



## **Asset Renewal**

The Asset Management Department is focused on the life cycle management of ATC's transmission assets. The objective is to ensure assets perform the required function in a sustainable manner at the lowest whole life cost.

Coordination of design, commissioning, operation, maintenance and replacement strategy is crucial to achieve this objective. Asset Renewal is the "replacement strategy" piece of the asset life cycle. Asset Renewal is driven by public and worker safety, regulatory compliance, reliability and operational performance.

The ATC Asset Renewal plan captures the balance between lowest whole life cycle cost and reliable performance of the ATC transmission system. ATC's Asset Renewal plan calls for an estimated spend of \$ 987 million over the 10-year plan horizon.

## **State of Existing Facilities**

ATC operates 733 lines with a total of 9400 circuit miles. A number of facilities have been identified as nearing end of life or having components at end of life during the 10 year assessment period.

ATC benchmarks its transmission line performance with 25 transmission operators across the United States. This sample comprises 47 percent of the United States/Canadian transmission grid based upon NERC bulk power line mileage. ATC lines operating at 115, 138, and 345kV were top 10 percent for reliability performance in 2010. ATC 69-kV transmission lines were top 25 percent for reliability performance in 2010. As evidenced by reliability data, our lines are performing well. However, targeted investment will be required to maintain reliability.

ATC operates a fleet of 190 in service transformers, with approximately 40 percent of these being more than 35 years old. Fortunately, ATC has not experienced a high failure rate of these aging transformers but the assessment anticipates an ongoing routine investment is required to maintain reliability and manage operational and financial risk.

ATC's protective relay systems are critical to the safe and reliable operation of the transmission system. The plan is to modernize the relay systems to meet compliance requirements, improve reliability, minimize inadvertent operation, and provide additional information to ATC Operations to improve the restoration time when an outage does occur.

ATC has a fleet of 1931 circuit breakers in service. Of these, 1276 use sulfur hexafluoride (SF<sub>6</sub>) as an arc quenching and insulating medium. There are 651 oil circuit breakers and 4 vacuum circuit breakers. Asset Renewal, as applied to circuit breakers will target units that have specific reliability and performance concerns and SF<sub>6</sub> circuit breakers with environmental concerns.



## **Transmission Line Asset Renewal**

### Overhead Transmission Line Facilities

The Asset Maintenance group of ATC monitors the overhead line facilities through a maintenance and inspection program designed to assess the condition of line facilities. Aerial and ground inspections of ATC facilities are performed periodically to identify issues for repair. The goal is to maintain reliable performance as well as public and worker safety. ATC System Operations and Asset Management personnel monitor performance and track the reliability of all ATC lines. Particular attention is paid to lightning withstand performance and improvements targeted at poor performing lines. The inspection and reliability performance programs are considered the initial drivers for asset renewal upgrades to a facility. The line design is further analyzed by Asset Management for structural and clearance-related issues to complete the list of possible drivers.

ATC has responded to the NERC Alert for Facilities Ratings and is in a three year program to verify field conditions match design assumptions for line facilities rated 115kV and above. Aerial surveys and other means are being used to evaluate line facility ratings.

Transmission line facilities categorized to have inadequate condition or poor operational performance history are brought to ATC Planning for consideration. Planning may have specific system reliability needs for the line or geographic area. If Planning and Asset Management both have drivers for a project, a primary need driver is agreed upon and the project progresses as either a network (Planning driven) or asset renewal (Asset Management driven) project. The scope of the Asset Renewal project can vary from complete rebuilds to replacements of problematic components such as poles, cross arms or insulators. The extent of renewal driven work may be further impacted by importance of the line to the end customer. Net present value (NPV) analysis is used to evaluate various options and determine the least whole life cost means of obtaining the desired reliability.



