

Instrument Transformers - Free Standing Potential Transformer ≥69 kV							
Component Classification Categories							
Criticality	I	X				Nuclear Switchyards ≥220 kV as defined in the respective Nuclear Plant Interface Requirements (NPIRs)	
	II		X			DC, SS, TDC, TSS locations that serve O'Hare & Midway Airports	
	III			X		<ul style="list-style-type: none"> Next Terminal Out [Equipment 220kV & Up] from Nuclear Switchyards (as defined in the respective NPIRs) Critical Transmission Interconnections Critical Equipment / Locations per AM-CE-P034-R0001 	
	IV				X	All other 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							
		Task Frequencies				Failure Codes	Comments
Record & Trend Voltage Output (scada)		SCADA	SCADA	SCADA	SCADA	1a-c	
Thermography		1Y	1Y	1Y	1Y	1c, 2c	
Power Factor Test		8Y	8Y	8Y	AR	2b-c	As Required means to perform test when monitored voltage output exceeds alarm thresholds.
Time Directed							
		Task Frequencies				Failure Codes	Comments
None		N/A	N/A	N/A	N/A		
Failure Finding Tasks							
		Task Frequencies				Failure Codes	Comments
Visual Inspection		5W	5W	10W	10W	1d, 2a-b, 3b-c	
Detailed Visual Inspection		8Y	8Y	8Y	AR	1d, 2b, 3a-c	As Required means to perform inspection when monitored voltage output exceeds alarm thresholds.
Condition Directed Tasks							
		Task Frequencies				Failure Codes	Comments
None		N/A	N/A	N/A	N/A		

Instrument Transformers - Free Standing Potential Transformer ≤34kV							
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 ≤34 kV ESS locations	
	III			X		DC locations	
	IV				X	≤34 kV 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							
Record & Trend Voltage Output (scada)		Task Frequencies		Failure Codes		Comments	
		SCADA	SCADA	SCADA	SCADA	1a-c	Where applicable
Thermography		1Y	1Y	1Y	4Y	1c, 2c	
Time Directed							
None		Task Frequencies		Failure Codes		Comments	
		N/A	N/A	N/A	N/A		
Failure Finding Tasks							
Visual Inspection		Task Frequencies		Failure Codes		Comments	
		5W	10W	3M	6M	1d, 2a-b, 3b-c	
Detailed Visual Inspection		AR	AR	AR	AR	1d, 2b, 3a-c	Performed if indicated by condition monitoring or inspection.
Condition Directed Tasks							
None		Task Frequencies		Failure Codes		Comments	
		N/A	N/A	N/A	N/A		

INSTRUMENT TRANSFORMER (PT) FAILURE MODES

FAILURE MODE	FAILURE CAUSES	MAINTENANCE TASKS
1. Fails to Provide Correct Output	1a. Open Winding	Record & Trend Voltage Output (scada)
1. Fails to Provide Correct Output	1b. Shorted Winding	Record & Trend Voltage Output (scada)
1. Fails to Provide Correct Output	1c. High Resistance Connections	Thermography
1. Fails to Provide Correct Output	1c. High Resistance Connections	Record & Trend Voltage Output (scada)
1. Fails to Provide Correct Output	1d. Corroded Connections	Visual Inspection
1. Fails to Provide Correct Output	1d. Corroded Connections	Detailed Visual Inspection
2. Fails to Provide Adequate Insulation Level	2a. Loss of Oil	Visual Inspection
2. Fails to Provide Adequate Insulation Level	2b. Cracked/Broken Bushing	Visual Inspection
2. Fails to Provide Adequate Insulation Level	2b. Cracked/Broken Bushing	Detailed Visual Inspection
2. Fails to Provide Adequate Insulation Level	2b. Cracked/Broken Bushing	Power Factor Test
2. Fails to Provide Adequate Insulation Level	2c. Insulation Breakdown	Power Factor Test
2. Fails to Provide Adequate Insulation Level	2c. Insulation Breakdown	Thermography
3. Fails to Maintain Boundary Integrity	3a. Gasket Failure	Detailed Visual Inspection
3. Fails to Maintain Boundary Integrity	3b. Weld Failure	Visual Inspection
3. Fails to Maintain Boundary Integrity	3b. Weld Failure	Detailed Visual Inspection
3. Fails to Maintain Boundary Integrity	3c. Tank Corrosion	Visual Inspection
3. Fails to Maintain Boundary Integrity	3c. Tank Corrosion	Detailed Visual Inspection

INSTRUMENT TRANSFORMER (PT) MAINTENANCE TASK DEFINITION

TASK	DEFINITION
Detailed Visual Inspection	Detailed visual inspection performed with equipment de-energized. Items to be checked / completed include: <ul style="list-style-type: none"> -- Detailed inspection for signs of oil leakage -- Porcelain should be free of contamination - wipe down if required -- Inspect for chips or cracks in porcelain -- Verify cabinet heater operation as applicable -- Verify oil levels as applicable
Power Factor Test	Power factor Testing (doble test) which helps to prove the insulating level of the device and capacitance measurements, that indicate if component failures are occurring inside the porcelain housings.
Record & Trend Voltage Output (scada)	On PT's monitored by scada, the scada system has alarm set points for voltage levels.
Thermography	Infrared inspection of electrical equipment and power path components to identify any hot spots that may exist. The inspection scope includes: <ul style="list-style-type: none"> -- Transformer and tank -- Bushings and connections -- Secondary connections
Visual Inspection	Visual assessment of the condition of the equipment. Scope includes: <ul style="list-style-type: none"> -- Check for signs of oil leakage -- Check for unusual noises and smells -- Check for chips or cracks in porcelain -- Verify cabinet heater operation as applicable -- Verify oil levels as applicable -- Check for abnormal contamination on porcelain

