EAST KENTUCKY POWER COOPERATIVE

**Policies and Procedures Cover Sheet**

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# Title: PJM Attachment M3 End of Life Assumptions and Criteria

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# Table of Contents

## 1. Purpose

The purpose of the PJM Attachment M3 End of Life (EOL) Assumptions and Criteria document is to comply with East Kentucky Power Cooperative (EKPC) asset end of life reporting as required by PJM Attachment M3 section (d)(1)(i) adopted under the tariff revision approved by FERC on 8-11-2020.

EKPC will revise and submit this document annually to PJM. The submittal will be at least 20 days in advance of a scheduled Sub-regional RTEP Committee "Assumptions" meeting where the information will be presented to PJM and stakeholders.

EKPC will subsequently submit an annual five-year EOL candidate list to PJM for the assets outlined in section 3 as required by attachment M3 section (d)(1)(iii).

The EOL candidate list submittal will allow for coordination with the RTEP planning process as described in section (d) (2) of attachment M3.

The EOL candidate list is non-public confidential and non-binding.

The EOL analysis described below mirrors EKPC's internal asset management procedures to a point. EKPC's internal asset management process (AMP) is an assessment of asset risk considering likelihood (LOF) and consequence of asset failure (COF). EKPC views COF from the standpoint of EKPCs corporate goals and mission statement. EKPC is geared toward safety, reliability, affordability, and sustainability.

This document is a sub-set of the EKPC AMP concerning the types of assets included. Additionally, the internal EKPC project review process also includes additional evaluation of COF and risk. This document focuses on LOF or how close the asset is to end of life.

## 2. Objectives

Objectives and additional benefits of this plan include:

- Increased transparency to internal and external stakeholders related to asset management.
- Support the PJM regional transmission expansion plan (RTEP)
- Provide synergy to ongoing EKPC asset management and aging infrastructure initiatives.

By undertaking this effort, EKPC will expand upon the local planning assumptions information presented December 2019 in the supplemental project category with the drivers related to asset end of life.

## 3. Scope

This section will provide an overview of each asset population that will be subjected to an EOL analysis. The EOL assumptions and criteria will be explained in section 4.

