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Witness: John P. DiPaola-Tromba
Request from: Office of Consumer Counsel

Question:

Refer to Exhibit CLP-TSP-1 at 55. For each proposed proactive replacement, identify whether the Company evaluated continued operation through enhanced inspection, testing, monitoring, maintenance, refurbishment, loading limits, load transfer, or use of a spare transformer. Provide each existing analysis and state whether it found that replacement could be deferred by one, three, or five years. If no deferral or life-extension or alternate analysis was performed, please confirm the reason.

Response:

Eversource employs several methods to both actively and passively monitor the health of all power transformers within its service area. Active and continuous monitoring methods include out-of-specification alarming. Remote alarming (if applicable) is conducted through the Eversource SCADA system with alarms existing for bushing monitoring, LTC trouble, dissolved gas, oil level alarms, and oil temperature alarms, among others. Per industry best practices, local alarming is performed through panel indication lamps with corresponding nameplate alarm descriptions and annunciation technologies such as bulb annunciators and Human Machine Interfaces (HMI's).

The preventive maintenance procedures for power transformers are documented within the Eversource Maintenance Program (EMP) 5.58 Station Transformers and Oil-Filled Shunt Reactors. The inspection and maintenance tasks are catalogued into three (3) categories which include a list of asset conditions for real-time condition monitoring, time-based regular inspections, and condition-based maintenance activities. These are described in more detail below:

Condition Monitoring: Various parameters related to power transformer health are actively monitored as applicable. The monitoring is performed both locally and remotely with local monitoring performed by individual equipment alarms and station annunciators. Remote monitoring is performed via Supervisory Control and Data Acquisition (SCADA) to enable real-time asset parameter output and SCADA equipment alarms. Such parameters include temperature, oil level, pressure, and load tap changer (LTC) status.

Time-Directed Maintenance and Inspections: Eversource has established multiple routine maintenance activities required to be performed for all power transformers within specific time intervals. These activities include monthly visual inspections, annual oil sampling including dissolved gas analysis (DGA), thermographic readings, LTC maintenance, and major maintenance

activities. Major maintenance activities include power factor testing, bushing testing, excitation testing, confirmation of proper operation and integrity of pressure relief devices and ensuring all alarms operate properly.

Condition-Based Maintenance: These activities are on an as-needed basis when identified upon visual inspection, when performing time-directed maintenance activities, and when output from condition monitoring devices indicate outside normal operating values. Such activities include, but are not limited to, acoustic measurements, core grounding tests, leak repairs, and chassis repair.

Substation Technical Engineering leverages data collected by the CASCADE, PTX Analysis, and substation equipment databases to perform asset condition assessments of power transformers. The reports are based on the following six (6) parameters with recommendations for replacement by the Substation Technical Engineering team being based upon whether two (2) of the following (6) parameters are considered high risk:

- Oil Analysis Results
  - DGA
  - Fluid Quality Analysis
  - Furan Analysis on Main Tanks
- Age
- Loading
- Maintenance History
- Historical Test Data
- Physical Inspection Findings

The above practices are applicable to all power transformers. Asset age and condition will prompt enhanced inspection, testing, monitoring, and maintenance as noted in the EMP toward the goal of maximizing the usable life of a transformer.

Historically the Company has effectively maximized the life of Transformers by extensive maintenance and monitoring practices, evidenced by the age demographics of the fleet which far exceed the typical design life of 40 years. While this practice continues, the risk profile of an aging fleet compounded by longer lead times and more challenging outage constraints has resulted in a need to initiate planned replacements, beyond the historical average of 1-2 transformer replacements per year, to minimize overall impact of a failed transformer and maximize efficiency. A typical transformer replacement can take from 2 to 5 years to plan and execute. From the time of identification of deteriorating health, the transformer will continue to degrade over the course of the project execution time period. While spares are an effective mitigation plan for emergent failures, it is not a “one-size fits all” long-term mitigation plan to address the fleet risk because depending on when the failure or urgent replacements occur, it may happen at a high-risk period of the year which cannot be controlled exposing the system and customers to a much higher risk. Allowing transformers to run to failure also poses a serious safety risk to both the public and utility

workers. Additionally a failed transformer could cause damage to adjacent healthy equipment compounding the negative impact.

Prior to initiation of a transformer replacement project, the various subject matter experts (SMEs) will confer and review the nameplate data, maintenance records, and PTX scores of the unit. If a transformer is reviewed and a capital project is not to be initiated, the transformer is typically recommended to have further evaluation for maintenance mitigation of the found issue. This may include repairs or minor refurbishment actions that enable the power transformer to be reenergized and placed back in-service.

If the transformer is identified as requiring a capital project an initial funding is established and a project team assembled. The project team includes various SMEs and they are required to review the technical and financial feasibility of transformer replacement, transformer refurbishment, load transfer options, and usage of existing spare transformer inventory for a replacement. After the feasible options are developed, the project team will proceed with a formal review of the multiple feasible options within the procedures of the Eversource Solution Design Committee.

Using the nameplate data with age and ratings combined with the PTX scores, the power transformers noted in Exhibit CLP-TSP-1 at 55 have been identified to proceed with the initial capital project evaluation within the Targeted System Plan. As these evaluations are completed, the power transformers will be prioritized and projects initiated as confirmed. The project sequencing and deferral options will be evaluated within this review.

The two active and ongoing projects for transformer replacements included within the Targeted System Plan followed the processes noted above, were prioritized within the project portfolio, and are planned to be placed in-service in 2028.