Q. Reference: Newfoundland Power's 2027 Capital Budget Application, 2.2 Substation Power Transformer Strategy

a) Does Newfoundland Power have an existing preventative Power Transformer Maintenance Program? Please provide a copy.

b) What strategy does Newfoundland Power apply for life extensions for power transformers?

A. a) Attachment A provides a copy of the Company's S*ubstation Inspection and Maintenance Practices* which outlines the timing and requirements of power transformer maintenance in *Section 6.0 Substation Preventative Maintenance Program* and *6.1 Power Transformers*.

Attachment B provides Power Transformer Maintenance Standard Procedures.

Attachment C provides sample Power Transformer Maintenance Standard Report Forms.

b) See the response to Request for Information PUB-NP-009 for additional information on the consideration of life extension alternatives.

ATTACHMENT A:

Substation Inspection and Maintenance Practices

WHENEVER. WHEREVER.
We'll be there.

NEWFOUNDLAND POWER
A FORTIS COMPANY

Substation Inspection and Maintenance Practices

September 2025

Substation Inspection and Maintenance Practices

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Revised By: -
Reviewed By: Asset Management Team
Approved By: Sam Losinski

Document Control

Revision	Date	Revised by	Reviewed by	Approved by	Details
1.0	15-09-2025	-	Asset Management Team	Sam Losinski	-

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1.0 PURPOSE

Newfoundland Power's (the "Company's") substation inspection and maintenance practices are part of a broader asset management strategy that is intended to ensure the safe and reliable operation of the electrical system.

The Company operates 131 substations located throughout its service territory. These include: (i) generation substations that connect generating plants to the electrical system; (ii) transmission substations that connect transmission lines of different voltages; and (iii) distribution substations that connect the low-voltage distribution system to the high-voltage transmission system.[1] The equipment in substations ensures the electrical system operates safely and at appropriate voltage levels.

Regular maintenance and testing reduce the likelihood of unexpected failures and power outages. Potential problems can be identified early and proactively addressed before they escalate, minimizing repair costs and downtime. These practices can extend the lifespan of equipment, delaying the need for costly replacements and upgrades.

Electrical Maintenance personnel ("inspectors") have the responsibility to inspect and maintain substation assets, as required by the asset management system. The Director of Operations, Manager of Electrical Maintenance, and Supervisors of Electrical Maintenance have the shared responsibility to ensure that inspections and maintenance are completed, and any identified deficiencies and hazards are recorded and corrected in accordance with this practice.

All substation inspection and preventative maintenance, deficiency identification and corrective maintenance activities shall be recorded in the Company's asset management technology. The manager and supervisors of electrical maintenance are responsible for ensuring that all inspectors have the training required to use the technology.

Please direct:

(i) Questions pertaining to the inspection and maintenance practices to the Manager Electrical Maintenance;

(ii) Questions related to the business processes, training requirements, requests for business processes and/or application enhancements to the asset management team; and

(iii) Problems with the operation of supporting technology to the technology Service Desk.

[1] Newfoundland Power's substations may serve multiple purposes and can be classified as any combination of the generation, transmission, and distribution functions.

2.0 INSPECTOR QUALIFICATIONS

As a minimum, a substation inspector must have the following qualifications to inspect and maintain the Company's substation assets:

(i) Certified as a Journeyperson Industrial or Construction Electrician in accordance with the Interprovincial Standards Red Seal Program;

(ii) Familiarity with the operation, maintenance and construction of substations; and

(iii) Basic understanding of the electrical and mechanical nature of substations, transmission and distribution.

The above qualifications can be obtained by a combination of on-the-job training, formal education and training as provided by a recognized educational institution, as well as internal company training and workshops.

3.0 TECHNOLOGY

3.1 Avantis

Avantis is an asset management application which is used:

(i) To manage preventative and corrective work, including inspections, scheduled maintenance and testing;

(ii) By employees to identify, plan, schedule and track executed work; and

(iii) To create asset reporting to inform data driven decisions for operations and capital expenditures.[2]

3.2 Substation Mobile and Substation Mobile Web Application

Substation Mobile provides access to Avantis data. It also provides the functionality to inspectors while in the field via their laptop to view and complete existing work orders for inspection and maintenance activities, create a work request, or record a "Do and Tell" task. Substation Mobile web application provides access to view asset information, inspection results, oil sampling forms, and special instructions for substation inspections through the internal intranet site, SharePoint.

