Exelon Utilities Asset Management Guidelines and Practices

Applicable to Atlantic City Electric, Baltimore Gas and Electric, ComEd, Delmarva Power and Light Company, PECO, and Potomac Electric Power Company

Contents

Revision History

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Scope and Objective of Guidelines

The bulk electric system is designed to reliably transport power from generating resources to distribution systems in order to serve the demand of end-use customers. In order to preserve system reliability to serve customers, sustaining a safe and reliable transmission system requires the maintenance of existing assets by repairing and or replacing equipment nearing or at the end of their useful lives. This document provides transmission replacement and retirement assumptions, guidelines, and/or industry best practices that may be considered and utilized by Exelon Corporation ("Exelon") inclusive of its utility subsidiaries, Baltimore Gas and Electric Company ("BGE"), Commonwealth Edison Company("ComEd"), PECO Energy Company ("PECO"), Pepco Holdings, Inc. ("PHI") which includes Potomac Electric Power Company ("Pepco"), Delmarva Power & Light Company ("Delmarva"), and Atlantic City Electric Company ("ACE"). These guidelines, where applicable, reflects Exelon's Attachment M-3 EOL Planning Criteria, used for identifying EOL Needs, and Asset Management Projects as defined in PJM Tariff Attachment M3.

Introduction

Serving approximately 10 million customers along 11,150 transmission circuit miles, Exelon plans, operates, and maintains a secure, reliable, and safe transmission grid traversing 25.6K square miles of service territory. Exelon is responsible for an extensive and diverse transmission system comprised of various transmission lines, substations, and their respective components with unique design and operational characteristics. Exelon utilities operate in the states of Delaware, Illinois, New Jersey, Pennsylvania, Virginia, and Maryland, as well as the District of Columbia, is required to maintain its transmission assets in order to provide customers with a cost-effective, efficient, reliable, safe, and resilient transmission system while meeting or exceeding industry and regulatory standards. Such obligations require that Exelon determine if, when, and how a transmission asset needs to be repaired, replaced or retired.

In order to craft a durable and long-term solution to address an ever-evolving grid into the future, asset management activities take into consideration both the needs that a particular asset currently serves along with future needs a replacement asset could provide. Addressing such needs through the replacement of an asset that is near or at the end of its useful life provides for the following benefits, amongst others, throughout the Exelon footprint and beyond:

- Maintains and improves the safety and reliability of the bulk electric system
- Reduces outage duration and frequency which improves service to customers
- Improves operations by increasing system flexibility

Process Overview

The methodology, guidelines, and best practices herein, which Exelon may use to develop transmission projects for assets nearing or at the end of its useful life, are consistent with or exceed Good Utility Practice.

As shown below in Figure 1, when assessing the need to replace an existing asset, Exelon undertakes a holistic process to:

1) Evaluate the overall health of an existing asset and the need to replace an asset nearing or at its end of useful life
2) Identify existing needs that the asset currently serves as well as future local and system-wide needs
3) Develop efficient and cost-effective solutions to address the identified needs while maintaining the integrity and reliability of the electric system during project execution

