

1 Q. Please provide electronic documents describing terminal station equipment and  
2 relay inspection, testing, and maintenance programs and practices. These  
3 documents should describe the activities to be conducted by equipment type, the  
4 time period between time-based activities, and what triggers condition-based  
5 activities.

6

7

8 A. The documents describing terminal station equipment and relay inspections,  
9 testing, and maintenance programs and practices and the description of the  
10 activities to be conducted by equipment type and the time period between time-  
11 based activities are contained in the attachments to PUB-NLH-082. These  
12 documents refer to the following equipment categories:

- 13 • Air Systems (See PUB-NLH-082 Attachment 1);
- 14 • Battery Banks (See PUB-NLH-082 Attachment 2);
- 15 • Terminal Station, Building & Grounds (See PUB-NLH-082 Attachment 3);
- 16 • Capacitor Banks (See PUB-NLH-082 Attachment 4);
- 17 • Circuit Breakers (See PUB-NLH-082 Attachment 5);
- 18 • Circuit Switchers (See PUB-NLH-082 Attachment 6);
- 19 • Disconnect Switches (See PUB-NLH-082 Attachment 7);
- 20 • Power Transformers and Shunt Reactors (See PUB-NLH-082 Attachment 8);
- 21 • Current Transformers and Potential Transformers (See PUB-NLH-082  
22 Attachment 9); and
- 23 • Protection and Control (See PUB-NLH-082 Attachment 10).

24

25 The above is the basis for the terminal station preventative maintenance (PM)  
26 program. The PM activities are completed by tradespersons who provide the first  
27 level of review and identify deficiencies. A second level review is then completed

1 by the Supervisor and a follow-up review is completed at a point in the future by an  
2 Asset Specialist. Each review level can trigger immediate or future work.

3  
4 Other activities that trigger condition inspections are:

- 5 • Equipment malfunctions that require inspection/test prior to restoring to  
6 service. Examples include: abnormal operation of a breaker, operation of a  
7 protection circuit, or an alarm or trip on a power transformer;
- 8 • Project work that requires inspection/test prior to restoring to service. Some  
9 examples include: overhaul work performed on tap changers, refurbishment  
10 work performed on transformers such as bushing replacements, and  
11 overhaul work performed on breakers; and
- 12 • New equipment installations will require inspection/test prior to placing the  
13 equipment into service to confirm the asset's condition, as well as form the  
14 baseline for future maintenance.

15  
16 Below is also a summary of other condition based activities completed on Terminal  
17 Station assets and the triggers that initiate action.

#### 18 19 **Dissolved Gas Analysis**

20 Oil samples are obtained from power transformers on a regular interval and are a  
21 form of transformer condition monitoring. Free-breathing transformers are  
22 sampled at least annually and sealed transformers are sampled at least every six  
23 years during their PM. A transformer is sampled more often if results indicate an  
24 abnormal gas generation rate.



**Oil Quality Analysis**

Oil quality data is obtained from oil samples and is used to determine if oil reclamation will be performed on power transformers. This is a form of oil maintenance which improves the quality of the oil to like-new condition. Hydro has a condition assessment ranking tool which scores transformers based on oil quality and system criticality. Transformers are selected for oil reclamation utilizing this ranking.

**Furan Analysis**

Furan analysis, which is performed on oil samples obtained via regular oil sampling, is a form of transformer condition monitoring. Furan analysis is an indirect non-destructive method for determining the mechanical strength of a transformer's paper insulation and yields data on the brittleness of the cellulose insulating paper inside the transformer. This level of brittleness, known as the Degree of Polymerization (DP), expresses an oil testing result as a whole number which can range from 200 to 1,000. If the DP level is less than 200, the paper is considered very brittle and is an indication that the transformer is at the end of its service life. Hydro is using a DP number of 400 as the baseline target for end of life with transformers, since this baseline gives a suitable lead time to procure a replacement transformer. Furan analysis is performed every four years on transformers whose DP is >649 and annually on transformers whose DP is <649.

**Radiator Condition Assessment**

Hydro has a condition assessment tool which scores transformer radiators based on their condition which is assessed via a detailed visual inspection by an Asset Specialist. Most were assessed in 2006 with the remainder either assessed in 2013 or planned for assessment in 2014. Those assessed in 2006 are planned for

1 reassessment in 2014. Transformers are selected from amongst the worst scored  
2 transformers for radiator replacement.

#### 4 **On-Load Tap Changer Condition Assessment**

5 Condition monitoring performed on power transformer on load tap changers  
6 (OLTCs) consists of oil sampling. An oil sample is taken from an OLTC every four  
7 years except those whose condition (as indicated by oil sampling) warrants bi-  
8 annual sampling. The oil samples are analyzed by a certified lab using a proprietary  
9 analysis technique which considers gas levels, oil quality, and solid particle counts.  
10 The analysis result is a condition score between one and four with four being the  
11 worst. On load tap changers that score three or higher are planned for overhaul  
12 and are sampled twice annually until overhauled.

# Air Systems

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**COMPRESSOR / DRYER / AIR SYSTEM MAINTENANCE PROCEDURES**

**Page 1 of 3**

**INSPECTION (Bi-Monthly)**

**1 Compressor/ Air Receiver:**

- 0.1 Check crank case oil level. Add oil as required and record do not overfill.  
*Note: Excessive oil consumption is indicative of developing trouble.*
- 0.2 Record running hours.
- 0.3 Check proper function of pneumatic reducing valves by observing a whisper of air discharge from the pilot air dome control. Observe normal air output pressure.
- 0.4 Check belt drives for tension, where applicable.
- 0.5 Function test compressor automatic control circuit. Discharge system to permit both compressors to cut in. Record running time of each compressor.
- 0.6 Observe proper function of automatic unloaders, the closing operation during start up and air discharge on stopping.
- 0.7 Clean unloaders.
- 0.8 Note any abnormal noises or vibrations.
- 0.9 Check and record motor amps during operation.
- 0.5 Clean up oil and dirt spills.
- 0.6 Check condition of intake /outlet filters.

**2 Dryer- Bowser ( ONLY )**

- 0.1 Check gauges for indication of air leaks between the towers.
- 0.2 Check blower motor , belt, change over limit switches and tower heater function.
- 0.3 Lubricate four way valve.
- 0.4 Check oil level in Norgren regulator, replenish if required.
- 0.5 Function test for proper dryer operation cycle.

**COMPRESSOR /DRYER /AIR SYSTEM MAINTENANCE PROCEDURES**

**Page 2 of 3**

0.6 Record running amperage for blower motor and heater.

**3 DRYER- OTHER MANUFACTURES**

0.1 Check purge pressure and line pressure.

0.2 Check pressure drop across the pre-filter. Should not be more than 5 psig. (35 kpa).

0.3 Function test dryer operation cycle.

0.4 Complete system dew point Test. Should be -45 C

0.5 Complete Bi Monthly Inspection Form.

**ANNUAL INSPECTION**

1. Complete inspection and checks listed on the Annual Compressor/Dryer/air system Inspection (form).

2. Replace all filters on the compressors and dryer system.

3. Drain and replace compressor oil.

4. Function test pressure switches.

5. Inspect all motor contractors and wiring.

6. Complete a condition running test on each compressor.

***Method:*** With only one compressor on line, and in lead position, drain air from air receiver until automatic cut-in occurs. Record the time it takes to bring the system up to normal pressure /shutdown. Repeat the identical test with the second compressor. Record results.

7. Check motor bearings for over heating and roughness when running. Lubricate when required.

8. Complete Annual Compressor/Dryer Form.

9. Breakers with Compressors Complete [ Breakers C/W Compressor Form ]

**COMPRESSOR / DRYER / AIR SYSTEM MAINTENANCE PROCEDURES**

**Page 3 of 3**

10. Clean Condensate Drain Valve on Air Dryer

**COMPRESSOR OVERHAULS**

The frequency and extent of compressor overhauls will be determined from experience with each compressor system.

**Factors that may indicate that an overhaul is required are:**

1. Excessive oil consumption.
2. Change in inter-stage pressure/back pressure.
3. Excessive time to bring system up to pressure.
4. Oil leaks.
5. Broken valve spring/overheating.
6. Excessive noise, vibration, etc.

## Bi-Monthly - COMPRESSOR/DRYER/AIR SYSTEM INSPECTION

Station: \_\_\_\_\_

Date: \_\_\_\_\_

Readings By: \_\_\_\_\_

Caution: Before inspection and maintenance provide the proper **Isolation** and **Permit**.

**DEW POINT TEMPERATURE**

DEW POINT TEMPERATURE: \_\_\_\_\_ °C @ TEST PRESSURE: \_\_\_\_\_ KPA

DEW POINT TEMPERATURE: \_\_\_\_\_ °C @ OPERATING PRESSURE: \_\_\_\_\_ KPA

	Comp. No. 1/A	Comp. No.2/B	
Base Oil Level			
Oil Added			
Oil Changed ( If Required )			
Un-loader Cleaned & Tested			
Moisture Discharger			
Operating Position (Lead / Lag)			
Cut In KPA			
Cut Out KPA			
Motor (amps)			
Running Time (min) (Cut in to Cut out)			
Compressor Running hrs			

**FUNCTION TEST SYSTEM:**

Dryer Heater (amps): A \_\_\_\_\_

B \_\_\_\_\_

C \_\_\_\_\_

Dryer Counter: \_\_\_\_\_

High Side: High Pressure Alarm: \_\_\_\_\_

Low Pressure Alarm: \_\_\_\_\_

Low Side: High Pressure Alarm: \_\_\_\_\_

Low Pressure Alarm: \_\_\_\_\_

Differential Pressure: \_\_\_\_\_

15 min Pressure Drop: \_\_\_\_\_

System Pressure: High Side: \_\_\_\_\_

Low Side: \_\_\_\_\_

**CHECKS COMPLETED:**

\_\_\_ Check guards/couplers

\_\_\_ Check oil relief valves, check valves, and press. gauges

\_\_\_ Check flex connections

\_\_\_ Check for oil &amp; air leaks in the system

\_\_\_ Check limit and flow switches operation

\_\_\_ Check dryer heater &amp; failure alarm

\_\_\_ Check thermostats &amp; all electrical controls

\_\_\_ Check condition of intake/outlet filters

## Bi-Monthly - COMPRESSOR/DRYER/AIR SYSTEM INSPECTION

Station: \_\_\_\_\_

Date: \_\_\_\_\_

Readings By: \_\_\_\_\_

☐ Check Blower oil, fan, & belt☐ Check Water/Oil Separator☐ Heat Tracing Working (Where applicable)☐ Report any Oil Leaks as per EERP  
(Environmental Emergency Response Plan)☐ Check Belt Drives for tension and wear

Note Any Concerns Below:

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ANNUAL BREAKERS WITH COMPRESSOR/DRYER/AIR SYSTEM INSPECTION

Equipment ID: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_

Station: \_\_\_\_\_  
Date: \_\_\_\_\_

JDE W/O # : \_\_\_\_\_  
Readings By: \_\_\_\_\_

DEW POINT TEPERATURE

( Breakers with Dryers Only )

DEW POINT TEMPERATURE: \_\_\_\_\_ °C @ TEST PRESSURE: \_\_\_\_\_ KPA

DEW POINT TEMPERATURE: \_\_\_\_\_ °C @ OPERATING PRESSURE: \_\_\_\_\_ KPA

COMPRESSOR/DRYER

COMPRESSOR HOURS:	HOURS
CUT IN:	KPA
CUT OUT:	KPA
( RUN TIME ) CUT IN / CUT OUT:	MINUTES
LOW PRESSURE ALARM:	KPA
MOTOR AMPS:	AMPS
CONTROL CABINET HEATERS:	AMPS
COMPRESSOR CABINET HEATER (If Applicable)	AMPS
CHANGE BASE OIL:	
REPLACE DESSICANT: ( Dryers Only )	
<b>CHECKS COMPLETED</b>	<b>CHECKED OK</b>
LOW POINT DRAINED:	
AIR FILTERS: ( CLEAN/REPLACE IF REQUIRED )	
CHECK V BELT: ( REPLACE IF REQUIRED )	
CHECK BKEAKER	
.INTERCONNECTING HOSES:	
CHECK CONTROL WIRING:	

COMMENTS:

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## ANNUAL - COMPRESSOR/DRYER/AIR SYSTEM

Equipment ID: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_Station: \_\_\_\_\_  
Date: \_\_\_\_\_JDE W/O #: \_\_\_\_\_  
Readings By: \_\_\_\_\_**NOTE: All TESTS MUST BE COMPLETED OR MARKED N/A (Unless Otherwise Instructed).****DEW POINT TEMPERATURE**

DEW POINT TEMPERATURE: \_\_\_\_\_ °C @ TEST PRESSURE: \_\_\_\_\_ KPA

DEW POINT TEMPERATURE: \_\_\_\_\_ °C @ OPERATING PRESSURE: \_\_\_\_\_ KPA

**NOTE: 1 BDETS. Do not have Compressors or a Dryer in the TS Air System.****NOTE: 2 CATTS. Do not have a Dryer in the TS Air System.****CAUTION:** Before inspection and maintenance provide the proper **Isolation** and **Permit**.

	COMP. #1	COMP. #2	DRYER
Hour Meter			
Replaced Pre-Filter			
Replaced After-Filter			
Clean Condensate Drain			
Change Desiccant			
Change Base Oil			
Condensate Drain Working			
Oil Level Alarm			
Start Failure			

**FUNCTION TEST SYSTEM:**

Compressor #1 (amps): A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_  
 Compressor #2 (amps): A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_  
 Dryer Heater (amps): A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_

Lead Comp. #1: Cut In \_\_\_\_\_ kpa Cut Out \_\_\_\_\_ kpa Running Time \_\_\_\_\_ min  
 Lead Comp. #2: Cut In \_\_\_\_\_ kpa Cut Out \_\_\_\_\_ kpa Running Time \_\_\_\_\_ min  
 Lag Comp.: Cut In \_\_\_\_\_ kpa Cut Out \_\_\_\_\_ kpa Running Time \_\_\_\_\_ min

High Side: High Pressure Alarm: \_\_\_\_\_ kpa

Low Pressure Alarm: \_\_\_\_\_ kpa

ANNUAL - COMPRESSOR/DRYER/AIR SYSTEM

Equipment ID: \_\_\_\_\_ Station: \_\_\_\_\_ JDE W/O #: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_ Date: \_\_\_\_\_ Readings By: \_\_\_\_\_

Low Side: High Pressure Alarm: \_\_\_\_\_ kpa Low Pressure Alarm: \_\_\_\_\_ kpa  
Differential Pressure: \_\_\_\_\_ kpa 15 min Pressure Drop: \_\_\_\_\_ kpa

**CHECKS COMPLETED:**

- |   |  |
|---|--|
| <input type="checkbox"/> Check/clean outlet and purge check valve assemblies        | <input type="checkbox"/> Check/clean the re-pressurization valve           |
| <input type="checkbox"/> Check/clean inlet & purge exhaust switching valves         | <input type="checkbox"/> Check limit switches, and flow switches operation |
| <input type="checkbox"/> Check oil relief valves, check valves, and pressure gauges | <input type="checkbox"/> Check belt drives for tension and wear            |
| <input type="checkbox"/> Check hold down bolts                                      | <input type="checkbox"/> Check all motor contactors, wiring, and bearings  |
| <input type="checkbox"/> Check for oil & air leaks in the system                    | <input type="checkbox"/> Check dryer failure alarm                         |
| <input type="checkbox"/> Check guards/couplers                                      | <input type="checkbox"/> Check thermostats & all electrical controls       |
| <input type="checkbox"/> Check flex connections                                     | <input type="checkbox"/> Heat Tracing Working (where applicable)           |
| <input type="checkbox"/> Clean condensate drain valve on air dryer                  |  |

**COMMENTS:**

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# Battery Banks

**BATTERY BANK MAINTENANCE PROCEDURE**

Page 1 of 2

**GENERAL INSPECTION (4 MONTH)**

- 1 Observe D.C. voltage by means of station voltmeter or the meter on the charger. The correct range of readings should be marked on the meter so that any variation from normal is visible. A reading outside normal range should be investigated and reported.
- 2 Observe charger ammeter reading. The normal current drain on the battery should be marked on the meter. If the reading is below the mark, the cause should be investigated and reported.
- 3 Check that the charger ammeter reading indicated that the battery current drain is normal.
- 4 Record the D.C. system voltage.
- 5 (VRLA) Measure voltage of pilot cell. Record on appropriate form.
- 6 (Flooded Cell) Measure specific gravity & voltage of pilot cell. Record on appropriate form.
- 7 (Flooded Cells) Check the electrolyte levels during a walk around inspection of the battery. Note that water must be added if lower limit is reached and at that time all cells should be filled to upper limit and given an equalize charge.
- 8 Function test 125V D.C. emergency lighting. Where applicable function test 6 and 12 volt emergency lighting and check battery condition.

**ANNUAL INSPECTION**

- 9 Check that the D.C. voltage is within the normal range marked on the voltmeter.
- 10 Check that the charger ammeter reading indicated that the battery current drain is normal.
- 11 For Cordex Rectifiers: Remove rectifier and clean internally
- 12 Record the D.C. system voltage.
- 13 Check and record with the use of the Midtronics Battery testing Equipment. The voltage, Conductance) MHOS and Temperature of each Cell.
- 14 Check and record the conductance MOHS of the Inter- Cell Connecting Straps.

**BATTERY BANK MAINTENANCE PROCEDURE**

Page 2 of 2

**Batteries Flooded Cells Annual Inspection Form**

- 15 Measure and record the voltage and specific gravity of the pilot cell.
- 16 Add water as required to bring levels in all cells to upper limits.
- 17 Determine the Pilot Cell by lowest specific gravity.
- 18 **REQUIRED IF WATER IS ADDED:**
  - (a) Apply an equalize charge for 24 hours at 2.33 volts per cell or at a lower voltage for locations having electronic or other voltage sensitive load that must not be subjected to the full equalize charge.
  - (b) To determine if the equalize charge has been maintained for a long enough period, a reading of specific gravity of all cells should be taken some time after gassing has stopped. (ie. Not less than one hour after an equalize charge is terminated or it can be delayed until next visit.) These readings should be taken under stable conditions so they are comparable. Use appropriate form to record specific gravities.
  - (c) If the equalize charge does not return the specific gravity of the pilot cell to "normal", continue the equalize charge for another 24 hour period.
- 19 Check each Cell for Cracks, Corrosion on Terminals and Leaks (Report any Leaks as per EERP Environmental Emergency Response Plan). Inspect the plates for deterioration, buckling, etc.
- 20 Wipe down cells if required.
- 21 Complete appropriate Inspection Forms.

**Batteries VRLA Annual Inspection Form**

- 22 Check each Cell for Cracks, Corrosion on Terminals and Leaks (Report any Leaks as per EERP Environmental Emergency Response Plan). Inspect the plates for deterioration, buckling, etc.
- 23 Measure and record the voltage of the pilot cell.
- 24 Complete Equalize Charge only if Required (Check Manufacture Battery Guide Line s).
- 25 Determine the Pilot Cell by lowest voltage.
- 26 Complete appropriate Inspection Forms.



120 DAY - FLOODED (VENTED) BATTERY AND CHARGER INSPECTION

Station: \_\_\_\_\_ Manufacture Batteries: \_\_\_\_\_ Manufacture Charger: \_\_\_\_\_  
Date: \_\_\_\_\_ Readings By: \_\_\_\_\_

BATTERY CHARGER # 1 _____ or # 2 _____		
DC Voltage Output:	Found	Left
DC Amperage Output:	Found	Left
Position Found:	Float	Equalize
Position Left	Float	Equalize

FLOODED ( VENTED ) BATTERY CELLS		
Room or Cabinet Temperature °C		Cabinet Heater ( If Applicable ) On _____ Off _____
Battery Bank Voltage ( Disconnected ) _____ DC		
Pilot Cell:	#	Voltage DC Specific Gravity Temperature
Water Added Yes _____ No _____		Equalize Charge Yes _____ No _____

**Note: Specific Gravity Should be maintained between 1200 & 1220.**

Battery Bank Electrolyte Level: ( Found )	Normal _____ Low _____ Very Low _____
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EQUALIZING CHARGE		
Why given:		
Voltage:	Amps:	Duration: hrs

Notes:

-Equalize charge is required after any distilled water is added

CHECKS COMPLETED:

- \_\_\_\_\_ Check the Accuracy of the Charger Voltage Meter against another Meter.
- \_\_\_\_\_ Check each Cell for Cracks, Corrosion on Terminals, Leaks (Report any Leaks as per EERP ).  
(Environmental Emergency Response Plan)
- \_\_\_\_\_ Inspect the Battery Rack for Signs of Corrosion & Battery Leakage.
- \_\_\_\_\_ Check Cells for Deposits on the Bottom
- \_\_\_\_\_ Check the Operation of Ventilation Fans and Thermostat.