Underground Transmission Line Asset Renewal

Our underground transmission system consists of high pressure fluid filled cable systems (HPFF), High Pressure Gas Filled cable systems (HPGF), solid dielectric cable (SD) systems and self-contained fluid filled system (SCFF).

| Cable Type                         | 69-kV Mileage | 138-kV Mileage |
|------------------------------------|---------------|----------------|
| High Pressure Fluid Filled (HPFF)  | 24.1          | 55.4           |
| High Pressure Gas Filled (HPGF)    | 0             | 3.4            |
| Solid Dielectric (SD)              | 12.6          | 4.7            |
| Self-Contained Fluid Filled (SCFF) | 0.4           | 8.2            |
| Total Miles                        | 37.1          | 71.7           |

The condition of high pressure fluid and high pressure gas filled systems is such that no investment is expected in the 10-year horizon. Several of the solid dielectric cable installations are approaching end of life and will require replacement over the 10 year horizon. The self-contained fluid filled cables between upper and lower Michigan are expected to reach end of life near the end of the 10-year horizon.

Details of the line asset renewal plan are shown in Table AR-1. The estimated cost of the plan over the 10 year horizon is \$ 596 million.

**Power Transformer Asset Renewal**

The intent of the ATC power transformer asset renewal program is to make an assessment of each transformer in the fleet based upon condition, operational importance and the probability of failure based on age. This assessment is used to determine a spare or renewal strategy. The strategy options are either an on-site spare, system wide spare that can be relocated to replace the failed transformer, or renewal replacement of the aged transformer. ATC has a spare transformer plan where 17 ATC owned units are available. ATC also participates in an industry spare equipment program.

- Healthy units with high importance and high probabilities of failure based on age may warrant an on-site spare or a system spare in the general area to minimize transport times.
- Units in poor health with high importance are candidates for renewal regardless of age.



- Healthy units with low importance will be backed up with a system wide spare regardless of age.
- Units in poor health and low importance will be backed up with system spares regardless of age.

The operational importance of a particular transformer to the transmission network is based upon a series of planning studies that look at the severity of the contingencies following the failure of the specific transformer. Given the high cost, specialty design and logistical challenges of moving a large power transformer, double-contingency studies provide guidance for the operation impact and prioritization.

Power transformer condition is monitored as part of the asset maintenance program through off-line electrical tests, visual inspection and tracking of maintenance history. On line tests include dissolved-gas-analysis-oil tests, infrared inspection, vibration analysis and partial discharge condition assessment.

A fleet approach has been taken to estimate the investment in the 10-year horizon and for consideration in determining the number of system spares. The fleet approach uses a curve that represents 50 percent of transformers will fail by age 50 years. A probability of failure for each unit is determined from the curve and aggregated for each year in the 10-year horizon. The expected investment to maintain this existing level of reliability will require replacement of approximately two 138/69-kV transformers per year and one 345/138-kV transformer every two years in the 10-year horizon. The cost estimate for this program over the 10 year horizon is \$129 million. Actual replacement of a specific transformer in the fleet will be based on the results of the ATC condition monitoring program and assessments of importance. Please refer to [Table AR-2](#) for details.

### **Instrument Transformer and Surge Arrester Renewal**

Instrument transformers used for monitoring voltages and currents on the ATC system are key to reliable performance. The goal of asset renewal efforts is to manage maintenance costs and avoid end of life failures on the ATC system. Instrument transformers at end of life or poor operational history are targeted for replacement.

Arresters are installed to prevent outages and protect equipment from lightning and over voltage surges. The goal of asset renewal efforts is to manage maintenance costs and avoid end of life failures on the ATC system. Arresters at end of life or poor operational history are targeted for replacement.

The cost estimate for this program over the 10 year horizon is \$50 million. Please refer to [Table AR-3](#) for details.

### **Relay Asset Renewal**

Relays are the cornerstone of a reliable transmission system. The goal of the ATC relay asset renewal effort is to improve relay performance, provide information for Operations, and reduce maintenance cost. ATC is able to improve line and equipment capabilities with microprocessor



based relays by eliminating over-reaching mis-operations and increasing capacity load limits. The improved performance of the microprocessor relays allows ATC to address stability issues and increase system reliability and security with the use of carrier and fiber optic communication systems. The new technology has additional benefits of better factory support, improved spare part availability, software upgrades and technical support to ATC staff.

