Duke Energy Ohio & Kentucky

2024 Local Planning Assumptions, Models and Criteria

PJM Subregional RTEP Committee Meeting – Western
December 2023

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  - Power Flow Models and Assumptions
  - Baseline Assessment
  - Supplemental Project Planning Criteria
    - Project Drivers
  - End of Life Planning Criteria

- Power Flow Models

  - DEOK works with PJM to develop the RTEP and MMWG power flow models
    - Topology verified
    - Contingencies verified
    - Bus/load/generator profiles submitted
    - Seasonal ratings profiles submitted

  - DEOK uses the most recently issued RTEP models for analysis

- Baseline Assessment

  - PJM analyzes the DEOK area
  - DEOK validates the analysis and coordinates with PJM to identify baseline reliability upgrades based on the following criteria:
    - NERC TPL Standards
    - PJM Reliability Criteria
    - DEOK FERC Form 715 Criteria

      (https://www.pjm.com/planning/planning-criteria/to-planning-criteria.aspx)

  - Baseline needs and solutions are presented to the Subregional RTEP Committee – Western and the Transmission Expansion Advisory Committee

- Supplemental Projects

  - M-3 projects include supplemental projects and asset management projects that address local planning needs
  - M-3 project needs and solutions are presented at the Subregional RTEP Committee – Western and Transmission Expansion Advisory Committee meetings
  - Project drivers include:
    - Customer service
    - Equipment condition, performance and risk
    - Operational flexibility and efficiency
    - Infrastructure resilience
    - Other

- Project Driver: Customer Service

  - Service to new and existing customers. Interconnect new customer load. Address distribution load growth, customer outage exposure, and equipment loading
    - Criteria includes:

      Serving new customer load
      Serving additional customer load
      Customer requested infrastructure
      New infrastructure to support economic development

- Project Driver: Equipment Condition, Performance and Risk

  - Degraded equipment performance, material condition, end of useful life, obsolescence, equipment failure, employee and public safety, and environmental impact
    - Criteria includes:

      Outage frequency and duration

      At risk load

      Number of customers and customer type affected

      Normal loading and loading limits

      Negative maintenance trends

      Increasing maintenance costs

      Availability of spare parts or vendor support

      Expected service life of equipment

- Project Driver: Equipment Condition, Performance and Risk

  - Criteria includes (continued):
    - Related ancillary equipment performance
    - Programmatic replacement of equipment
    - Long lead time or construction time required for replacement
    - Risk of failure based on industry or company data
    - End of life planning criteria

- Project Driver: Operational Flexibility and Efficiency

  - Optimizing system configuration, equipment duty cycles and restoration capability, minimize outages
    - Criteria includes:

      Operational options for switching

      Networking of radial lines

      Remedy recurring operational problems

      Provide more options to deal with non-standard operating conditions

      Enhance system operational functionality

- Project Driver: Infrastructure Resilience

  - Improve system ability to anticipate, absorb, adapt to, and/or rapidly recover from a potentially disruptive event, including severe weather and geo-magnetic disturbances
    - Criteria includes:
      - Improving the system's ability to absorb and recover from an interruption
      - Networking of radial lines
      - Eliminating three-terminal lines
      - Separating circuits from shared structures or paths
      - Adding or reconfiguring infrastructure to limit circuit and/or load loss
      - Diversifying sources and source paths to load areas

- Project Driver: Other
  - Meet objectives not included in other drivers
    - Criteria includes:
      - Industry recommendations
      - Customer connection retirements
      - New technology pilot projects
      - Roadway relocation or expansion projects
      - Environmental and safety impacts
      - Good utility practice

- Retirement of Existing Facilities

  - The purpose of transmission planning is to ensure that the capacity of the existing transmission system is maintained or expanded as needed to provide a reliable, efficient, safe, resilient and secure transmission system for the benefit of customers.
  - There are no national, regional or local standards or criteria driving the retirement and not the replacement of existing facilities. In specific situations facilities may be removed and not replaced as dictated by system or customer needs, or the construction of new transmission facilities. However, decisions to not replace individual facilities may have the cumulative effect of negatively impacting the reliability, efficiency, safety, resilience and security of the transmission system. That cumulative negative impact could also drive the need for additional facilities to be constructed to compensate for those removed, including greenfield installations.
  - Accordingly, existing facilities are maintained in service or retired based on Good Utility Practice.