Note Any Concerns Below:

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120 DAY - VRLA BATTERY AND CHARGER INSPECTION

Station: \_\_\_\_\_ Manufacture Batteries: \_\_\_\_\_ Manufacture Charger: \_\_\_\_\_  
Date: \_\_\_\_\_ Readings By: \_\_\_\_\_

BATTERY CHARGER # 1 \_\_\_\_\_ or # 2 \_\_\_\_\_

DC Voltage Output:	Found	Left
DC Amperage Output:	Found	Left

VRLA BATTERY CELLS

Room or Cabinet Temperature °C	Cabinet Heater ( If Applicable ) On _____ Off _____
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Battery Bank Voltage ( Charger Off ) \_\_\_\_\_ DC

Pilot Cell:	#	Voltage	DC	Temperature °C
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CHECKS COMPLETED:

- \_\_\_\_\_ Check the Accuracy of the Charger Voltage Meter against another Meter.
- \_\_\_\_\_ Check each Cell for Cracks, Corrosion on Terminals, Leaks ( Report any Leaks as per EERP ).  
(Environmental Emergency Response Plan)
- \_\_\_\_\_ Inspect the Battery Rack for Signs of Corrosion & Battery Leakage.
- \_\_\_\_\_ Check the Operation of Ventilation Fans and Thermostat.
- \_\_\_\_\_ Complete Equalize Charge only if Required (Check Manufacture Battery Guide Lines ).

Note Any Concerns Below:

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ANNUAL - Battery Cell Temperature Inspection

Station: \_\_\_\_\_ JDE W/O # : \_\_\_\_\_  
Manufacturer: \_\_\_\_\_ Date: \_\_\_\_\_ Readings By: \_\_\_\_\_

Cell No.	Temp (°C)	Cell No.	Temp (°C)	Cell No.	Temp (°C)
1		21		41	
2		22		42	
3		23		43	
4		24		44	
5		25		45	
6		26		46	
7		27		47	
8		28		48	
9		29		49	
10		30		50	
11		31		51	
12		32		52	
13		33		53	
14		34		54	
15		35		55	
16		36		56	
17		37		57	
18		38		58	
19		39		59	
20		40		60	

Table 1: Take temperature readings at the negative terminal of cells.

ANNUAL – Flooded Battery Cell Inspection

Station: \_\_\_\_\_ JDE W/O # : \_\_\_\_\_  
Manufacturer: \_\_\_\_\_ Date: \_\_\_\_\_ Readings By: \_\_\_\_\_

	Volt	Temp (°C)	Specific Gravity	Electrolyte Level			Volt.	Temp (°C)	Specific Gravity	Electrolyte Level	
				(low / normal / high)	Refilled					(low / normal / high)	Refilled
1						31					
2						32					
3						33					
4						34					
5						35					
6						36					
7						37					
8						38					
9						39					
10						40					
11						41					
12						42					
13						43					
14						44					
15						45					
16						46					
17						47					
18						48					
19						49					
20						50					
21						51					
22						52					
23						53					
24						54					
25						55					
26						56					
27						57					
28						58					
29						59					
30						60					

\*\* Take temperature readings at the negative terminal of cells.

Take specific gravity readings before adding water to cells.

Add water to cells with low levels of electrolyte.

ANNUAL - FLOODED (VENTED) BATTERY AND CHARGER INSPECTION

Station: \_\_\_\_\_ JDE W/O #: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_ Date: \_\_\_\_\_ Readings By: \_\_\_\_\_

Room Temperature: \_\_\_\_\_ °C  
Average Battery Temperature: \_\_\_\_\_ °C

Voltage of Battery Bank with Charger Off: \_\_\_\_\_ V  
Pilot Cell Voltage: \_\_\_\_\_ V  
Pilot Cell No.: \_\_\_\_\_

Cordex Rectifiers – Clean internally

Rectifier #1 \_\_\_\_\_, Rectifier #2 \_\_\_\_\_, Rectifier #3 \_\_\_\_\_

	( CHARGER #1 )		( CHARGER #2 )	
Voltage Output of Charger (V):	_____ Found	_____ Left	Found _____	Left _____
DC Current Output of Charger (A):	_____ Found	_____ Left	Found _____	Left _____
AC Current Output of Charger (A):	_____ Found	_____ Left	Found _____	Left _____

Terminal DC Voltage to Ground (V): \_\_\_\_\_ Positive \_\_\_\_\_ Negative

CHECKS COMPLETED:

- \_\_\_\_\_ Check the accuracy of the charger voltage meter against another meter.
- \_\_\_\_\_ Check each cell for cracks, corrosion on terminals, leaks.
- \_\_\_\_\_ Inspect the battery rack for signs of corrosion & battery leakage.
- \_\_\_\_\_ Clean and lubricate all battery and cell connections as needed.
- \_\_\_\_\_ Record specific gravity, electrolyte level & temperature of cells.
- \_\_\_\_\_ Check the operation of ventilation fans and thermostat.
- \_\_\_\_\_ Evaluate and attach MIDTRONICS Battery Diagnosis Test report.
- \_\_\_\_\_ ( Tests to be completed on all Batteries and Cell Interconnections ( Straps ) ).
- \_\_\_\_\_ Apply an equalizing charge to battery.

\*\*Notes:

- Equalize charge is required after any distilled water is added
- Do not allow excessive gassing

COMMENTS:

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ANNUAL - VRLA Battery Cell Inspection

Station: \_\_\_\_\_ JDE W/O #: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_ Date: \_\_\_\_\_ Readings By: \_\_\_\_\_

Cell No.	Impedance	Conductance	Resistance	Cell No.	Impedance	Conductance	Resistance
1				31			
2				32			
3				33			
4				34			
5				35			
6				36			
7				37			
8				38			
9				39			
10				40			
11				41			
12				42			
13				43			
14				44			
15				45			
16				46			
17				47			
18				48			
19				49			
20				50			
21				51			
22				52			
23				53			
24				54			
25				55			
26				56			
27				57			
28				58			
29				59			
30				60			

ANNUAL - VRLA BATTERY CELL AND CHARGER INSPECTION

Station: \_\_\_\_\_ Manufacture: Batteries: \_\_\_\_\_ Charger: \_\_\_\_\_  
JDE W/O #: \_\_\_\_\_ Date: \_\_\_\_\_ Readings By: \_\_\_\_\_

Room Temperature: \_\_\_\_\_ °C  
Average Battery Temperature: \_\_\_\_\_ °C

Voltage of Battery Bank with Charger Turned Off: \_\_\_\_\_ V  
Pilot Cell Voltage: \_\_\_\_\_ V  
Pilot Cell No.: \_\_\_\_\_

Cordex Rectifiers – Clean internally  
Rectifier #1 \_\_\_\_\_, Rectifier #2 \_\_\_\_\_, Rectifier #3 \_\_\_\_\_

	( CHARGER #1 )		( CHARGER #2 )	
Voltage Output of Charger (V):	_____ Found	_____ Left	Found _____	Left _____
DC Current Output of Charger (A):	_____ Found	_____ Left	Found _____	Left _____
AC Current Input of Charger (A):	_____ Found	_____ Left	Found _____	Left _____

Terminal DC Voltage to Ground (V): \_\_\_\_\_ Positive \_\_\_\_\_ Negative

CHECKS COMPLETED:

- \_\_\_\_\_ Check the accuracy of the charger voltage meter against another meter.
- \_\_\_\_\_ Check each cell for cracks, corrosion on terminals, leaks, swelling.
- \_\_\_\_\_ Inspect the battery rack for signs of corrosion & battery leakage.
- \_\_\_\_\_ Clean, lubricate cell connections if required.
- \_\_\_\_\_ Conduct individual cell temperature
- \_\_\_\_\_ Check the operation of ventilation fans and thermostat.
- \_\_\_\_\_ Evaluate and attach MIDTRONICS Battery Diagnosis Test report.  
( Tests to be completed on all Batteries and Cell Interconnections ( Straps ).

COMMENTS:

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## ANNUAL - BATTERY CONNECTIONS RESISTANCE INSPECTION

Station: \_\_\_\_\_ JDE W/O #: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Date: \_\_\_\_\_ Readings By: \_\_\_\_\_

**\*\*Clean & re-torque any connections with high resistance readings\*\***

Meter Probes Between Cell Posts	As-Found (Micro-Ohms)	As-Left (Micro-ohms)	Meter Probes Between Cell Posts	As-Found (Micro-Ohms)	As-Left (Micro-Ohms)
Lug & No. 1			30 – 31		
1 – 2			31 – 32		
2 – 3			32 – 33		
3 – 4			33 – 34		
4 – 5			34 – 35		
5 – 6			35 – 36		
6 – 7			36 – 37		
7 – 8			37 – 38		
8 – 9			38 – 39		
9 – 10			39 – 40		
10 – 11			40 – 41		
11 – 12			41 – 42		
12 – 13			42 – 43		
13 – 14			43 – 44		
14 – 15			44 – 45		
15 – 16			45 – 46		
16 – 17			46 – 47		
17 – 18			47 – 48		
18 – 19			48 – 49		
19 – 20			49 – 50		
20 – 21			50 – 51		
21 – 22			51 – 52		
22 – 23			52 – 53		
23 – 24			53 – 54		
24 – 25			54 – 55		
25 – 26			55 – 56		
26 – 27			56 – 57		
27 – 28			57 – 58		
28 – 29			58 – 59		
29 – 30			59 – 60		
			No. 60 & lug		

# **Terminal Station Building and Grounds**



## **TERMINAL STATION, BUILDING AND GROUNDS MAINTENANCE PROCEDURE**

Page 1 of 6

### **Building Fire Extinguishers**

#### **GENERAL INSPECTION (One Month for occupied Terminal Stations HWDTS & SVLTS and 4 months for all others).**

- 1 Inspection date and inspectors initials should be recorded on the tag attached to the extinguisher.
- 2 Check the accessibility of the extinguisher.
- 3 Check that it is the proper extinguisher for that location.
- 4 Check that the lock pin is in place, the seal intact, and the hanger secure.
- 5 If equipped with a pressure gauge, check to be sure the indicator is in the operating range. Tap the gauge lightly with your finger to be sure the needle is not stuck.
- 6 Check the general condition of the hose, nozzle, and shell.
- 7 Check that the extinguisher is clean and the instructions are readable.
- 8 If there is any indication the extinguisher has been used or tampered with, it should be completely checked and/or recharged.
- 9 Complete Building & Grounds Inspection Form - noting condition of hoses, charged or discharged, number of extinguishers inspected, initial tag and date all extinguishers. Note if a hydrostatic test is required.

#### **ANNUAL INSPECTION: C02 TYPE ONLY**

- 10 Weigh extinguisher with the approved extinguisher weighting scale and recharge if weight is 10% below fully charge weight indicated on the nameplate or as specified by the manufacturer.
- 11 Check condition of shell, nozzle, hose, and mechanism of the extinguisher.
- 12 Have shell tested hydrostatically if evidence or corrosion or damage is found.
- 13 Record weight, date of inspection, and initials of inspector on the tag attached to the extinguisher.
- 14 Complete ( Fire Extinguishers Inspection Form )



**TERMINAL STATION, BUILDING AND GROUNDS MAINTENANCE PROCEDURE**

Page 2 of 6

**ANNUAL INSPECTION: STORED PRESSURE & CARTRIDGE OPERATED  
DRY CHEMICAL TYPES:**

- 15 Check condition of extinguisher shell. If there is any indication of damage or corrosion, test hydrostatically.
- 16 Remove hose and check for plugging and deterioration.
- 17 For the stored pressure type, weigh complete extinguisher with the approved extinguisher weighing scale. If the weight is 10% less than the weight indicated on extinguisher recharging is necessary.
- 18 For the stored pressure type, invert the extinguisher to determine the condition of the powder. If it appears to be caked, the extinguisher should be emptied and recharged.
- 19 For the cartridge operated type, remove the gas cartridge and weigh with the approved extinguisher cartridge scale. If the weight is ½ oz. or less than weight stamped on cartridge or as per instruction plate of extinguisher, it must be replaced.
- 20 For the cartridge operated type, open the extinguisher and check the powder. If it is low or caked, the powder should be replaced.
- 21 Extinguishers located near electrical equipment should be checked for corona damage to the hose.
- 22 Inspection date and inspectors initials should be marked on the tag each inspection.
- 23 Complete Annual Fire Extinguishers Inspection.  
*Note: Hydrostatic Tests are to be performed as the extinguisher comes due.*

**24 Inventory - First Aid Kits/Stationery/Cleaning Supplies**

- 0.1 Check the contents of the first aid kit and refill according to the list of contents posted:

**#2 First Aid Kit Checklists:**

- 1 Emergency First Aid Safety Oriented Manual
- 1 First Aid Record Book
- 12 Safety Pins
- 1 Splinter Tweezers- Blunt Nose
- 1 Pair Scissors - 10 cm

## **TERMINAL STATION, BUILDING AND GROUNDS MAINTENANCE PROCEDURE**

Page 3 of 6

### **Dressings:**

Sterile Bandage Compressed - 10 cm x 10 cm	2
Sterile Pads - 7.5 cm x 7.5 cm	16
Sterile Adhesive Dressings - 2.5 cm x 7.5 cm	3
Triangular Bandages - 95 cm x 95 cm	6

### **Adhesive Tape:**

1 Roll - 2.5 cm x 5 m

Check the stationery supplies on hand and replenish according to the checklist posted.

### **Stationary Supplies Checklist**

	<u>Min</u>	<u>Max</u>
1. PC Tags Series	10	15
2. PC10A Red Tags	15	20
3. Caution Operation Restriction Tags	10	15
4. Hold - off Tags	10	15
5. Tag Holder Ties	15	30
6. Periodic Maintenance Record Tags	10	15
7. Periodic Maintenance Record Tags	5	10
8. Work Permit or Condition Guarantee Book PC2	1	1
9. Test Operate Under a Work Permit Book PC14	1	1
10. Order to Operate Trades Use Book PC17A	1	1
11. Order to Operate Trades Use Book Pc17B	1	1
12. Writing Pads	1	2
13. Clip Board	1	1
14. Thumb Tack Box	1	1
15. 1835 Bulbs (Boxes)	1	2
16. 24X Bulbs (Boxes)	1	2
17. NE44 Bulbs (Boxes)	1	2
18. AC Exit Bulbs	2	6
19. DC Exit Bulbs	2	6

0.2 Check the cleaning supplies on hand and replenish according to the checklist posted.

### **Cleaning Supplies Checklist**

	<u>MIN</u>	<u>MAX</u>
1. Garbage Bags	5	20
2. Mop	1	1
3. Bucket	1	1
4. Broom	1	1
5. Dust Pan	1	1
6. Floor Soap Container	1	1
7. Toilet Tissue	2	10

**TERMINAL STATION, BUILDING AND GROUNDS MAINTENANCE PROCEDURE**

Page 4 of 6

8.	Hand Towels	2	6
9.	Hand Soap	2	4
10.	Plunger	1	1
11.	Sani Flush Bowl Cleaner	1	2

**25 Emergency Oil Spill Kits ( Annual Inspection ):**

- 0.1 Check and restock Spill Kit ( If Required ).
- 0.2 Install seal after inspection is completed.
- 0.3 Refer to SOP-20 procedure & complete appropriate form.

**26 Eye Wash Stations Inspection :**

- 0.1 Check the water supply to ensure it is clean, the flow and pressure adequate.
- 0.2 Ensure the nozzles are unobstructed and the valve operates freely.
- 0.3 Ensure the nozzle caps are in place.
- 0.4 For self contained units, replace the water and anti fungus solution every four months.

**27 Security Building/Yard:**

- 0.1 Check to ensure the fencing is intact and the barbed wire is in good condition.
- 0.2 Check that crushed stone is up to the bottom of the fence and no access can be provided under the fence.
- 0.3 Ensure all locks are in place and in good working order.
- 0.4 If an intruder alarm is present, ensure it is working properly and has not been tampered with.

**28 System Grounding:**

- 0.1 Ensure that fence grounding is intact, all clamps are tight and flexible braids are on the gates.
- 0.2 Ensure that all equipment grounding is in place and straps and connections secure.

## ***TERMINAL STATION, BUILDING AND GROUNDS MAINTENANCE PROCEDURE***

*Page 5 of 6*

### **29 General Conditions:**

- 0.1 Check conditions of the yard surface stone, note any washouts or erosion of ditches.
- 0.2 Check the condition of building inside and out, note if any repairs are required.

### **30 Warning Signs:**

- 0.1 Check that High voltage warning signs are around perimeter fence.
- 0.2 Check for the presence of hard hat, noise level, and any other warning sign that may be required.

### **31 Station Service:**

- 0.1 Check and function test yard lighting.
- 0.2 Check and function test emergency lighting.
- 0.3 Check all building and entrance lights.
- 0.4 Check and clean bug light if one is provided.
- 0.5 Check station service condition.

### **32 Telephone:**

- 0.1 Ensure the remote bell is working properly.

### **33 Access Road:**

- 0.1 Check if road surface is in good condition.
- 0.2 Check to ensure all drainage ditches and culverts are free.
- 0.3 Check for good visibility along roadway.

### **34 Vegetation:**

- 0.1 Check for excess weeds, grass, etc.
- 0.2 Check for alders, shrubs, etc., and remove.

***TERMINAL STATION, BUILDING AND GROUNDS MAINTENANCE PROCEDURE***

*Page 6 of 6*

- 0.3 Ensure there is an adequate fire break around outside of fence

**35 Rodent Guards:**

- 0.1 Check rodent guards for correct operation if applicable. Check by listening close to the unit to detect changing tones emitting from the unit.

**INFRARED THERMOGRAPHY MAINTENANCE PROCEDURE***Page 1 of 1***INSPECTION (Annually)****Normally completed from ground level during a period of heavy system load.**

- 1 A visual inspection of external high-voltage electrical connections performed using an infrared thermography camera.
- 2 Check all high-voltage electrical connections between equipment and conductor/bus and between one section of conductor/bus and another section of conductor/bus.
- 3 For each set of connections (i.e. all three phases at one location), view one phase at a time on the infrared camera.
- 4 For each phase, identify the maximum temperature of the connection shown on the infrared camera. Compare the maximum temperatures of all three phases. A connection whose temperature is higher than another phase is a hot spot.
- 5 If a hot spot is present, capture a photo of it on the infrared camera and record the following information about that hot spot on the completed work order: equipment name, connection location, phase, and temperature difference between that phase and the phase with the lowest temperature.
- 6 Continue until all external connections in the terminal station have been viewed.
- 7 Submit a work request for each identified hot spot.