Microprocessor based relays offer valuable information for ATC Operations. New relay systems are able to be used to direct field resources to the problem area and verify what component of the transmission system has failed. Additionally, fault location information is used with the geographic lightning detection network to correlate lightning strikes with line outages. This enables ATC to historically track performance of specific sections of the line to aid in determining transmission line Asset Renewal prioritization.

Relay renewals are being made to satisfy NERC reliability standard requirements and recommendations from the Florida blackout.

The self-check and remote monitoring capabilities of microprocessor based relays allow longer maintenance cycles and reduce maintenance costs.

Approximately 11,000 in service relays protect the ATC network. The asset renewal program is prioritized by replacing the least reliable relays by type, relays at end-of-life and, relays with schemes that have a history of inadvertent operations. This includes single relays that require remote back-up and electromechanical relays that do not provide fault location or self-alarm.

ATC plans to spend approximately \$ 121 million for relay renewal in the 10 year horizon. This equates to about 50 relay panels per year. Please refer to [Table AR-4](#) for details.

### **Circuit Breaker Asset Renewal**

Circuit breakers are essential to the reliability and safety of the network. ATC has a fleet of 1931 gas, oil, and vacuum circuit breakers. The goal of the circuit breaker renewal program is to improve reliability and environmental performance. This includes reducing maintenance outage requirements, reducing SF<sub>6</sub> emissions, and reducing the number of unplanned outages. ATC plans to spend approximately \$ 68 million on the circuit breaker fleet over the 10 year horizon. Please refer to [Table AR-5](#) for details.

*Table AR-1  
Transmission System Additions – Asset Renewal Line Work*

| System Additions  | Projected In-Service Year | Planning Zone | Need Category  |
|---|---------------------------|---------------|--|
| Partial rebuild Deer Trail - Whitcomb 69-kV line Y-86   | 2011                      | 1             | Improve condition and increase reliability performance of existing line  |
| Partial rebuild Wautoma - Berlin 69-kV line Y-95  | 2011                      | 1             | Improve condition and increase reliability performance of existing line  |
| Re-insulate Winneconne - Berlin 69-kV line Y-80   | 2012                      | 1             | Improve condition and increase reliability performance of existing line  |
| Rebuild North Point - Rocky Run 115-kV line T-20  | 2016                      | 1             | Improve condition and increase reliability performance of existing line. |
| Rebuild Wautoma - Montello 69-kV line Y17   | 2017                      | 1             | Improve condition and increase reliability performance of existing line  |
| Rebuild Whiting Avenue-Plover 115-kV line B-106   | 2019                      | 1             | Improve condition and increase reliability performance of existing line  |
| Partial rebuild Coyne - Saratoga 115-kV line T-72   | 2020                      | 1             | Improve condition and increase reliability performance of existing line  |
| Partial rebuild Petenwell - Saratoga 138-kV line X-43   | 2020                      | 1             | Improve condition and increase reliability performance of existing line  |
| Partial rebuild Coyne - Plover 115-kV line J-114  | 2020                      | 1             | Improve condition and increase reliability performance of existing line  |
| Re-insulate top phase and add additional arresters on Chandler - Forsyth 69-kV line (Chandler line) | 2012                      | 2             | Improve condition and increase reliability performance of existing line  |
| Partial rebuild Roberts - 9 Mile 69-kV line 6952  | 2012                      | 2             | Improve condition and increase reliability performance of existing line  |
| Re-insulate Munising - Forsyth 138-kV line (Munising 138 line)                                      | 2012                      | 2             | Improve condition and increase reliability performance of existing line  |
| Re-insulate Munising - Gwinn 69-kV line (Autrain line) – Double circuited portion with Munising 138 | 2012                      | 2             | Improve condition and increase reliability performance of existing line  |
| Partial rebuild Munising-Gwinn 69-kV line (Autrain line) – Single circuit portion                   | 2013                      | 2             | Improve condition and increase reliability performance of existing line  |