[2] Avantis will be replaced by IBM Maximo by the end of 2026.

3.3 ArcGIS Survey123 and Fieldmaps

ArcGIS Survey123 and Fieldmaps are software applications used to collect and analyze field data and plot the geographical position of substation equipment and structures. Some Electrical Maintenance applications include the completion of digital tailboards, SF6 gas tracking, and substation wooden bus structure inspections.

Additional digital forms are currently being designed for substation inspections and internal health scoring inspections.[3]

3.4 PowerDB Pro

PowerDB Pro is a software application that:

(i) Connects to Megger test equipment for importing and live testing;

(ii) Provides digital access to some maintenance forms via a laptop application; and

(iii) Allows the user to create and customize digital forms.

This software is primarily used for equipment acceptance testing and for completing maintenance on substation battery systems.

3.5 GIS Map Center

An application that provides an "As Built" view of Newfoundland Power's Electrical Distribution and Transmission Network. This application provides the Inspectors the ability to identify and locate downstream substation equipment.

3.6 Maintenance Status Spreadsheet

A spreadsheet used to track the status and progress of maintenance work. Live data is refreshed from Avantis and recorded monthly. The spreadsheet is located in the Substation Maintenance directory, and can be accessed via the following file path: \\nphome1\Maintenance\Substation Maintenance\<year> Work

3.7 Internal Health Scoring Spreadsheet

Internal health scoring spreadsheets are used to record the results of annual health index inspections for power transformers and circuit breakers. Health scoring results input annual maintenance work planning. The spreadsheet is located in the Substation Maintenance directory, and can be accessed via the following link: \\nphome1\Maintenance\Substation Maintenance\HEALTH INDEX FORMS

[3] Design is currently paused while decisions are being made on the IBM Maximo implementation.

3.8 Test Equipment and Associated Software

Electrical Maintenance uses a variety of test equipment and associated software to complete work. All test equipment is captured in the Asset Management Technology.

4.0 SUBSTATION AND EQUIPMENT INSPECTIONS

Substation and equipment inspections are currently separated into two different types:

(i) Maintenance II – Groups 1, 2, 3, & 4 ("Long Inspection"); and

(ii) Maintenance II – Group 5 ("Short Inspection").

Inspections are completed on a six-week cycle such that every substation gets a Short Inspection and a Long Inspection quarterly.

Short inspections focus on the physical condition of substation property and equipment. The primary goals are to:

(i) Identify the presence of leaks in oil filled substation equipment;

(ii) Identify any theft or vandalism to substation property or equipment; and

(iii) Verify that voltage regulating equipment is operating satisfactorily.

Long inspections include the items listed for a short inspection, as well as the following:

(i) Inspect all control panels and miscellaneous equipment such as lightning arrestors, potheads and cables;

(ii) Inspect the physical condition of gauges & meters and record quantities that are not communicated back through the Company's Supervisory Control and Data Acquisitions (SCADA) system; and

(iii) Inspect all downstream reclosers and voltage regulators.[4]

Substation inspection forms can be accessed on SharePoint via the Substation Mobile Web Application at the following link:
Substation Mobile Web Application - Inspection Forms

[4] Completed once annually.

Appropriate operations manual procedures must be followed. Relevant procedures include the following:

(i) OPR110.11 – Portable Substations
(ii) OPR110.16 – Entering Substations and Switchyards
(iii) OPR300.03 – Working Alone
(iv) OPR2000 – Electrical Maintenance Work Methods
(v) Risk Management Job Safety Planning

5.0 EQUIPMENT OIL SAMPLING

Dissolved gases and oil quality are the primary diagnostic tools to determine the condition and potential lifespan of a power transformer. The Company samples all in-service power transformers annually as part of the Transformer Condition Assessment ("TCA") and Tap Changer Activity Signature Analysis ("TASA") predictive maintenance programs. The Company also samples all in-service Bulk-Oil Circuit Breakers annually as part of the Breaker Oil Analysis ("BOA") predictive maintenance program.

Oil samples are sent for lab analysis and a condition assessment is given based on Dissolved Gas Analysis ("DGA") and American Society for Testing and Materials ("ASTM International") standard procedures. These condition assessments provide electrical maintenance supervisors and planners with recommended operating procedures and sampling intervals for the piece of equipment in question.