The following provides guidance as to priority and time to respond to different severities of hot spots:

Priority	Temp. Difference ( $\Delta T$ Phase to Phase)	Respond Within
1 (Emergency)	Visually Hot	24 hours
2	Above 50°C	1 week
3	20°C to 50°C	1 month
4	Below 20°C	1 year

## 120/180 DAY INSPECTION – TERMINAL STATION, BUILDING &amp; GROUNDS INSPECTION

Station: \_\_\_\_\_

Date: \_\_\_\_\_

Readings By: \_\_\_\_\_

<b>Building Fire Extinguishers</b>		
	A. Check condition of hoses	<input type="checkbox"/> okay
	B. Check if charged/discharged	<input type="checkbox"/> charged <input type="checkbox"/> discharged
	C. Number inspected	
	D. Initial tag & date	
<b>Inventory (Refer to posted List)</b>		
	A. First Aid Contents	<input type="checkbox"/> okay
	B. Stationary/Cleaning Supplies	<input type="checkbox"/> okay
<b>Eye Wash Stations</b>		
	A. Water supply/pressure	<input type="checkbox"/> okay
	B. Caps on spray nozzles	<input type="checkbox"/> okay
	C. Initial tag & date	<input type="checkbox"/> okay
<b>Security Building/Yard</b>		
	A. Locks in Place	<input type="checkbox"/> okay
	B. Barbed wire	<input type="checkbox"/> okay
	C. No open access , Intruder alarm	<input type="checkbox"/> okay
<b>System Grounding</b>		
	A. Fence /Equipment grounding	<input type="checkbox"/> okay
<b>General Conditions of Yard</b>		
	A. Crushed stone/holes etc.	<input type="checkbox"/> okay
	B. Building condition outside/inside	<input type="checkbox"/> okay
	C. Check & report any environmental Substandard Conditions as per EERP	<input type="checkbox"/> okay
	D. Box Structure Concrete Base	<input type="checkbox"/> okay
	E. Post Insulator Concrete Base	<input type="checkbox"/> okay
<b>Warning Signs</b>		
	A. High voltage	<input type="checkbox"/> okay
	B. Hard hat	<input type="checkbox"/> okay
	C. Noise levels	<input type="checkbox"/> okay
<b>Station Service</b>		
	A. Yard Lighting (Check and Function Test)	<input type="checkbox"/> okay
	B. Emergency Lighting (Check and Function Test)	<input type="checkbox"/> okay
	C. Building & Entrance	<input type="checkbox"/> okay
	D. Bug light (Empty if required)	<input type="checkbox"/> okay
	E. Station Service Condition (Panel, Conduit, Wiring)	<input type="checkbox"/> okay
<b>Telephone</b>		
	A. Remote bell ( Check if Applicable )	<input type="checkbox"/> okay
	B. Verify Emergency Telephone numbers are posted near telephone	<input type="checkbox"/> okay
<b>Access Road</b>		
	A. Surface	<input type="checkbox"/> okay <input type="checkbox"/> rough <input type="checkbox"/> icy <input type="checkbox"/> narrow
	B. Visibility ( Vegetation, Access etc; )	<input type="checkbox"/> okay
<b>Vegetation</b>		
	A. Weeds	<input type="checkbox"/> okay
	B. Alders	<input type="checkbox"/> okay
	C. Fire break around yard	<input type="checkbox"/> okay
<b>Rodent Guards</b>		
	A. Check Power on	<input type="checkbox"/> okay



## 120 DAY INSPECTION TERMINAL STATION SUPPLIES

Station: \_\_\_\_\_

Date: \_\_\_\_\_

Checked By: \_\_\_\_\_

## INSPECT: LOCKOUT CENTER: \_\_\_\_\_

Stationary Supplies:	MIN.	MAX.	#On hand
PC3 Tags Series _____, _____, _____, _____.	10	15	
PC 10A Tags	15	20	
Caution Operation Restricted Tags	10	15	
Hold Off Tags	10	15	
Tag Holder Ties	15	30	
Tag Protectors	10	15	
Period Maintenance Record Tags	5	10	
Work Protection or Condition Guarantee Book PC2	1	1	
Test Operate Under a Work Permit Book PC14	1	1	
Order to Operate Trades Use Book PC 17A	1	1	
Order to Operate Trades Use Book PC 17B	1	1	
Writing Pads	2	1	
Clip Board	1	1	
Thumb Tack Box	1	1	
1835 Bulbs ( Boxes )	1	2	
24X Bulbs ( Boxes )	1	2	
NE44 Bulbs ( Boxes )	1	2	
AC Exit Bulbs	2	6	
DC Exit Bulbs	2	6	

Note: All of the above Items apply to Stations with Control rooms. Items 1 to 5 inclusive apply to all Terminal Stations.

Cleaning Supplies:	MIN.	MAX.	#On hand
Garbage Bags	5	10	
Mop	1	1	
Bucket	1	1	
Broom	1	1	
Dust Pan	1	1	
Floor Soap Container	1	1	
Toilet Paper	4	10	
Hand Towels	2	4	
Hand Soap	1	2	
Plunger	1	1	
Toilet Bowl Cleaner	1	2	

REMARKS: \_\_\_\_\_

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_





## ANNUAL – FIRE EXTINGUISHERS INSPECTION

Location: \_\_\_\_\_ Date: \_\_\_\_\_ Completed By: \_\_\_\_\_

AREA LOCATION:	TYPE:	CLASS:	SIZE:
MFG:	SERIAL #	HYDROSTATIC TEST DATE: MONTH ____ YEAR ____	

**CHECKS**

GAUGE:	HOSE:	SEAL:
CYLINDER:	CONDITION:	ACCESSIBILITY:
CARTRIDGE WEIGHT:	CYLINDER WEIGHT:	
TAG INITIALED:		

NOTES: If Hydrostatic test is required refer to Cylinder Instructions.

Replace Cartridge if required.

REMARKS:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

AREA LOCATION:	TYPE:	CLASS:	SIZE:
MFG:	SERIAL #	HYDROSTATIC TEST DATE: MONTH ____ YEAR ____	

**CHECKS**

GAUGE:	HOSE:	SEAL:
CYLINDER:	CONDITION:	ACCESSIBILITY:
CARTRIDGE WEIGHT:	CYLINDER WEIGHT:	
TAG INITIALED:		

NOTES: If Hydrostatic test is required refer to Cylinder Instructions.

Replace Cartridge if required.

REMARKS:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

AREA LOCATION:	TYPE:	CLASS:	SIZE:
MFG:	SERIAL #	HYDROSTATIC TEST DATE: MONTH ____ YEAR ____	

**CHECKS**

GAUGE:	HOSE:	SEAL:
CYLINDER:	CONDITION:	ACCESSIBILITY:
CARTRIDGE WEIGHT:	CYLINDER WEIGHT:	
TAG INITIALED:		

NOTES: If Hydrostatic test is required refer to Cylinder Instructions.

Replace Cartridge if required.

REMARKS:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

# Capacitor Banks

## **CAPACITOR BANK MAINTENANCE PROCEDURE**

Page 1 of 2

### **120 DAY PM VISUAL INSPECTION (No Outage or Work Protection Required)**

- 1 Check primary connections - Visually inspect connections for looseness or damage.
- 2 Check grounding connections- Visually inspect connections for looseness or damage.
- 3 Bushing Condition - Visually inspect bushings for burns, cracks and general condition.
- 4 Capacitor Tanks (Oil Leaks/Rust) – Visually inspect all cans for signs of leaks, excessive rust, or tank bulging.
- 5 Fuses Blown – Identify and report any blown fuses
- 6 Arrestor (If Applicable) – Visually inspect for burns, cracks and general condition.
- 7 Support Insulators - Visually inspect for burns, cracks and general condition.
- 8 Record load current on each phase and the neutral. (Only required if the bank is on-line)
- 9 Record any abnormality or discrepancy in the remarks section on the form.

### **6 YEAR PM INSPECTION**

- 10 When de-energizing the bank wait 10 minutes prior to applying grounds.
- 11 Check primary connections. (Inspect each connection up close and move with hand to check for looseness or damage. Re-torque any loose connections and repair any damaged conductor.)
- 12 Check grounding connections (Inspect each connection up close and move with hand to check for looseness or damage. Re-torque any loose connections and repair any damaged conductor.)
- 13 Clean Bushings and Support Insulators (Clean with Methyl Hydrate, as required)
- 14 Check all fuses. Ensure none are loose and spring tension is adequate. Note all fuses blown in each phase and document number of fuses replaced.
- 15 Record nameplate capacitance per phase. It will be required to calculate the phase capacitance based upon the individual nameplate value.
- 16 Measure capacitance for each phase. Compare to nameplate values and investigate if there are any discrepancies greater than 2 %.

**CAPACITOR BANK MAINTENANCE PROCEDURE**

Page 2 of 2

- 17 Perform 5 kV Megger test phase to ground and record results.
- 18 Check for leaks. (Report any Leaks as per the EERP Environmental Emergency Response Program.)
- 19 After capacitor bank is energized, check and record load current on each phase and the neutral. (Bank must be placed on-line.)
- 20 Record any abnormality or discrepancy in the remarks section on the form.

# 120 DAY VISUAL INSPECTION – CAPACITOR BANK

Inspected By: \_\_\_\_\_ Station: \_\_\_\_\_ W/O No. \_\_\_\_\_ Date: \_\_\_\_\_

MFG:		Capacitor Bank ID No:	
Status :    Energized <input type="checkbox"/> De-Energized <input type="checkbox"/>			
	Phase A	Phase B	Phase C
Cans per Phase In Service			
Primary Connections			
Grounding			
Bushings (Condition)			
Capacitor Tanks Condition (Oil Leaks/Rust)			
No. of Fuses Blown			
No. of Fuses Replaced			
Arrestors (if applicable)			
Support Insulators			
Bank Currents	Neutral		
Bank Voltages	Neutral		

## VISUAL INSPECTION TO INCLUDE:

- |   |  |
|---|--|
| <input type="checkbox"/> Check Bushings & Tanks   | <input type="checkbox"/> Check Porcelain Insulators for Flashover, Cracks and Burn Marks |
| <input type="checkbox"/> Check & Report any Oil Leaks as per EERP Environmental Emergency Response Plan |  |
| <input type="checkbox"/> Check Paint/Rust Condition   | <input type="checkbox"/> Check Conduits & Cabinets                                       |
| <input type="checkbox"/> Check Concrete Base  | <input type="checkbox"/> Check Grounding   |
| <input type="checkbox"/> Check Primary Connections  |  |

Remarks:

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# 6 YEAR INSPECTION – CAPACITOR BANK

Inspected By: \_\_\_\_\_ Station: \_\_\_\_\_ JDE W/O # \_\_\_\_\_ Date: \_\_\_\_\_

**NOTE: All TESTS MUST BE COMPLETED OR MARKED N/A (unless otherwise instructed).**

MFG: _____		Capacitor Bank ID No: _____		
<b>OUT OF SERVICE (DE-ENERGIZED) CHECKS</b>				
	PHASE A	PHASE B	PHASE C	
Cans Per Phase				
Check Primary Connections				
Check Grounding Connections				
Clean Bushings				
Clean Support Insulators				
No. Of Fuses Blown				
No. Fuses Replaced				
Capacitance Nameplate (UF)				
Capacitance Measured (UF)				
Megger Test ( 5 kV) (Mohms)				
<b>IN SERVICE (ENERGIZED) CHECKS</b>				
Bank Amps	NEUTRAL			
Capacitor Voltage*	NEUTRAL			

\*NOTE: Look at capacitance of individual cans or phases.

## GENERAL CHECKS TO INCLUDE:

- |  |   |
|--|---|
| ___ Check Bushings & Tanks   | ___ Check Porcelain Insulators for Flashover, Cracks and Burn Marks |
| ___ Check & Report any Oil Leaks as per EERP Environmental Emergency Response Plan | ___ Check Conduits & Cabinets                                       |
| ___ Check Paint/Rust Condition   | ___ Check Grounding   |
| ___ Check Concrete Base  |   |
| ___ Check Primary Connections  |   |

REMARKS:

# Circuit Breakers



## **AIR BLAST CIRCUIT BREAKER MAINTENANCE PROCEDURE**

Page 1 of 2

### **120 DAY GENERAL INSPECTION**

- 1 Visual inspection of the porcelain insulators.
- 2 A general visual inspection of the mechanism box including the mechanism space heater.
- 3 Check the air pressure.
- 4 Check for air leaks, (Listen, Ultrasonic Leak Detector.)
- 5 Inspect all grounding connections.
- 6 Check general paint coating condition.
- 7 Complete Inspection Form 120 Day-Air Blast Breaker Inspection.

### **6 YEAR PM INSPECTION**

- 8 Outage required.
- 9 Check the counter operations and record reading before and after work is performed.
- 10 Complete pressure drop check. Close main air supply valve and record pressure. Record again after 20 minutes. Pressure drop should not be more than 5 psig (35.5 kpa). Type DCF and DCVF breakers must be in the open position for test.
- 11 Check and clean auxiliary contacts in each control block and main control cabinet. Check each contact assembly for physical damage or deterioration. Clean all contacts and function test via breaker operation.
- 12 Complete sequence timing. (Note: Test to be completed only on breakers that have single phase operating circuits unless otherwise instructed).
- 13 Complete contact resistance (ductor) test.
- 14 Complete interrupter insulation (megger) test.
- 15 Complete continuity (resistance) test on all control coil circuits.
- 16 Monitor pressure switches (with air pressure dropping).
- 17 Complete a general inspection of control cabinet and mechanism boxes including heaters, auxiliary switches, contactors and control wire terminations.

## **AIR BLAST CIRCUIT BREAKER MAINTENANCE PROCEDURE**

Page 2 of 2

- 18 Lightly lubricate the tripping system in the control blocks. (Type DCF and DCVF breakers).
- 19 Check all primary connections.
- 20 Repair all air leaks.
- 21 Recharge with air and check pressure to be within normal range.
- 22 Complete Appropriate Form.

### **AS INSTRUCTED OR AS CONDITIONS INDICATE**

- 23 Clean air intake filters.
- 24 Clean pressure reducing valve.
- 25 Lubricate all arcing chambers.
- 26 Time individual interrupter heads.
- 27 Doble test. (Normally only during commissioning).

## **SF6 CIRCUIT BREAKER MAINTENANCE PROCEDURE**

Page 1 of 2

### **120 DAY GENERAL INSPECTION - SF6 CIRCUIT BREAKER**

- 1 Check all primary connections.
- 2 Visual inspection of all porcelain.
- 3 Check condition of air receiver if applicable.
- 4 Check all grounding.
- 5 Check for air or hydraulic leaks if applicable.
- 6 Perform a general visual inspection of the control cables, door hinges, and paint condition.
- 7 Check operation of and record current for cabinet and control box heaters.
- 8 Record reclose counters and operation counters.
- 9 Drain sufficient air to check operation of pressure switches. Record cut in and cut out of compressor if applicable.
- 10 Record compressor hours and dryer counter if applicable.
- 11 Check and record interrupter SF6 gas pressures.
- 12 Complete Form 120-Day SF6 Breaker Inspection.

### **INSPECTION: ELF TYPE BREAKERS C/W COMPRESSOR & DRYER**

- 1 Complete the appropriate form for records.
- 2 Complete Dew Point Test, as per form.
- 3 Complete compressor/dryer checks as per form.
- 4 Change compressor base oil (note condition).
- 5 Replace desiccant (note condition).
- 6 Drain low point of any water.
- 7 Clean or replace air filters, as required.

## ***SF6 CIRCUIT BREAKER MAINTENANCE PROCEDURE***

Page 2 of 2

- 8 Check V belt. Replace if required.
- 9 Check all breaker interconnecting hoses.
- 10 Check control wiring.

### **6 YEAR PM INSPECTION:**

- 1 Outage required.
- 2 Complete the appropriate form for records.
- 3 Record operating pressure and counter reading before operating breaker.
- 4 Complete resistance (Ductor) test and record.
- 5 Complete timing test and record. (Note: Test to be completed only on breakers that have single phase operating circuits unless otherwise instructed.)
- 6 General visual check of air system or hydraulic system, if applicable.
- 7 Complete 20 minute pressure drop test, if applicable.
- 8 Check pressure switches and record.
- 9 Perform dew point test/moisture PPM on SF6 gas and record.
- 10 Check operation of all heaters.
- 11 Lubricate all moving parts, as required.
- 12 Replace dessicant in operating air system, if applicable.
- 13 Drain condensate from dryer, if applicable.
- 14 Perform doble test during commissioning only.
- 15 Complete internal inspection, if instructed.
- 18 Check SF6 pressure gauges for accuracy, using test gauge.

## **OIL CIRCUIT BREAKER MAINTENANCE PROCEDURE**

*Page 1 of 2*

### **120 DAY GENERAL INSPECTION - OIL CIRCUIT BREAKERS**

- 1 Check oil levels in tanks and bushings.
- 2 Check operation of and record current for cabinet and tank heaters.
- 3 Perform a general visual inspection in mechanism cabinet and around breaker including paint condition.
- 4 Record operating and reclose counters.
- 5 Record compressor running time, if applicable.
- 6 Drain sufficient air to check operation of pressure switches. Record cut in and cut out of compressor, if applicable. *Note: Record if there is any moisture being drained off.*
- 7 Listen for air leaks or abnormal noises from compressor and note belt condition if applicable.
- 8 Complete appropriate form.

### **6 YEAR PM INSPECTION:**

- 1 Record operating pressure and counter reading before operating breaker.
- 2 General visual check of the air system including belt condition and adjustment if applicable.
- 3 Change oil in compressor.
- 4 Check external dash pot oil level (breaker in open position.)
- 5 Drain air system noting operation of pressure switches and record, if applicable.
- 6 Inspect latches, clean and lubricate, as required.
- 7 Inspect contactors and auxiliary switches.
- 8 Lubricate operating mechanism as required.
- 9 Measure and record run time of compressor from cut-in to cut-out, if applicable. (10% increase in run time requires compressor overhaul.)

**OIL CIRCUIT BREAKER MAINTENANCE PROCEDURE**

*Page 2 of 2*

- 10 Measure interrupter resistors bushing to bushing (138 KV kSO only), with breaker contacts open but mechanism jacked in sufficiently for resistor contacts to make.
- 11 Visual check bushings and wipe down, if required.
- 12 Complete a dielectric test ASTM 877 of the oil.
- 13 Perform insulation test (megger) of each phase to ground with breaker in closed position and record results.
- 14 Perform resistance (Ductor) tests and record results.
- 15 Record final operating pressure and counter reading.
- 16 Doble test as required.

**PERFORM THE FOLLOWING ONLY IF INSTRUCTED**

- 17 Complete internal inspection.
- 18 Perform complete motion analyzer test and record results.



## **MINIMUM OIL CIRCUIT BREAKER MAINTENANCE PROCEDURE**

Page 1 of 2

### **120 DAY GENERAL INSPECTION-MINIMUM OIL CIRCUIT BREAKERS**

- 1 Check interrupter nitrogen pressure (normal working pressure is 0.3 – 0.7 MPA and can be read on the manometers). Note: Breakers at the Town Switching SS and Quartzite SS Labrador West are not nitrogen pressurized.
- 2 Check operation of and record current for cabinet heaters.
- 3 Perform a general visual inspection in mechanism cabinet and around breaker including paint /rust condition.
- 4 Check interrupter insulators and CTs for cracks and flashover.
- 5 Complete appropriate form.

### **6 YEAR PM INSPECTION:**

- 6 Record operating pressure and counter reading before operating breaker.
- 7 Check control coils 3-PH Trip and 3-PH close resistance.
- 8 Complete Megger test on the interrupters (5KV test).
- 9 Complete resistance (Ductor) test on the interrupters. Acceptable readings < 80  $\mu$  ohm.
- 10 Record nitrogen pressure, if applicable. Top up, if required, and check for the source of the leak (repair/ report findings).
- 11 Pneumatic regulated units: operate breaker and record pressure.
- 12 Spring charged units: Check motor amps.
- 13 Lubricate Operating mechanism.
- 14 Record cabinet heater amps.
- 15 Record final operation counter.
- 16 Perform visual check of bushings and wipe down, if required.
- 17 Doble test.



## **MINIMUM OIL CIRCUIT BREAKER MAINTENANCE PROCEDURE**

Page 2 of 2

### **CHECKS TO BE COMPLETED IF INSTRUCTED**

- 18 Internal inspection.
- 19 Oil lab analysis.

# MONTHLY - COMPRESSOR/DRYER/AIR SYSTEM INSPECTION

Station: \_\_\_\_\_ Date: \_\_\_\_\_ Readings By: \_\_\_\_\_

Caution: Before inspection and maintenance provide the proper **Isolation** and **Permit**.

## DEW POINT TEMPERATURE

DEW POINT TEMPERATURE: _____ °C @ TEST PRESSURE: _____ KPA
DEW POINT TEMPERATURE: _____ °C @ OPERATING PRESSURE: _____ KPA

	Comp. No. 1/A	Comp. No.2/B	
Base Oil Level			
Oil Added			
Oil Changed ( If Required )			
Un-loader Cleaned & Tested			
Moisture Discharger			
Operating Position (Lead / Lag)			
Cut In KPA			
Cut Out KPA			
Motor (amps)			
Running Time (min) (Cut in to Cut out)			
Compressor Running hrs.			