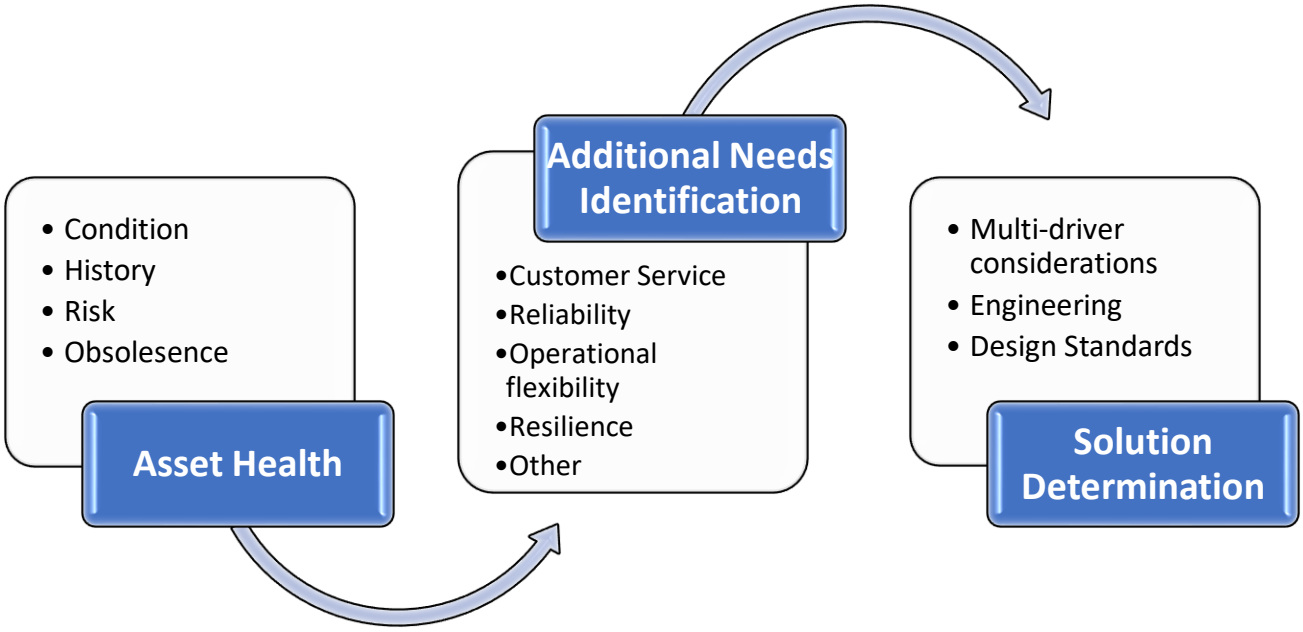

Figure 1: Asset Management Replacement Process

Asset management consists of evaluating asset health, identifying system needs, determining a project solution, and bringing optimal projects into service. The first step in the process begins with evaluating the health of an asset including but not limited to an asset's condition, performance, and risk of failure.

Asset Condition – Health/Risk Assessments

The Exelon transmission system has assets that were built to suit unique topologies based on various design and engineering standards that were applicable at the time of construction. Since these assets can range from newly in-service facilities to those that are over 90 years old, and with different geographical footprints, the overall health and condition of a specific type of asset can greatly vary. However, there are varying factors that are evaluated for the health and condition of a transmission asset which are coupled with good engineering judgement to determine if an asset should be replaced.

The following provides a list including, but not limited to, some of the factors that may be considered and incorporated as inputs into asset health tools to determine which assets may need to be further evaluated for replacement.

Asset Condition Factors:

- **Equipment Inspection and testing** - Periodic inspections of assets is based on technical standards, industry best practices, and vendor recommendations. Inspections can include but are not limited to visual patrols, thermographic checks, diagnostic testing, etc.
- **Maintenance History** – Periodic preventative and corrective maintenance can improve an asset's overall health. However, unplanned maintenance due to component failures or excessive maintenance due to defects may be indicative of an asset nearing the end of its useful life. Additionally, comparisons of maintenance cost to replacement cost may be evaluated.
- **Historical Performance** - The "real-world" performance of an asset may be tracked and evaluated to determine if the asset is meeting its design goals. Transmission performance metrics such as System Average Interruption Duration Index (SAIDI), Customer Average Interruption Duration Index (CADI), System Average Interruption Frequency Index (SAIFI), Momentary Average Interruption Frequency Index (MAIFI), Customers Interrupted (CI), Customer Minutes of Interruptions (CMI), Forced or Manual Outage rates and duration, where applicable, are considered.