Standard sampling frequency for power transformers and bulk oil circuit breakers are as follows:

Table 1
Equipment Oil Sampling Frequency

Maintenance Type	Age	Frequency
TCA	≤ 50	1 year
TCA	> 50	6 months
TASA	-	1 year
BOA	-	1 year

If the condition assessment worsens, the recommended sampling frequency will be adjusted to ensure the equipment is more closely monitored.

6.0 SUBSTATION PREVENTATIVE MAINTENANCE PROGRAM

The Company's preventative maintenance (PM) program for substations includes five primary maintenance types (Maintenance I through V) as well as a number of minor maintenance activities. Each of the five primary maintenance types vary in scope based on the type of equipment. A brief description of each primary maintenance type is as follows:

(i) Maintenance I – Acceptance testing or installation of new equipment. Acceptance testing ensures that equipment has arrived free of any damage or defects from the manufacturer.

(ii) Maintenance II – Inspections of substation property and equipment. These inspections monitor asset condition and enable the early detection of issues before they lead to equipment failure or more significant problems.

(iii) Maintenance III – Diagnostic testing and/or minor repair of equipment.

(iv) Maintenance IV – Diagnostic testing and overhaul of equipment. This maintenance is completed with the equipment removed from service. This procedure is to detect and correct any deficiencies and to prepare the equipment for another service cycle.

(v) Maintenance V – Unscheduled maintenance carried out because of equipment malfunction or failure. This procedure allows for the repair or replacement of a part, or to make minor adjustments or modifications to the piece of equipment.

The frequency at which each type of maintenance is performed is described in the Substation Maintenance Standard Reference Document MSR011 – Maintenance Cycles which can be accessed on SharePoint via the following link:
Substation - MSR011 - Maintenance Cycles - All Documents

An overview of equipment specific maintenance practices and frequencies are presented in the following sections.

6.1 Power Transformers

The Company's maintenance program for power transformers is shown in Table 2 below.

Table 2
Maintenance Program for Power Transformers

Equipment Type	Maintenance Type	Maintenance Title	Frequency
All Power Transformers	M1	Acceptance Testing/ Installation	As needed
All Power Transformers	M2	Substation Inspection	6 weeks
All Power Transformers	M3	Protection Inspections	6 years
All Power Transformers	IR Inspection	Equipment Thermoscan	1 year
All Power Transformers	Inspection/ Investigation	Health Inspections	1 year
All Power Transformers	Predictive Maintenance	TCA	1 year[5]
Power Transformers with On-Load Tap Changer	Predictive Maintenance	TASA	1 year[6]
All Power Transformers	M4	Equipment Overhaul	12 years
All Power Transformers	M5	Unscheduled Maintenance	As needed

Details for the Company's various power transformer maintenance activities are described in Maintenance Standard Procedure Manual *MSP009 – Power Transformers*.[7,8] Upon completion of the task, Maintenance Standard Form *MSF001 – Nameplate and Description* and/or *MSF009 – Power Transformer Maintenance Report* must be completed and sent to the maintenance planners for evaluation and filing.[9]

5 This frequency is subject to change based on the condition code and age of the unit.
6 This frequency is subject to change based on the condition code of the unit.
7 All Maintenance Standard Procedure Manuals are located on SharePoint and can be accessed via the following link: Substation - 3. Equipment Standards - All Documents
8 Any required Test Procedure Manuals are located on SharePoint and can be access via the following link: Substation - 4. Test Procedures - All Documents
9 All Maintenance Standard Forms are located on SharePoint and can be accessed via the following link: Substation - Maintenance Report Forms - All Documents

6.2 Circuit Breakers

The Company's maintenance program for circuit breakers is shown in Table 3 below:

Table 3
Maintenance Program for Circuit Breakers

Equipment Type	Maintenance Type	Maintenance Title	Frequency
All Circuit Breakers	M1	Acceptance Testing/ Installation	As needed
All Circuit Breakers	M2	Substation Inspection	6 weeks
All Circuit Breakers	IR Inspection	Equipment Thermoscan	1 year
All Circuit Breakers	Inspection/ Investigation	Health Inspections	1 year
Bulk Oil Circuit Breakers	Predictive Maintenance	BOA	1 year
Circuit Breakers	M4	Equipment Overhaul	10 years
Plant Circuit Breakers	M4	Equipment Overhaul	5 years
All Circuit Breakers	M5	Unscheduled Maintenance	As needed

Details for the Company's various circuit breaker maintenance activities are described in Maintenance Standard Procedure Manuals *MSP004 A-E – Circuit Breakers* and *MSP011 - Switchgear*. Upon completion of the task, Maintenance Standard Form *MSF001 – Nameplate and Description* and/or *MSF004 A-E – Circuit Breakers* must be completed and sent to the maintenance supervisor for evaluation and filing.

