Instrument Transformers -							
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			▪ 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, 1e**	
Thermography	**1Y**	**1Y**	**1Y**	**1Y**	**1c, 2c**	
Power Factor Test	**8Y**	**8Y**	**8Y**	**AR**	**1a-b, 1e, 2a-b**	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**	**2a, 2c, 3b-c**	
Detailed Visual Inspection	**8Y**	**8Y**	**8Y**	**AR**	**2b, 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 - Coupling Capacitor Voltage Transformer (CCVT) ≤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		**Task Frequencies**				**Failure Codes**	**Comments**
Thermography		**1Y**	**1Y**	**1Y**	**4Y**	**1c, 2c**	
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**	**10W**	**3M**	**6M**	**2a, 2c, 3b-c**	
Condition Directed Tasks		**Task Frequencies**				**Failure Codes**	**Comments**
None		**N/A**	**N/A**	**N/A**	**N/A**		

INSTRUMENT TRANSFORMER CCVT TEMPLATE 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	1a. Open Winding	Power Factor Test
1. Fails to Provide Correct Output	1b. Shorted Winding	Record & Trend Voltage Output (scada)
1. Fails to Provide Correct Output	1b. Shorted Winding	Power Factor Test
1. Fails to Provide Correct Output	1c. High Resistance Connections	Record & Trend Voltage Output (scada)
1. Fails to Provide Correct Output	1c. High Resistance Connections	Thermography
1. Fails to Provide Correct Output	1d. Corroded Connections	Visual Inspection
1. Fails to Provide Correct Output	1d. Corroded Connections	Detailed Visual Inspection
1. Fails to Provide Correct Output	1e. Shorted Capacitor Unit	Record & Trend Voltage Output (scada)
1. Fails to Provide Correct Output	1e. Shorted Capacitor Unit	Power Factor Test
2. Fails to Provide Adequate Insulation Level	2a. Cracked/Broken Bushing	Visual Inspection
2. Fails to Provide Adequate Insulation Level	2a. Cracked/Broken Bushing	Detailed Visual Inspection
2. Fails to Provide Adequate Insulation Level	2a. Cracked/Broken Bushing	Power Factor Test
2. Fails to Provide Adequate Insulation Level	2b. Insulation Breakdown	Power Factor Test
2. Fails to Provide Adequate Insulation Level	2b. Insulation Breakdown	Thermography
2. Fails to Provide Adequate Insulation Level	2b. Insulation Breakdown	Detailed Visual Inspection
2. Fails to Provide Adequate Insulation Level	2c. Loss of Oil	Visual Inspection
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 CCVT MAINTENANCE TASK DEFINITIONS

TASK	DEFINITION
Detailed Visual Inspection	Detailed visual inspection performed with equipment de-energized. Items to be checked / completed include: -- 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 -- Clean / wipe down components in base-box
Power Factor Test	Electrical loss measurement, usually performed using Doble power factor equipment, which helps to prove the insulating level of the device and capacitance measurements, that indicate if component failures are occurring inside the porcelain housings. In addition ratio testing of connected windings is proven during power factor testing.
Record & Trend Voltage Output (scada)	On CCVT'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: -- Capacitor units -- Bushings and connections -- Transformer unit
Visual Inspection	Visual assessment of the condition of the equipment. Scope includes: -- Check for signs of oil leakage -- Check for unusual noises and smells

INSTRUMENT TRANSFORMER CCVT TEMPLATE MAINTENANCE BASIS

Coupling Capacitive Voltage Transformer - CCVT 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 CCVT for the purpose of this document is defined to include the CCVT Capacitor Units, the Transformer, the secondary cabinet and its components, and the tuning unit if equipped.

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

Failure Experiences
CCVT 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

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 Testing (Doble): Power factor testing is recommended as viable electrical test on CCVT's. Power Factor testing provides indication of insulation degradation and changes in capacitance. Best applied as a trending tool. If the capacitance changes from nameplate by more the 2% or the power factor is higher then 0.5% the CCVT should be replaced on a scheduled basis and if it changes by more then 4% or the power factor is higher then 1.0% it should be replaced prior to re-energization.

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

INSTRUMENT TRANSFORMER CCVT TEMPLATE DEVELOPMENT HISTORY

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

	Revision EU 1	**Date 06/30/2014**
Writer	Chris Stefanski (Exelon Utilities)	
Reviewer(s)	Ken Wendt, George Leinhauser, Tom Harrington	
Approver(s)	Michael Moy (UFAM ComEd) , J. Coffman(UFAM PECO), Cory Summerson (UFAM BGE)	
Reason Written	Changed cycle for Power Factor Test and Detailed Visual Inspection from 6 years to 8 years. Changed applicability note regarding BGE maintenance programs. Changed criticality definition to include applicability to BGE - Calvert Cliffs nuclear switchyard.	

	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)	

INSTRUMENT TRANSFORMER CCVT TEMPLATE DEVELOPMENT HISTORY

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.