EXHIBIT NO. ______

BEFORE
THE PUBLIC UTILITIES COMMISSION OF OHIO

| | | |
|---|---|---|
| In the Matter of the Application of<br>Ohio Power Company for an<br>Increase in Electric Distribution Rates. | )<br>)<br>) | Case No. 20-585-EL-AIR |
| In the Matter of the Application of<br>Ohio Power Company<br>for Tariff Approval. | )<br>)<br>) | Case No. 20-586-EL-ATA |
| In the Matter of the Application of<br>Ohio Power Company for Approval<br>to Change Accounting Methods. | )<br>)<br>) | Case No. 20-587-EL-AAM |

DIRECT TESTIMONY OF
KAMRAN ALI
ON BEHALF OF
OHIO POWER COMPANY

Management Policies, Practices & Organizations

Operating Income

Rate Base

Allocations

Rate of Return

Rates and Tariffs

X Other

Filed: June 15th, 2020

INDEX TO DIRECT TESTIMONY OF
KAMRAN ALI

BEFORE
THE PUBLIC UTILITIES COMMISSION OF OHIO
DIRECT TESTIMONY OF
KAMRAN ALI
ON BEHALF OF
OHIO POWER COMPANY

## I. PERSONAL DATA

**Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.**

A. My name is Kamran Ali. My business address is 8500 Smiths Mill Road, New Albany, Ohio 43054.

**Q. BY WHOM ARE YOU EMPLOYED AND WHAT IS YOUR POSITION?**

A. I am employed by the American Electric Power Service Corporation ("AEPSC") as Managing Director of Transmission Planning. AEPSC supplies engineering, financing, accounting, planning, advisory, and other services to the subsidiaries of the American Electric Power ("AEP") system, one of which is Ohio Power Company ("Ohio Power" or the "Company").

**Q. WOULD YOU PLEASE DESCRIBE YOUR EDUCATIONAL AND PROFESSIONAL BACKGROUND?**

A. I received a Bachelor of Science – Electrical Engineering degree from the University of Alabama in Tuscaloosa, Alabama and a Master of Science –Electrical Engineering degree from Kansas State University in Manhattan, Kansas. I also received a Master of Business Administration degree from Ohio University in Athens, Ohio.

I started my career as an electrical engineer at SMC Electrical and joined AEP as a substation engineer in 2006. In 2007, I transferred to Transmission Planning, where I advanced through increasing levels of responsibility. In December 2018, I assumed the position of Managing Director of Transmission Planning.

**Q. WHAT ARE YOUR RESPONSIBILITIES AS THE MANAGING DIRECTOR OF TRANSMISSION PLANNING?**

A. My responsibilities include organizing and managing all activities related to assessing the adequacy of AEP's and its operating companies' transmission networks, including within the PJM Interconnection, LLC ("PJM") Regional Transmission Organization region, to meet customers' and system needs in a reliable, cost effective, and environmentally compatible manner.

**Q. HAVE YOU PREVIOUSLY SUBMITTED TESTIMONY IN ANY REGULATORY PROCEEDINGS?**

A. Yes, I have testified on behalf of AEP Ohio before the Public Utilities Commission of Ohio. I have testified on behalf of AEP Ohio affiliates in proceedings before the Indiana Utility Regulatory Commission, the Maryland Public Service Commission, the Pennsylvania Public Utility Commission, the Public Service Commission of Kentucky, and the Public Utility Commission of Texas. I have submitted testimony before the Michigan Public Service Commission, the Oklahoma Corporation Commission, the Louisiana Public Service Commission, and the Arkansas Public Service Commission.

## II. <u>PURPOSE OF TESTIMONY</u>

**Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?**

A. The purpose of my testimony is to provide an overview of the coordination of AEP Ohio's distribution projects associated with transmission work. In addition, I also describe and support the Company's capital spares program that establishes an inventory of power transformers, mobile transformers, and skid stations to maintain customer reliability, ensure quick restoration, and serve new customers in a timely manner.

**Q. ARE YOU SPONSORING ANY EXHIBITS?**

A. Yes, I sponsor the following exhibits:

- Exhibit KA-1 – Distribution Projects Necessary to Complete Transmission Projects
- Exhibit KA-2 – Transmission Capital Asset Sparing Strategy

## III. DISTRIBUTION PROJECTS ASSOCIATED WITH TRANSMISSION WORK

**Q. PLEASE DESCRIBE THE TYPES OF DISTRIBUTION PROJECTS AEP OHIO COMPLETES IN COORDINATION WITH AEP TRANSMISSION PROJECTS.**

A. As also discussed by Company witness Kratt, AEP Ohio undertakes two types of distribution projects that are related to transmission projects in AEP Ohio's service territory. The first group consists of distribution projects that are necessary to complete transmission projects. The second group includes projects that AEP Ohio has identified are necessary to complete and that can be constructed with a transmission project in an area in order to maximize operational efficiencies and cost effectiveness.

I will address the first group of projects in more detail below. Company witness Kratt describes the second group.

**Q. PLEASE FURTHER EXPAND ON THE FIRST GROUP OF DISTRIBUTION PROJECTS NECESSARY TO COMPLETE TRANSMISSION PROJECTS.**

A. The transmission system interfaces with distribution facilities at substations, which transform electricity from transmission voltages to distribution voltages for the purpose of serving distribution customers. Due to this interface, improvements or additions to the transmission system may require AEP Ohio to perform work on the distribution facilities to implement the transmission project. One example of this type of project includes upgrading a transmission line's voltage, which also requires upgrades of the associated distribution facilities within the substations served by the transmission line. When a transmission line is upgraded, from 69 kilovolts ("kV") to 138 kV for example, the AEP Ohio transformers within the substation that serve distribution customers must also be upgraded from 69/12.5 kV to 138/12.5 kV. This distribution transformer work is required to accomplish the overall transmission project and to continue to serve customers. In addition, while performing construction in the substation, it may also be necessary for AEP Ohio to upgrade the transformer protection and control schemes as part of the project to meet current standards. Specific projects that required distribution upgrades to implement transmission projects for 2021 and 2022 can be found in Exhibit KA-1.