6.3 Reclosers

The Company's maintenance program for reclosers is shown in Table 4 below:

Table 4
Maintenance Program for Reclosers

Equipment Type	Maintenance Type	Maintenance Title	Frequency
All Reclosers	M1	Acceptance Testing/ Installation	As needed
Substation Reclosers	M2	Substation Inspection	6 weeks
Downline Reclosers	M2	Substation Inspection	1 year
All Reclosers	IR Inspection	Equipment Thermoscan	1 year
All Reclosers	M3	Battery Replacement	Varies[10]
All Reclosers	M5	Unscheduled Maintenance	As needed

Details for the Company's various recloser maintenance activities are described in Maintenance Standard Procedure Manuals *MSP010 A, C & D – Reclosers*. Upon completion of the task, Maintenance Standard Form *MSF001 – Nameplate and Description* and/or *MSF006 C & D – Reclosers* must be completed and sent to the maintenance supervisor for evaluation and filing.

[10] Older 8 AH and 12 AH batteries are replaced on a 3-year cycle, while newer 45 AH batteries are replaced on a 6-year cycle.

6.4 Voltage Regulators

The Company's maintenance program for reclosers is shown in Table 5 below:

Table 5
Maintenance Program for Voltage Regulators

Equipment Type	Maintenance Type	Maintenance Title	Frequency
All Voltage Regulators	M1	Acceptance Testing/ Installation	As needed
Substation Voltage Regulators	M2	Substation Inspection	6 weeks
Downline Voltage Regulators	M2	Substation Inspection	1 year
All Voltage Regulators	IR Inspection	Equipment Thermoscan	1 year
All Voltage Regulators	M4	Equipment Overhaul	As needed
All Voltage Regulators	M5	Unscheduled Maintenance	As needed

Details for the Company's various voltage regulator maintenance activities are described in Maintenance Standard Procedure Manual *MSP013 – Voltage Regulators*. Upon completion of the task, Maintenance Standard Form *MSF001 – Nameplate and Description* and/or *MSF012 – Voltage Regulators* must be completed and sent to the maintenance supervisor for evaluation and filing.

6.5 Battery Banks and Chargers

The Company's maintenance program for battery banks and chargers is shown in Table 6 below:

Table 6
Maintenance Program for Battery Banks and Chargers

Equipment Type	Maintenance Type	Maintenance Title	Frequency
All Battery Banks and Chargers	M1	Acceptance Testing/ Installation	As needed
All Battery Banks and Chargers	M2	Substation Inspection	6 weeks
All Battery Banks	Predictive Maintenance	Battery Capacity Testing	4 years
All Battery Banks and Chargers	M3	Inspection & Impedance Testing	1 year
All Battery Banks and Chargers	M5	Unscheduled Maintenance	As needed

Details for the Company's various battery bank and charger maintenance activities are described in Maintenance Standard Procedure Manuals *MSP002 – Batteries* and *MSP003 – Battery Chargers*. Upon completion of the task, Maintenance Standard Form *MSF001 – Nameplate and Description, MSF003 – Batteries* and/or *MSF004 – Battery Chargers* must be completed and sent to the maintenance supervisor for evaluation and filing.

7.0 DEFICIENCY CORRECTION AND PRIORITIZATION

Identified deficiencies are remediated in one of two ways: (i) A Do & Tell; or (ii) Corrective Maintenance.

7.1 Do & Tell

Deficiencies that can be readily corrected (less than 30 minutes of effort) may be fixed by inspectors upon identification and logged in Substation Mobile as a "Do & Tell". When a Do & Tell is created, a work order is automatically created and closed.

7.2 Corrective Maintenance

In the case that there is an issue found that cannot be corrected through a Do & Tell, a work request must be created and submitted. When a work request is created, an initial work priority is assigned. The supervisor then reviews the request and makes any desired modifications. Once approved, a planner will create a work order and plan for job completion.

