if required).
- __5. Reshape/re-smooth contacts of voltage regulating relays if pitted or worn (never lubricate).
- __6. Examine motor operating and auxiliary relays for dirty or burned contacts - clean and adjust as needed.
- __7. Adjust motor and brake as required
- __8. Inspect both stationary and moval contacts for burning and inspect hardware for tightness (note: slight blackening is normal – do not file to clean).
- __9. Check that relay armatures and interlock arms operate freely.
- __10. Inspect gaskets.
- __11. Check all bolted connections for tightness.
- __12. Perform TTR of LTC at all taps.
- __13. Observe operation of the load tap changers by checking the operations counter and reading the voltage levels at various locations along the circuit beyond the tap changer.
- __14. Fill out maintenance report/record.

SOW Item No. C26-35
HV Arrestors/Insulators 10 Year PGM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

- 1. Contact power dispatch before initiating work.
- 2. Clean the porcelain surfaces of the arrestors and insulators to remove contamination.
- 3. Confirm names of equipment with HV and LV one line diagrams.
- 4. Fill out maintenance report/record

SOW Item No. C26-36
HV Grounding Transformers 5 Year PGM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

- __1. Request and follow switching and isolation order from power dispatcher.
- __2. Visual inspection
 - a. Grounding
 - b. Bushings
 - c. Insulators
- __3. Perform the following oil tests on transformer LTC tank and oil filled compartment:
 - a. Dielectric (ASTM D877, D1816)
 - b. Acid neutralization (ASTM D974)
 - c. Specific gravity (ASTM 1298)
 - d. Interfacial tension (ASTM D971 or D2285)
 - e. Color (ASTM D1500)
 - f. Visual condition (ASTM D1524)
 - g. PPM of water (ASTM 1533)
 - h. Dissolved gas analysis (GDA) (ASTM D-3612)
 - i. Dissipation or power factor (ASTM D-924).

Note: Report low oil levels for SR to add as needed.

- __4. Check all connections for tightness
- __5. Clean bushings
- __6. Meggar grounding Xfmr (with resistor disconnected). 10 minute test
- __7. Record all results/observations.
- __8. Confirm names of equipment with HV and LV one line diagrams.
- __9. Fill out maintenance report/record.

SOW Item No. C26-37
HV Grounding Transformers Oil Sample 2 1/2 Year PT&I

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

- __1. Request and follow switching and isolation order from power dispatcher.
- __2. Visual inspection
 - a. Grounding xfmr
 - b. Grounding resistor
 - c. Bushings
 - d. Insulators
- __3. Perform the following oil tests on transformer LTC tank and oil filled compartment:
 - a. Dielectric (ASTM D877, D1816)
 - b. Acid neutralization (ASTM D974)
 - c. Specific gravity (ASTM 1298)
 - d. Interfacial tension (ASTM D971 or D2285)
 - e. Color (ASTM D1500)
 - f. Visual condition (ASTM D1524)
 - g. PPM of water (ASTM 1533)
 - h. Dissolved gas analysis (GDA) (ASTM D-3612)
 - i. Dissipation or power factor (ASTM D-924).

Note: report low oil levels for SR to add as needed.

- __4. Record all results/observations.
- __5. Confirm names of equipment with HV and LV one line diagrams.
- __6. Fill out maintenance report/record.

SOW Item No. C26-38
HV Grounding Resistors 5 Year PGM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

Coordinate with C26-36 HV Grounding Transformers as applicable.

- __1. Request and follow switching and isolation order from power dispatcher.
- __2. Visual inspection.
 - a. Grounding resistor.
 - b. Resistor electrical connections.
- __3. Check all connections for tightness.
- __4. Clean resistor.
- __5. Check resistance of grounding resistor and compare to nameplate.
- __6. Record all results/observations.
- __7. Confirm names of equipment with HV and LV one line diagrams.
- __8. Fill out maintenance report/record.

SOW Item No. C26-39
HV Emergency Eyewash Station Semi-Annual PM

For all maintenance operations follow the safety procedures required for working with high voltage electrical equipment as identified and referenced in the latest edition of the GRC Safety manual.

- __1. Visually inspect unit for leaks.
- __2. Visually inspect nozzle for cracks, damage or corrosion. Replace if necessary.
- __3. Visually inspect black strap for cracks, damage or corrosion. Replace if necessary.
- __4. Pull nozzle strap to activate unit and drain all fluid.
- __5. Rinse out old saline solution with clean water.
- __6. Fill with water and saline solution per manufacturer.
- __7. Fill out maintenance report/record and inspection tag.