## IV. CAPITAL SPARE PARTS

**Q. WHAT ARE CAPITAL SPARE PARTS?**

A. A capital spare part is a major piece of equipment that is purchased for use in the event of a planned or emergency situation to ensure continued, reliable operations. The purpose of capital spare part is to protect against extended interruptions of service caused by mechanical and electrical failures of equipment that have long procurement lead times.

**Q. PLEASE DESCRIBE AEP OHIO'S CAPITAL SPARE PARTS PROGRAM AND THE TYPES OF ASSETS IT INCLUDES.**

As also described by Company witness Kratt, AEP Ohio's capital spare parts program maintains an inventory of power transformers, mobile transformers, and skid stations.

Transformers. The purpose of having an adequate supply of spare transformers on-hand is to ensure that a permanent or temporary replacement is available to minimize service outages to customers. Given the production lead-time for a new transformer, spare transformers are important to have on-hand in the appropriate voltages to quickly replace failed transformers. The typical procurement lead-time for a transformer, depending on its size and manufacturer, can be up to 1.5 years.

Mobile Transformers. Although mobile transformers can be used in emergency situations, they are not intended for long-term use. The ability to use a mobile transformer from the capital spares program allows the Company to return to normal operations in a substantially shorter period of time, lessening the number of customer outages and the duration of those outages.

Skid Stations. Skid stations are designed to be transported with a tractor/trailer. Skid Stations are deployed when a facility requires significant upgrades and replacements as a result of an emergency or to supply construction power to customers until a permanent solution can be implemented.

**Q. IN WHAT SITUATIONS ARE CAPITAL SPARE PARTS TYPICALLY USED?**

A. Capital spare parts are typically used either to replace failed equipment or to ensure customers continue to have power while work is completed to install a permanent replacement. Two examples highlight the importance of capital spares to keep customers in-service. These two examples, the Buckskin Substation 69/12 kV transformer failure and the South Side Lima Substation 34/4 kV transformer failure, are discussed in more detail below.

The transformer at Buckskin Substation in Hillsboro, Ohio was proactively removed from service after inspection and testing revealed one of the windings to be unserviceable, meaning the transformer was at risk of catastrophic failure and could not be put back in-service. In response to this failure, a capital spare was sourced from Canton, Ohio and transported to Buckskin Substation for installation. Over 1,900 customers are served by the Buckskin Substation, and none of them were impacted by this transformer failure because a spare transformer was immediately available.

At the South Side Lima Substation in Lima, Ohio, a transformer failure was triggered by a failure of the high side fuse. After that fuse failed, the transformer was taken out of service to investigate. The transformer failed subsequent testing and was not able to be returned to service. This transformer failure caused 1,128,185 customer minutes of interruption affecting 1,468 customers. A spare transformer was not immediately available. In order to get the station back online, a mobile transformer was brought in to prevent an extended outage while a permanent replacement is scheduled. This further emphasizes the effects on customers when spares are not available.

**Q. PLEASE EXPLAIN THE ROLE AEP TRANSMISSION PLAYS IN DETERMINING THE AMOUNT OF CAPITAL SPARES REQUIRED FOR THE OHIO DISTRIBUTION SYSTEM.**

A. In order to maintain an adequate amount of capital spare parts throughout the system, AEP utilizes one process across operating companies and business units to optimize the capital spare inventory. AEP Transmission performs all maintenance activities at AEP Ohio substations, including restoration failures, and manages the capital spare parts inventory.

**Q. PLEASE EXPLAIN HOW THE APPROPRIATE INVENTORY LEVELS FOR THE CAPITAL SPARES PROGRAM ARE DETERMINED.**

A. The Transmission Capital Asset Sparing Strategy, as found in Exhibit KA-2, defines the process for determining an appropriate quantity of spare assets to maintain in stock. The document describes a modeling process that uses available data to derive a set of recommendations for use in purchasing decisions and risk assessment. This inventory is maintained based on the failure rate of each type of spare asset and uses a statistical probability analysis in order to manage the long lead-time of the procurement cycle for these assets. Capital spare inventory is limited to assets with large per unit dollar values of more than fifty thousand dollars and long procurement times. This allows the Company to balance keeping the most critical assets in inventory and overall cost of the program.

**Q. PLEASE FURTHER DESCRIBE THE STATISTICAL PROBABILITIES ANALYSIS THAT AEP TRANSMISSION UTILIZES TO DETERMINE THE APPROPRIATE LEVEL OF CAPITAL SPARE PARTS TO MAINTAIN IN INVENTORY.**

A. AEP Transmission uses the Poisson probability model to predict transformer failures and make recommendations on the number of spare transformers to maintain in inventory to address these potential failures. This model provides a probabilistic approach for a solution to minimize the risk of a ‘stock out’ or a situation where no spare units are available to restore a failed unit. Failure data is a key data element of the model. Historical transformer failure data is based on failure events collected in AEP’s IT systems. The failure data is collected across the various kV configurations so that the model can be more specific to the many deployed transformer configurations.

**Q. HOW DOES AEP TRANSMISSION DETERMINE THE NUMBER OF MOBILE AND SKID STATIONS TO MAINTAIN IN INVENTORY?**

Mobile transformers and skids are separate from the spare transformer planning and modeling. Historical usage rates and their useful life govern the number of temporary mobile transformers and skids purchased. Future mobile transformers and skids will be purchased on an as-needed basis.

**Q. COULD THE COMPANY BORROW OR RENT EQUIPMENT AS NEEDED INSTEAD OF PURCHASING CAPITAL SPARE PARTS?**

A. No, it typically does not make economic sense to borrow or rent capital spare parts from a third party entity. First, capital spare transformers are often, if not primarily, used as permanent replacements for failed equipment. As a result, the Company has capital spare transformers to facilitate the replacement of a failed unit in a timely manner. Second, it is often not possible to obtain the types of equipment included in the Company's Capital Asset Sparing Strategy on a temporary basis from third parties. Few, if any, providers offer this type of equipment on a temporary basis, and the costs of mobilizing and demobilizing equipment on a temporary basis can meet or exceed any cost savings associated with utilizing temporary equipment.