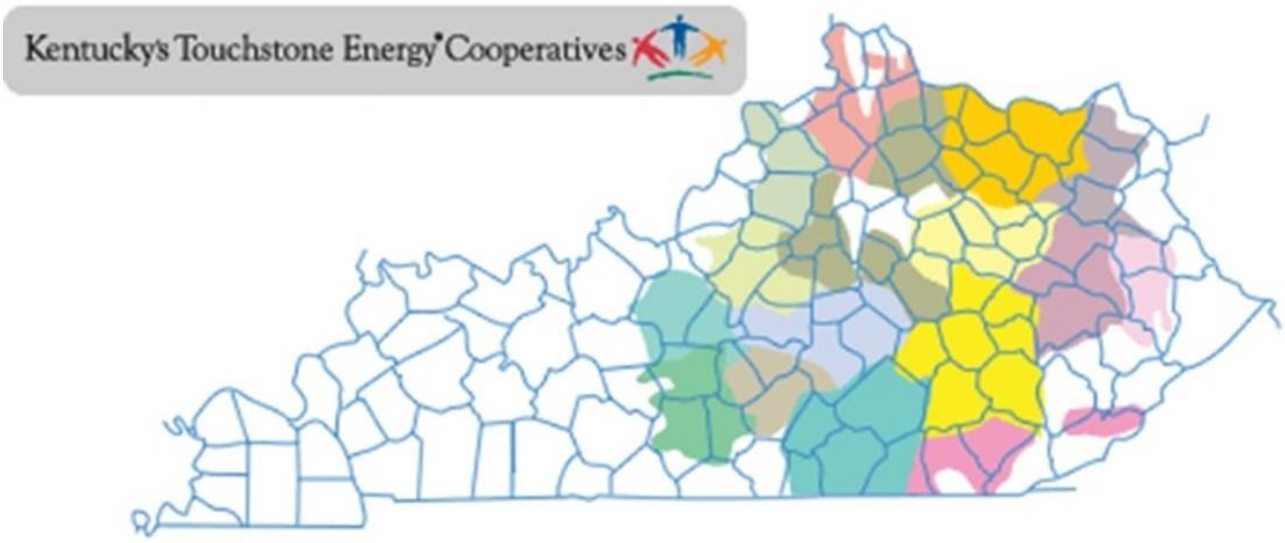


Figure 1 – EKPC Territory

### *3.1 Transmission Lines*

EKPC has approximately 962 miles of transmission line that define the asset population subject to the PJM EOL candidate list requirement. There are 122 miles of 345kV, 440 miles of 161kV, and 400 miles of 138kV.

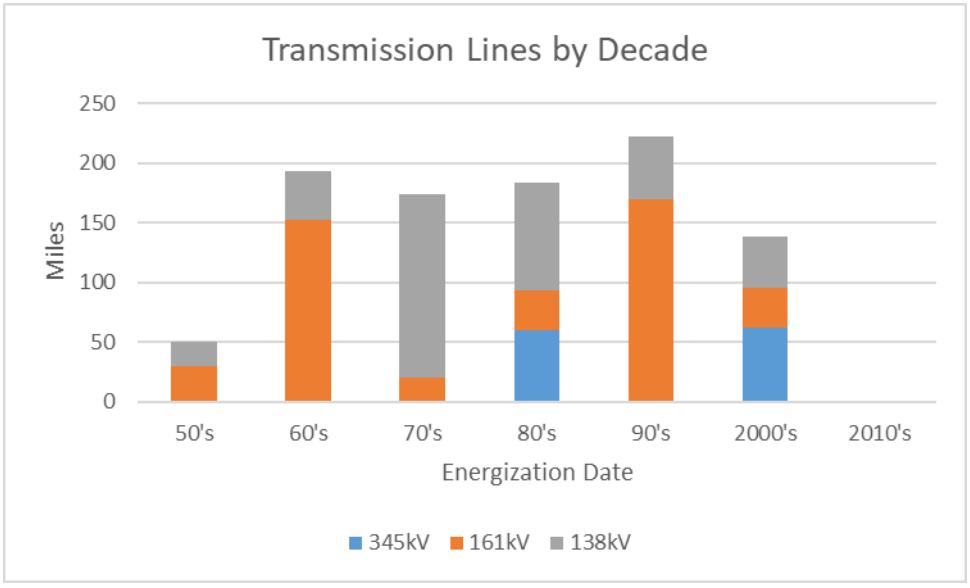


Figure 2 – Transmission Line Demographics

### *3.2 Transformers*

| Voltage (Kv) | Quantity |
|---|---|
| 345/138 | 6 |
| 161/138 | 2 |

| | |
|---|---|
| 161/69 | 16 |
| 138/69 | 20 |

Figure 3 –Transformer Population

There are 44 large power transformers that are evaluated for EOL status and subject to the PJM candidate list submittal.