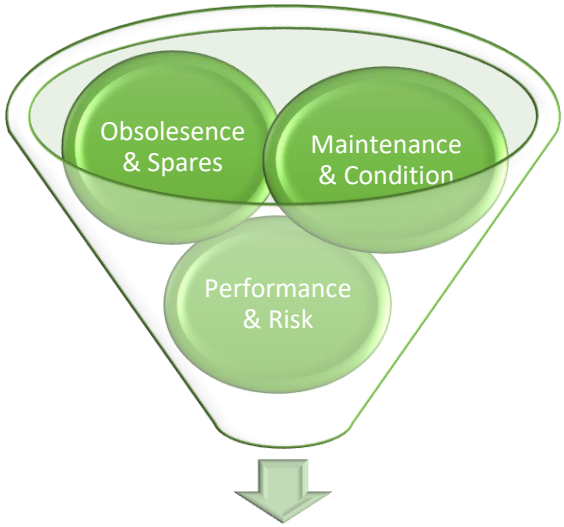

Figure 2: Asset Assessment Considerations

- **Obsolescence** - Equipment identified as obsolete due to unavailability of parts, lack of or retired manufacturer support, problematic equipment, environmental risk, etc. Equipment identified as obsolete does not automatically lead to immediate replacement once asset reaches end of service life.
- **Third - Party Consultations** – On an as needed basis, a third-party assessment will be performed on an asset or class of assets
- **Industry Operational Experience** – Technical guidance may be reviewed from industry groups such as Electric Power Research Institute (EPRI), Centre for Energy Advancement through Technological Innovation (CEATI), National Electric Energy Testing, Research and Applications Center (NEETRAC), Southeast Electric Exchange (SEE), Edison Electric Institute (EEI), North

American Transmission Forum (NATF), International Council on Large Electric Systems (CIGRE), etc.

- **Manufacturers Suggestion** – Manufacturers may provide guidance and recommendation for sustaining the reliable and safe usage of transmission assets. Manufacturers guidance may include, but is not limited to, identification of known defects, recommended service life, planned obsolescence, etc.
- **Environmental Conditions –** Environmental conditions such as topography, weather, and land condition due to oil/gas leaks, can be a contributing factor in an asset's operational life. Icing and wind, for example, can stress facilities which contribute to shortened life spans. Additionally, protected habitats, avian activities, and other species may impact the operability and maintenance of an asset.
- **Equipment Failure Data -** Failure and extent of condition analysis is a critical part of determining whether problems are isolated exceptions or systemic.
- **Asset Criticality** – Equipment criticality is determined relative to the electrical position of the equipment on the system along with additional aspects such as major transmission substations, critical customers & customer count, critical transmission lines, interconnections to generators & tying utilities, etc.
- **Age** – The age of an asset is determined based on when the asset was manufactured and/or installed. Although age is a factor, it alone is not the single most influential criteria supporting repair or replacement decisions.

When Exelon engineers consider factors relating to asset health and condition as previously described, not every asset is evaluated the same way. Depending on the factor and topography, there may be specific metrics that are not applicable for an asset even when an asset is the same type (i.e. water crossing analysis for a class of overhead lines in Delaware may not be applicable to the same class of overhead lines in rural Illinois). Likewise, there may be specific tests performed for transmission line components that would not be suitable for substation components. Therefore, each need is evaluated on a case-by-case basis (except for programmatic reviews that are for specific classes of assets known for poor performance, failure, defect, safety concern, etc.) since the circumstances driving the need to replace an asset can have different underlying aspects. The description of needs attributing to the replacement of existing assets will be provided as part of the Needs Meeting, however, proprietary and/or confidential information will not be disclosed.

Types of Equipment Evaluated

Transmission equipment is generally classified under two categories – transmission lines and/ or substations. With each having distinct components, each may have specific aspects that contribute to the end of an equipment's operational life. The table provides an overview of transmission and substation components, material or types, and factors affecting component service life that may be evaluated to determine an asset's condition.

Transmission Line		
Equipment	**Material/Types**	**Factors Affecting Service Life**
Wood Structures	Wood	Decay (ground line / soil condition), avian damage, corrective maintenance volume, associated equipment condition and failure history (arms, insulators & hardware)
Steel Structures	Steel	Degraded & damaged coating, mechanical external damage, structural degradation, pack outs at joints and bolts, corrective maintenance volume, associated equipment condition and failure history (arms, insulators & hardware)
Foundations	Steel, Concrete	Structural degradation, concrete degradation
Wire	Aluminum, Steel, Copper	Strand damage, core degradation
Switch	Steel, Aluminum, Copper	Parts obsolescence, mechanical fatigue
Underground Cable	Copper, Aluminum HPFF, XLPE, EPR, LPFF, MPFF, Solid Dielectric (land/submarine)	Failure history, insulating fluid health trends, DGA results, partial discharge presence, associated equipment condition (eg. duct/pipe/tunnel, sheath & bonding, splices, terminations, manholes/vaults, pressurizing/circulation/refrigeration systems)
Substation		
Equipment	**Type**	**Factors Affecting Service Life**
Transformers	autotransformers, phase shifters, power transformers	gas trending, loading/heating, through-faults, leaks, tap changer mechanical issues, moisture in insulation, design, system harmonics, over-voltage/excitation
Breakers	oil, gas	loading, fault history, number of operations, moisture, oil quality, insulation breakdown
Relays	electrical mechanical, static, microprocessor	component failures, availability of spares, service advisories, NERC compliance, industry & historical performance
Capacitors	static, dynamic	di-electric failure, performing thermography, advisories, capacitor bank phase imbalances, leaks, fault history
Bus, Insulators	strain bus / rigid bus	environmental factors (tracking/rusting/moisture ingress/worn insulation) obsolescence, performing thermography, mechanical and electrical stresses
Disconnect Switches	MOD, Hook stick DSWs, Gang-operated DSWs	mechanical fatigue, weather, environmental factors, utilization, alignment, material breakdown, component failure, replacing with MODs, performing thermography