**Q. ARE THERE ANY INDUSTRY STANDARDS REGARDING THE USE OF CAPITAL SPARE PARTS?**

A. Yes. Best utility practices dictate the use and availability of spare capital assets to mitigate higher operating costs and unnecessarily long outage times when equipment fails. PJM has a Spare Equipment Philosophy for Bulk Electric System Facilities & Interfaces[1]. In

[1] https://pjm.com/-/media/planning/design-engineering/maac-standards/section-iv-spare-equip.ashx?la=en

this document, PJM states that "[e]quipment critical to the integrity of the grid known to have long lead times should be supported by a spare."  In particular, the expectation is that the Interconnected Transmission Owners would not be reliant on another party or even the vendor for immediate spare support.

**Q. DOES THE CAPITAL ASSET SPARING STRATEGY PROVIDE COST BENEFITS TO CUSTOMERS?**

A. Yes, it does.  Maintaining an inventory of capital spares ensures that the Company can control the cost of spares by avoiding last minute, expedited purchases when replacements are required.  Additionally, AEP negotiates contracts with many transformer suppliers in order to ensure that more than one supplier is able to produce every transformer configuration.  This approach creates competitive bids for the spare equipment.  In addition, the inventory of capital spares also minimizes the cost of prolonged outages to customers.

**Q. DOES THIS CONCLUDE YOUR TESTIMONY?**

A. Yes it does.

## Distribution Projects Necessary to Complete Transmission Projects

| CPP Description | Project Description | | 2021 Est. Capital Cost | 2022 Est. Capital Cost |
|---|---|---|---|---|
| TA2015703 Replace/Refurbish - OHPCo | A15703474 | Vigo Station: Rebuild | $178,914 | $90,735 |
| TA2016913 Ohio Region Major Eq/Spares Pr | TA1691306 | OH Major Eq/Spares Chkbk-Distr | $3,484,902 | $0 |
| TA2019331 Columbus Area Telecom Moderniz | A19331001 | Bolton Station TTMP | $40,338 | $0 |
| TA2019332 E. Ohio Area Telecom Moderniza | A19332003 | Belpre TS TTMP | $56,054 | $0 |
| | A19332008 | Kyger Creek TS TTMP | $45,577 | $0 |
| | A19332013 | Saint Clair Ave (OP) Sta TelMo | $6,810 | $0 |
| TA2019334 East Central OH Area Telecom M | A19334027 | Dow Chemical Hebron Sta TTMP | $3,003 | $0 |
| | A19334028 | Frazeysburg Station TTMP | $1,600 | $0 |
| | A19334030 | Granville Station TTMP | $2,049 | $0 |
| | A19334031 | Newark Station TTMP | $1,600 | $0 |
| | A19334032 | North Hebron Station TTMP | $365 | $0 |
| | A19334033 | North Zanesville Station TTMP | $1,600 | $0 |
| | A19334034 | Powelson Station TTMP | $2,442 | $0 |
| | A19334035 | South Newark Station TTMP | $2,049 | $0 |
| TA2019335 North Central OH AreaTelecomMo | A19335017 | Centerburg Station TTMP | $2,442 | $0 |
| | A19335018 | Martinsburg Road Station TTMP | $2,442 | $0 |
| | A19335019 | Millwood Station TTMP | $1,600 | $0 |
| | A19335020 | Mount Vernon (OP) Station TTMP | $1,600 | $0 |
| | A19335021 | Pittsburgh Avenue Station TTMP | $2,049 | $0 |
| | A19335022 | Utica (OP) Station TTMP | $1,600 | $0 |
| | A19335023 | West Benton Station TTMP | $2,049 | $0 |
| TA2022553 OH Meter Modernization 2022 | A19443001 | Bridgeport Meter Mod | $79,524 | $34,294 |
| | A19443002 | Killbuck Meter Mod | $77,638 | $33,481 |
| | A19443011 | Wagenhalls Meter Mod 077751300 | $440,053 | $189,769 |
| TBLANKTOP Trans Capital Blanket - Ohio | B250OHSRC | D/OH NonSpecific Stati CO REG | $4,102,624 | $4,296,618 |
| | B250OHSRF | D/OH Non-Specific WorkStation | $42,433 | $43,808 |
| TP2011075 North Baltimore Area Conversio | P11075024 | N Baltimore Ohio Power | $1,531,549 | $0 |
| TP2012061 Marietta Area Improvements | P12061033 | Devola-HighlandRdgSw: ROW | $1,063,595 | $0 |
| | P12061049 | Buell Sta: Inst Xfmr&12kV Bus | $1,021,033 | $0 |
| | P12061058 | Devola: Inst Xfmrs & 12kV Bus | $510,516 | $0 |
| TP2015055 Elliot - Strouds Run Improv 69 | P15055003 | Elliott Distr XF Install-PH1 | $1,375 | $715 |
| | P15055006 | Strouds Run Dist. Inst/Rem-PH1 | $1,111,274 | $372,344 |
| | P15055032 | LeeXFMR Inst./Dist Rem PH2 | $2,118 | $1,471 |
| TP2015057 Marietta Area Improvements - E | P15057025 | BellRdgSw: Deliv Pt Meter | $1,304 | $0 |
| TP2015117 Northeast Canton Upgrades | P15117005 | Northeast Canton Distribution | $805,444 | $0 |
| TP2016081 E.Cambridge-Vail 69 kV convers | P16081004 | Old Washington 34.5 kV ret&ins | $3,285,743 | $0 |
| | P16081025 | Cambridge 34kV relay removal | $16,651 | $0 |
| | P16081026 | Cambridge ICON Install | $11,265 | $0 |
| TP2016108 W. Bellaire-Moundsville 69 kV | P16108006 | Monroe Street Distribution | $1,595,739 | $11,419 |
| | P16108027 | Skid for Monroe Street | $271,936 | $94,059 |
| TP2016121 Friendship 69 kV Loop | P16121014 | SugarHill Station 69kV OPCo-D | $11,433 | $505 |
| TP2017003 Kirk Sta Rehab & Upgrades | P17003003 | Kirk Station OP-D | $149,572 | $0 |
| TP2017054 Kaiser Jct-Air Force Jct | P17054005 | Heath Distribution work | $983,615 | $0 |
| TP2017069 The East Dover Project | P17069002 | E Dover - dist work & removal | $679,892 | $0 |
| TP2017100 Beatty-Cole-Harrison Upgrades | P17100011 | Hilliard Sta OP-D | $451,849 | $1,095 |
| | P17100014 | Trabue Sta OP-D | $1,360,740 | $706 |
| | P17100017 | Beatty Sta OP-D | $1,395,586 | $641,384 |
| TP2017242 Chrome Station | P17242006 | Chrome Station: Meter | $20,727 | $0 |
| TP2017CC1 Blanket | P17CC1031 | OHPCo-MREGT D Projects | $0 | $13,917,308 |
| TP2018141 Bluffton Area Improvements | P18141024 | Beaverdam Station | $139 | $84 |
| **Total** | | | $24,866,452 | $19,729,795 |