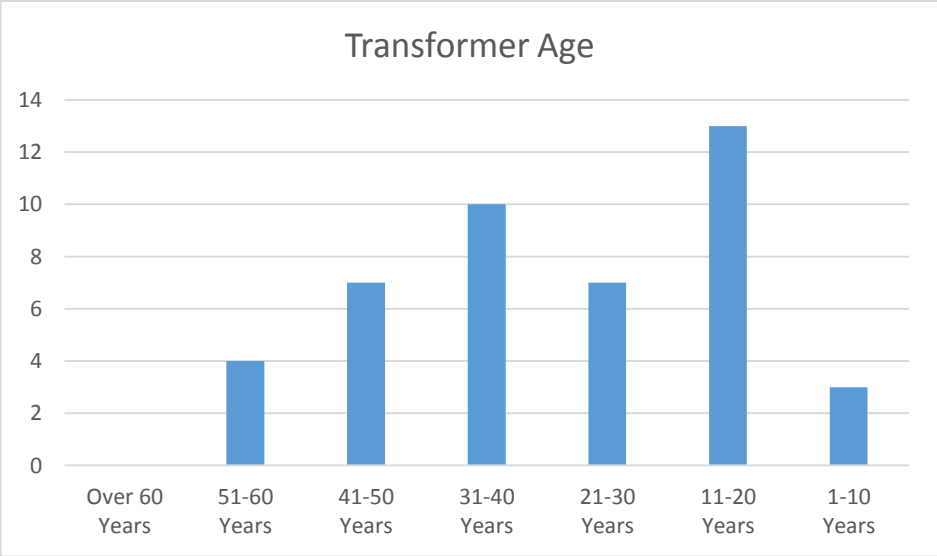


Figure 4 – Transformer Age

## 4. EOL Analysis

This section outlines the process that EKPC uses to identify assets that are nearing end of life. In general, the EOL analysis consists of choosing a set of data that best characterizes the asset population, data management and analysis, and further action on a smaller subset of the population that has been deemed over a threshold of deficiency (approaching end of life).

For transmission lines and transformers, the further action may include submittal of the asset into the five-year EOL candidate list.

The key component to EKPC's EOL analysis is an annual review of all asset data by a team of subject matter experts. In order to focus this review, an asset preliminary health score is calculated to rank the asset population. The preliminary health score is derived from data listed in section 4.1.

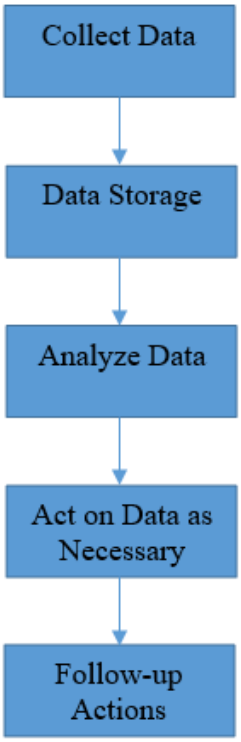


Figure 5 – Asset Decision-Making Process Flow

### *4.1 Data Collection*

Transmission Lines

- Performance
  - Outages in the last five years
  - PCLLRW
  - Data from system planning models
- Condition
  - Age
    - <40 years old may not be assessed
  - Inspection Data (Issues identified from scheduled line patrols, drone inspection, foot patrols, or outage patrols.)
    - Structure Issues
      - Wood Poles (hammer sound test, visual inspection)
        - Woodpecker holes, rotting, bad top
        - Damaged cross arms
      - Steel Towers
        - Corrosion, loose hardware
        - Foundations
        - Grounding
    - Conductor Damage
      - Bad splice, broken strands, steel core corrosion, vandalism
    - Insulator Issues
      - Flashed, broken
    - Hardware
      - Loose, corrosion

        - Static Wire
            - Loose, corrosion, pitting
        - Guy wires, anchors
            - Loose, corrosion
        - Ground wires
            - Loose, missing
    - Other data from detailed condition assessments (when available)
    - Additional considerations
        - Lightning and grounding performance
        - Parts availability, design issues

Line Section data above is used to compile a preliminary health score for asset ranking.

Transformers

- Performance
    - Five year outage data
    - PCLLRW
- Condition
    - Age
        - Considered for assessment, but not a defining factor.
    - Transformer assessment results, substation inspections, or from outage investigation
        - Control wiring condition
        - Monitoring and sampling data
            - DGA Analysis
                - DGA condition code status, total dissolved gas, active gassing due to arcing or thermal faults
            - Temperature monitoring
                - Highest temperature after last reset
        - Test Data
            - Overall power factor
            - Partial discharge test results
            - Infrared analysis
        - Oil
            - Leaks, water content, oil quality
        - Cooling system checks
            - Pumps, fans, radiators (IR check), temperature gauges
        - Known design deficiencies
        - Parts availability
    - Maintenance cost
    - Additional considerations
        - Loading and fault history

### *4.2 Data Storage*

EKPC uses a variety of repositories for storage of the collected data.