### FUNCTION TEST SYSTEM:

Dryer Heater (amps): A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_

Dryer Counter: \_\_\_\_\_

High Side: High Pressure Alarm: \_\_\_\_\_

Low Pressure Alarm: \_\_\_\_\_

Low Side: High Pressure Alarm: \_\_\_\_\_

Low Pressure Alarm: \_\_\_\_\_

Differential Pressure: \_\_\_\_\_

15 min Pressure Drop: \_\_\_\_\_

System Pressure: High Side: \_\_\_\_\_ Low Side: \_\_\_\_\_

### CHECKS COMPLETED:

- |  |   |
|--|---|
| <input type="checkbox"/> Check guards/couplers                       | <input type="checkbox"/> Check oil relief valves, check valves, and press. gauges |
| <input type="checkbox"/> Check flex connections                      | <input type="checkbox"/> Check for oil & air leaks in the system                  |
| <input type="checkbox"/> Check limit and flow switches operation     | <input type="checkbox"/> Check dryer heater & failure alarm                       |
| <input type="checkbox"/> Check thermostats & all electrical controls | <input type="checkbox"/> Check condition of intake/outlet filters                 |

## MONTHLY - COMPRESSOR/DRYER/AIR SYSTEM INSPECTION

Station: \_\_\_\_\_ Date: \_\_\_\_\_ Readings By: \_\_\_\_\_

- |  |  |
|--|--|
| <input type="checkbox"/> Check blower oil, fan, & belt                 | <input type="checkbox"/> Report any oil leaks as per EERP<br>(Environmental Emergency Response Plan) |
| <input type="checkbox"/> Check water/oil separator                     | <input type="checkbox"/> Check belt drives for tension and wear                                      |
| <input type="checkbox"/> Check heat tracing working (where applicable) |  |

Note Any Concerns Below:

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# 120 DAY - AIR BLAST CIRCUIT BREAKER INSPECTION

Station: \_\_\_\_\_ Date: \_\_\_\_\_ Readings By: \_\_\_\_\_

WEATHER CONDITIONS: \_\_\_\_\_ dry \_\_\_\_\_ rain \_\_\_\_\_ humidity \_\_\_\_\_ temperature

Breaker No.					
Air Pressure (kPA)					
Operations Counter					
Recloser Counter					
Heater (amps)					
Heater (on / off)					
Heat Trace Cable (amps)					

Breaker No.					
Air Pressure (kPA)					
Operations Counter					
Recloser Counter					
Heater (amps)					
Heater (on / off)					
Heat Trace Cable (amps)					

## CHECKS COMPLETED:

- |   |   |
|---|---|
| <input type="checkbox"/> Check primary connections and bushings | <input type="checkbox"/> Check for air leaks                    |
| <input type="checkbox"/> Check porcelain for cracks or chips    | <input type="checkbox"/> Check tank and paint condition         |
| <input type="checkbox"/> Check grounding                        | <input type="checkbox"/> Check pipes and fittings               |
| <input type="checkbox"/> Check control cables                   | <input type="checkbox"/> Check tank and cabinet heaters         |
| <input type="checkbox"/> Check concrete base                    | <input type="checkbox"/> Check heat trace cable (if applicable) |

Remarks:

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# 120 DAY - OIL CIRCUIT BREAKER INSPECTION

Station: \_\_\_\_\_ Date: \_\_\_\_\_ Readings By: \_\_\_\_\_

WEATHER CONDITIONS: \_\_\_\_\_ dry \_\_\_\_\_ rain \_\_\_\_\_ humidity \_\_\_\_\_ temperature

Breaker No.					
Voltage (kV)					
Operations Counter					
Reclose Counter					
Air Pressure (kPA)	Cut In				
	Cut Out				
Comp. Running Time (mins)					
Base Oil (Nor. / Low / Added)					
Motor (amps)					
Moisture Discharge					
Heaters (amps)	Cabinet				
	Tank				
Minimum Oil Breaker: Equipment ID# _____		A PH PRESSURE _____ KPA		B PH PRESSURE _____ KPA	
				C PH PRESSURE _____ KPA	

## CHECKS COMPLETED:

- |   |  |
|---|--|
| <input type="checkbox"/> Check Air Vent                       | <input type="checkbox"/> Check for Air Leaks   |
| <input type="checkbox"/> Check Porcelain for Cracks or Chips  | <input type="checkbox"/> Check Tank & Paint/Rust Condition   |
| <input type="checkbox"/> Check Primary Connections            | <input type="checkbox"/> Check Door Hinges & Lubricate as required   |
| <input type="checkbox"/> Check Grounding                      | <input type="checkbox"/> Check Tank and Cabinet Heaters  |
| <input type="checkbox"/> Check Oil level of Tank and Bushings | <input type="checkbox"/> Check Concrete Base   |
| <input type="checkbox"/> Check Compressor Operation           | <input type="checkbox"/> Check & Report any Oil Leaks as per EERP<br>(Environmental Emergency Response Plan) |

# 120 DAY - SF<sub>6</sub> CIRCUIT BREAKER INSPECTION

Station: \_\_\_\_\_ Date: \_\_\_\_\_ Readings By: \_\_\_\_\_

WEATHER CONDITIONS: \_\_\_\_\_ dry \_\_\_\_\_ rain \_\_\_\_\_ humidity \_\_\_\_\_ temperature

Breaker No.						
Voltage (kV)						
Operations Counter	A					
	B					
	C					
	3 PH					
Reclose Counter	A					
	B					
	C					
	3 PH					
Pressure (kPA)	Cut In					
	Cut Out					
Comp. Running Time						
Comp. Oil (Nor. / Low)						
Oil Added (Yes /No)						
Motor (amps)						
Moisture Dis.						
Dryer Counter						
SF <sub>6</sub> Pressure	Recommended - Kpa					
	A ph - Kpa					
	B ph - Kpa					
	C ph - Kpa					
Hydraulic Oil Pressure						
Heaters (amps)	Cabinet					
	Drive Gaskets					
	Heat Trace Cable ( if applicable )					
	Dryer Drain					

## CHECKS COMPLETED:

SF6 GAS: \_\_\_\_\_

Dew Point: \_\_\_\_\_

Operating Temp: \_\_\_\_\_

- |   |   |
|---|---|
| <input type="checkbox"/> Check for Air Leaks                            | <input type="checkbox"/> Check Primary Connections and bushings     |
| <input type="checkbox"/> Check Porcelain Insulators for Cracks or Chips | <input type="checkbox"/> Check Control Cables                       |
| <input type="checkbox"/> Check Grounding                                | <input type="checkbox"/> Check Door Hinges & Lubricate, as required |
| <input type="checkbox"/> Check Cabinet heaters                          |   |

## 120 DAY - SF<sub>6</sub> CIRCUIT BREAKER INSPECTION

Station: \_\_\_\_\_

Date: \_\_\_\_\_

Readings By: \_\_\_\_\_

- ☐ Drain Air to Check Compressor Pressure Switches    ☐ Air System (Operate Low Point Drain) if applicable
- ☐ Report any SF<sub>6</sub> Losses as per EERP during Top Up
- ☐ Check Concrete Base



# 6-YEAR 69 KV - SF<sub>6</sub> CIRCUIT BREAKER INSPECTION

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ Nominal Voltage Class: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E.W/O #: \_\_\_\_\_

WEATHER CONDITIONS: ☐ dry ☐ rain ☐ humidity ☐ temperature

**NOTE: All TESTS MUST BE COMPLETED OR MARKED N/A ( unless otherwise Instructed ).**

## BEFORE OPERATING: ( If Applicable )

SF6 Pressure:	3 ph	kpa	A ph	Kpa	B ph	Kpa	C ph	Kpa
Operation Counter:	3 ph		A ph		B ph		C ph	

## ACCEPTABLE DUCTOR READING

69 KV < 100 μOhm

% CURRENT

MICRO Ω

A ph

B ph

C ph

DENSITY MONITOR TEST (kPa): SF<sub>6</sub>

Low: \_\_\_\_\_

Lockout: \_\_\_\_\_

CONTROL COILS:	3-PH TRIP #1	Ω	3- Ph TRIP #2	Ω	3-PH CLOSE:	Ω
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## OPERATING MECHANISM

### PNEUMATIC REGULATED ( AIR ) OPERATOR: ( COMPRESSOR INSPECTION ) ( If Applicable )

CUT IN	KPA	CUT OUT	KPA	L.PRESSURE ALARM	KPA
ON TIME	MIN.				

MOTOR AMPERAGE

### SPRING CHARGED ( MOTOR ) OPERATOR: ( If Applicable )

MOTOR AMPERAGE

CABINET HEATER AMPERAGE:

SF6 Gas: Dew Point: \_\_\_\_\_

Operating Temp: \_\_\_\_\_

## CHECKS COMPLETED:

- \_\_\_\_\_ Check Primary Connections
  - \_\_\_\_\_ Check for oil at top end of dash-pot
  - \_\_\_\_\_ Check Pullrod connections
  - \_\_\_\_\_ Check Dash-pot oil level
  - \_\_\_\_\_ Lubricate Mechanism
  - \_\_\_\_\_ Change Breaker Compressor Oil
  - \_\_\_\_\_ Report any SF6 losses per EERP during Top Up.
- Doble Test Performed: ☐ Yes ☐ No

## ONLY IF INSTRUCTED:

- \_\_\_\_\_ Timing Test
- \_\_\_\_\_ Gas Analysis Sample

## AFTER OPERATING: ( If Applicable )

SF6 Pressure:	3 ph	kpa	A ph	Kpa	B ph	Kpa	C ph	Kpa
Operation Counter:	3 ph		A ph		B ph		C ph	

## 6-YEAR 69 KV - SF<sub>6</sub> CIRCUIT BREAKER INSPECTION

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ Nominal Voltage Class: \_\_\_\_\_  
Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E.W/O #: \_\_\_\_\_

### COMMENTS:

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## 6- YEAR 69/230 KV - MINIMUM OIL CIRCUIT BREAKER INSPECTION

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ Nominal Voltage Class: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E.W/O #: \_\_\_\_\_

WEATHER CONDITIONS: \_\_\_\_\_ dry \_\_\_\_\_ rain \_\_\_\_\_ humidity \_\_\_\_\_ temperature

**NOTE: All TESTS MUST BE COMPLETED OR MARKED N/A (unless otherwise Instructed).**

BEFORE OPERATING: Counter: \_\_\_\_\_

CONTROL COIL RESISTANCE	3-PH TRIP:	3- PH CLOSE:
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### INTERRUPTOR MEGGER TEST 5 KV ( Breaker in Open Position )

Note: Hydro has only one 230 KV Min Oil breaker at SVLTS that is no longer in service.

A PH	1 LEFT _____ Mega $\Omega$	2 RIGHT _____ Mega $\Omega$
B PH	1 LEFT _____ Mega $\Omega$	2 RIGHT _____ Mega $\Omega$
C PH	1 LEFT _____ Mega $\Omega$	2 RIGHT _____ Mega $\Omega$

230 kv breakers have 2 Interrupters 69 kv Breakers have 1 Interrupter ( Per PH )

### ACCEPTABLE DUCTOR READING

69KV & 230 KV < 80  $\mu\Omega$

	% CURRENT	MICRO $\Omega$
A ph		
B ph		
C ph		

### INTERRUPTER NITROGEN PRESSURE

A ph	/	Kpa	B ph	/	Kpa	C ph	/	Kpa
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### OPERATING MECHANISM

PNEUMATIC REGULATED ( AIR ) OPERATOR: ( If Applicable )

OPERATING PRESSURE :

SPRING CHARGING ( MOTOR ) OPERATOR: ( If Applicable )

MOTOR AMPERAGE:

CABINET HEATER: \_\_\_\_\_ AMPS

AFTER OPERATING: Counter: \_\_\_\_\_

### CHECKS COMPLETED:

\_\_\_\_\_ Check Primary Connections and Bushings

\_\_\_\_\_ Check Control Wiring

\_\_\_\_\_ Lubricate Hinges

Doble Test Performed: \_\_ Yes \_\_ No

### ONLY IF INSTRUCTED

\_\_\_\_\_ Internal Inspection

\_\_\_\_\_ Oil Analysis

## 6- YEAR 69/230 KV - MINIMUM OIL CIRCUIT BREAKER INSPECTION

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ Nominal Voltage Class: \_\_\_\_\_  
Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E.W/O #: \_\_\_\_\_

### COMMENTS:

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# 6 Year PM – 138/69 KV OIL CIRCUIT BREAKER INSPECTION

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ Nominal Voltage Class: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E.W/O #: \_\_\_\_\_

WEATHER CONDITIONS: \_\_\_\_\_ dry \_\_\_\_\_ rain \_\_\_\_\_ humidity \_\_\_\_\_ temperature

**NOTE: All TESTS MUST BE COMPLETED OR MARKED N/A (unless otherwise Instructed).**

BEFORE OPERATING:	OPERATION COUNTER	PRESSURE	KPA ( 138 KV KSO ONLY )
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CONTROL COIL RESISTANCE	3-PH TRIP:	3- PH CLOSE:
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INTERRUPTING RESISTORS ( 138 KV KSO ONLY )			
A-PH	Ω	B-PH	Ω
		C-PH	Ω

INTERRUPTOR MEGGER TEST 5 kV ( Phase to Ground / Breaker in Close position):		
A ph	B ph	C ph

ACCEPTABLE DUCTOR READING		
138 KV- KSO < 900 μOhm		
69 KV- KSO/FKP < 450 μOhm		
	% CURRENT	MICRO Ω
A ph		
B ph		
C ph		

BUSHING OIL LEVEL ( LOW/NORMAL/HIGH )			
LINE:	A	B	C
LOAD:	A	B	C

OPERATING MECHANISM			
PNEUMATIC REGULATED ( AIR ) OPERATOR: ( COMPRESSOR INSPECTION ) ( 138 KV KSO Only )			
CUT IN	KPA	CUT OUT	KPA
RECHARGE TIME	MIN.		
L.PRESSURE ALARM KPA			
MOTOR AMPERAGE			
SPRING CHARGING ( MOTOR ) OPERATOR: ( FKP Type Only )			
MOTOR AMPERAGE			
SOLENOID TYPE OPERATOR: ( 69 KV KSO Only )			
SOLENIOD RESISTANCE Ω			

HEATER AMPERAGE:	CONTROL CABINET	A	TANK	A
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AFTER OPERATING:	OPERATION COUNTER	PRESSURE	KPA (138 KV KSO ONL )
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## 6 Year PM – 138/69 KV OIL CIRCUIT BREAKER INSPECTION

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ Nominal Voltage Class: \_\_\_\_\_  
Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E.W/O #: \_\_\_\_\_

OIL INSULATION TEST: ASTM D877 (field) – Dielectric (kV): \_\_\_\_\_ (Min. 22 KV)

### CHECKS COMPLETED:

- \_\_\_\_\_ Check Primary Connections and Bushings
- \_\_\_\_\_ Lubricate Control Cabinet Door Hinges
- \_\_\_\_\_ Check Control Wiring
- \_\_\_\_\_ Check Tank Paint/Rust Condition
- \_\_\_\_\_ Lubricate Mechanism
- \_\_\_\_\_ Check OCB Oil Level

### 138 KV KSO Only

- \_\_\_\_\_ Check for Air Leaks
- \_\_\_\_\_ Drain Air Receiver
- \_\_\_\_\_ Check External Closing Dashpot Oil Level (Breaker Open)

### ONLY IF INSTRUCTED

- \_\_\_\_\_ Internal Inspection
- \_\_\_\_\_ Timing/ Motion Analyzer Test

### CHECKS COMPLETED:

\_\_\_\_\_ Doble Test Performed: \_\_ Yes \_\_ No

### COMMENTS:

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# 6 Year – 230 KV DLF AIR BLAST CIRCUIT BREAKER INSPECTION

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ Nominal Voltage Class: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E.W/O #: \_\_\_\_\_

WEATHER CONDITIONS: ☐ dry ☐ rain ☐ humidity ☐ temperature

**NOTE: ALL TESTS MUST BE COMPLETED OR MARKED N/A ( unless otherwise Instructed ).**

BEFORE OPERATING: Pressure \_\_\_\_\_ kPa Counter: \_\_\_\_\_

ACCEPTABLE DUCTOR READINGS < 120 $\mu$ Ohm		
	% CURRENT	$\mu$ Ohm
A ph		
B ph		
C ph		

MEGGER TEST 5 KV ( PHASE TO GROUND )					
A PH	Mega $\Omega$	B PH	Mega $\Omega$	C PH	Mega $\Omega$

TIMING TEST (milliseconds)			
	A	B	C
3-PH Close			
3-PH Trip			
Trip Free (dwell)			
Disagreement On Trip			
Resistor Contacts			

Command Current Close \_\_\_\_\_ amps Trip \_\_\_\_\_ amps

**NOTE: THE BREAKER ( TIMING TEST ) PERFORMANCE REPORT INCLUDING ALL MAIN CONTACTS SHOULD BE ATTACHED TO THE COMPLETED INSPECTION FORM.**

CONTROL CIRCUIT RESISTANCE (Ohms): ( test to be completed from the Control Cabinet Terminal Board )						
Trip Coil # 1:	A ph	Ω	B ph	Ω	C ph	Ω
Trip Coil # 2:	A ph	Ω	B ph	Ω	C ph	Ω
Close:	A ph	Ω	B ph	Ω	C ph	Ω

HEATER AMPERAGE		
CABINET HEATER :		
CONTROL BLOCKS:	A:	B: C:



PRESSURE SETTINGS (kPa)		
	Found	Left
Block Reclose		
Block Trip		
Aux Block Trip		
Block Close		
Low Pressure Alarm		

☐ Check for Air Leaks  
☐ Lubricate Control Blocks  
☐ Check Primary Connections and Bushings  
☐ 20 Minute Pressure Drop  
☐ Clean Air Intake Filters  
☐ Clean Main Filters  
☐ A ph Control Block Aux Contacts  
☐ B ph Control Block Aux Contacts  
☐ C ph Control Block Aux Contacts  
☐ Control Cabinet Aux Contacts  
☐ Visually Inspect  
 Double Test Performed: ☐ Yes ☐ No

[illegible]

# 6 YEAR - AIR BLAST CIRCUIT BREAKER 230/138 KV DCF/DCVF INSPECTION

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ Nominal Voltage Class: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E.W/O #: \_\_\_\_\_

WEATHER CONDITIONS: \_\_\_\_\_ dry \_\_\_\_\_ rain \_\_\_\_\_ humidity \_\_\_\_\_ temperature  
 BEFORE OPERATING: Pressure \_\_\_\_\_ kpa: \_\_\_\_\_ Counter: \_\_\_\_\_

**NOTE: All TESTS MUST BE COMPLETED OR MARKED N/A (unless otherwise Instructed).**

DUCTOR ( RESISTANCE ) READING ACCEPTABLE READING < 350 $\mu$ OHM 230 KV <250 $\mu$ OHM 138 KV			
	% CURRENT	MICRO $\Omega$	
A ph			
B ph			
C ph			

TIMING TEST (milliseconds)			
	A	B	C
3-PH Close			
3-PH Trip			
Trip Free (dwell)			
Disagreement On Trip			
Resistor Contacts			

Command Current Close \_\_\_\_\_ amps Trip \_\_\_\_\_ amps

**NOTE: THE BREAKER ( TIMING TEST ) PERFORMANCE REPORT INCLUDING ALL MAIN & RESISTOR CONTACTS SHOULD BE ATTACHED TO THE COMPLETED INSPECTION FORM. ( If Applicable )**

CONTROL CIRCUIT RESISTANCE (Ohms): ( Tests to be Completed from Control Cabinet Terminal Board )				
Trip Coil # 1:	A ph	$\Omega$	B ph	$\Omega$
Trip Coil # 2:		$\Omega$		$\Omega$
Close:	A ph	$\Omega$	B ph	$\Omega$
			C ph	$\Omega$

HEATER : AMPS	CABINET HEATER:		
CONTROL BLOCKS:	A:	B:	C:

### PRESSURE SETTINGS (kPa)

### AFTER OPERATING:

Counter: 10000

\_\_\_\_\_ A ph Control Block Aux Contacts  
 \_\_\_\_\_ B ph Control Block Aux Contacts  
 \_\_\_\_\_ C ph Control Block Aux Contacts  
 \_\_\_\_\_ Control Cabinet Aux Contacts  
 \_\_\_\_\_ Clean Main Filters

\_\_\_\_\_ Inspect 1 Arcing Chamber  
Chamber Lubrication Required \_\_\_\_\_ Yes \_\_\_\_\_ No

## Doble Test Performed: Yes No

Blank lined paper for writing.

