Transmission Asset Management Analytics (Program 34)

Catalog of ongoing analytics efforts; how utilities can engage and contribute data to help advance ongoing developments

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Purpose Of The Catalog

Transmission Utilities can benefit from a single document that catalogs and makes them aware of the various asset analytics tasks that EPRI is working on as part of Transmission Asset Management Analytics (P34).

This document:

- Helps create awareness of specific asset focused analysis currently underway.
- Provides information on how you can get engaged in a specific analysis.
- Provides information on data that you can provide to help advance the development.
- Provide feedback to EPRI asset analytics team in case we need to add a new analytics task.

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Asset Management Principles & Practices

	Topic	Description	How can utilities engage & help advance ongoing research?
1	Asset Management and Applied Analytics Workshop	• Many transmission utilities are adopting asset management methods for making data driven decisions. This task aims to develop & deliver a workshop to introduce the concepts, processes, techniques and value of analytics in transmission asset management decision making. Data requirements, techniques and application examples will be presented. Utilities are encouraged to share their perspectives on asset management and applied analytics.	• Attend workshop • Share utility perspectives • Provide feedback • Let us know if you would like to present at the workshop
2	Transmission Asset Performance Metrics	• Catalog metrics currently being used to manage and assess transmission asset performance.	• Respond to survey
3	Utility Information Exchange	• Provides a forum for utilities to exchange information, experiences, and lessons learned.	• Propose topics for information exchange

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Power Transformer Asset Management Analytics

	Topic	Description	How can utilities engage & help advance ongoing research?
1	Collect & Analyze Industry wide Data to better understand current performance, project future performance and inform other research	• In-service & failure records to better understand hazard rates by family, make, model, application & age • In-service & removal records to better understand replacement rates by family, make, model, application & age • Maintenance records (work orders) to better understand maintenance issues affecting transformer performance - incurred O&M, leak rates, tap changers, cooling system etc. • Bushing power factor data to draw meaningful and statistically defensible inferences regarding bushing performance	Please contribute: • In-service records • Failure & replacement records • Maintenance records (preventive & corrective) • Historical bushing power factor test records
2	Develop & deliver new version of the Power Transformer Expert System Software (PTX)	• Test online DGA monitor data analysis algorithm with field data to ensure minimal false positives & With field data overlaid with lab generated fault data to ensure timely discernment of fault • Continued Main tank assessment indices improvement with continuous validation based on blind testing using data set of in-service & failed transformers, correlating the paper degradation index with degree of polymerization test results & improve moisture assessment • Improve LTC assessment by developing rules for additional makes/models based on member interest • Improve software with increase flexibility in import from databases, improve reporting & visualization	Please contribute: • Historical test data – dissolved gas analysis, oil quality, furans, electrical test results, maintenance history. • Failures with known root causes. • Paper samples and historical test data from failed and retired transformers • Load Tap Changer Inspection Reports • Data from online DGA monitors
3	Next Generation Power Transformer Asset Management	• Identify & evaluate various approaches, for e.g., machine learning, probabilistic graphical models to better understand their value & applicability in predictive analysis	• Review progress & provide feedback

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Circuit Breaker Asset Management Analytics

	Topic	Description	How can utilities engage & help advance ongoing research?
1	Collect & Analyze Industry wide Data to better understand current performance, project future performance and inform additional research	• Continue gathering in-service & removal records to better understand replacement rates by family, make, model, application & age • Continue collecting and processing maintenance records (preventive & corrective) to develop new insights & analytics that utilities can use to improve existing maintenance programs, selection of new breakers & deciding which ones to repair/replace/refurbish	Please contribute: • In-service records • Replacement records • Maintenance records (preventive & corrective) • SF_6 usage (gas fills)

2	Investigate the use of relay event data to better understand breaker operating performance and patterns?	• Develop Methods & Techniques to Analyze Relay Data to Better Understand Circuit Breaker Performance
		  • Continue to work with utilities to:
		    • Obtain relay event data
		    • Better understand the extraction process
		  • Analyze the relay data to better understand the resulting pattern
		  • Correlate with breaker operations and maintenance
		    • For example, faster after maintenance?
		  • If successful, develop a plan to use the methodology and results in improving circuit breaker asset management decisions.
			Please contribute:
			
			• Relay event files
			• In-service breaker demographics

3	Circuit Breaker Replacement Ranking Framework	• Continue efforts underway at twelve utilities to implement the CBRR tool using their fleet information
		  • Applying methodology on live as well as dead tank circuit breaker fleets
		• Investigate how to incorporate new inputs in the ranking process
		• Incorporate industry wide circuit breaker data analysis results
		• Incorporate lessons learned from framework implementation at various utilities
		• Deliver a new version of the software by year end
		• Develop material to improve utilities' ability of implementing the framework:
		  • Application guidelines
		  • Tools to assist with data preparation and manipulation
		  • Reports to view, interpret and use results
			• Let EPRI know if you are interested in:
			  • Learning more about the framework
			  • If you need help in applying the framework
			  • Provide feedback if you are applying the framework on you own

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Substation Battery Asset Management Analytics

	Topic	Description	How can utilities engage & help advance ongoing research?