*Table AR-1  
Transmission System Additions – Asset Renewal Line Work (Continued)*

| <b>System Additions</b>  | <b>Projected In-Service Year</b> | <b>Planning Zone</b> | <b>Need Category</b>  |
|--|----------------------------------|----------------------|---|
| Rebuild Atlantic - M38 69-kV line (Atlantic 69 line)   | 2013                             | 2                    | Improve condition and increase reliability performance of existing line |
| Partial rebuild Blaney Park-Munising 69-kV line (Inland line)                                  | 2014                             | 2                    | Improve condition and increase reliability performance of existing line |
| Re-insulate Portage - 9 Mile 69-kV lines 6901/6902   | 2014                             | 2                    | Improve condition and increase reliability performance of existing line |
| Re-insulate Sawyer-Gwinn 69-kV line (Sawyer line)  | 2014                             | 2                    | Improve condition and increase reliability performance of existing line |
| Partial rebuild Rexton-Hiawatha 69-kV line ESE_6908  | 2015                             | 2                    | Improve condition and increase reliability performance of existing line |
| Underground cable replacement Magazine-Nine Mile/Three Mile 69-kV line ESE_6903                | 2015                             | 2                    | Improve condition and increase reliability performance of existing line |
| Partial rebuild Conover-Mass 69-kV line 6530   | 2018                             | 2                    | Improve condition and increase reliability performance of existing line |
| Partial rebuild Powers-Chalk Hill 69-kV line 6910  | 2018                             | 2                    | Improve condition and increase reliability performance of existing line |
| Underwater cable replacement McGulpin-Straits 138-kV line 9901                                 | 2020                             | 2                    | Improve condition and increase reliability performance of existing line |
| Underwater cable replacement McGulpin-Straits 138-kV line 9903                                 | 2020                             | 2                    | Improve condition and increase reliability performance of existing line |
| Partial rebuild Stage Coach - Spring Green 69-kV line Y-62                                     | 2011                             | 3                    | Improve condition and increase reliability performance of existing line |
| Install anti-galloping and grounding improvements on Columbia-South Fond Du Lac 345-kV line W5 | 2011                             | 3                    | Improve condition and increase reliability performance of existing line |

*Table AR-1  
Transmission System Additions – Asset Renewal Line Work (Continued)*

| System Additions  | Projected In-Service Year | Planning Zone | Need Category  |
|---|---------------------------|---------------|--|
| Partial rebuild Pardeeville Tap - North Randolph/Rio 69-kV line Y-64                        | 2011                      | 3             | Improve condition and increase reliability performance of existing line  |
| Partial rebuild Dane - Dam Heights 69-kV line Y-8   | 2012                      | 3             | Improve condition and increase reliability performance of existing line  |
| Underground cable replacement East Towne - Sycamore 69-kV line 6987                         | 2012                      | 3             | Improve condition and increase reliability performance of existing line. |
| Underground cable replacement East Towne to Sycamore 69-kV line 6988                        | 2012                      | 3             | Improve condition and increase reliability performance of existing line. |
| Replace underground with overhead cable on Pheasant Branch - West Middleton 69-kV line 6963 | 2012                      | 3             | Improve condition and increase reliability performance of existing line  |
| Partial rebuild Kirkwood - Trienda 138-kV line X-52   | 2012                      | 3             | Improve condition and increase reliability performance of existing line  |
| Rebuild Doylestown - Rio Pumping station 69-kV line Y20                                     | 2013                      | 3             | Improve condition and increase reliability performance of existing line  |
| Rebuild Rubicon - Concord 138-kV line 9061  | 2016                      | 3             | Improve condition and increase reliability performance of existing line  |
| Rebuild Rubicon - Butler Ridge 138-kV line RUBG11   | 2016                      | 3             | Improve condition and increase reliability performance of existing line  |
| Rebuild Butler Ridge - Hartford 138-kV line HTFG51  | 2016                      | 3             | Improve condition and increase reliability performance of existing line  |
| Rebuild Darlington - Hillman 138-kV X-14  | 2016                      | 3             | Improve condition and increase reliability performance of existing line  |
| Rebuild Portage - Dam Heights 69-kV line Y16  | 2016                      | 3             | Improve condition and increase reliability performance of existing line  |
| Rebuild Eden - Hillman 69-kV line Y105  | 2018                      | 3             | Improve condition and increase reliability performance of existing line  |
| Rebuild Boscobel - Lone Rock 69-kV line Y-124   | 2018                      | 3             | Improve condition and increase reliability performance of existing line  |
| Underground cable replacement Stagecoach - West Middleton 69-kV line 6927                   | 2019                      | 3             | Improve condition and increase reliability performance of existing line  |