# 6 YEAR - SF<sub>6</sub> 230 KV CAT ARM BREAKER INSPECTION

System ID: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E.W/O #: \_\_\_\_\_

**NOTE: All TESTS MUST BE COMPLETED OR MARKED N/A (Unless Otherwise Instructed ).**

## BEFORE OPERATING:

SF<sub>6</sub> Pressure \_\_\_\_\_ kPa Air. Pressure \_\_\_\_\_ kPa  
 Phase Counters: A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_

NOTE: L47T1 CURRENT POINTS ( b - g ) POTENTIAL POINTS ( c - d )  
 L47T2 CURRENT POINTS ( b - g ) POTENTIAL POINTS ( e - f )

## ACCEPTABLE DUCTOR READINGS 230 KV -< 100 μOhm COMPLETE DUCTOR FORM

	% CURRENT	MICRO Ω
A ph		
B ph		
C ph		

## TIMING TEST (milliseconds)

	A	B	C
3-PH Close			
3-PH Trip			
Trip Free (dwell)			
Disagreement On Trip			

Command Current Close \_\_\_\_\_ amps Trip \_\_\_\_\_ amps

**NOTE: THE BREAKER ( TIMING TEST ) PERFORMANCE REPORT INCLUDING ALL MAIN CONTACTS SHOULD BE ATTACHED TO THE COMPLETED INSPECTION FORM.**

## CONTROL COIL RESISTANCE (Ohms): ( test to be completed from the Control Cabinet Terminal Board )

Trip Coil # 1:	A ph	Ω	B ph	Ω	C ph	Ω
Trip Coil # 2:	A ph	Ω	B ph	Ω	C ph	Ω
Close:	A ph	Ω	B ph	Ω	C ph	Ω

DENSITY MONITOR TEST ( KPA ) SF6 LOW: \_\_\_\_\_ LOCKOUT: \_\_\_\_\_

# 6 YEAR - SF<sub>6</sub> 230 KV CAT ARM BREAKER INSPECTION

System ID: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E.W/O #: \_\_\_\_\_

GAS PRESSURE SWITCH READINGS (kPa) (operate / reset)				
	Found		Left	
L.P. SF6 Alarm (63GA)				
L.P.SF6 Block (63GL)				
L.P.SF6 Alarm Bus (63GI)				
L.P. Air Alarm(63AL)				
L.P Air Block(63AR)				

## PNEUMATIC SYSTEM INSPECTION:

\_\_\_\_\_ Check Safety Relief Valve  
 \_\_\_\_\_ Drain Condensate-Dryer  
 \_\_\_\_\_ 20 min. Pressure Drop  
 \_\_\_\_\_ Lubricate Mechanism  
 \_\_\_\_\_ Report any SF6 losses to EERP during Top Up.

## CHECKS COMPLETED:

Doble Test Performed: \_\_\_ Yes \_\_\_ No  
 \_\_\_ Check Primary Connections and Bushings

SF<sub>6</sub> GAS: Dew Point: \_\_\_\_\_ Operating Temp: \_\_\_\_\_

## AFTER OPERATING:

SF<sub>6</sub> Pressure \_\_\_\_\_ kPa Air Pressure \_\_\_\_\_ kPa  
 Phase Counters: A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_

## COMMENTS:

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# 6 YEAR –CAT ARM CIRCUIT BREAKER & DISCONNECT INSPECTION DUCTOR FORM

Date: \_\_\_\_\_

Readings By: \_\_\_\_\_

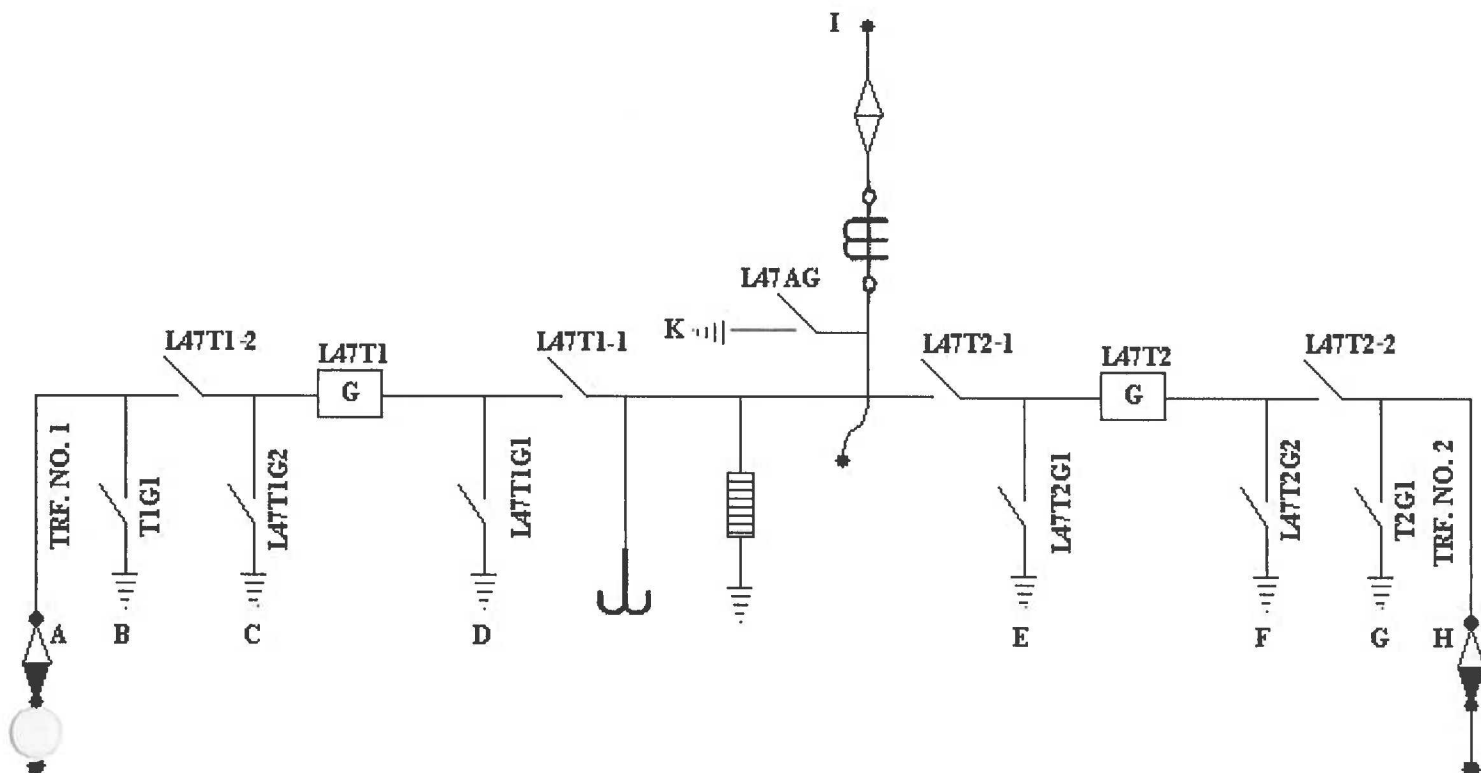
Section	Phase A		Phase B		Phase C	
	Resistance ( $\mu\Omega$ )	Tolerance at 20 <sup>0</sup> C	Resistance ( $\mu\Omega$ )	Tolerance at 20 <sup>0</sup> C	Resistance ( $\mu\Omega$ )	Tolerance at 20 <sup>0</sup> C
B – C						
C – D						
D - E						
D – K						
K – E						
E – F						
F - G						

\*\* Current connection points are B & G

\*\* Record on resistance for L47T1-2 will include T1G1 ( B – C )

\*\* Record on resistance for L47T2-2 will include T2G1 ( F – G )

Ground connections to ground switches will be disconnected for test



## 6-YEAR - SF<sub>6</sub> CIRCUIT BREAKER INSPECTION

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ Nominal Voltage Class: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E.W/O #: \_\_\_\_\_

WEATHER CONDITIONS: ☐ dry ☐ rain ☐ humidity ☐ temperature

**NOTE: All TESTS MUST BE COMPLETED OR MARKED N/A ( unless otherwise Instructed ).**

### BEFORE OPERATING: ( If Applicable )

SF6 Pressure:	Kpa.	Air Pressure:	Kpa.	Hydraulic Pressure:	Kpa.
Operation Counters:	3 ph	A ph	B ph	C ph	

DENSITY MONITOR TEST (kPa): SF<sub>6</sub> Low: \_\_\_\_\_ Lockout: \_\_\_\_\_

### ACCEPTABLE DUCTOR READINGS

230 KV SIEMENS-3AQ1- < 50 μOhm

230 KV ELF & SPRECH SCHU. < 150 μOhm

138 KV < 100 μ Ohms

	% CURRENT	MICRO Ω
A ph		
B ph		
C ph		

### TIMING TEST (milliseconds)

	A	B	C
3-PH Close			
3-PH Trip			
Trip Free (dwell)			
Disagreement On Trip			

Command Current Close \_\_\_\_\_ amps Trip \_\_\_\_\_ amps

### 3AQ1 ACCEPTABLE TIMING

TEST	NORMAL	WITH RC ELEMENTS
CLOSE	100 +/- 5MS	100 +/- 5MS
TRIP	36 +/- 3MS	23 +/- 3MS
TRIP FREE	65 +/- 10MS	65 +/- 10MS

**NOTE: THE BREAKER ( TIMING TEST ) PERFORMANCE REPORT INCLUDING ALL MAIN CONTACTS SHOULD BE ATTACHED TO THE COMPLETED INSPECTION FORM.**

### CONTROL COIL RESISTANCE (Ohms): ( test to be completed from the Control Cabinet Terminal Board )

Trip Coil # 1:	A ph	Ω	B ph	Ω	C ph	Ω
Trip Coil # 2:	A ph	Ω	B ph	Ω	C ph	Ω
Close:	A ph	Ω	B ph	Ω	C ph	Ω

## 6-YEAR - SF<sub>6</sub> CIRCUIT BREAKER INSPECTION

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ Nominal Voltage Class: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E.W/O #: \_\_\_\_\_

HEATER AMPERAGE:			
CABINET HEATER :			
CONTROL BLOCKS:	A:	B:	C:

OPERATING MECHANISM			
PNEUMATIC REGULATED ( AIR ) OPERATOR: ( If Applicable )		OPERATE SAFETY RELIEF VALVE	
HYDRAULIC OPERATOR: ( If Applicable )		HYD.PUMP AMPS.	HYD PUMP HOURS
CUT IN:	KPA	CUT OUT	KPA
PNEUMATIC REGULATED ( AIR ) OPERATOR: ( COMPRESSOR INSPECTION ) ( If Applicable )			
CUT IN	KPA	CUT OUT	KPA
COMPRESSOR HOURS		DRYER COUNTER	MOTOR AMPERAGE
SPRING CHARGED ( MOTOR ) OPERATOR: ( If Applicable )			
MOTOR AMPERAGE			

SF<sub>6</sub> GAS:      Dew Point: \_\_\_\_\_      Operating Temp: \_\_\_\_\_

### CHECKS COMPLETED:

PRESSURE SETTINGS (kPa)		
	Found	Left
Block Reclose		
Block Trip		
Block Close		
Low Air Pressure Alarm		
N <sub>2</sub> General Loss ( Hyd. Breakers )		

- \_\_\_ Check Pullrod Connections
- \_\_\_ Check Primary Connections and Bushings
- \_\_\_ Lubricate Mechanism
- \_\_\_ Change Breaker Compressor Oil
- \_\_\_ Check Control Wiring
- \_\_\_ Check All Heaters  
( Including any Operating Rod's Heaters )
- \_\_\_ Air Operated Breakers  
( Drain Air Condensate Dryer, 20 Minute Pressure drop Test )

AFTER OPERATING: ( If Applicable )					
SF <sub>6</sub> Pressure:		Kpa.	Air Pressure:		Kpa.
Operation Counters:		3 ph	A ph	B ph	C ph

### CHECK COMPLETED:

Doble Test Performed: \_\_\_ Yes \_\_\_ No

\_\_\_ Report any SF<sub>6</sub> losses per EERP during Top Up.

### ONLY IF INSTRUCTED:



## 6-YEAR - SF<sub>6</sub> CIRCUIT BREAKER INSPECTION

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ Nominal Voltage Class: \_\_\_\_\_  
Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E.W/O #: \_\_\_\_\_

- ☐ Check Pull Rod Connections  
☐ Gas Analysis

### COMMENTS:

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# Circuit Switchers

## **CIRCUIT SWITCHER MAINTENANCE PROCEDURE**

*Page 1 of 1*

### **120 DAY GENERAL INSPECTION**

- 1 Check Gas Pressure Indicators on Interrupters.  
Clear – Normal  
Red – Loss of Gas
- 2 Check blades are properly closed and alignment.
- 3 Check insulators for chips, tracking and oil leaks (if applicable).
- 4 Check arcing horns and blades for signs of burning.
- 5 Check motor mechanism for voltage supply, parts clean and dry, lubrication as required.
- 6 Check heater.
- 7 Complete 120 Day-Circuit Switcher Inspection Form.

### **6 YEAR PM INSPECTION**

- 8 Outage required.
- 9 Check all items on the 120 Day-Circuit Switcher Inspection Form.
- 10 Check and record motor amperage
- 11 Complete interrupter resistance (Ductor) test.
- 12 Check rubber spider of motor coupling for wear and cracks.
- 13 Operate shunt trip, if applicable, blades will open after shunt trip is initiated.
- 14 Complete interrupter resistor check, if applicable. (Four Meg Ohms). Open switch manually and stop after audible trip of interrupters.
- 15 Complete 6 Year -230/138 kV Circuit Switcher Inspection Form.

Station: \_\_\_\_\_ Date: \_\_\_\_\_ Readings By: \_\_\_\_\_

WEATHER CONDITIONS: \_\_\_\_\_ dry \_\_\_\_\_ rain \_\_\_\_\_ humidity \_\_\_\_\_ temperature

Circuit Switcher No.					
Gas Pressure Indication (Clear/Red)	A				
	B				
	C				
Gas Pressure Indicator Gauge: ( If Equipped ) _____ KPA					
Control Source Voltage					
Heater (amps)					
Heater (On / Off)					
Motor Control (Man / Auto)					
Counter					

**CHECKS COMPLETED:**

- \_\_\_ Check disconnect blades for alignment
- \_\_\_ Check insulators for signs of burns, flashover, cracks and ( oil leaks if applicable )
- \_\_\_ Check structure condition
- \_\_\_ Check grounding
- \_\_\_ Check motor operator heater
- \_\_\_ Check control power supply
- \_\_\_ Check arcing horns
- \_\_\_ Check Concrete Base
- \_\_\_ Report any SF6 losses ( Red indicators ) as per EERP

**REMARKS:**

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## 6 YEAR - 230/138 KV CIRCUIT SWITCHER INSPECTION

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ Voltage: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E.W/O #: \_\_\_\_\_

WEATHER CONDITIONS: ☐ dry ☐ rain ☐ humidity ☐ temperature  
**NOTE: All TESTS MUST BE COMPLETED OR MARKED N/A ( unless otherwise Instructed ).**

BEFORE OPERATING: Counter \_\_\_\_\_

INTERRUPTORS SF6 PRESSURE INDICATORS		
A ph	Clear	Red
B ph	Clear	Red
C ph	Clear	Red
Pressure Indicator ( If Equipped ) _____		KPA

DUCTOR ( RESISTANCE ) READING		
	% CURRENT	MICRO $\Omega$
A ph		
B ph		
C ph		

OPERATING MECHANISM	
RING CHARGING/ ( MOTOR ) OPERATOR:	
Motor Amperage _____	Cabinet Heater _____

AFTER OPERATING: Counter \_\_\_\_\_

## CHECKS COMPLETED:

\_\_\_\_\_ Check Operation of Manual & Electrical Trip  
 \_\_\_\_\_ Check Pinned Connections in Transition Box  
 \_\_\_\_\_ Check Power train for Damage, Wear, & Corrosion  
 \_\_\_\_\_ Check Limit Switches  
 \_\_\_\_\_ Check Primary Connections  
 \_\_\_\_\_ Check Disconnect Switch Alignment (If Applicable)  
 Doble Test Performed: \_\_\_\_ Yes \_\_\_\_ No

\_\_\_\_\_ Check Break Condition  
 \_\_\_\_\_ Check & Lubricate as Required  
 \_\_\_\_\_ Check Motor Coupling

## ONLY IF INSTRUCTED

\_\_\_\_\_ Dismantle and check Pinned Connections

## COMMENTS:

# Disconnect Switches

***DISCONNECT SWITCH MAINTENANCE PROCEDURE***

*Page 1 of 3*

***DISCONNECT SWITCHES - AIR BREAK/SF6-15KV TO 230 KV***

**120 DAY GENERAL INSPECTION:**

- 1 Perform a visual check of blade positions for alignment and signs of over heating.
- 2 Check insulator stack conditions.
- 3 Check operating of motor mechanism heater.
- 4 Check control voltage and fuses.
- 5 Complete appropriate inspection 120/180 Day-Disconnect Switch Inspection Form to record:
  - a) Switch no.
  - b) Switch-Alignment: Check if okay if adjustment is required, provide details in remarks.
  - c) Insulators: Check condition (cracks, broken skirts etc.)
  - d) Heater amps (record if applicable).
  - e) Operating motor voltage source (record if applicable).

**6 YEAR PM INSPECTION: (Air Break Switches)**

- 6 Outage required.
- 7 Manually operate the switch and check contact alignment, toggles, stops, linkage and ease of operation.
- 8 Check contact pressure - observe jaw spread as blade rotates in jaw.
- 9 On Kearney switches check that the blade is positioned opposite the pressure springs in the jaws.
- 10 Check contacts for burns or wear.
- 11 Check the silver plating for peeling or deterioration.
- 12 Check hinge end shunts or wiping contact.



***DISCONNECT SWITCH MAINTENANCE PROCEDURE***

*Page 2 of 3*

- 13 Clean contacts and lubricate by applying grease and then removing so there is only a light film left. If too much grease is applied, it will harden. Lubricate linkage pivot points.
- 14 Check cap screws, bolts, lock nuts, pins, etc. for tightness. On double horizontal break switches, remove cover from centre stacks and check gear bolts and pivot.
- 15 If the switch is equipped with arcing horns, see that beads of material caused by burning are removed.
- 16 Check shunts for tightness, fraying or deterioration.
- 17 Check line connections to the switch.
- 18 Check that there is a minimum of stress on the insulator stack from the line connections.
- 19 Gear box covers should be removed, if readily accessible, for inspection and lubrication of gears.
- 20 Check that switch grounding is tight and undamaged.
- 21 Ground mats, if supplied, should be checked for continuity with the station grounding system.
- 22 Lubricate, where necessary.
- 23 Test operate manually and electrically.
- 24 Check grounding device on drive mechanism.

**MOTOR MECHANISM**

- 25 Check the operation of the mechanism space heater.
- 26 Contacts on auxiliary switches and motor circuits should be cleaned.
- 27 Auxiliary contacts should be checked for compression and alignment.
- 28 Check wiring connections for tightness.
- 29 Apply a light film of multi-purpose grease to the gear train.
- 30 Apply a few drops of light oil to the main bearings.

DISCONNECT SWITCH MAINTENANCE PROCEDURE

Page 3 of 3

- 31 Check interlock switches and locking devices for proper operation.
- 32 Observe the mechanism during switch operations.
- 33 Operate in motor both local and remote.  
*Note: Check that indicating lights on panels work, and that in motor mode, the switch does not bring up hard against stops.*
- 34 Complete appropriate inspection form.

**GROUND SWITCHES-HIGH SPEED SOLENOID OPERATED/MANUAL RESET**

- 35 Check and record solenoid resistance.
- 36 Check auxiliary contacts and switches.
- 37 Check electrical operation.
- 38 Check cable terminations.
- 39 Check junction boxes for moisture.
- 40 Complete appropriate inspection form.

**DISCONNECT SWITCHES WITH (LOAD BREAK) VACUUM MODULES**

- 1 Complete lubrication.
- 2 Complete resistance (Ductor) test on each vacuum module (Max 1500 Micro  $\Omega$  each Module)
- 3 Complete AC High Potential test, if instructed.
- 4 Paint interrupter housing, if required. (Use manufactures recommended paint.)
- 5 Complete appropriate inspection form.