Work priorities are used as a guide for planning and scheduling to provide a level of urgency, define the maximum acceptable due date, and rank jobs in priority order. These are based upon safety, environment and reliability.

(i) I – Immediate (failure within one week);
(ii) P1 – Very High (failure within one month);
(iii) P2 – High (failure within 3 months);
(iv) P3 – Medium (failure greater than 3 months);
(v) P5 – Project (correct during next project); and
(vi) P6 – Low (no risk of failure).

Re-prioritization and/or additions to the set annual maintenance list may result in deferring or extending the timeline of planned maintenance. In-service failures, weather, budget consideration, employee availability or upcoming capital work may create reason to do so.

ATTACHMENT B:

Power Transformer Maintenance Standard Procedures

NEWFOUNDLAND POWER
A FORTIS COMPANY

Maintenance Standard Number: MSP009
Effective Date: 2024-09-12
Page 1 of 3

POWER TRANSFORMERS

Created by: M. Rideout
Revised by: M. Greening
Reviewed by: M. Greening
Approved by: G. Samms

The following steps are considered as standard procedures for maintenance on power transformers. Other scope may be completed as required on a case-by-case basis.

Form MSF009, *"Power Transformer Maintenance Report"*, is used in reporting Maintenance I, III, IV or V through paper form or PowerDB. Also, Maintenance Standard Form MSF001, *"Nameplate and Description"*, is completed during Maintenance I.

Type of Maintenance				Procedure
I	III	IV	V	
X				1. Assign and install an ID number.
X				2. Record the complete nameplate information on MSF001. This will include the main nameplate, the tapchanger (if it has a separate nameplate), bushings, lightning arresters, gas detector relays, fan motors, and any other accessories that would have a nameplate.
X				3. An internal inspection should be made on all new transformers and on transformers that have been in storage or have been moved from one location to another. For transformers that have been energized previously, this internal inspection may be omitted if the Substation Asset Management Group has determined that it is not practical or necessary. Refer to MSR017 for detailed guidelines to be followed in completing this internal inspection.
X				4. Perform a dew point test if moisture is suspected to have entered the tank.
X				5. Ensure continuity of all CT taps; check that the CT is not grounded; and check all ratios. Refer to MST005 for ratio checking procedures.
X				6. If not already installed, install a fall arrest bracket on the unit.
X	X	X		7. Ensure an appropriate PCB label is installed on the unit. Record the PCB level on MSF009. Place a label on the inside of the control cabinet indicating PCB level. If no lab oil test has been previously conducted on the unit, take an oil sample for lab testing.
X	X	X		8. Make a visual inspection, noting the general condition of the transformer. Check for such things as dents, oil leaks (particularly around gasketed joints), paint condition, damaged bushings, broken glass on gauges, abnormal readings on thermometers, oil level gauges, etc. Report issues to the electrical Maintenance Planner Group.
X	X	X	X	9. Ensure that the tank is properly grounded. A good, permanent, low-resistance ground is essential. All grounding connections to be upgraded to 19/#9 copper clad steel unless otherwise noted. Neutral connections to remain copper.
X	X	X		10. Check the oil level as indicated by the gauge on the conservator tank or on the main tank if there is no conservator tank. Top up as required.
X	X	X		11. Check bushings for oil leakage and oil level where possible. Report issues to the electrical Maintenance Planner Group

