

**VOLTAGE CONTROL RELAY
MAINTENANCE TEMPLATE**

AM-CE-P034-R1049
Rev. 2

Revisions to this document shall be communicated in accordance with program document AM-EU-P034 to ensure alignment between Maintenance Templates and field work procedures.

Voltage Control Relay						
Component Classification Categories						
Criticality	I	X				DC, SS, TDC, TSS locations that serve O'Hare & Midway Airports
	II		X			ComEd locations exclusive of Criticality I, DC, and ≤34kV ESS locations
	III			X		DC locations
	IV				X	≤ 34kV ESS locations
Duty Cycle	Heavy Load	N/A	N/A	N/A	N/A	
	Normal Load	N/A	N/A	N/A	N/A	
Service Condition	In Service	X	X	X	X	
	Spare	N/A	N/A	N/A	N/A	
Condition Monitoring Tasks						
Monitor Circulating Current	SCADA	SCADA	SCADA	SCADA	2d, 4e	Monitored via scada
Monitor LTC Operations Counter	5W	10W	3M	6M	1a, 1c-d, 2a-c, 4c	
Monitor LTC Position Ind and Drag-hands	5W	10W	3M	6M	1a-d, 4a-c	
Time Directed						
None	N/A	N/A	N/A	N/A	N/A	
Failure Finding Tasks						
Visual Inspection	5W	10W	3M	6M	1d, 3a	
Condition Directed Tasks						
Calibrate the Voltage Control	AR	AR	AR	AR	1b, 2b, 4a, 4b	Triggered by results of monthly inspections, scada voltage alarms, or customer concern.

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FAILURE MODE	FAILURE CAUSES	MAINTENANCE TASKS
1. Fails to Regulate Voltage	1a. Control Circuit Failure	Functional Operations Check
1. Fails to Regulate Voltage	1a. Control Circuit Failure	Monitor LTC Operations Counter
1. Fails to Regulate Voltage	1a. Control Circuit Failure	Monitor LTC Position Ind and Drag-hands
1. Fails to Regulate Voltage	1b. Control Out of Calibration	Calibrate the Voltage Control
1. Fails to Regulate Voltage	1b. Control Out of Calibration	Monitor LTC Position Ind and Drag-hands
1. Fails to Regulate Voltage	1c. LTC Mechanism Problem	Functional Operations Check
1. Fails to Regulate Voltage	1c. LTC Mechanism Problem	Monitor LTC Operations Counter
1. Fails to Regulate Voltage	1c. LTC Mechanism Problem	Monitor LTC Position Ind and Drag-hands
1. Fails to Regulate Voltage	1d. 90 Relay Failure	Functional Operations Check
1. Fails to Regulate Voltage	1d. 90 Relay Failure	Monitor LTC Operations Counter
1. Fails to Regulate Voltage	1d. 90 Relay Failure	Monitor LTC Position Ind and Drag-hands
1. Fails to Regulate Voltage	1d. 90 Relay Failure	Visual Inspection
2. LTC Operates Too Frequently	2a. Control Circuit Failure	Monitor LTC Operations Counter
2. LTC Operates Too Frequently	2b. Control Out of Calibration	Calibrate the Voltage Control
2. LTC Operates Too Frequently	2b. Control Out of Calibration	Monitor LTC Operations Counter
2. LTC Operates Too Frequently	2c. LTC Mechanism Problem	Monitor LTC Operations Counter
2. LTC Operates Too Frequently	2d. Circulating Current Circuit Problem	Monitor Circulating Current
3. Fails to Provide Proper Indication	3a. 90 Relay Failure	Visual Inspection
4. LTC Runs to Full Boost or Buck	4a. Control Out of Calibration	Calibrate the Voltage Control
4. LTC Runs to Full Boost or Buck	4a. Control Out of Calibration	Monitor LTC Position Ind and Drag-hands
4. LTC Runs to Full Boost or Buck	4b. LTC Mechanism Problem	Calibrate the Voltage Control
4. LTC Runs to Full Boost or Buck	4b. LTC Mechanism Problem	Monitor LTC Position Ind and Drag-hands
4. LTC Runs to Full Boost or Buck	4c. 90 Relay Failure	Functional Operations Check
4. LTC Runs to Full Boost or Buck	4c. 90 Relay Failure	Monitor LTC Operations Counter
4. LTC Runs to Full Boost or Buck	4c. 90 Relay Failure	Monitor LTC Position Ind and Drag-hands
4. LTC Runs to Full Boost or Buck	4e. Circulating Current Circuit Problem	Monitor Circulating Current