## 120/180 DAY - DISCONNECT SWITCH INSPECTION

Station: \_\_\_\_\_

Date: \_\_\_\_\_

Readings By: \_\_\_\_\_

Switch No.	Alignment	Insulators ( Condition )	Motor ( Operator )	
			Control Voltage	Heater (Amps)

## CHECKS COMPLETED:

- \_\_\_ Check disconnect blades for alignment
- \_\_\_ Check interlocks operating
- \_\_\_ Check insulators for signs of burns, flashover, & cracks
- \_\_\_ Check structure condition
- \_\_\_ Check grounding
- \_\_\_ Check concrete base

Note Any Concerns Below:

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6 YEAR PM - DISCONNECT SWITCH (Manual)

Equipment ID: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_

Station: \_\_\_\_\_  
Date: \_\_\_\_\_

JDE W/O #: \_\_\_\_\_  
Readings By: \_\_\_\_\_

CHECKS COMPLETED:

GENERAL

- \_\_\_ Check disconnect blades for alignment.
- \_\_\_ Check insulators for signs of burns, flashover, & cracks.
- \_\_\_ Clean insulators as necessary.
- \_\_\_ Check structure condition, grounding, and concrete base.
- \_\_\_ Check & lubricate as required: main contacts, inter linkages, & ground-slide contacts.

MAIN CONTACTS, INTER LINKAGE, & GROUND SLIDE CONTACTS

- \_\_\_ Check mechanical stops and conductor terminations.
- \_\_\_ Check all connections & tighten as necessary.
- \_\_\_ Examine contacts for burns and corrosion.
- \_\_\_ Check condition of shunt blades.
- \_\_\_ Operate manually and observe for ease of operation.
- \_\_\_ Check gear boxes for moisture.

Note Any Concerns Below:

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6 YEAR PM - DISCONNECT SWITCH (Motorized)

Equipment ID: \_\_\_\_\_ Station: \_\_\_\_\_ JDE W/O #: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_ Date: \_\_\_\_\_ Readings By: \_\_\_\_\_

CHECKS COMPLETED:

GENERAL

- \_\_\_ Check disconnect blades for alignment.
- \_\_\_ Check insulators for signs of burns, flashover, cracks & clean insulators as necessary.
- \_\_\_ Check structure condition, grounding, and concrete base.
- \_\_\_ Check & lubricate as required: main contacts, inter linkages, & ground-slide contacts.

MAIN CONTACTS, INTER LINKAGE, & GROUND SLIDE CONTACTS

- \_\_\_ Check mechanical stops, conductor terminations. Check all connections & tighten as necessary.
- \_\_\_ Examine contacts for burns and corrosion.
- \_\_\_ Check condition of shunt brads.
- \_\_\_ Operate manually and observe for ease of operation.
- \_\_\_ Check gear boxes for moisture.

VACUUM MODULES (LOAD BREAK) DISCONNECTS

- \_\_\_ Check & lubricate as required
- \_\_\_ Check & paint interrupter housing if required. (Use manufactures recommended paint.)
- \_\_\_ Complete continuity resistance (doctor) test each vacuum modules. (Max 1500 Micro  $\Omega$  each Module)
  - A ph \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ Micro $\Omega$
  - B ph \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ Micro $\Omega$
  - C ph \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ Micro $\Omega$

MOTOR

- \_\_\_ Check cable terminations.
- \_\_\_ Check local/remot disconnect operation.
- \_\_\_ Check auxiliary contacts and switches.
- \_\_\_ Check motor and brake condition.
- \_\_\_ Check operating limits and indicating lights.

Motor Open: \_\_\_\_\_ amps      Motor Close: \_\_\_\_\_ amp s  
Motor Voltage: \_\_\_\_\_ volts      Heater: \_\_\_\_\_ amps

Note Any Concerns Below:

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6 YEAR PM - GROUND SWITCH

Equipment ID: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_

Station: \_\_\_\_\_  
Date: \_\_\_\_\_

JDE W/O #: \_\_\_\_\_  
Readings By: \_\_\_\_\_

MANUAL OPERATED GROUND SWITCH

CHECKS COMPLETED:

GENERAL

- \_\_\_ Check insulators for signs of burns, flashover, & cracks.
- \_\_\_ Check ground switch blades for alignment and any pitting or burning.
- \_\_\_ Clean insulators as necessary.
- \_\_\_ Check structure condition, grounding, and concrete base.
- \_\_\_ Check & lubricate as required: main contacts, inter linkages, & ground-slide contacts.

HIGH SPEED SOLENOID OPERATED/MANUAL RESET  
( ALL CHECKS ABOVE PLUS )

OPERATING MECHANISM

- \_\_\_ Solenoid Resistance (  $\Omega$  ) \_\_\_\_\_
- \_\_\_ Check auxiliary contacts and switches.
- \_\_\_ Check electrical operation.
- \_\_\_ Check cable terminations.
- \_\_\_ Check junction boxes for moisture.
- \_\_\_ Operate electrically & manually and observe for ease of operation.

Note Any Concerns Below:

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6 YEAR PM – GROUND SWITCH (CAT ARM) (SF<sub>6</sub>)

Equipment ID: \_\_\_\_\_ JDE W/O #: \_\_\_\_\_

Manufacturer: \_\_\_\_\_ Date: \_\_\_\_\_

Readings By: \_\_\_\_\_

## RECORD MECHANICAL STOPS (mm):

Close: A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_ Open: A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_

## RECORD INTERLOCK COIL RESISTENCE (ohms):

Close: \_\_\_\_\_ open: \_\_\_\_\_ Interlock: \_\_\_\_\_

## CHECKS COMPLETED:

GENERAL

- \_\_\_ Check the contact s for alignment and any pitting or burning.
- \_\_\_ See that all bolt s, nuts, ground terminal connection s, etc. are tight.
- \_\_\_ Check & lubricate as required: (inter linkage s).
- \_\_\_ Check mechanical indicators.
- \_\_\_ Examine contacts for burns and corro sion through view port.
- \_\_\_ Operate manually and observe for ease of operation .
- \_\_\_ Check for simultaneous operation of all three poles and adjust as necessary.

ELECTRIC OPERATING MECHANISM (If Applicable)

- \_\_\_ Check manual/remote DC interlock.
- \_\_\_ Check auxiliary contacts and switches.
- \_\_\_ Check electrical operating limits.
- \_\_\_ Check local/remote operation.
- \_\_\_ Check cable terminations.

Note Any Concerns Below:

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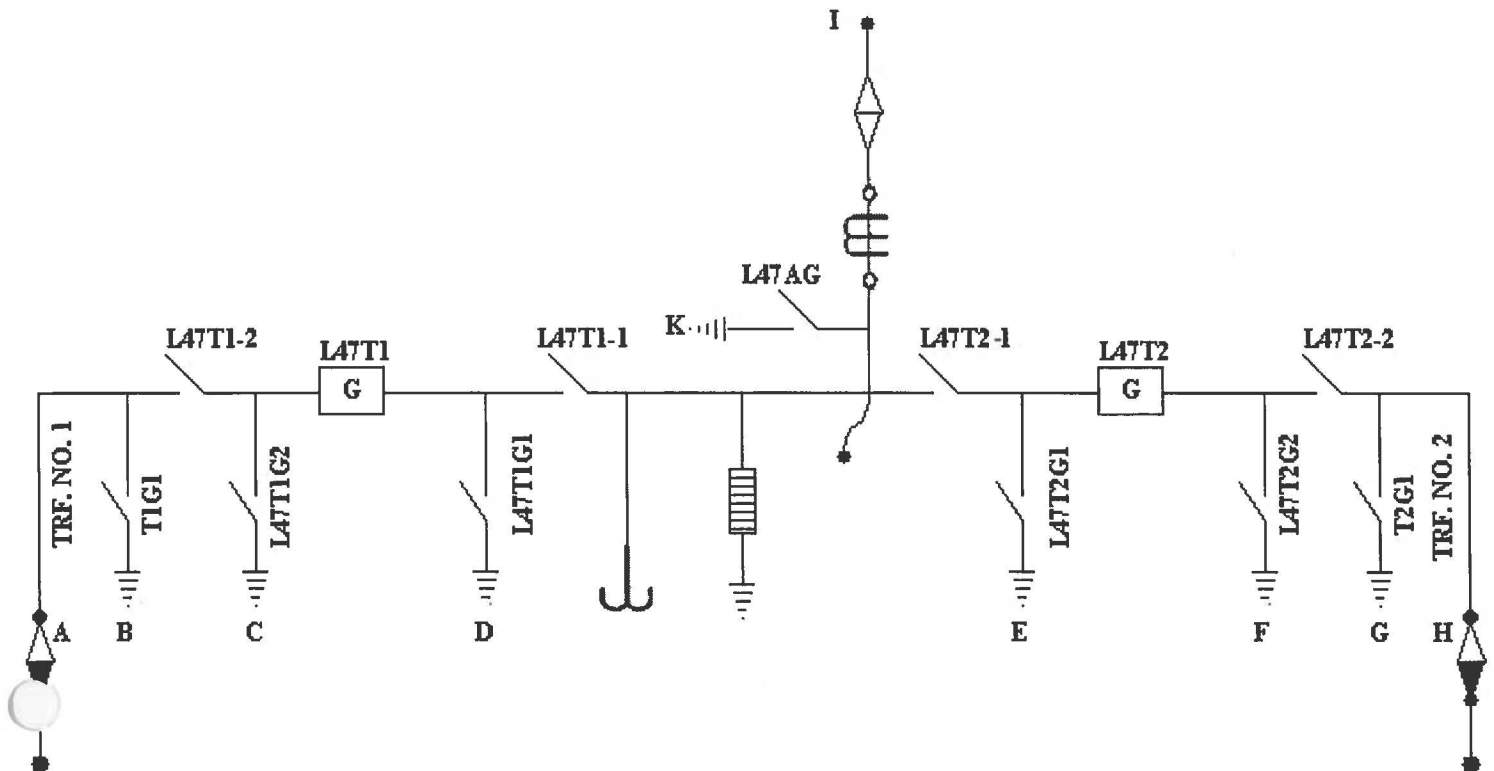


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Readings By: \_\_\_\_\_

- \*\* Current connection points are B & G
- \*\* Record on resistance for L47T1-2 will include T1G1 (B – C)
- \*\* Record on resistance for L47T2-2 will include T2G1 (F – G)
- Ground connections to ground switches will be disconnected for test



6 YEAR - DISCONNECT SWITCH PNEUMATIC (CAT ARM) (SF<sub>6</sub>)

Equipment ID: \_\_\_\_\_ JDE W/O #: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_ Date: \_\_\_\_\_ Readings By: \_\_\_\_\_

RECORD MECHANICAL STOPS (mm):

Close: A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_ Open: A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_

RECORD CONTROL COIL RESISTENCE (ohms):

Close \_\_\_\_\_ Open \_\_\_\_\_ Interlock \_\_\_\_\_

RECORD DUCTOR READING (micro ohms):

Tester Connections: Current Points (b-g) Potential Points ( \_\_\_\_\_ - \_\_\_\_\_ )

Readings: A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_

CHECKS COMPLETED:

GENERAL

- \_\_\_ Check insulators for signs of burns, flashover, & cracks.
- \_\_\_ Clean insulators as necessary.
- \_\_\_ Check structure condition, grounding, and concrete base.
- \_\_\_ Check & lubricate as required: main contacts, inter linkages, & ground-slide contact s.

OPERATING MECHANISM

- \_\_\_ Check mechanical stops and conductor terminations.
- \_\_\_ Operate manually and observe for ease of operation.
- \_\_\_ Check manual/remote DC interlock.
- \_\_\_ Check auxiliary contacts and switches.
- \_\_\_ Check operating limits and indicating lights.
- \_\_\_ Check local, remote and pneumatic operation.
- \_\_\_ Check gear boxes for moisture.

Note Any Concerns Below:

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# **Power Transformers and Shunt Reactors**

## **POWER TRANSFORMERS**

**Page 1 of 3**

### **POWER TRANSFORMER MAINTENANCE PROCEDURE:**

#### **120 DAY GENERAL INSPECTION**

**Normally completed from ground level. Visual inspection.**

- 1 Check oil levels in main tank, conservator tank, tap changer compartment and bushings. Check for oil leaks. Record findings.
- 2 Observe all HV connections for signs of overheating or broken terminations.
- 3 Inspect all oil and winding temperature devices and record findings.
- 4 Check explosion vent diaphragm for signs of damage or deterioration.
- 5 Observe for signs of oil leaks. Clean up any stains or spills.
- 6 Check condition of silica gel. Change if 50 % or more contaminated.
- 7 Check that all equipment grounds are in place and all connections are sound.
- 8 Check condition of concrete foundations for cracks and/or heaving.
- 9 Check main tank, radiators and other metal parts for signs of rust penetration.
- 10 Control Cabinets and devices:
  - 10.1 Check cabinet heaters, function test and record amperage. Observe for signs of overheating such as burn marks on adjacent wires and/or cabinet paint coating.
  - 10.2 Inspect control wiring and terminations for breaks, corrosion, overheating or damage.
  - 10.3 Manually operate each cooling fan stage and record amperage.
  - 10.4 Observe all cooling fans while running for abnormal noise, vibrations or bearing overheating.
  - 10.5 Check all cabinet doors for ease of operation. Lubricate as required.
- 11 Complete 120 Day Inspection – Power Transformer Inspection Form.

## **POWER TRANSFORMERS**

**Page 2 of 3**

### **6 Year (PM) Preventive Maintenance**

- 1 Perform on site dielectric oil test for all applicable compartments, conservator, tap change compartment and diverter switches.
- 2 Check conservative tank drain for presence of water. If water is present, drain and record.
- 3 Function test & complete 500 Volt megger test on protection devices:
  - 3.1 Winding temperature relay.
  - 3.2 Liquid temperature relay.
  - 3.3 Fault pressure gas relays & pressure relief devices.
  - 3.4 Low oil level gauge.
- 4 Tap Changer (On-Load TYPE )
  - 4.1 Record operations count before and after test.
  - 4.2 Visual inspect mechanical and tap position indicating devices and gear drives. Lubricate when necessary. Observe for mechanical parts that may be worn or loose. Confirm operation.
  - 4.3 Check wiring and contactor controls.
  - 4.3 Operate the tap-changer through the full range of taps raise and lower. Observe Operation of the tap indicating devices. Confirm electrical and mechanically limits in both raise and lower positions.
  - 4.4 Complete winding resistance test on Tap position **Found**.
  - 4.6 Complete winding resistance test on Maximum Tap position **Raise**.
  - 4.7 Complete winding resistance test on Maximum Tap position **Lower**.
  - 4.8 Complete winding resistance test on Tap position **Left**.
- 5 Check cabinet heaters ( Record Amperage ).

**POWER TRANSFORMERS**

**Page 3 of 3**

- 6 Replace oil in diverter or tap changer compartment, if instructed or if condition of oil indicates a requirement.
- 7 Check function and accuracy of Tap Changer indication Local/Remote ( control building & ECC).
- 8 Tap Changer (Off Load TYPE ):
  - 8.1 Complete winding resistance test on Tap position **Found**.
  - 8.2 Operate the tap changer through all of the tap positions to wipe contacts clean.
  - 8.3 Complete winding resistance test on Maximum Tap position **Raise**.
  - 8.4 Complete winding resistance test on Maximum Tap position **Lower**.
  - 8.5 Select final tap position and complete a mechanical centre and continuity check.
  - 8.6 Complete winding resistance test on Tap position **Left**.
- 9 Inspect all HV/LV connections, look for signs of overheating. Apply Anti-Oxid Compound (Pentrox) to all connections that were opened and are to be remade.
- 10 Complete dielectric absorption test. Record Polarization Index ( 10 Minute Divided by 1 Minute reading = Polarization Index )
- 11 Inspect all ground connections to arrestors. Complete low resistance (Ductor) test from each Arrestor Base to the closest point to the Ground Grid.
- 12 Complete a close up inspection of all porcelain for cracks and wipe down, if required .
- 13 Repair identified oil leaks.
- 14 Clean and paint rust areas found on the top of transformer tank.
- 15 Complete applicable 6 Year PM – Transformer c/w Conservator Tank Form.
- 16 Complete Doble Test, if scheduled.



## **SHUNT REACTORS**

Page 1 of 2

### **SHUNT REACTORS MAINTENANCE PROCEDURE:**

#### **120 DAY GENERAL INSPECTION FORM**

**Normally completed from ground level. Visual Inspection.**

- 1 Observe primary connections.
- 2 Check bushing conditions.
- 3 Check bushing oil levels.
- 4 Check tank and fittings for rust, paint condition.
- 5 Check if ladder guards are in place.
- 6 Check condition of silica gel. Change if 50 % or more contaminated.
- 7 Check breather "oil lock" for moisture contents and correct oil level.
- 8 Check all oil levels (normal, high, low).
- 9 Check explosion vent and fault pressure relief.
- 10 Check winding and oil temperatures for current and peak.
- 11 Check gas relay for accumulation.
- 12 Check all equipment grounding.
- 13 Check cabinet heaters.
- 14 Complete 120 Day-Power Transformer Inspection.

#### **6 Year (PM) Preventive Maintenance**

An outage will be required.

- 15 Complete items identified in the general inspection checklist.
- 16 Complete dielectric oil test on conservator tanks.
- 17 Check conservator tank drain for water.



## **SHUNT REACTORS**

Page 2 of 2

- 18 Function test protective devices:
  - 18.1 Oil temperature relay.
  - 18.2 Gas detector relay.
  - 18.3 Winding temperature relay.
  - 18.4 Fault pressure relay.
  - 18.5 Protective relay RS1000.
- 19 Complete circuit resistance check:  
(Including Wiring to Terminal Boards 500 Volt Megger test)
  - 19.1 Oil temperature relay alarm/trip.
  - 19.2 Gas detector relay alarm/trip.
  - 19.3 Fault pressure relay trip.
  - 19.4 Protection relay RS1000 trip.
  - 19.5 Conservator oil level gauge alarm.
- 20 Check conservator oil level.
- 21 Check bushing oil levels.
- 22 Check conservator low oil alarm.
- 23 Inspect all bushing connections.
- 24 Perform dielectric absorption at 5 kV (record).
- 25 Perform ground continuity (micro-ohms) on H.V. arrestors.
- 26 Complete sampling for analysis, as required.
- 27 Complete 6 Year PM Form-138kV Shunt Transformer Inspection.
- 28 Completed Doble Test, if scheduled.

**TRANSFORMER WINDING RESISTANCE TEST FORM** **PUB-NLH-082, Attachment 8**  
**Page 7 of 26, Isl Int Sys Power Outages**

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No: \_\_\_\_\_ Manufacturer: \_\_\_\_\_  
 Type: OLTC \_\_\_\_\_ TC \_\_\_\_\_ High Voltage \_\_\_\_\_ Low Voltage \_\_\_\_\_ Tester Serial No: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E. W/O #: \_\_\_\_\_

VECTORS:      HV:      LV:      TERT:

- NOTE:** 1- Complete Winding Resistance Test on Tap Position **Found**.  
 2- Complete Winding Resistance Test on Maximum Tap Position **Raise**.  
 3- Complete Winding Resistance Test on Maximum Tap Position **Lower**.  
 4- Confirm Mechanical Center ( Off Load Tap Changers ).  
 5- Complete Winding Resistance Test on Tap Position **Left**.

TAP CHANGER LOCATION:    HV \_\_\_\_\_ LV \_\_\_\_\_

TAP POSITION	WINDING TESTED	CURRENT RANGE	RESISTANCE RANGE	% CURRENT	RESISTANCE	RESISTANCE DELTA x 1.5
Found _____						
Found _____						
Found _____						
Max. Raise _____						
Max. Raise _____						
Max. Raise _____						
Max. Lower _____						
Max. Lower _____						
Max. Lower _____						
Left _____						
Left _____						
Left _____						
Non Tap Winding						
Non Tap Winding						
Non Tap Winding						
Tertiary Winding						
Tertiary Winding						
Tertiary Winding						

**Note: Observe Indicator Light & Record OHMS or MILLI-OHMS**

**REMARKS:**

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VECTORS:      HV:      LV:      TERT:

Page 1 of 1

120 DAY - POWER TRANSFORMER INSPECTION

Station: \_\_\_\_\_ Date: \_\_\_\_\_ Readings By: \_\_\_\_\_

WEATHER CONDITIONS: dry: ☐ rain: ☐ humidity: ☐ ambient temperature: \_\_\_\_\_ °C

NOTE: All ITEMS MUST BE COMPLETED OR MARKED N/A (unless otherwise Instructed).