### *4.3 Data Analysis*

Transmission Lines

- Preliminary health score
- Subject matter expert
- Personnel experience

Transformers

- Preliminary health score
- Subject matter expert
- Personnel experience

### *4.4 Act on Data*

All Assets

- Do nothing
  - For satisfactory data analysis.
- Increase frequency of inspection
  - When inspection results flag an issue.
- Increase frequency of monitoring or sampling
  - Check for unacceptable trends.
- Initiate a test procedure
- Initiate a maintenance procedure
  - Unacceptable inspection results

Transmission Lines

- Add line section to PJM five-year EOL candidate list as warranted after review by subject matter experts.
- Maintenance actions as required to improve performance or condition.

Transformers

- Add transformer to PJM five-year EOL candidate list as warranted after review by subject matter experts.
- Maintenance action as required to improve performance or condition.

### *4.5 Follow up Actions*

All Assets

- Follow up for increased/enhanced inspection, monitoring, or sampling
- Revisions to data
- Consider asset for refurbishment, retirement, or replacement.
- Present at Needs meeting
- Present at Solutions meeting
- Maintain a  minimum 5 year End-of-Life (EOL) candidate list

### *4.6 Line Process*

The reliability and maintenance teams collect performance and condition data described in section 4.1 for transmission line sections at least annually. There are 68 EKPC line sections above 100kV that are evaluated for EOL status and subject to submittal for the PJM five-year EOL candidate list. Some

transmission lines (breaker to breaker) have multiple spreadsheet entries due to separate energization dates for sections of the line. Tap lines are not included for consideration in the PJM EOL candidate list, but are reviewed for internal asset management purposes.

The EKPC reliability team enters the data from section 4.1 into a spreadsheet. Each data category is weighted according to its impact on EOL for the assets. Reliability engineers develop an annual preliminary health score ranking based on performance and condition scores and the weighting of each.

| Factor | Weight Percentage |
|---|---|
| Performance | 25 |
| Condition | 75 |

Figure 6 – Line Ranking Factors

Line sections with the lowest preliminary health scores are considered for submittal into the PJM five year EOL candidate list. A team of subject matter experts decides the threshold required for submittal. The team conducts an individual review of each asset above the threshold.

After a thorough review of all asset data available, subject matter experts will decide on actions to take.

One consideration at this point is to review any cost-effective maintenance actions that could improve performance or condition.

Assets submitted to the PJM EOL candidate list are considered to be sufficiently near end of life to begin consideration for the PJM RTEP process.

### *4.7 Transformer Process*

Large oil insulated transformers can have very long life as compared to other assets on the transmission system. However, each transformer will have an EOL that will be reduced by numerous factors such as fault exposure, overloading (heating), moisture, and insulation quality.

In the interest of EKPC asset management and PJM EOL candidate list review, the reliability and maintenance teams collect performance and condition data described in section 4.1 for 44 large power transformers at least annually.

The EKPC reliability team enters the data from section 4.1 into a spreadsheet. Each data category is weighted according to its impact on EOL for the assets. Reliability engineers develop an annual preliminary health score ranking based on performance and condition scores and the weighting of each.

| Factor | Weight Percentage |
|---|---|
| Performance | 25 |
| Condition | 75 |

Figure 7 – Transformer Ranking Factors

Transformers with the lowest preliminary health scores are considered for submittal into the PJM five year EOL candidate list. A team of subject matter experts decides the threshold required for submittal. The team conducts an individual review of each asset above the threshold.

After a thorough review of all asset data available, subject matter experts will decide on actions to take.

One consideration at this point is to review any cost-effective maintenance actions that could improve performance or condition.

Assets submitted to the PJM EOL candidate list are considered to be sufficiently near end of life to begin consideration for the PJM RTEP process.

## 5. Conclusion

This document will be revised annually to capture ongoing improvements that EKPC will accomplish for the asset management process and consequently the PJM EOL assumptions and criteria. Periodic review of utility best practices, average EOL data across utilities, and manufacturer's recommendations will support this improvement. EKPC continues to collaborate with other utilities while participating in associations such as the North American Transmission Forum (NATF).