Transmission Field Services

# Transmission Capital Asset Sparing Strategy

## Effective Date: 6/8/2020

Original Document

Description: Defines a process for determining an appropriate quantity of spare assets to maintain in stock to address emergencies.

# Document Control

## Preparation

| **Prepared By:** | **Title** |
|---|---|
| Garrett P. Thomas | Coordinator, Transmission Asset Planning & Renewal |
| Stephanie E. Krueger | Engineering Technologist, TFS Station Asset Management |

## Review

| **SME:** | **Title** |
|---|---|
| Garrett P. Thomas | Coordinator, Transmission Asset Planning & Renewal |
| **Reviewed By:** | **Title** |
| Drew Swick | Planning & Engineering Supervisor |
| Jomar M. Perez-Ramos | Manager, Transmission Asset Performance & Renewal Manager |

## Approval

| **Name** | **Title** | **Signature** | **Date** |
|---|---|---|---|
| Daniel J. Recker | Managing Director, TFS Tech Support | DocuSigned by: Dan Recker 635B748D47F74FF... | 6/2/2020 \| 7:37 PM EDT |
| Kamran Ali | Managing Director, Transmission Planning | DocuSigned by: Kamran Ali 8E2A34F588354AB... | 6/2/2020 \| 10:47 AM EDT |

## Implementation

| | |
|---|---|
| **Effective Date** | 6/8/2020 |
| **Review Frequency** | 2 years |
| **Retention Period** | Permanent |

## Revision History

| Rev. | Change(s) | Revision By | Date |
|---|---|---|---|
| 0 | Original Issue | R. D. Russell | 10/15/2014 |
| 1 | Title change and clarifying scope of document (see section 2.0); other miscellaneous updates | R. D. Russell | 11/30/2020 |
| 2 | Updated to a TFS and Transmission Planning document. In addition to wording clarification, added the section Engineering Judgment to the Assets & Equipment Addressed section. | Garrett P. Thomas<br>Stephanie E. Krueger | 6/2/2020 |

## Audience/Distribution List

| Name | Department | Type (Individual or Group) |
|---|---|---|
| TFS Line, P&C, Station | Transmission Field Services | Group |
| All | Transmission Planning | Group |

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## Table of Equations

## 1.0 Purpose

The purpose of this document is to define a process for determining an appropriate quantity of spare assets to maintain in stock to address emergencies. The document describes a modeling process that uses available data to derive a set of recommendations for use in purchasing decisions and risk assessment. The primary users of this document are planners, station standards, and asset engineers

## 2.0 Scope

This document only addresses the sparing strategy of capitalized Transmission assets. Capitalized assets are defined in AEP accounting policy documents: *AEP System Accounting Bulletin 14, Accounting for Spare Parts and Spare Equipment*. This sparing strategy document will not address non-capitalized parts or equipment. Non-capitalized assets continue to be addressed via the *Supply Chain System Procedures Manual*, which is owned and maintained by the Supply Chain organization. This strategy document does not require any changes and will not affect the Stores routines.

This document does not address the following sparing items:

- Determining if a greenfield station or station upgrades should include an active spare to the station design; e.g., should a station with three active banks include a 4th spare bank.
- Whether a station's design will include a switchable spare configuration

The above examples relate to station design concepts. This document only addresses capital spares to address field failures and the strategy to maintain an adequate inventory to avoid stock-out scenarios.

## 3.0 Documentation

All spares are documented in IPS.

## 4.0 References

| Document ID | Document Title |
|---|---|
| N/A | AEP System Accounting Bulletin 14, Accounting for Spare Parts and Spare Equipment |
| TRANS.02.003.00_PRO | Spare and Mobile Acquisition Procedure |
| N/A | Supply Chain System Procedures Manual |

## 5.0 Terms and Definitions

| Term | Description |
|---|---|
| ARO | After Receipt Purchase Order |
| CB | Circuit Breaker |
| GIC | Geomagnetically Induced Current |
| IPS | Intelligent Process Solutions (Short for IPS-Energy) – IPS-Energy is AEP Transmission and Generation's asset management database. IPS is used for asset management, maintenance and inspection scheduling, compliance reporting, managing device settings, and testing documentation, etc. |
| PO | Purchase Order |
| SME | Subject Matter Expert |
| TAP&R | Transmission Asset Planning & Renewal |

## 6.0 Sparing Strategy Overview

AEP Transmission operates a highly complex power grid. The grid is composed of equipment and assets that, at some point, experience failures. Restoration could involve repairing assets, or in more extreme cases the failed equipment must be replaced. To assure proper consideration and planning for replacement equipment, a sparing strategy is required.

A good sparing strategy must consider the many potential causes of risk. Assets commonly fail due to age related issues. As the asset ages, it exhibits "wear and tear" vulnerabilities caused by issues such as loading, historical faults, maintenance history, etc. Beyond age related failures, unexpected failures can be caused by weather extremes, natural events (e.g., GIC), or newer asset fallout. Finally, in today's environment, a deliberate act of terror is another unpredictable event that might result in equipment failures.

A sparing strategy must also provide a good balance between financial prudence and service level. The strategy should ensure that proper quantities and product configurations are included in a spares inventory to ensure network failures cause no or minimal service interruptions.