Visual Inspection:

- > Primary terminations
- > Tank & fittings
- > Explosion vent
- > Check for gas accumulation
- > Paint conditions
- > Temperatures (Current & Peak)
- > Check bushings and lightening arrestors
- > Access ladder/guard
- > Foundation
- > Silica Gel Breather checked
- > Oil Levels (Normal, High, Low)
- > Check vacuum pressure gauge (Sealed Units if equipped)
- > Rust Condition
  - A - Minor
  - B - Moderate
  - C - Severe
- > Check Concrete Base
- > Check & Report all Oil leaks  
As per EERP  
(Environmental Emergency Response Plan)

Operate Manually:

- > Cabinet heater thermostat
- > Fan controls
- > Circulating Pumps Controls  
( T1, T2, T3-HRDTS)

Trf. No. \_\_\_\_\_ Tap Pos. \_\_\_\_\_

Load: M.W. \_\_\_\_\_ (or) Amps \_\_\_\_\_

Temp: Winding \_\_\_\_\_ /Peak \_\_\_\_\_ Oil: \_\_\_\_\_ /Peak \_\_\_\_\_

Reset Drag Hands Once Completed: \_\_\_\_\_

Oil Levels: Tank \_\_\_\_\_ Tap Chr. \_\_\_\_\_ Bush. \_\_\_\_\_

Vacuum Pressure Gauge (Sealed Unit, if equipped) KPA: \_\_\_\_\_

SF<sub>6</sub> Bushing Diff. (kPa): H1 \_\_\_\_\_ H2 \_\_\_\_\_ H3 \_\_\_\_\_

Fan Load Current (amps): Stage I \_\_\_\_\_ Stage II \_\_\_\_\_

Fan Control Return to Auto/Remote \_\_\_\_\_

Cabinet Heaters: On \_\_\_\_\_ Off \_\_\_\_\_ Amps \_\_\_\_\_

Tap Chr: Counter \_\_\_\_\_

Rust Condition: Tank \_\_\_\_\_ Cont.Cabinet \_\_\_\_\_ Rads \_\_\_\_\_

Silica Gel: OK \_\_\_\_\_ Replace if 50% or Greater Contamination: \_\_\_\_\_

Explosion Vent Diaphragm \_\_\_\_\_

Remarks: \_\_\_\_\_

Trf. No. \_\_\_\_\_ Tap Pos. \_\_\_\_\_

Load: M.W. \_\_\_\_\_ (or) Amps \_\_\_\_\_

Temp: Winding \_\_\_\_\_ /Peak \_\_\_\_\_ Oil: \_\_\_\_\_ /Peak \_\_\_\_\_

Reset Drag Hands Once Completed: \_\_\_\_\_

Oil Levels: Tank \_\_\_\_\_ Tap Chr. \_\_\_\_\_ Bush. \_\_\_\_\_

Vacuum Pressure Gauge (Sealed Unit, if equipped) KPA: \_\_\_\_\_

SF<sub>6</sub> Bushing Diff. (kPa): H1 \_\_\_\_\_ H2 \_\_\_\_\_ H3 \_\_\_\_\_

Fan Load Current (amps): Stage I \_\_\_\_\_ Stage II \_\_\_\_\_

Fan Control Return to Auto/Remote \_\_\_\_\_

Cabinet Heaters: On \_\_\_\_\_ Off \_\_\_\_\_ Amps \_\_\_\_\_

Tap Chr: Counter \_\_\_\_\_

Rust Condition: Tank \_\_\_\_\_ Cont.Cabinet \_\_\_\_\_ Rads \_\_\_\_\_

Silica Gel: OK \_\_\_\_\_ Replace if 50% or Greater Contamination: \_\_\_\_\_

Explosion Vent Diaphragm \_\_\_\_\_

Remarks: \_\_\_\_\_

Trf. No. \_\_\_\_\_ Tap Pos. \_\_\_\_\_

Load: M.W. \_\_\_\_\_ (or) Amps \_\_\_\_\_

Temp: Winding \_\_\_\_\_ /Peak \_\_\_\_\_ Oil: \_\_\_\_\_ /Peak \_\_\_\_\_

Reset Drag Hands Once Completed: \_\_\_\_\_

Oil Levels: Tank \_\_\_\_\_ Tap Chr. \_\_\_\_\_ Bush. \_\_\_\_\_

Vacuum Pressure Gauge (Sealed Unit, if equipped) KPA: \_\_\_\_\_

SF<sub>6</sub> Bushing Diff. (kPa): H1 \_\_\_\_\_ H2 \_\_\_\_\_ H3 \_\_\_\_\_

Fan Load Current (amps): Stage I \_\_\_\_\_ Stage II \_\_\_\_\_

Fan Control Return to Auto/Remote \_\_\_\_\_

Cabinet Heaters: On \_\_\_\_\_ Off \_\_\_\_\_ Amps \_\_\_\_\_

Tap Chr: Counter \_\_\_\_\_

Rust Condition: Tank \_\_\_\_\_ Cont.Cabinet \_\_\_\_\_ Rads \_\_\_\_\_

Silica Gel: OK \_\_\_\_\_ Replace if 50% or Greater Contamination: \_\_\_\_\_

Explosion Vent Diaphragm \_\_\_\_\_

Remarks: \_\_\_\_\_

## 6 YEAR PM – 138 KV SHUNT TRANSFORMER INSPECTION

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ M.V.A: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E. W/O #: \_\_\_\_\_

**NOTE: All TESTS MUST BE COMPLETED OR MARKED N/A (unless otherwise Instructed).**

WEATHER CONDITIONS: dry: ☐ rain: ☐ humidity: ☐ ambient temperature: \_\_\_\_\_ °C  
 DIELECTRIC OIL TEST ASTM D-1816 (kV): \_\_\_\_\_ Conservator: \_\_\_\_\_

## LIQUID TEMP RELAY: (Check if Applicable)

Alarm: Setting: _____ °C	Found _____ °C	Left _____ °C
Trip: Setting: _____ °C	Found _____ °C	Left _____ °C
Yes ___ N/A ___		

## FAULT PRESSURE RELAY: (GAS DETECTOR)

Alarm:	Found _____ (cc)	Left _____ (cc)
Trip:	Found _____ (kpa)	Left _____ (kpa)

## FAULT PRESSURE RELEASE DEVICES: (Check if Applicable)

Function Test Control Circuit: (Relay # )	Tested Ok _____
Function Test Control Circuit: (Relay RS1000)	Tested Ok _____

## CONSERVATOR TANK: ( Function Test Low level Alarm ) OK \_\_\_\_\_

**RESISTANCE CHECKS:** (including Wiring to Terminal Boards) 500 Volt Test  
 Test & record in Mega Ohms or N/A (acceptable readings > 500 Mega Ohm)

	Line 1-line 2	Line 1/2 - GND
Liquid Temp Relay: Alarm		
Trip		
Fault Pressure Relay: Alarm		
Trip		
Conservator O/L Gauge: Alarm		

**\*\* Caution:** Confirm all Primary Protection Circuits are open before Closing Links.

CHECK OIL LEVEL: ( High , Normal , Low )			Conservator Tank
HV BUSHINGS:	H1	H2	H3
LV BUSHINGS:	HO1	HO2	HO3

## CABINET HEATER AMPERAGE:

## GROUND CONTINUITY: ( Micro-Ohms )

HV. ARRESTORS:	H1	H2	H3
LV BUSHINGS/GROUND:	HO1	HO2	HO3

CORE GROUND: ( 500 Volt test ) Externally Connected Yes \_\_\_\_\_ No \_\_\_\_\_



6 YEAR PM – 138 KV SHUNT TRANSFORMER INSPECTION

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ M.V.A: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E. W/O #: \_\_\_\_\_

RESISTOR: (Ohms)	CORE GROUND: (Mega Ohms)
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DIELECTRIC ABSORPTION (5 KV): 10 MIN. ÷ 1 MIN. = INDEX					
H1/H0 - H2/H0/H3H0/GND	1 Min.	Mega Ω	10 Min.	Mega Ω	Index. %
H2/H0 - H1/H0/H3H0/GND	1 Min.	Mega Ω	10 Min.	Mega Ω	Index. %
H3/H0 - H1/H0/H2H0/GND	1 Min.	Mega Ω	10 Min.	Mega Ω	Index. %
H1/H0/H2/H0/H3H0 - GND	1 Min.	Mega Ω	10 Min.	Mega Ω	Index. %

RUST/PAINT CONDITION (A - Minor , B – Moderate , C – Severe)	
MAIN TANK:	RADIATORS:
CONTROL CABINET:	OTHER:

CHECKS COMPLETED:

- |   |   |
|---|---|
| <input type="checkbox"/> Check HV & LV Connections                      | <input type="checkbox"/> Silica Gel Checked replace if 50% or more Contaminated |
| <input type="checkbox"/> Check porcelain insulators for chips or cracks | <input type="checkbox"/> Visual Check for Dirty Insulators & Clean if Necessary |
| <input type="checkbox"/> Check Paint/Rust Condition (Main Tank)         | <input type="checkbox"/> Check Conservator For Water & Drain if Necessary       |
|   | Doble Test Performed: <input type="checkbox"/> Yes <input type="checkbox"/> No  |

CHECKS COMPLETED ONLY IF INSTRUCTED:

- ☐ Obtain Gas Analysis Sample  
☐ Capacitive Bridge Testing

COMMENTS:

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## 6 YEAR PM – 230 KV TRANSFORMER INSPECTION (CAT ARM)

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ M.V.A: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E. W/O #: \_\_\_\_\_

**NOTE: All TESTS MUST BE COMPLETED OR MARKED N/A (Unless Otherwise Instructed).**

WEATHER CONDITIONS: dry: ☐ rain: ☐ humidity: ☐ ambient temperature: \_\_\_\_\_ °C  
 DIELECTRIC OIL TEST ASTM D-1816 (kV): \_\_\_\_\_ Conservator: \_\_\_\_\_

WINDING TEMP RELAY: ( Check if Applicable )			
First Stage Fans: Settings _____ °C	Found _____ °C	Left _____ °C	
Alarm: Settings _____ °C	Found _____ °C	Left _____ °C	
Trip: Settings _____ °C	Found _____ °C	Left _____ °C	

LIQUID TEMP RELAY: ( Check if Applicable )			
Alarm: Settings _____ °C	Found _____ °C	Left _____ °C	
Trip: Settings _____ °C	Found _____ °C	Left _____ °C	

FAULT PRESSURE RELAY: (IN LINE GAS DETECTOR) Function Test Control Circuit: Alarm \_\_\_\_\_ Trip \_\_\_\_\_

LOW PRESSURE ALARM (63G1) Kpa (Lightning arrestors)  
 Found: Operate: \_\_\_\_\_ / Reset: \_\_\_\_\_ Left: Operate: \_\_\_\_\_ / Reset: \_\_\_\_\_

BUSHING/TRANSFORMER INTERFACE MONITOR ( KPA ) ( Normal KPA is 0 )  
 HV Bushings: \_\_\_\_\_ A ph \_\_\_\_\_ B ph \_\_\_\_\_ C ph \_\_\_\_\_

CONSERVATOR TANK: ( Function Test Low level Alarm ) OK \_\_\_\_\_

RESISTANCE CHECKS		
(including Wiring to Terminal Boards) 500 Volt Test		
Test & record in Mega Ohms or N/A ( Acceptable readings > 500 Mega Ohm )		
	Line 1-line 2	Line 1/2 - GND
Winding Temp Relay: Alarm		
Trip		
Liquid Temp Relay: Alarm		
Trip		
Fault Pressure Relay: Alarm		
Trip		
Conservator O/L Gauge: Alarm		

**\*\* Caution: Confirm all Primary Protection Circuits are open before Closing Links.**

GROUND CONTINUITY: (Micro-Ohm) \_\_\_\_\_ NEUTRAL BUSHING: \_\_\_\_\_

LIGHTNING ARRESTOR COUNTER: \_\_\_\_\_ A ph \_\_\_\_\_ B ph \_\_\_\_\_ C ph \_\_\_\_\_



6 YEAR PM – 230 KV TRANSFORMER INSPECTION (CAT ARM)

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ M.V.A: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E. W/O #: \_\_\_\_\_

CHECK OIL LEVEL: ( High , Normal , Low )      Conservator Tank: \_\_\_\_\_

OPERATING AMPERAGE:

1 st Stage Fans: \_\_\_\_\_ Cabinet Heater: \_\_\_\_\_

OFF LOAD TAP CHANGER:

Tap Position: (Located on the HV Windings)      Found \_\_\_\_\_ Left \_\_\_\_\_

Off load Tap Changer (Confirm Mechanical Center): \_\_\_\_\_

Transformer Winding Resistance: Completed Yes \_\_\_\_\_ No \_\_\_\_\_

DIELECTRIC ABSORPTION ( 5 KV ): 10 Min Divided By 1 Min = Index

H-LG	1 Min.	Mega $\Omega$	10 Min.	Mega $\Omega$	Index.	%
L-HG	1 Min.	Mega $\Omega$	10 Min.	Mega $\Omega$	Index.	%
HL-G	1 Min.	Mega $\Omega$	10 Min.	Mega $\Omega$	Index.	%

CORE GROUND: ( 500 Volt test ) \_\_\_\_\_

RESISTOR: ( Ohms ) \_\_\_\_\_ CORE GROUND: ( Mega Ohms ) \_\_\_\_\_

RUST/PAINT CONDITION ( A - Minor , B – Moderate , C – Severe )

MAIN TANK: \_\_\_\_\_ RADIATORS: \_\_\_\_\_

CONTROL CABINET: \_\_\_\_\_ OTHER: \_\_\_\_\_

CHECKS COMPLETED:

- \_\_\_ Check Explosion Vent
- \_\_\_ Check HV & LV Connections
- \_\_\_ Ladder Guards
- \_\_\_ Check LV porcelain insulators for chips or cracks
- \_\_\_ Manually Operate Fans
- Doble Test Performed: \_\_\_ Yes \_\_\_ No
- \_\_\_ Silica Gel Checked replace if 50% or more Contaminated
- \_\_\_ Visual Check for Dirty Insulators & Clean if Necessary
- \_\_\_ Check Conservator For Water & Drain if Necessary

CHECKS COMPLETED ONLY IF INSTRUCTED:

- \_\_\_ Obtain Gas Analysis Sample
- \_\_\_ Transformer Ratio Readings
- \_\_\_ Capacitive Bridge Testing

## 6 YEAR PM – 230 KV TRANSFORMER INSPECTION (CAT ARM)

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ M.V.A: \_\_\_\_\_  
Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E. W/O #: \_\_\_\_\_

## COMMENTS:

## 6 YEAR PM – OLTC TRANSFORMER C/W DIVERter SWITCHES

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ M.V.A: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E. W/O #: \_\_\_\_\_

**NOTE: All TESTS MUST BE COMPLETED OR MARKED N/A (Unless Otherwise Instructed).**

WEATHER CONDITIONS: dry: ☐ rain: ☐ humidity ☐ ambient temperature: \_\_\_\_\_ °C

DIELECTRIC OIL TEST ASTM D-1816 (kV): Conservator Main Tank: \_\_\_\_\_ Conservator Diverter Switches: \_\_\_\_\_  
 Diverter Switch # 1 \_\_\_\_\_ Diverter Switch # 2 \_\_\_\_\_ Diverter switch # 3 \_\_\_\_\_

**WINDING TEMP RELAY:** (Check if Applicable)

First Stage Fans: Setting: _____ °C	Found _____ °C	Left _____ °C
Second Stage Fans: Setting: _____ °C	Found _____ °C	Left _____ °C
Alarm: Setting: _____ °C	Found _____ °C	Left _____ °C
Trip: Setting: _____ °C	Found _____ °C	Left _____ °C

**LIQUID TEMP RELAY:** (Check if Applicable)

Alarm: Setting: _____ °C	Found _____ °C	Left _____ °C
Trip: Setting: _____ °C	Found _____ °C	Left _____ °C

**FAULT PRESSURE RELAY: (GAS DETECTOR) Main Tank**

Alarm: _____	Found _____ (cc)	Left _____ (cc)
Trip: _____	Found _____ (kp)	Left _____ (kpa)

**FAULT PRESSURE RELAY: (IN LINE GAS DETECTOR) diverter Switches** (Check if Applicable)

( Function test Control Circuits ) Tested OK \_\_\_\_\_ N/A \_\_\_\_\_

**FAULT PRESSURE RELEASE RELAYS:** (Function test Control Circuit if Applicable)

Main Tank: Tested Ok \_\_\_\_\_ N/A \_\_\_\_\_

Diverter Sw: A ph: Tested OK \_\_\_\_\_ N/A \_\_\_\_\_ Diverter Sw: B ph: Tested OK \_\_\_\_\_ N/A \_\_\_\_\_ Diverter Sw: C ph: Tested OK \_\_\_\_\_ N/A \_\_\_\_\_

**CONSERVATOR MAIN TANK:** (Function Test Low level Alarm) OK \_\_\_\_\_

**CONSERVATOR DIVERter SWITCHES:** ( Function Test Low level Alarm ) OK \_\_\_\_\_

**RESISTANCE CHECKS:** (including Wiring to Terminal Boards) 500 Volt Test

Test & record in Mega Ohms or N/A (Acceptable readings > 500 Mega Ohms)

	Line 1 – Line 2	Line 1 / 2 - GND		Line 1 – Line 2	Line 1 / 2 GND
Winding Temp Relay: Alarm			Trip		
Liquid Temp Relay: Alarm			Trip		
Fault Pressure Relay: Alarm ( Main Tank )			Trip		
Fault Pressure Relay: Alarm ( In Line Diverter Switches )			Trip		

## 6 YEAR PM – OLTC TRANSFORMER C/W DIVERTER SWITCHES

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ M.V.A: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E. W/O #: \_\_\_\_\_

**RESISTANCE CHECKS:** (including Wiring to Terminal Boards) **500 Volt Test**

Test &amp; record in Mega Ohms or N/A (Acceptable readings &gt; 500 Mega Ohms)

	Line 1 – Line 2	Line 1 / 2 - GND
Conservator (Main tank) Oil level Gauge: <b>Alarm</b>		
Conservator (Diverter Sw's) Oil level Gauge: <b>Alarm</b>		
Fault Pressure Release Relay (Diverter Sw A ph): <b>Trip</b>		
Fault Pressure Release Relay (Diverter Sw B ph): <b>Trip</b>		
Fault Pressure Release Relay (Diverter Sw C ph): <b>Trip</b>		

**\*\* Caution:** Confirm all Primary Protection Circuits are open before Closing Links.

**CHECK OIL LEVELS** (High , Normal , low)

CONSERVATOR (MAIN TANK)		CONSERVATOR (DIVERTER SWITCHES)	
HV BUSHINGS:	H1	H2	H3
LV BUSHINGS:	X1	X2	X3

**OPERATING AMPERAGE:** (If Applicable)

1 st STAGE FANS	2 nd STAGE FANS	MAIN TANK CABINET HEATER
-----------------	-----------------	--------------------------

**GROUND CONTINUITY (RESISTANCE):** (Micro-Ohms)

NEUTRAL BUSHING:			
HV. ARRESTORS:	H1	H2	H3
LV. ARRESTORS:	X1	X2	X3

**ON LOAD TAP CHANGER**

TAP CHANGER COUNTER:	FOUND	LEFT
CHECK LIMITS:	RAISE	LOWER
AMPERAGE:	MOTOR	CONTROL CABINET HEATER
CHECK GEARS, CHAINS or BELTS:	Checked OK: _____	
TRANSFORMER WINDING RESISTANCE:	Completed Yes: ____ No: ____	

**DIELECTRIC ABSORPTION (5 KV): 10 MIN. ÷ 1 MIN. = INDEX**

H-LG	1 Min.	Mega Ω	10 Min.	Mega Ω	Index.	%
L-HG	1 Min.	Mega Ω	10 Min.	Mega Ω	Index.	%
HL-G	1 Min.	Mega Ω	10 Min.	Mega Ω	Index.	%

**CORE GROUND: (500 Volt test)**

Externally Connected Yes _____ No _____	
RESISTOR: (Ohms)	CORE GROUND: (Mega Ohms)



RUST/PAINT CONDITION (A - Minor , B – Moderate , C – Severe)	
MAIN TANK:	RADIATORS:
CONTROL CABINET:	OTHER:

CHECKS COMPLETED ONLY IF INSTRUCTED:

Blank lined paper for writing.