Exelon may determine that a need to replace an asset should be initiated as a result of the periodic review of asset condition, risk evaluation, industry recommendation, system and

customer impact, capital and operational expenses, resource availability, outage scheduling, and other aspects. Likewise, proactive programmatic reviews may be initiated for known equipment types with poor technology, safety, or reliability performance such as, but not limited to:

- Circuit Breakers
- Circuit Switchers
- Wood Poles

Additional Needs Identification & Solution Determination

Solutions to address system needs are considered holistically and not necessarily on a single need basis. When determining if an asset needs to be replaced due to equipment material condition, operational performance, and risk, additional system needs are taking into account in developing a solution to address multiple needs. As such, replacement projects, inclusive of Asset Management Projects, may singularly address an end of useful life issue or may also address other drivers including, but not limited to:

1. Operational Flexibility and Efficiency - Optimizing system configuration, equipment duty cycles and restoration capability, and/or minimizing outages.
2. Infrastructure Resilience – Improving the grid's ability to anticipate, absorb, adapt to, and/or rapidly recover from a potentially disruptive event, including severe weather, geo-magnetic disturbances, physical and cyber security challenges, critical infrastructure reduction.
3. Customer Service - Servicing new and existing interconnecting load customers, addressing customer transmission & distribution load growth, outage exposure, and equipment loading.
4. Meeting other objectives not previously captured including, but not limited to industry recommendations, potential generation retirements, technological pilot projects, and governmental / utility commission regulations.

Additionally, solution development for the replacement or retirement of existing assets takes into account both maintaining the reliable operation of the grid during project execution as well as updating antiquated designs with current design standards. Solutions reflect modern design standards which are based on operational experience, good engineering judgement, industry recommendation, environmental and regulatory standards, and other factors which improve system reliability and safety. Furthermore, recommended solutions strive to minimize out-of-configuration conditions, since such conditions can stress the transmission system while an asset is out of service**.**

Retirement of Assets

Maintaining and or improving upon the reliability, safety, security, resiliency, and efficiency of the transmission system leads to the evaluation of the replacement of an asset and at times the retirement of existing assets, ultimately to continue to benefit and serve customers. In certain

circumstances, it may be determined that the replacement of an existing asset is not necessary and instead assets may be removed and not replaced. The decisions regarding the retirement of assets, although there are no national, regional, or local criteria or standards driving transmission asset retirements, may at times be undertaken based on customer needs, system needs, and/or new transmission construction being undertaken, amongst other things. Ultimately, the replacement or retirement of existing assets is analyzed so as not to negatively impact the operability of the grid.

Conclusion

In summary, this document provides transmission replacement and retirement assumptions, guidelines, and/or industry best practices that may be utilized by Exelon when evaluating assets near or at the end of their useful lives. Exelon's asset management replacement decisions are driven by geography, maintenance, design, manufacturer guidelines, age, parts, condition, environment, safety, risk and other factors contributing to a specific asset. Solutions that are developed to address a facility near or at its end of useful life may also consider additional drivers such as customer service, resilience, reliability, and operational flexibility to develop one encompassing efficient and cost-effective solution. Due to the extensive and vast amount of transmission assets within the Exelon footprint, decisions to replace assets are developed and scheduled taking into account maintenance programs, customer concerns, reliability impact, corporate prioritization and risk determinations.