# 7.0 Capital Asset Definition

Based on the *AEP System Accounting Bulletin 14, Accounting for Spare Parts and Spare Equipment* guidelines, and the key requirement of a minimum $50K cost for capitalized spares, the following Transmission assets will be addressed in this document. Note that the asset kV class coverage range could change over time as the price of equipment changes.

- Transformers (approximately 4kV high-side units and larger)
- Circuit Breakers (138kVclass and higher)
- Mobiles and Skids

# 8.0 Purchasing

Prior to finalizing each piece of equipment's Purchase Order, procurement must determine the appropriate payment structure – Progress Payments or Payment Upon Delivery. Traditionally, larger voltage equipment (138kV & above) have the option for progress payments, largely due to the longer lead-time. The most commonly used progress payment structure reflects the following milestone payments:

- 40% ARO (After Receipt of PO)
- 20% Upon Receipt of Materials
- 30% Upon Delivery of Equipment
- 10% Upon Final Acceptance

The other payment structure, Payment Upon Delivery, is generally utilized for equipment with shorter lead time (<6mos), and tends to be less expensive (<$500k).

# 9.0 Regional Sharing

Refer to Appendix A: Regional Sharing Chart for an overview of the regional sharing policy.

# 10.0 Assets & Engineering

## 10.1 Transformers

Transformer sparing is key to ensure safe, reliable and cost effective power of delivery and service to customers for two main reasons: First, the transformation function is fundamental to the operation of the grid, and failures can cause significant wide-spread service interruptions. Second, the manufacturing, delivery, and installation intervals for replacement units can be lengthy, potentially to 1.5 years for the largest configurations. This high-probability and high-impact equipment class requires a sparing approach to ensure an available supply of units for continued, safe and reliable service.

AEP's strategy for Transformer sparing is built around a probability model. Specifically, the strategy uses the Poisson probability model to predict failures and make recommendations on the number of spares to maintain in inventory to address these potential failures. This model provides a probabilistic approach for a solution to minimize the risk of a 'stock out' or a situation where no spare units are available to restore a failed unit.

See Appendix B: Overview of the Poisson Model for a high level discussion of the Poisson Model.

### 10.1.1 Data for the Model

Failure data is a key data element of the model. Historical transformer failure data is based on failure events collected in AEP's systems and records from 2000 through 2013. The failure data is collected across the various kV configurations so that the model can be more specific to the many deployed transformer configurations.

Replacement lead-times are based on Subject Matter Expert (SME) inputs, which use past delivery intervals, from various suppliers, to compile the overall summary. In addition, the geographical location of the station and feasible delivery routes are also considered.

The number of units in-service and the number of available spares is based on IPS-ENERGY information.

The original modeling for transformer sparing considered only failures due to wear & tear, natural events, etc. Recently the model's failure rate has been expanded to consider acts of terror and Geomagnetically Induced Current (GIC) events. These events are independent of the typical causes of failures, but are included in the model to develop a more comprehensive sparing strategy position.

To account for acts of terror, the model assumes that higher kV stations and assets are more likely to be targets since an attack at these stations would cause broader network impacts. The impacts to the failure rate are:

- Extra High Voltage Transmission (>= 230kV) is highest risk for a terror event, as these stations are larger in size, more visible to terrorists, and would have broader network impact. Increase the expected failure rate by 5%. (For example, if the previous failure rate was 0.005, the new failure rate would be 0.00525)
- High Voltage Transmission (approximately 200kV to 46kV) level is medium risk. A terror strike is likely to have some impact to service, but not as wide-spread as an Extra High Voltage Transmission event; the risk factor is increased by 2.5%.
- Distribution (generally 34.5kV and below). Assumed to have more local and limited impact at this level; the risk factor is increased by 2%.

The probability of a GIC impacting event is unknown. The available information suggests that stations with a northern longitude and a more porous soil composition are more vulnerable. However, there are arguments that suggest other factors could also be considered. Given the lack of agreement on the GIC station risks across the industry, the model will assume all stations face a similar risk. Thus, the same increase in risk (2%) has been applied to all transformers categories. As more knowledge and information becomes available on the risks of GIC impact, the overall risk level will be reassessed for the model.

### 10.1.2 Level of Risk Objective

Based on the transformer data, the Poisson model provides a probability that total failures will not exceed the number of available spares in inventory. There is no industry standard defined for an acceptable risk level. The AEP model currently recommends quantities of spares to assure a 98% confidence level. That is, if spares could be purchased based strictly on the model's recommendation, there is a 98% chance that there is at least 1 available spare to restore the site and have minimal impact to service.

### 10.1.3 Limiting Factor

The model provides an estimate of the probability of an event, and this probability data can be used to help drive decisions on the quantities and timing of spares purchases. However, to balance financial prudence and the objective to ensure reliable service, the following thresholds are suggested to help drive purchasing decisions.

- 5% or higher - high risk; purchase spare immediately
- 2% to 5% - medium risk; purchase spare in near term
- < 2% - monitor inventory; no purchases currently required

### 10.1.4 Budgetary Planning

Maintaining the appropriate number of spares in inventory is necessary to minimize risk. The historical failure rates, combined with the modeling tool, can provide a good estimate of the cost required to minimize service risk due to failures.

The historical failure data suggests 30 to 35 transformers fail per year. Using this historical data, and making some assumptions about the transformer costs, the yearly average cost to replace expected failures can be established.

The modeling tool can be used to estimate the additional investment necessary to address the high risk spares needs (i.e., to achieve 98% confidence level). The quantity and configuration recommendations will change regularly as failures occur, changing the available data used for modeling, and purchases are made (or not made).

### 10.1.5 Modeling Tool

The Transmission Asset Planning & Renewal (TAP&R) team has developed a tool to execute the Poisson modeling calculations. The tool automatically collects the in-service transformer data from IPS; failure rate data is based on ~14 years of data collected from past events. The tool can be executed as often as needed, but is typically executed at least once a year to assure that any significant spares risks are addressed in a timely manner.

See Appendix C: Modeling Tool for an overview of the modeling tool.