NEWFOUNDLAND POWER
A FORTIS COMPANY

POWER TRANSFORMERS

Type of Maintenance				Procedure
I	III	IV	V	
X	X	X		12. Check radiators for paint condition, oil leaks, and position of all valves. Ensure Radiators are well painted to prevent corrosion and rusting unless otherwise noted.
X	X	X		13. Check the condition of the silica gel. Replace as required. Breather piping and silica gel canister shall be replaced unless otherwise noted. Refer to MSR020 for silica gel breather requirements.
X		X*		14. Install or replace humidity absorbent packets in the gas detector relay as required if relay is not replaced.
X	X	X	X	15. If the unit is equipped with a spill pan, check that heat tracing and valve is operational. Ensure pan is free of oil and drained.
X		X*		16. Clean bushings and lightning arresters where they exist. The porcelain should be kept clean and free from atmospheric pollution. Inspect closely for chips and cracks. All chips and cracks are to be reported to the Electrical Maintenance Planner Group and painted with glyptol to prevent moisture ingress. In cases with excessive damage bushings may require replacement.
X	X	X		17. Painting is done at intervals determined by visual inspection. Refer to MSR014 for painting guidelines. The entire transformer shall be painted unless otherwise noted.
X	X	X		18. Check that the upper diaphragm on the explosion vent is intact. PRD and piping shall be installed if identified in the scope of work by the Planner.
X		X		19. Check the operation of the gas detector relay. Refer to MST007.
	X			20. Record the reading of the maximum indicating pointer on the temperature gauges and check that the method of resetting the pointer is operational.
X		X		21. Check the operation of the temperature gauges including the settings of switches. Refer to MST010.
X	X	X		22. Check the cooling fans for proper operation. Ensure that drain plugs or adhesive tape is removed from fan motors. If the unit is equipped with a fan exerciser, ensure it is operational and that an appropriate time interval is established.
X	X	X		23. Check the dielectric value of the insulating oil. Refer to MSR013 for method of testing. Refer to MSR010 for oil dielectric requirements.
X	X	X	X	24. Obtain an oil sample with a syringe and bottle for gas analyses. Refer to MSR013 for sampling procedures. Record results on MSF020. Do this during Maintenance V if requested.
X		X*		25. Megger the windings. To do so, all bushings should be wiped clean and dry and all connections to live bus bars and lightning arresters should be disconnected. Give the measured resistance on MSF009 (do not make the temperature correction conversion). Refer to MSR012 for evaluation of megger readings and maximum meggering voltages. Refer to MST008 for transformer meggering procedure.

NEWFOUNDLAND POWER
A FORTIS COMPANY

POWER TRANSFORMERS

Type of Maintenance				Procedure
I	III	IV	V	
X		X*		26. Megger core ground with a 500V megger. If this will require removing oil, which may not be practical, this step may be omitted. This must be done as part of the acceptance procedure for a new unit.
X		X*		27. Carry out ratio tests with ratiometer. Refer to MST011 for TTR procedure.
		X		28. Carry out power factor and winding resistance testing. See appropriate manufacture manual for the test equipment that is being used.
X		X		29. Carry out a Transformer Protection Devices Inspection as per maintenance standard MST017. Ensure to inspect all junction boxes, making special note of any wear/cracking or any point at which water could enter the box. Ensure all gaskets and seals are checked and replaced as necessary. Install humidisorb packs in all junction boxes.
X		X		30. Ensure that all accessories are tested. Examine all apparatus, electrical cables, conductors, signaling and operating devices. A megger test is recommended if applicable.
X	X	X		31. Observe drop leads for signs of strain on bushings or associated equipment. If transformer is de-energized, check line connections for tightness.
X	X	X		32. Ensure that the control cabinet is clean and dry. Ensure the cabinet heater is operating to prevent condensation build up.
X				33. If present, ensure that any bushing wrap is removed.
X*		X		34. If transformer is to be kept as spare, wrap bushings with plastic wrap.
			X	35. For unplanned maintenance as a result of breakdown or diagnostic tests, make the necessary repairs and note on MSF009.
X	X	X	X	36. Any changes made or abnormal conditions found should be noted on MSF009 and reported to the Electrical Maintenance Planners Group.
X	X	X	X	37. Send copies of form MSF009 to the Electrical Maintenance Planners' group along with any unresolved issues with the equipment or with the procedures. Any outstanding work shall be entered into an Avantis work request and submitted.
X	X	X	X	38. Update maintenance history and nameplate information in Avantis.

*** Only if the transformer is de-energized and if it is deemed necessary to make these checks.**

Caution: For some transformer maintenance, control wiring may have to be disconnected to disable alarms and trip circuits. This normally applies to gas detector relays, temperature gauges, pressure relief devices, etc., that are connected to external trip schemes. An approved protection plan may be required for such cases.

Note: For transformers with an on-load tapchanger, refer to MSP012 for standard maintenance procedures.

ATTACHMENT C:

Power Transformer Maintenance Standard Report Forms

NEWFOUNDLAND POWER
A FORTIS COMPANY

MSF009
Form No. 353

Revised: November 2024

Maintenance Standard Report Form

Power Transformer

Substation Designation:	AVANTIs Work Order Number:	Company Number:	
Manufacturer:	Serial Number:	Type:	Rated Voltage:

Check each item with a √ for OK, X to indicate a problem, NA for not applicable, or ND for not done. All entries must be completed during a Maintenance IV. Once work is completed, the Electrical Maintenance Lead Hand must sign and forward to Planner for processing and filing. Additional scope may be indicated by the Maintenance Planner and shall be documented in the remarks section.