*Table AR-1  
Transmission System Additions – Asset Renewal Line Work (Continued)*

| <b>System Additions</b>  | <b>Projected In-Service Year</b> | <b>Planning Zone</b> | <b>Need Category</b>  |
|--|----------------------------------|----------------------|---|
| Rebuild Colley Road – Brick Church 69-kV line Y-32                               | 2022                             | 3                    | Improve condition and increase reliability performance of existing line |
| Partial rebuild Glenview - New Holstein 69-kV line J-140                         | 2011                             | 4                    | Improve condition and increase reliability performance of existing line |
| Shield wire replacement Stiles - Pulliam 138-kV lines KK64441-64451              | 2013                             | 4                    | Improve condition and increase reliability performance of existing line |
| Underwater cable replacement First Avenue - Redwood 69-kV line T-46              | 2015                             | 4                    | Improve condition and increase reliability performance of existing line |
| Rebuild Neevin - Butte Des Morts 138-kV line 43021                               | 2015                             | 4                    | Improve condition and increase reliability performance of existing line |
| Rebuild Custer - New Holstein 69-kV line P-68                                    | 2015                             | 4                    | Improve condition and increase reliability performance of existing line |
| Rebuild Sawyer - Dykesville 69-kV line DYKY21                                    | 2016                             | 4                    | Improve condition and increase reliability performance of existing line |
| Rebuild Sunset Point-Mears-Woodenshoe-Neevin 138-kV lines A-79, MCRG21 and 80952 | 2016                             | 4                    | Improve condition and increase reliability performance of existing line |
| Rebuild Highway V - Oak Street 69-kV line Z-26                                   | 2016                             | 4                    | Improve condition and increase reliability performance of existing line |
| Rebuild Manrap - Wesmark 69-kV line R-44   | 2016                             | 4                    | Improve condition and increase reliability performance of existing line |
| Rebuild Danz - Finger Road 69-kV line L-64                                       | 2016                             | 4                    | Improve condition and increase reliability performance of existing line |
| Rebuild Finger Road - Highway V 69-kV line U-47                                  | 2016                             | 4                    | Improve condition and increase reliability performance of existing line |
| Underground cable replacement University - Danz Avenue 69-kV line O-15           | 2017                             | 4                    | Improve condition and increase reliability performance of existing line |
| Rebuild Butte des Morts - North Appleton 138-kV line 6853                        | 2017                             | 4                    | Improve condition and increase reliability performance of existing line |
| Rebuild Pioneer - Sobieski 69-kV line E-83 Tap                                   | 2018                             | 4                    | Improve condition and increase reliability performance of existing line |

*Table AR-1  
Transmission System Additions – Asset Renewal Line Work (Continued)*