## 6 YEAR PM – OLTC TRANSFORMER C/W TAP CHANGER COMPARTMENT

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ M.V.A: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E. W/O #: \_\_\_\_\_

**NOTE: All TESTS MUST BE COMPLETED OR MARKED N/A (Unless Otherwise Instructed).**

WEATHER CONDITIONS: dry: ☐ rain: ☐ humidity ☐ ambient temperature: \_\_\_\_\_ °C

DIELECTRIC OIL TEST ASTM D-1816 (kV): Conservator Tank: \_\_\_\_\_ Tap Changer Compartment: \_\_\_\_\_

## WINDING TEMP RELAY: (Check if Applicable)

First Stage Fans: Setting: _____ °C	Found _____ °C	Left _____ °C
Second Stage Fans: Setting: _____ °C	Found _____ °C	Left _____ °C
Alarm: Setting: _____ °C	Found _____ °C	Left _____ °C
Trip: Setting: _____ °C	Found _____ °C	Left _____ °C

## LIQUID TEMP RELAY: (check if Applicable)

Alarm: Setting: _____ °C	Found _____ °C	Left _____ °C
Trip: Setting: _____ °C	Found _____ °C	Left _____ °C

## FAULT PRESSURE RELAY: (GAS DETECTOR) Main Tank

Alarm: _____	Found _____ (cc)	Left _____ (cc)
_____	Found _____ (kpa)	Left _____ (kpa)

## FAULT PRESSURE RELAY: (GAS DETECTOR) Tap Changer Compartment

Trip: _____	Found _____ (kpa)	Left _____ (kpa)
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## FAULT PRESSURE RELEASE DEVICES: (Check if Applicable)

Function Test Control Circuit:	Main Tank: Tested Ok ___ N/A ___	Tap Changer Compartment Tested ok ___ N/A ___
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## CONSERVATOR TANK:

Function Test Low Level Alarm: OK _____
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6 YEAR PM – OLTC TRANSFORMER C/W TAP CHANGER COMPARTMENT

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ M.V.A: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E. W/O #: \_\_\_\_\_

RESISTANCE CHECKS			
(Including Wiring to Terminal Boards) 500 Volt Test			
Test & record in Mega Ohms or N/A (Acceptable readings > 500 Mega Ohms)			
		Line 1-line 2	Line 1 / 2 -GND
Winding Temp Relay:	Alarm		
	Trip		
Liquid Temp Relay:	Alarm		
	Trip		
Fault Pressure Relay (Main Tank):	Alarm		
	Trip		
Fault Pressure Relay (T/Changer):	Alarm		
	Trip		
Conservator O/L Gauge:	Alarm		

\*\* Caution: Confirm all Primary Protection Circuits are open before Closing Links.

OIL LEVELS; (High , Normal , Low)			
CONSERVATOR TANK:		TAP CHANGER COMPARTMENT:	
HV BUSHINGS:	H1	H2	H3
LV BUSHINGS:	X1	X2	X3

OPERATING AMPERAGE: ( If Applicable )		
1 st STAGE FANS	2 nd STAGE FANS	MAIN TANK CABINET HEATER

GROUND CONTINUITY ( RESISTANCE ): ( Micro-Ohms )			
NEUTRAL BUSHING:			
HV. ARRESTORS:	H1	H2	H3
LV. ARRESTORS:	X1	X2	X3

ON LOAD TAP CHANGER		
TAP CHANGER COUNTER:	FOUND	LEFT
CHECK LIMITS:	HIGH	LOW
AMPERAGE:	MOTOR	CONTROL CABINET HEATER
CHECK GEARS, CHAINS or BELTS:	Checked OK: _____	
TRANSFORMER WINDING RESISTANCE:	Completed Yes: ____ No: ____	

DIELECTRIC ABSORPTION (5 KV): 10 MIN. ÷ 1 MIN. = INDEX					
H-LG	1 Min.	Mega Ω	10 Min.	Mega Ω	Index. %
L-HG	1 Min.	Mega Ω	10 Min.	Mega Ω	Index. %
HL-G	1 Min.	Mega Ω	10 Min.	Mega Ω	Index. %



System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ M.V.A: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E. W/O #: \_\_\_\_\_

RUST/PAINT CONDITION (A - Minor , B – Moderate , C – Severe)	
MAIN TANK:	RADIATORS:
CONTROL CABINET:	OTHER:

- \_\_\_ Silica Gel Checked replace if 50% or more Contaminated
- \_\_\_ Visual Check For Dirty Insulators & Clean if required
- \_\_\_ Check Conservator For Water & Drain if Necessary

[illegible]

## 6 YEAR PM – TRANSFORMER C/W CONSERVATOR TANK

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ M.V.A: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E. W/O #: \_\_\_\_\_

**NOTE: All TESTS MUST BE COMPLETED OR MARKED N/A (Unless Otherwise Instructed).**

WEATHER CONDITIONS: dry: ☐ rain: ☐ humidity: ☐ ambient temperature: \_\_\_\_\_ °C  
 DIELECTRIC OIL TEST ASTM D-1816 (kV): \_\_\_\_\_ Conservator: \_\_\_\_\_

## WINDING TEMP RELAY: ( Check if Applicable )

First Stage Fans: Setting: _____ °C	Found _____ °C	Left _____ °C
Second Stage Fans: Setting: _____ °C	Found _____ °C	Left _____ °C
Alarm: Setting: _____ °C	Found _____ °C	Left _____ °C
Trip: Setting: _____ °C	Found _____ °C	Left _____ °C

## LIQUID TEMP RELAY: ( Check if Applicable )

Alarm: Setting: _____ °C	Found _____ °C	Left _____ °C
Trip: Setting: _____ °C	Found _____ °C	Left _____ °C

## FAULT PRESSURE RELAY: ( GAS DETECTOR ) ( In Line or Top Mounted ) ( Check if Applicable )

Alarm: Setting: _____ ( cc )	Found _____ ( cc )	Left _____ ( cc )
Trip: Setting: _____ ( kpa )	Found _____ ( kpa )	Left _____ ( kpa )

## FAULT PRESSURE RELEASE DEVICE: ( Check if Applicable )

Function Test Control Circuit:	Tested Ok _____ N/A _____
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## CONSERVATOR TANK

Function Test Low level Alarm: OK \_\_\_\_\_

## RESISTANCE CHECKS

( including Wiring to Terminal Boards ) 500 Volt Test

Test & record in Mega Ohms or N/A ( Acceptable Reading > 500 Mega Ohm )

	Line 1-line 2	Line 1/2 - GND
Winding Temp Relay: Alarm		
Trip		
Liquid Temp Relay: Alarm		
Trip		
Fault Pressure Relay: Alarm		
Trip		
Conservator O/L Gauge: Alarm		

**\*\* Caution: Confirm all Primary Protection Circuits are open before Closing Links.**

## OIL LEVELS; ( High , Normal , Low )

Conservator Tank :

## 6 YEAR PM – TRANSFORMER C/W CONSERVATOR TANK

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ M.V.A: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E. W/O #: \_\_\_\_\_

HV BUSHINGS:	H1	H2	H3
LV BUSHINGS:	X1	X2	X3

OPERATING AMPERAGE: ( N/A If not Applicable )		
1 st STAGE FANS;	2 nd STAGE FANS	CABINET HEATER
PUMPS: HRDTS T1,T2,T3 (ONLY )	1 st STAGE:	2 nd STAGE:

GROUND CONTINUITY ( RESISTANCE ): ( Micro-Ohms )			
NEUTRAL BUSHING:			
HV. ARRESTORS:	H1	H2	H3
LV.ARRESTORS: (If Applicable )	X1	X2	X3

OFF LOAD TAP CHANGER LOCATION: ( Located on the HV Winding )		
Tap Position:	Found	Left
Off load Tap Changer ( Confirm Mechanical Center):		
Transformer Winding Resistance: Form Completed Yes _____ No _____		

DIELECTRIC ABSORPTION ( 5 KV ): 10 MIN. DIVIDED BY 1 MIN. = INDEX					
H-LG	1 Min.	Mega $\Omega$	10 Min.	Mega $\Omega$	Index. %
L-HG	1 Min.	Mega $\Omega$	10 Min.	Mega $\Omega$	Index. %
HL-G	1 Min.	Mega $\Omega$	10 Min.	Mega $\Omega$	Index. %

CORE GROUND: ( 500 Volt test )	
Externally Connected Yes _____ No _____	
RESISTOR: ( Ohms )	CORE GROUND: ( Mega Ohms )

RUST/PAINT CONDITION ( A - Minor , B – Moderate , C – Severe )	
MAIN TANK:	RADIATORS:
CONTROL CABINET:	OTHER:

CHECKS COMPLETED:

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ M.V.A: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E. W/O #: \_\_\_\_\_

- [illegible]



## 6 YEAR PM – TRANSFORMER ( SEALED TANK TYPE ) INSPECTION

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ M.V.A: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E. W/O #: \_\_\_\_\_

**NOTE: All TESTS MUST BE COMPLETED OR MARKED N/A (Unless Otherwise Instructed).**

Sheet 1 of 2

WEATHER CONDITIONS: dry: ☐ rain: ☐ humidity: ☐ ambient temperature: °C

DIELECTRIC OIL TEST ASTM D-1816 (kV): Main Tank \_\_\_\_\_ ( Sample to be taken ONLY if Vacuum/ Pressure Gauge reads 0 or + Pressure )

**WINDING TEMP RELAY: ( Check if Applicable )**

First Stage Fans: Setting: _____ °C	Found _____ °C	Left _____ °C
Second Stage Fans Setting: _____ °C	Found _____ °C	Left _____ °C
Alarm: Setting: _____ °C	Found _____ °C	Left _____ °C
Trip: Setting: _____ °C	Found _____ °C	Left _____ °C

**LIQUID TEMP RELAY: ( Check if Applicable )**

Alarm: Setting: _____ °C	Found _____ °C	Left _____ °C
Trip: Setting: _____ °C	Found _____ °C	Left _____ °C

**FAULT PRESSURE RELAY: ( GAS DETECTOR )**

Function Test control Circuit:	Tested Ok _____ N/A _____
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**FAULT PRESSURE RELEASE DEVICE:**

Function Test Control Circuit:	Tested Ok _____ N/A _____
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VACUUM/PRESSURE GAUGE: ( KPA ) Pressure \_\_\_\_\_ Zero \_\_\_\_\_ Vacuum \_\_\_\_\_

**RESISTANCE CHECKS**

( including Wiring to Terminal Boards ) 500 Volt Test

Test & record in Mega Ohms or N/A ( Acceptable readings > 500 Mega Ohms )

	Line 1-line 2	Line 1/2 - GND
Winding Temp Relay: Alarm		
Trip		
Liquid Temp Relay: Alarm		
Trip		
Fault Pressure Relay: Alarm		
Trip		
Fault Pressure device: Alarm		

**\*\* Caution: Confirm all Primary Protection Circuits are open before Closing Links.**

**OIL LEVELS( High , Normal , Low )**

Main Tank:	Neutral Bushing:
HV BUSHINGS: H 1	H2 H3
BUSHINGS: X1	X2 X3

## 6 YEAR PM – TRANSFORMER ( SEALED TANK TYPE ) INSPECTION

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ M.V.A: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E. W/O #: \_\_\_\_\_

## OPERATING AMPERAGE: ( If Applicable )

1 st STAGE FANS;	2 nd STAGE FANS:	CABINET HEATER
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## GROUND CONTINUITY ( RESISTANCE ): ( Micro-Ohms )

## NEUTRAL BUSHING:

HV. ARRESTORS:	H1	H2	H3
LV. ARRESTORS:	X1	X2	X3

## OFF LOAD TAP CHANGER: ( Located on the HV Winding )

Tap Position:	Found:	Left:
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Off load Tap Changer ( Confirm Mechanical Center):

Transformer Winding Resistance: Completed \_\_\_\_ Yes \_\_\_\_ No

## DIELECTRIC ABSORPTION ( 5 KV ): 10 MIN. DIVIDED BY 1 MIN. = INDEX

H-LG	1 Min.	Mega $\Omega$	10 Min.	Mega $\Omega$	Index.	%
L-HG	1 Min.	Mega $\Omega$	10 Min.	Mega $\Omega$	Index.	%
HL-G	1 Min.	Mega $\Omega$	10 Min.	Mega $\Omega$	Index.	%

## CORE GROUND: ( 500 Volt test )

Externally Connected Yes \_\_\_\_ No \_\_\_\_

RESISTOR: ( Ohms )	CORE GROUND: ( Mega Ohms )
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## RUST/PAINT CONDITION ( A - Minor , B – Moderate , C – Severe )

MAIN TANK:	RADIATORS:
CONTROL CABINET:	OTHER:

## CHECKS COMPLETED:

- \_\_\_\_ Manually Operate Fans
- \_\_\_\_ Check HV & LV Connections
- \_\_\_\_ Ladder Guards
- \_\_\_\_ Check porcelain insulators for chips or cracks
- \_\_\_\_ Visual Check For Dirty Insulators & Clean if Necessary

## CHECKS COMPLETED ONLY IF INSTRUCTED:

- \_\_\_\_ Obtain Gas Analysis Sample
- \_\_\_\_ Transformer Ratio Readings
- \_\_\_\_ Capacitive Bridge Testing

## COMMENTS:

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6 YEAR PM – TRANSFORMER ( SEALED TANK TYPE ) INSPECTION

System ID: \_\_\_\_\_ Station: \_\_\_\_\_ Serial No.: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Type: \_\_\_\_\_ M.V.A: \_\_\_\_\_  
 Test Date: \_\_\_\_\_ Test Completed By: \_\_\_\_\_ J.D.E. W/O #: \_\_\_\_\_



# **Current Transformers and Potential Transformers**

**CURRENT TRANSFORMER MAINTENANCE PROCEDURE**

*Page 1 of 1*

**CURRENT TRANSFORMERS - 12.5 KV AND UP**

**120 DAY GENERAL INSPECTION**

- 1 Perform a general visual check of bushings, tanks and oil levels, if gauged.
- 2 Complete 120 Day-Current Transformer Inspection Form.

**6 YEAR PM INSPECTION**

- 3 Outage required.
- 4 Check conduit, fittings, and wiring connections.
- 5 Check porcelains for chips, cracks, cementing, and fastenings. Wipe down, if required.
- 6 Check for signs of overheating or flashovers.
- 7 Check oil levels, if gauged.
- 8 Do touch-up painting, if required.
- 9 Complete CT & PT 6 Year – Current Transformer Inspection Form.
- 10 Perform Doble Test, if required.

## **POTENTIAL TRANSFORMER MAINTENANCE PROCEDURE**

Page 1 of 2

### **POTENTIAL TRANSFORMERS**

#### **120 DAY GENERAL INSPECTION**

- 1 Complete visual check of connections.
- 2 Completed visual check for leaking fluid.
- 3 Completed visual check for dirty insulators and external flashovers.
- 4 Check secondary voltages and record.
- 5 Complete 120 Day-Potential Transformer Inspection Form.

#### **6 YEAR PM INSPECTION**

- 6 Requires outage.
- 7 Check connections for position and tightness.
- 8 Check insulators and wipe down, if required.
- 9 Check for weeping or leaking units.
- 10 Check the grounding device.
- 11 Open the door of the coupler box and inspect to confirm if conditions inside are normal.
- 12 Check gaskets and gap clearances.
- 13 Check heater operation, if so fitted.
- 14 Report excessive rusting.
- 15 Check conduit, fittings, and wiring connections.
- 16 Check porcelains for chips, cracks, cementing, fastenings; wipe down.
- 17 Check for signs of overheating and flashovers.
- 18 Check oil levels.
- 19 Complete touch-up painting, if required.

**POTENTIAL TRANSFORMER MAINTENANCE PROCEDURE**

Page 2 of 2

20 Complete 6 Year-Potential Transformer Inspection form.

21 Perform Doble test, if scheduled.

Date: \_\_\_\_\_

[illegible]

- \_\_\_ Check Paint/Rust Condition Tank
- \_\_\_ Check & report any Oil Leaks as per EERP  
(Environmental Emergency Response Plan)
- \_\_\_ Check Groundings & Terminations
- \_\_\_ Check Conduits & Cabinets
- \_\_\_ Check Porcelain Insulators for Tracking or Cracks
- \_\_\_ Check Concrete Base

Date: \_\_\_\_\_

**VISUAL INSPECTION:**

- \_\_\_ Check Porcelain Insulators for Flashover, Cracks and Burn Marks
- \_\_\_ Check Conduits & Cabinets
- \_\_\_ Check Grounding



# 6 YEAR-CURRENT TRANSFORMER INSPECTION

Station: \_\_\_\_\_

Readings By: \_\_\_\_\_

Date: \_\_\_\_\_

Location	Oil Level (Normal / High / Low) Rust Condition					
	* Note: Class A-Small amount of Rust. (Clean with brush and touched up with paint, if possible). Class B-Remove unit from service within 12-24 months and refurbish Class C- Remove unit from service, ASAP (within same maintenance year) and replace unit.					
	Phase A		Phase B		Phase C	
	Oil Level	Condition Rust Etc;	Oil Level	Condition Rust Etc;	Oil Level	Condition Rust Etc;

## VISUAL INSPECTION:

- ☐ Check bushings & tanks
- ☐ Check for oil leaks
- ☐ Check paint conditions
- ☐ Check conduits & cabinets
- ☐ Check porcelain insulators for tracking
- ☐ Check groundings & terminations
- ☐ Check primary connections

## CHECKS COMPLETED:

- ☐ Check primary & secondary connections
- ☐ Clean porcelain insulators if dirty
- ☐ Test and read heater amps (Record Heater Amperage \_\_\_\_\_)

Doble Test Performed: ☐ Yes ☐ No

## 6 YEAR - POTENTIAL TRANSFORMER INSPECTION

Page 8 of 8, Isl Int Sys Power Outages

Readings By: \_\_\_\_\_

Station: \_\_\_\_\_

Date: \_\_\_\_\_

Location	Oil Level (Normal / High / Low) Rust Condition					
	* Note: Class A-Small amount of Rust. (Clean with brush and touched up with paint, if possible). Class B-Remove unit from service within 12-24 months and refurbish Class C- Remove unit from service, ASAP (within same maintenance year) and replace unit.					
	Phase A		Phase B		Phase C	
	Oil Level	Condition Rust Etc;	Oil Level	Condition Rust Etc;	Oil Level	Condition Rust Etc;

## VISUAL INSPECTION:

- \_\_\_ Check bushings & tanks
- \_\_\_ Check for oil leaks
- \_\_\_ Check paint condition
- \_\_\_ Check concrete base
- \_\_\_ Check primary connections

- \_\_\_ Check porcelain insulators for tracking
- \_\_\_ Check conduits & cabinet
- \_\_\_ Check grounding and terminations

## CHECKS COMPLETED:

- \_\_\_ Check secondary connections
- \_\_\_ Clean & lubricate ground switches
- \_\_\_ Test and read heater amps (Record Heater Amperage \_\_\_\_\_)
- \_\_\_ Check surge gap
- \_\_\_ Check primary and secondary connections
- \_\_\_ Clean porcelain insulators, if dirty

Doble Test Performed: \_\_\_ Yes \_\_\_ No

# Protection and Control

**6 YEAR PM INSPECTION**

- 1 Equipment outage required.

**PROTECTIVE RELAY FUNCTION TESTING**

- 2 Function test each protective relay one at a time.
- 3 For each relay:
  - a. Using appropriate drawings, identify the locations where the protection circuit will be blocked
  - b. Block the protection circuit.
  - c. If required, remove the relay from the panel.
  - d. Connect the relay test equipment to the relay.
  - e. Configure the relay test equipment settings to those required for the relay.
  - f. Function test each in-service function of the relay using the relay test equipment.
  - g. Troubleshoot the relay if it fails any function tests.
  - h. Record and save the results in the relay testing software.
  - i. Un-block the protection circuit.

**PROTECTION CIRCUIT FUNCTION TESTING**

- 4 Function test each protection circuit one at a time.
- 5 For each protection circuit:
  - a. Using appropriate drawings, identify the locations where the protection circuit will be blocked
  - b. Block the protection circuit.
  - c. Operate the relay (or jumper out the relay contacts if the relay has already been function tested)
  - d. Verify the function of the circuit.
  - e. Troubleshoot the protection circuit if it fails any function tests.
  - f. Un-block the protection circuit.