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2024 End of Life Planning Criteria

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Duke Energy Asset Management End of Life Methodology

Identifying a Duke Energy transmission facility that is approaching its end of useful life is the responsibility of Transmission Asset Management. Transmission Asset Management has established system reliability programs to evaluate various types of transmission facilities. These programs provide key drivers for initiating end of life asset management projects.

- The following factors are taken into consideration when determining if the asset is approaching end of life:
  - Asset Health – Condition Based Assessments
  - Failure Risks – System Criticality
  - Outdated/Obsolete Technology
  - Environmental Considerations
  - Maintenance History – Upward Trending Costs and Frequency
  - Performance History
  - Failure History
  - Manufacturer Design Life

Duke Energy Asset Management End of Life Criteria

Transformers

The following global characteristics may be considered to determine if a transmission power transformer has reached its end of useful life:

- Manufacturer & Type and any related Service Bulletins
- Level of criticality to system performance and operations
- Outage frequency and/or durations
- Increasing negative trend in maintenance findings and repair costs
- Failure risk
- Limited availability of spare parts or vendor technical support
- Operational, Design, or other considerations
- Feasibility of repairs
- Environmental considerations – Oil Leakage – Sound Levels

Duke Energy Asset Management End of Life Criteria

Transformers (continued)

The following components and operational/maintenance history may be considered to determine if a transmission power transformer has reached its end of useful life:

- Asset Components
  - Alarm and device testing (including thermometers, pressure devices, and nitrogen system)
  - Bushings
  - Coolers
  - Pumps
  - Radiators
  - Core ground
  - Load Tap Changer Type & Operation History (if applicable)

Duke Energy Asset Management End of Life Criteria

Transformers (continued)

- Operational/Maintenance History
  - Dissolved gas in oil
  - Insulation Power Factor
  - Bushing Power Factor
  - Internal inspection of the clamping, blocking, steel core, and core and coil support structure shall be performed
  - Loading and fault history
  - Moisture content
  - Oil dielectric
  - Oil screen
  - Oxygen content
  - Total combustible gas
  - Turns ratio

Duke Energy Asset Management End of Life Criteria

Transmission Lines

The following global characteristics may be considered to determine if a transmission line has reached its end of useful life:

- Negative impact on reliability
- Transmission and customer outage impact
- Increasing trend in frequency and/or cost of maintenance
- Failure risk due to design characteristics and/or historical industry/company performance
- Limited availability of spare parts and/or vendor support
- Operational, design, or installation limitations
- System characteristics including lightning performance, galloping overlap, structural capacity needs, clearance margins, and future needs (e.g. fiber path)
- Current design criteria, applicable codes, and industry best practices
- Environmental considerations

Duke Energy Asset Management End of Life Criteria

Transmission Steel Towers, Wood, Concrete, and Steel Poles

The following components and operational/maintenance history may be considered to determine if transmission steel towers, wood and steel poles have reached their end of useful life:

- Asset Components
  - Foundations
  - Steel members
  - Steel structural components and their associated foundations
  - Steel structure fasteners
  - Corten steel members
  - Concrete poles
  - Wood cross arm and brace
  - Wood pole reinforcements (C-Truss, cross arm, stub pole, etc.)
  - Wood poles with phase raisers

Duke Energy Asset Management End of Life Criteria

Transmission Steel Towers, Wood, Concrete and Steel Poles (continued)

- Operational /Maintenance History
  - Inspection History
  - Outage performance
  - Maintenance history
  - Asset design characteristics

Duke Energy Asset Management End of Life Criteria

Transmission Line Conductors

The following components and operational/maintenance history may be considered to determine if transmission line conductors have reached their end of useful life:

- Asset Components
  - Multiple splices per phase per mile
  - Conductor core/strands
  - Connector
  - Span Length
  - Material type
  - Shield wires

Duke Energy Asset Management End of Life Criteria

Transmission Line Conductors (continued)

- Operational/Maintenance History
  - Inspection History
  - Outage performance
  - Maintenance performance
  - Asset Design Characteristics
  - Lightning Performance

Duke Energy Asset Management End of Life Criteria

Transmission Underground Power Cables and Support Equipment

The following components and operational/maintenance history may be considered to determine if transmission power cables and support equipment have reached their end of useful life:

- Asset Components
  - Conduit
  - Insulation
  - Shielding
  - Terminators

Duke Energy Asset Management End of Life Criteria

Transmission Underground Power Cables and Support Equipment (continued)

- Operational/Maintenance History
  - Impulse Test
  - Monitoring and Protection System
  - Nitrogen Gas System
  - Oil Preservation System
  - Pressure System

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