Duke Energy Ohio & Kentucky

2022 End of Life Planning Criteria

PJM Subregional RTEP Committee Meeting – Western
December 2021

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  - Outdated/Obsolete Technology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
  - Structural loss and environmental testing (galvanization thickness, soil resistivity, soil pH, Redox measurement, half cell potential)

Duke Energy Asset Management End of Life Criteria

Transmission Wood and Fiberglass Crossarms

The following components and operational/maintenance history may be considered to determine if transmission wood or fiberglass crossarms have reached their end of useful life:

- Asset Components
  - Wood or Fiberglass crossarm
  - Wood or Fiberglass structure bracing and cross members
  - Crossarm connected components (insulators, connectors, small bracing)

Duke Energy Asset Management End of Life Criteria

❖ Transmission Wood and Fiberglass Crossarms (continued)

- Operational/Maintenance History
  - Inspection History
  - Outage performance
  - 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


DUKE
ENERGY®