### 10.1.6 Engineering Judgment

As the modeling tool provides a recommendation based upon the Poisson Model, it is important to understand the limitations of the model. The model covers the probability of series of discrete, independent events which would not cover issues such as manufacturing defects. This drives the importance of an engineering review of model recommendations in comparison to the engineers' understanding of the system. In addition to manufacturing defects, an engineer may request a one-time increase to the model recommendation due to transformers demonstrating failure tendencies as determined through electrical or insulating medium tests. Engineering review may also result in the recommendation to forego pursuing acquiring a spare due to expected system topology changes such as the elimination of a voltage class through improvement projects.

### 10.1.7 Storage Location & Other Considerations

Another aspect to be included in the future strategy plan is the storage location for each transformer configuration. The idea is to store spares in a geographic location that is the most efficient, when considering the concentration of deployed configurations, and the distance of the spares inventory to the deployed sites. Optimization modeling tools can be applied to this type of problem. However, there is a challenge in applying this sort of model because not all AEP sites have similar level of access. Some sites require special permits and access roads to deliver major equipment. As a result, SMEs are consulted to improve decisions made by the tool concerning configuration match and geographic proximity.

## 10.2 Mobile Transformers and Skids

Mobile transformers and Skids are separate from the spare Transformer planning and modeling. Mobiles/Skids are considered one group of many used to drive spares purchases and inventory. Mobiles/Skids will be purchased on an as needed basis.

## 10.3 Circuit Breakers

Circuit Breakers (CB) are another key component of the AEP grid, and a sparing strategy is necessary to ensure safe, reliable and cost effective delivery of electricity. When compared to transformers, there are a few unique characteristics that make the CB strategy quite different.

- CBs procurement intervals generally have shorter delivery (manufacture, ship, install) cycles. Thus, the planning horizon is shorter than transformers. The delivery interval for 765 kV units is around 8-9 months, and the 345 kV class is approximately 6-7 months. Circuit breakers at 138 kV voltage and lower have even shorter delivery cycles.
- In addition, in some cases, a failed CB may be rebuilt and restored to a functional state to restore while a more permanent solution involving replacement is investigated. These types of differences make the sparing of CBs less critical than transformers, where longer procurement lead-times and inability to temporarily by-pass or repair tend to dictate the urgency for sparing.

The AEP Accounting Policy on Sparing only covers capital expenses at the $50K threshold. 765kV to 138kV CBs cost approximately $50K or more and are thus capitalized spares. CB's below the 138kV class typically cost less than the capital spare threshold. This document only addresses capitalized spares. Non-capitalized spares are handled via Stores.

### 10.3.1 Modeling & Data

Circuit Breaker sparing is also based on the Poisson model. Like the transformer, various data is collected such as in-service units, procurement lead-times, available spares, etc. However, the CB failure rate is not based on historical data. At this time, AEP does not have an established process to collect CB failures when a unit is replaced. The CB SMEs help determine the model inputs that are needed based on their expertise.

Variation to CB failure rates for other events, i.e., terror attacks and GIC, are applied to CBs failure rates in the same way they are applied to the transformers. The station class, Extra High Voltage Transmission, High Voltage Transmission, and Distribution, are the basis to apply the terror risk impacts. The same GIC risk factor is applied to each class, as well.

### 10.3.2 Level of Risk Objective

Based on the CB data, the Poisson model provides a probability that total CB failures will not exceed the number of available CB spares in inventory, per kV category. There is no industry standard defined for an acceptable risk level. The AEP model would recommend quantities of spares to assure a 98% confidence level that there should be at least 1 available spare to address the failure and have no impact to service.

### 10.3.3 Modeling Tool

The TAP&R team has developed a tool to execute the Poisson modeling. The tool automatically collects the in-service transformer data from IPS and the current failure rate for CBs (plus variations for possible attack and GIC events). The tool can be executed as often as needed, but is typically executed at least once a year to assure that any significant spares risks are addressed in a timely manner.

### 10.3.4 Other Considerations

CB spares are stored at various locations throughout the AEP network. The approach is to have spares of each kV class geographically close to needed sites. As with transformers, spare CB purchases also require adjustments to the quantity and location of spares based on access and distance from service centers.

## 11.0 Spare Commissioning

All spare equipment is required to go through a commissioning process prior to being placed ‘In-Service’. Commissioning ensures that a spare is meeting its electrical duty allowing it to be capitalized on. Once a spare has been added to IPS it will be assigned a commissioning action. The commissioning action should be completed by the field within three months of delivery. If AEP field personnel cannot commission the spare within three months, a contractor is hired to complete the commissioning within six months of arrival. Once the commissioning action has been executed the Commissioning Date should be selected and the Status shall be changed to Spare – Capitalized in IPS.

## 12.0 Appendix A: Regional Sharing Chart

The matrix below shows the ability to transfer an asset between two AEP affiliates. Green represents ease of transfer due to accounting and regulatory rules.

For general reference ONLY. Please consult with the legal department regarding actual specific transactions.
Attorney-Client Privileged Communication - Confidential (Last Updated 11/07/2019)