1	Substation Batteries Performance Assessment	• Collect historical data from utilities:
		   • Demographic information
		   • Inspection/test results
		   • Maintenance and replacement records
		• Investigate the analysis of this to data help:
		   • Glean insights that provide early indication of battery degradation?
		   • Identify maintenance trends, rates, and other factors?
		   • Better understand the performance characteristics of certain battery populations?
			Please contribute:
			• Demographic information
			• Outage history
			• Maintenance history

2	Assessing the efficacy of online battery monitoring	• Are there failure modes seen during rounds inspections that online monitors cannot detect?
		• How good are correlations between online monitor and rounds measurements?
		• Can online monitoring increase frequency of rounds inspection?
		• Investigation Approach:
		   • Work with funders to obtain data – demographic, rounds inspection, online monitor, maintenance records (preferably from same population)
		   • Understand the technology – battery, online monitor
		   • Understand the underlying data
		   • Formulate analytical investigation approach
		   • Implement approach, perform investigation
		   • Share results
			Please contribute:
			• Demographic, rounds inspection, online monitor, maintenance records (preferably from same population)
			• Documentation to help understand the technology – battery, online monitor

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Balance of Substation Asset Management Analytics

	Topic	Description	How can utilities engage & help advance ongoing research?

1	Capacitor Bank Performance Assessment	• Collect historical data from utilities:
		   • Demographic information
		   • Outage history
		   • Maintenance history
		• Investigate analysis of this data to help the utility better understand transmission capacitor bank performance?
		   • For example,
		      • What is the underlying outage cause?
		      • Fuse, protection,
		      • What are the failure rates by manufacturer and bank type?
			Please contribute:
			• Demographic information
			• Outage history
			• Maintenance history

2	Protection and control assets	• Replacement rates • Failure rates • Maintenance trends • Performance outliers	Please contribute: • Demographic information • Maintenance history • Inspection results • Other suitable data – e.g. test results

3	Disconnect Switch Performance Assessment	• Collect historical data from utilities:
		   • Demographic information
		   • Maintenance history
		   • Inspection results
		• Investigate analysis of this data to help the utility better understand disconnect switch population performance?
		   • For example,
		      • Where am I spending maintenance dollars?
		      • Insulator problems
		      • Contact issues
		      • Lubrication issues
		• Which makes and models require more maintenance than others?
			Please contribute:
			• Demographic information
			• Maintenance history
			• Inspection results

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Overhead Transmission Asset Management Analytics

	Topic	Description	How can utilities engage & help advance ongoing research?
1	T&D Wood Pole Population Performance	• Continue Collection & processing of industry wide wood pole inspection, replacement & demographic data • Continue development of algorithms to better understand the useful life of wood poles & the effect of variables such as species, original treatment type, environment, inspection providers, pole dimensions etc.	• In-service records • Historical inspection records • Historical replacement records • Geospatial information
2	Steel Structure Population Performance	• Continue Collection & processing of industry wide steel structure inspection, replacement & demographic data • Continue development of algorithms to better understand the performance of steel structure & the effect of variables such age, land cover type, soil chemistry, environment etc.	• In-service records • Historical inspection records • Historical replacement records • Geospatial information
3	Transmission Line Conductor & Shield Wire	• Continue Collection of industry wide conductor & shield wire data, for e.g., laboratory condition assessment results from field aged samples, replacement records, demographic records • Continue development of algorithms to better understand the survivability conductors & shield wires & the effect of variables such as conductor type, environment etc.	• Field aged conductor samples with supporting information • Laboratory condition assessment results • Demographic information • Removal records
4	Overhead component performance data collection	• Work with utilities to collect information on overhead transmission line component performance (for example, dominant failure modes of insulators, connector failure causes, and failures by manufacturer)	• Historical failure records & component defects • Type issues/service bulletins • Root cause failure analysis reports
5	New circuit & component level metrics	• Develop & test data model to collect inspection & maintenance records & associate them with the underlying component & circuit (span, structure etc.). • Populate the data model with real world utility data to assess its applicability. Make changes based on experience. • Develop new circuit & component level metrics to better understand circuit & component performance.	• Transmission line component demographic data • Historical inspection records • Historical corrective maintenance records • Geospatial information
6	Utilizing other data sources	• Research available data sources and evaluate their usefulness	• Review progress & provide feedback
7	Overhead transmission line risk assessment framework	• Continue development of a framework that utilizes results of the above-mentioned efforts & helps utilities gain a holistic view of transmission line risk	• Review progress & provide feedback

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Underground Transmission Asset Analytics

	Topic	Description	How can utilities engage & help advance ongoing research?
1	Underground Transmission Asset Management Analytics: Utility Needs Assessment	• Develop a survey to seek feedback from utilities to understand underground system asset management issues, readily available data, which issues may be addressed/benefit from an analytical approach?	• Respond to survey
2	Value & Use of Readily Available Data	• Work with utilities to collect readily available data – failures, in-service records, time series data (e.g., alarms, historical test records), defect data (maintenance records) etc. • Apply analytics to determine if the data can be transformed into a format that is useful for analysis & if so, what can we learn from the analysis results? • Use results of this task to scope out future year efforts to better understand component & sub-system performance, underground transmission risk assessment etc.	• Contribute readily available data • Participate in periodic meetings

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