INSTRUMENT TRANSFORMER PT'S MAINTENANCE BASIS

Instrument Transformer – Potential Transformer (PT) Template Summary

The Preventive Maintenance program is documented via maintenance templates. Templates have been developed that address transmission, substation, and distribution equipment that is owned and 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:

Internal failure reports

OEM Maintenance Manuals and Interviews

EPRI 1001779 Guidelines for the Life Extension of Substations

Boundary Definition

The boundary of a PT for the purpose of this document is defined to include the Potential Transformer, Primary and Secondary Windings, the insulating medium, the bushings, and the secondary cabinet and its components.

Excluded from this treatment are: The associated secondary equipment that are fed by the PT such as relays, scada equipment, and fuses are not included as part of this maintenance program.

Failure Experiences

Failures are subject to ACE/RCI investigation. Findings/recommended corrective actions are incorporated into the template as required.

Vendor Recommendations

OEM manuals were referenced and interviews conducted during the development of this template.

Disposition of Vendor Recommendations

Recommendations were incorporated into the template as deemed necessary.

Basis For Template Tasks

INSTRUMENT TRANSFORMER PT'S MAINTENANCE BASIS

Detailed Visual Inspection: This inspection is performed on de-energized equipment and allows for more in depth evaluation of the components than when the equipment is in an energized state.

Power Factor Test: Power factor testing is recommended as viable electrical test on PTs. Power Factor testing provides indication of insulation degradation and/or changes in capacitance. Best applied as a trending tool.

Record & Trend Voltage Output (scada): Task is in place to capture ability to monitor voltage output of the PT via scada.

Thermography: IEEE Standard 62 identifies thermography as a primary tool for detection of connection issues, bushing issues. EPRI 1002913 identifies thermography as a tool for detection of connection issues, insulator degradation and cooling system operation. EPRI TR-106857-V38 Identifies thermography as a tool for detection of loose electrical connections, LTC contact problems, local flux current heating, proper cooler operation, bearing wear in pump and fan motors.

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.

INSTRUMENT TRANSFORMER PT'S TEMPLATE DEVELOPMENT HISTORY

Revision 0		Date 06/17/2005
Writer	Drew Reindel (Strategic Programs)	
Reviewer(s)	August 2004 EED/Nuclear 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 11/17/2006
Writer	Drew Reindel (Strategic Programs)	
Reviewer(s)		
Approver(s)	Kathy McHugh (FAM Maintenance Planning)	
Reason Written	General scrub, task and periodicity review/update	

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. Created separate tabs by voltage.	

Revision EU 0		Date 12/14/2012
Writer	Chris Stefanski (Material Condition)	
Reviewer(s)	Ken Wendt, Drew Reindel, Jim Crane, Greg Hitzke, Drew Davis	
Approver(s)	Bill Fluhler (UFAM ComEd) , J. Coffman(UFAM PECO), Chris Lotz (UFAM BGE)	

INSTRUMENT TRANSFORMER PT'S TEMPLATE DEVELOPMENT HISTORY

Reason Written	Changed document number and document template to align with Exelon Utilities Management Model. Modified criticality definitions; Power Factor and Detailed Visual changed from 6Y to AR for lower criticality locations at ComEd; Detailed Visual changed from 6Y to AR for ≤34kV locations. The changes associated with Rev.0 of this document will not result in any changes to maintenance activities or maintenance frequencies on Nuclear Switchyard equipment covered under the NRC Maintenance Rule (NPIR Maintenance Requirements).
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Revision EU 1		Date 06/12/2014
Writer	Steven Scalcucci (Material Condition)	
Reviewer(s)	Ken Wendt, George Leinhauser, Greg Hitzke	
Approver(s)	Michael Moy (UFAM ComEd) , J. Coffman(UFAM PECO), Corry Summerson (UFAM BGE)	
Reason Written	Changed equipment description to include the term "Free Standing", PF and Details Visual to 8Y for ≥ 69kV.	

Revision CE 0		Date 02/20/2015
Writer	Chris Stefanski (Exelon Utilities)	
Reviewer(s)	Ken Wendt, Greg Hitzke, Tu Liang	
Approver(s)	Michael Moy (UFAM ComEd)	
Reason Written	Created to document the ComEd maintenance program tasks, frequencies, failure modes, and maintenance basis.	

Revision CE 1		Date 10/27/2017
Writer	Hugo Castaneda (ComEd Material Condition)	
Reviewer(s)	Greg Hitzke (ComEd), Tu Liang (ComEd), Dale Player (ComEd), Nitin Patel (ComEd), Rich Bellino (ComEd), Betsy Spolarich (ComEd), Ismael Rivera Jr (Dresden Nuclear Station Systems Engineer), Travis Greene (Byron Nuclear Station Systems Engineer), Sachin Shukla (Braidwood Nuclear Station Systems Engineer), Aaron Kulow (Quad Cities Nuclear Station Systems Engineer), Kent Nelson (LaSalle Nuclear Station Systems Engineer)	
Approver(s)	Michael Moy (UFAM ComEd)	
Reason Written	Revised to include new criticalities as defined in AM-CE-P034-R0001.	