| | APCo<br>14-15-AG<br>140-150-215 | Wheeling<br>20-21<br>200-210 | I&M<br>12-17-IG-19[7]<br>120-170-132<br>190[7] | KPCo<br>11-18-KG<br>110-180-117 | Ohio<br>16-25<br>160-250 | Kingsport<br>23-26<br>230-260 | SWEPCo<br>SC-SE-ST-SX-SG<br>161-159-194-111-168 | PSO<br>PD-PT-PG<br>167-114-198 | AEP TX<br>CK-WD-CJ-WU<br>211-119-169-192 | ETT<br>TJ<br>374 | Transource WV<br>PW<br>415 | OH Transco<br>PE<br>380 | WV Transco<br>PH<br>383 | IM Transco<br>PI<br>385 | KY Transco<br>PK<br>384 | OK Transco<br>PN<br>386 | Appalachian Transco<br>PV<br>382 | SW Transco<br>PF<br>388 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| APCo<br>14-15-AG<br>140-150-215 | | Cost1 | Cost1 | Cost1 | Cost1 | Cost1 | VA & WV Approvals2 | VA & WV Approvals2 | VA & WV Approvals2 | VA & WV Approvals2 | Cost1 | VA & WV Approvals2 | VA & WV Approvals2 | VA & WV Approvals2 | VA & WV Approvals2 | VA & WV Approvals2 | VA & WV Approvals2 | VA & WV Approvals2 |
| Wheeling<br>20-21<br>200-210 | Cost1 | | Cost1 | Cost1 | Cost1 | Cost1 | WV Approval | WV Approval | WV Approval | WV Approval | WV Approval for Both | WV Approval | WV Approval for Both | WV Approval | WV Approval | WV Approval | WV Approval | WV Approval |
| I&M<br>12-17-IG-19[7]<br>120-170-132<br>190[7] | Cost1 | Cost1 | | Cost1 | Cost1 | Cost1 | Cost5,6 | Cost5,6 | Cost5,6 | Cost5,6 | WV Approval | Cost1 | WV Approval | IN Approval (Requires ~4 months) | Cost1 | Cost5,6 | Cost1 | Cost5,6 |
| KPCo<br>11-18-KG<br>110-180-117 | Cost1 | Cost1 | Cost1 | | Cost1 | Cost1 | A/P4.2; KY approval required if KPCo is paying higher of cost or market, or receiving lower of cost or market | A/P4.2; KY approval required if KPCo is paying higher of cost or market, or receiving lower of cost or market | A/P4.2; KY approval required if KPCo is paying higher of cost or market, or receiving lower of cost or market | A/P4.2; KY approval required if KPCo is paying higher of cost or market, or receiving lower of cost or market | WV Approval; KY approval required if KPCo is paying higher of cost or market, or receiving lower of cost or market | A/P4.1 | WV Approval; KY approval required if KPCo is paying higher of cost or market, or receiving lower of cost or market | A/P4.1 | A/P4.1 | A/P4.2; KY approval required if KPCo is paying higher of cost or market, or receiving lower of cost or market | A/P4.1 | A/P4.2; KY approval required if KPCo is paying higher of cost or market, or receiving lower of cost or market |
| Ohio<br>16-25<br>160-250 | Cost1 | Cost1 | Cost1 | Cost1 | | Cost1 | Cost5,6 | Cost5,6 | Cost5,6 | Cost5,6 | WV Approval | OH Approval5 | WV Approval | Cost1 | Cost1 | Cost5,6 | Cost1 | Cost5,6 |
| Kingsport<br>23-26<br>230-260 | Cost1 | Cost1 | Cost1 | Cost1 | Cost1 | | Cost5,6 | Cost5,6 | Cost5,6 | Cost5,6 | WV Approval | Cost1 | WV Approval | Cost1 | Cost1 | Cost5,6 | Cost1 | Cost5,6 |
| SWEPCo<br>SC-SE-ST-SX-SG<br>161-159-194-111-168 | VA & WV Approvals2 | WV Approval | Cost5,6 | A/P4.2; KY approval required if KPCo is paying higher of cost or market, or receiving lower of cost or market | Cost5,6 | Cost5,6 | | Cost6 | Cost6 | Cost6 | WV Approval | Cost5,6 | WV Approval | Cost5,6 | Cost4,6 | Cost6 | Cost5,6 | Cost6 |
| PSO<br>PD-PT-PG<br>167-114-198 | VA & WV Approvals2 | WV Approval | Cost5,6 | A/P4.2; KY approval required if KPCo is paying higher of cost or market, or receiving lower of cost or market | Cost5,6 | Cost5,6 | Cost6 | | Cost6 | Cost6 | WV Approval | Cost5,6 | WV Approval | Cost5,6 | Cost4,6 | Cost6 | Cost5,6 | Cost6 |
| AEP TX<br>CK-WD-CJ-WU<br>211-119-169-192 | VA & WV Approvals2 | WV Approval | Cost5,6 | A/P4.2; KY approval required if KPCo is paying higher of cost or market, or receiving lower of cost or market | Cost5,6 | Cost5,6 | Cost6 | Cost6 | | Cost6 | WV Approval | Cost5,6 | WV Approval | Cost5,6 | Cost4,6 | Cost6 | Cost5,6 | Cost6 |
| ETT<br>TJ<br>374 | VA & WV Approvals2 | WV Approval | Cost5,6 | A/P4.2; KY approval required if KPCo is paying higher of cost or market, or receiving lower of cost or market | Cost5,6 | Cost5,6 | Cost6 | Cost6 | Cost6 | | WV Approval | Cost5,6 | WV Approval | Cost5,6 | Cost4,6 | Cost6 | Cost5,6 | Cost6 |
| Transource WV<br>PW<br>415 | Cost1 | WV Approval for Both | WV Approval | WV Approval; KY approval required if KPCo is paying higher of cost or market, or receiving lower of cost or market | WV Approval | WV Approval | WV Approval | WV Approval | WV Approval | WV Approval | | WV Approval | WV Approval for Both | WV Approval | WV Approval | WV Approval | WV Approval | WV Approval |
| OH Transco<br>PE<br>380 | VA & WV Approvals2 | WV Approval | Cost1 | A/P4.1 | OH Approval5 | Cost1 | Cost5,6 | Cost5,6 | Cost5,6 | Cost5,6 | WV Approval | | WV Approval | Cost1 | Cost1 | Cost5,6 | Cost1 | Cost5,6 |
| WV Transco<br>PH<br>383 | VA & WV Approvals2 | WV Approval for Both | WV Approval | WV Approval; KY approval required if KPCo is paying higher of cost or market, or receiving lower of cost or market | WV Approval | WV Approval | WV Approval | WV Approval | WV Approval | WV Approval | WV Approval for Both | WV Approval | | WV Approval | WV Approval | WV Approval | WV Approval | WV Approval |
| IM Transco<br>PI<br>385 | VA & WV Approvals2 | WV Approval | IN Approval (Requires ~4 months) | A/P4.1 | Cost1 | Cost1 | Cost5,6 | Cost5,6 | Cost5,6 | Cost5,6 | WV Approval | Cost1 | WV Approval | | Cost1 | Cost5,6 | Cost1 | Cost5,6 |
| KY Transco<br>PK<br>384 | VA & WV Approvals2 | WV Approval | Cost1 | A/P4.1 | Cost1 | Cost1 | Cost4,6 | Cost4,6 | Cost4,6 | Cost4,6 | WV Approval | Cost1 | WV Approval | Cost1 | | Cost4,6 | Cost1 | Cost4,6 |
| OK Transco<br>PN<br>386 | VA & WV Approvals2 | WV Approval | Cost5,6 | A/P4.2; KY approval required if KPCo is paying higher of cost or market, or receiving lower of cost or market | Cost5,6 | Cost5,6 | Cost6 | Cost6 | Cost6 | Cost6 | WV Approval | Cost5,6 | WV Approval | Cost5,6 | Cost4,6 | | Cost5,6 | Cost6 |
| Appalachian Transco<br>PV<br>382 | VA & WV Approvals2 | WV Approval | Cost1 | A/P4.1 | Cost1 | Cost1 | Cost5,6 | Cost5,6 | Cost5,6 | Cost5,6 | WV Approval | Cost1 | WV Approval | Cost1 | Cost1 | Cost5,6 | | Cost5,6 |
| SW Transco<br>PF<br>388 | VA & WV Approvals2 | WV Approval | Cost5,6 | A/P4.2; KY approval required if KPCo is paying higher of cost or market, or receiving lower of cost or market | Cost5,6 | Cost5,6 | Cost6 | Cost6 | Cost6 | Cost6 | WV Approval | Cost5,6 | WV Approval | Cost5,6 | Cost4,6 | Cost6 | Cost5,6 | |