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TASK	DEFINITION
Calibrate the Voltage Control	Perform calibration of voltage control to ensure proper band-center, band-width, load-drop compensation, and time-delay settings.
Monitor Circulating Current	Monitor the amount of circulating current via scada. If circulating current is excessive then issue CM to have the control functionally checked or calibrated.
Monitor Operations Counter	Record and trend regulator operations counter. Data collected is used to trigger regulator control recalibration for excessive or minimal operations.
Monitor Position Indicator and Drag-hands	Record and trend regulator position indicator and max/min drag hand positions. Reset drag-hands.
Visual Inspection	Items to be checked are: <ul style="list-style-type: none">-- Check voltage control relay for any obvious signs of damage-- Check for unusual noises and smells-- Monitor operations counter-- Monitor position indicator and drag-hands

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Voltage Control Relay Template Summary

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

References:

IEEE C57.12.30, paragraph 19.3, "Automatic Control Equipment - Accuracy and Burden"

IEEE C57.15 "Requirement, Terminology, and Test Code for Step-Voltage and Induction-Voltage Regulators"

Beckwith Electric - Tapchanger Controls Applications Note #11, "Introduction to Paralleling of LTC Transformers by the Circulating Current Method".

Boundary Definition

This template includes the voltage control (90) relay, associated parallel balancing modules and associated LTC control circuit. Regulator voltage controls are included as part of the regulator template and are not included in this template.

Failure Experiences

The failure of the LTC regulating relay or associated control circuit will lead to the inability of the LTC to regulate voltage as designed. This failure mode can be identified through normal substation inspections and will occasionally be identified by a customer voltage complaint. This template recommends condition monitoring tasks which will be used to determine when corrective maintenance is required, therefore the voltage control relays are primarily run-to-failure devices.

Vendor Recommendations

N/A

Disposition of Vendor Recommendations

N/A

Basis for Template Tasks

IEEE Guides, Vendor Manuals, Operating Experience, and OEM Recommendations.

Visual Inspection: This inspection approximates real-time condition monitoring that can detect developing problems and degradation, and provides condition data used to initiate corrective actions.

**VOLTAGE CONTROL RELAY
MAINTENANCE TEMPLATE**

Revision 0		Date 06/17/2005
Writer	Drew Reindel (Strategic Programs)	
Reviewer(s)	3/4/05 Template Challenge Session Attendees	
Approver(s)	Kathy McHugh (FAM Maintenance Planning)	
Reason Written	To document the maintenance program tasks, frequencies, failure modes, and maintenance basis	

Revision 1		Date 01/26/2007
Writer	Drew Reindel (Strategic Programs)	
Reviewer(s)		
Approver(s)	Kathy McHugh (FAM Maintenance Planning)	
Reason Written	General format review, revised monthly tasks to 5W to add specificity	

Revision 2		Date 11/30/2010
Writer	Chris Stefanski	
Reviewer(s)	Ken Wendt (Mgr. Material Condition), Drew Reindel (Mgr. T&S Engineering)	
Approver(s)	Bill Fluhler , Bill Gannon, Nitin Patel, Jim Crane, Bill Sullivan	
Reason Written	Added note to ensure template changes are communicated to affected work groups.	

Revision 3		Date 04/29/2011
Writer	Chris Stefanski (Material Condition)	
Reviewer(s)	Ken Wendt, Drew Reindel, Jim Crane	
Approver(s)	Bill Fluhler (ComEd) , Bill Sullivan (PECO)	
Reason Written	Modified criticality definitions and incorporated 10-week, 3-month and 6-month inspection task frequencies	

Revision CE 0		Date 10/31/2015
Writer	Kevin Swiat (ComEd)	
Reviewer(s)	Ken Wendt (ComEd)	
Approver(s)	Michael Moy (UFAM ComEd)	
Reason Written	Modified document to serve as the ComEd maintenance standard.	

Revision CE 1		Date 9/1/2018
Writer	Kevin Swiat (Material Condition)	
Reviewer(s)	Joe Qiu (Relay & Protection Engineering)	
Approver(s)	Michael Moy (UFAM ComEd)	
Reason Written	Revised criticalities to align with AM-CE-P034-R0001; Removed detail from "Monitor Operations Counter" definition since not all equipment is inspected every 5W; Completed 3 Year Review.	

Revision CE 2		Date 11/9/2018
Writer	Kevin Swiat (Material Condition)	
Reviewer(s)	Joe Qiu (Relay & Protection Engineering)	
Approver(s)	Michael Moy (UFAM ComEd)	
Reason Written	Corrected copy/paste error in wording for criticality II in "Voltage Control Relay" tab.	