Step	Task	Status	Done By
1	Ensure an appropriate PCB label is installed on the transformer Place a label on the inside of the control cabinet indicating PCB level. If no lab oil test has been previously conducted on the unit, take an oil sample for lab testing.		
2	Make a visual inspection, noting the general condition of the transformer. Check for such things as dents, oil leaks (particularly around gasketed joints and radiators), paint condition, damaged bushings, broken glass on gauges, abnormal readings on thermometers, oil level gauges, etc. Report issues to the electrical Maintenance Planner Group.		
3	All grounding and neutral connections upgraded to 19/#9 copper clad steel. (Neutral meant to be copper not copper clad)		
4	Check the oil level as indicated by the gauge on the conservator tank or on the main tank if there is no conservator tank and top up as required.		
5	Silica gel, breather and piping replaced.		
6	Pressure relief vent replaced with new PRD.		
7	Cabinet heater function check completed.		
8	Replace Gas Detector Relay and confirm operation. Refer to MST007 (2.5-3.0 psi).		
9	Lighting Arresters replaced HV Rating: LV Rating:		
10	Bushings and Lighting Arresters clean and free of damage.		
11	Check the operation of the temperature gauges including the set point of switches using thermocal.		
12	Transformer Protection Devices Inspection completed as per maintenance standard MST017 and complete MSF031 attached.		
13	Transformer painted.		

Step	Task	Status	Done By
14	Spill pan, check that heat tracing, valve and petro pipe is operational. Ensure pan is free of oil and drained.		
15	Check the cooling fans for proper operation and replace as required.		
16	Check the dielectric value of the insulating oil. Refer to MSR013. Refer to MSR010 for oil dielectric requirements.		
17	Inspect transformer leads for signs of strain on bushings or associated equipment. Check tightness of all connections.		
18	Megger test complete and results recorded below. Refer to MSR012 for evaluation of megger readings and maximum meggering voltages. Refer to MST008 for transformer meggering procedure.		
19	Megger core ground with a 500V megger. If this requires removing oil, which may not be practical, this step may be omitted.		
20	Transformer turns ratio (TTR) test completed and results recorded below or attached. Refer to MST011.		
21	Winding resistance test completed, and results attached. Refer to MST016.		
22	Transformer power factor test completed and results attached.		
23	Bushing power factor test completed and results attached.		
24	Lightning Arrester watts loss test completed and results attached. Refer to MST020.		

Insulation Resistance Test (Refer to MSR012)					
Test	**Voltage**	**Min. Acceptable Value**	**Result**		
Core Ground	500V	100 MΩ			
Two Winding Transformer					
Test	**Voltage**	**Min. Acceptable Value**	**1 Minute Result**	**10 Minute Result**	**10/1 Minute Ratio**
H-LG	5000V	5000 MΩ			
L-HG	5000V	5000 MΩ			
HL-G	5000V	5000 MΩ			
Three Winding Transformer					
Test	**Voltage**	**Min. Acceptable Value**	**1 Minute Result**	**10 Minute Result**	**10/1 Minute Ratio**
H-LTG	5000V	5000 MΩ			
L-HTG	5000V	5000 MΩ			
T-HLG	5000V	5000 MΩ			
HL-TG	5000V	5000 MΩ			
HT-LG	5000V	5000 MΩ			
LT-HG	5000V	5000 MΩ			
HLT-G	5000V	5000 MΩ			

Ratio Test:
Turns-ratio test results should not deviate by more than one-half percent from either the adjacent coils or the calculated ratio.

Tap Position	Calc	H1 Phase H1 - -	H2 Phase H2 - -	H3 Phase H3 - -	Tap Position	Calc	H1 Phase H1 - -	H2 Phase H2 - -	H3 Phase H3 - -
1					18				
2					19				
3					20				
4					21				
5					22				
6					23				
7					24				
8					25				
9					26				
10					27				
11					28				
12					29				
13					30				
14					31				
15					32				
16					33				
17									

Remarks:
Any scope of work completed beyond the check list above shall be recorded below. Any follow up work not completed as park of maintenance shall be entered into Avantis via a work request.

Sign-Offs

Maintenance Level	Date Completed:	Maintenance Crew
M4		