Note: Ohio/Ohio Transco; WV Transco/East; I&M/I&M Transco - application being prepared; expected to be filed May 2020; ECD May 2021

**Notes:**

**The table assumes the state with the more stringent rule governs. A/P = Asymmetric Pricing**

1 = Affiliated Transaction Agreement (December 31, 1996) governs the sales of M&S and capital spares between the AEP East Utility Companies, which will be priced at cost.

2 = For APCO, WV has a $1MM threshold for transactions with regulated affiliates, $50,000 for competitive affiliates, and VA has no threshold. APCO thresholds in WV should apply to its transactions with WV Transco from APCO's point of view (WV Transco itself requires approval).

3 = For I&M, asymmetric pricing applies to unregulated affiliate transactions in MI, and approval is required for transactions over $50MM. Notice filing is required in IN for all affiliate transactions. The IM Transco is treated like a utility in IN but not MI.

4.1 = (East primarily) If entity dealing with KPCo can sell or buy at the better of cost or market in favor of KPCo, then the transaction is generally okay. KY approval required if KPCo is paying higher of cost or market, or receiving lower of cost or market. KPCo requires Commission approval to sell property with an original book value of $1MM or more. KY Transco is treated like an unregulated affiliate of KY Power by the KY PSC.

4.2 = (West primarily) Because West jurisdictions require that sale be made at cost, transactions only work without approval if: (a) cost is better than market from KPCo's point of view, and (b) the transaction is at cost. KY approval required if KPCo is paying higher of cost or market, or receiving lower of cost or market. KPCo requires Commission approval to sell property with an original book value of $1MM or more. KY Transco is treated like an unregulated affiliate of KY Power by the KY PSC.

5 = In Ohio, affiliate transfers are authorized at fully allocated cost. The OH Transco is treated like a utility in OH. Transactions between OH utilities require PUCO approval. Indiana and Tennessee do not require a filing for prior approval.

6 = For AEP TX, SWEPCO and PSO, transfers to affiliated utilities can generally be made at net book value if that value represents a fair and non-discriminatory price and is in the public interest. Transactions for $10MM or more involving Texas entities (AEP Texas, SWEPCO, ETT) require Texas approval. The OK Transco is treated like a utility in OK.

7 = Check the transactions for export control rules. Contact Budd Haemer.

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**Figure 1: Regional Sharing Chart**

## 13.0 Appendix B: Overview of the Poisson Model

The Poisson model is used across many industries and applications for failure predictions. The model requires an understanding of the average frequency of an occurrence (i.e., failures) over a given time period. The model also assumes that events are random and independent. AEP's historical transformer failure data is used as an input to this model for the sparing strategy.

$$P(x) = \sum_{x=0}^{s} \frac{(n\mu R)^x e^{-(n\mu R)}}{x!}$$

**Equation 1: Poisson Model Calculation**

Where:

| | | |
|---|---|---|
| P | = | probability of event |
| n | = | number of units in-service |
| μ | = | failure rate |
| R | = | replacement equipment lead-time |
| s | = | number of available spares |
| x | = | number of failures |

## 14.0 Appendix C: Modeling Tool

The modeling tool has been developed to assist in the execution of various scenarios for recommendations for the number of spares to stock for a particular equipment. The tool performs the Poisson calculations (see Appendix B: Overview of the Poisson Model) which when completed outputs the probability of a specific event occurring. The event in this case would be the failure of equipment during a one year time span. The tool is set up in a way that the model's variables (e.g., failure rate, in-service units, available spares units, lead times, etc.) can be modified and the calculations can be quickly run to determine event probabilities.

The tool directly pulls the following data from IPS:

- In-service units (from the 'Status' field)
- Available spares; this includes either the 'Spare – System' or 'Spare – Dedicated' from the 'Status' field.
- Transformers have been organized into groups with similar characteristics (e.g., high & low side voltages, MVA, LTC/non-LTC, etc.). The groups are defined in the IPS fields 'TR Spare ID' and 'Category Name'.

Another capability of the tool is a recommendation on which spare is the best match for an in-service unit that might fail. The tool considers the geographic location of both in-service and spare units, and attempts to match the closest via proximity calculations. This feature only applies to the transformers since it uses the grouping (i.e., TR Spare ID).

## CERTIFICATE OF SERVICE

In accordance with Rule 4901-1-05, Ohio Administrative Code, the PUCO's e-filing system will electronically serve notice of the filing of this document upon the following parties. In addition, I hereby certify that a service copy of the foregoing *Direct Testimony of Kamran Ali* was sent by, or on behalf of, the undersigned counsel to the following parties of record this 15th day of June 2020, via electronic transmission.

/s/ *Steven T. Nourse*
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