| <b>System Additions</b>  | <b>Projected In-Service Year</b> | <b>Planning Zone</b> | <b>Need Category</b>  |
|--|----------------------------------|----------------------|---|
| Rebuild Sobieski - Bayport 69-kV line T-98                         | 2018                             | 4                    | Improve condition and increase reliability performance of existing line |
| Rebuild Goodman - Caldron Falls 69-kV line J-88                    | 2019                             | 4                    | Improve condition and increase reliability performance of existing line |
| Partial rebuild Howard - Pulliam 138-kV line D-82                  | 2019                             | 4                    | Improve condition and increase reliability performance of existing line |
| Underground cable replacement Erdman - Lodestar 138-kV line X-48   | 2019                             | 4                    | Improve condition and increase reliability performance of existing line |
| Rebuild Finger Road – Canal 69-kV line J-10                        | 2020                             | 4                    | Improve condition and increase reliability performance of existing line |
| Underground cable replacement Edgewater - Erdman 69-kV line Y-31   | 2021                             | 4                    | Improve condition and increase reliability performance of existing line |
| Shield wire replacement Tosa - Butler 138-kV line 5061             | 2013                             | 5                    | Improve condition and increase reliability performance of existing line |
| Shield wire replacement Tosa - Bluemound 138-kV line 5041          | 2013                             | 5                    | Improve condition and increase reliability performance of existing line |
| Shield wire replacement Butler - Tower#4291 138kV line 3443        | 2013                             | 5                    | Improve condition and increase reliability performance of existing line |
| Rebuild Hartford - St. Lawrence 138-kV line 8031                   | 2014                             | 5                    | Improve condition and increase reliability performance of existing line |
| Rebuild Cooney - Concord 138-kV line 9042                          | 2015                             | 5                    | Improve condition and increase reliability performance of existing line |
| Partial rebuild Merrill Hills - Waukesha 138-kV line 7021          | 2015                             | 5                    | Improve condition and increase reliability performance of existing line |
| Rebuild Albers - Paris 138-kV line 3124                            | 2016                             | 5                    | Improve condition and increase reliability performance of existing line |
| Rebuild St. Martins - Edgewood 138-kV line 3013                    | 2017                             | 5                    | Improve condition and increase reliability performance of existing line |
| Rebuild and add breaker on Edgewood - Mukwonago 138-kV line 671K61 | 2017                             | 5                    | Improve condition and increase reliability performance of existing line |

*Table AR-1  
Transmission System Additions – Asset Renewal Line Work (Continued)*

| <b>System Additions</b>                                 | <b>Projected In-Service Year</b> | <b>Planning Zone</b> | <b>Need Category</b>  |
|---|----------------------------------|----------------------|---|
| Partial rebuild Summit - Merrill Hills 138-kV line 3551 | 2017                             | 5                    | Improve condition and increase reliability performance of existing line |
| Rebuild Oak Creek SW YD – Hayes 138-kV line 811         | 2019                             | 5                    | Improve condition and increase reliability performance of existing line |

*Table AR-2  
Asset Renewal Transformer Replacements*

| <b>System Upgrade</b>                 | <b>Projected In-Service Year</b> | <b>Voltage</b> | <b>Planning Zone</b> | <b>Need Category</b>           |
|---------------------------------------|----------------------------------|----------------|----------------------|--------------------------------|
| Aurora T3                             | 2011                             | 138/69-kV      | 1                    | Improve condition, reliability |
| Bluemound T3                          | 2011                             | 230/138-kV     | 5                    | Improve condition, reliability |
| Bluemound T1                          | 2012                             | 230/138-kV     | 5                    | Improve condition, reliability |
| Edgewater T31 and T32                 | 2012                             | 138/69-kV      | 4                    | Improve condition, reliability |
| Atlantic T1                           | 2013                             | 138/69-kV      | 2                    | Improve condition, reliability |
| Lancaster T31                         | 2014                             | 138/69-kV      | 3                    | Improve condition, reliability |
| Fitzgerald SS – relocate system spare | 2014                             | 345/138-kV     | 4                    | Reliability                    |
| Paddock T22 Spare                     | 2014                             | 345/138-kV     | 3                    | Reliability                    |
| Replace one transformer               | 2014                             | 138/69-kV      | various              | Improve condition, reliability |
| Replace two transformers              | 2015                             | 138/69-kV      | various              | Improve condition, reliability |
| Replace two transformers              | 2016                             | 138/69-kV      | various              | Improve condition, reliability |
| Replace one transformer               | 2016                             | 345/138-kV     | various              | Improve condition, reliability |
| Replace two transformers              | 2017                             | 138/69-kV      | various              | Improve condition, reliability |
| Replace two transformers              | 2018                             | 138/69-kV      | various              | Improve condition, reliability |
| Replace one transformer               | 2018                             | 345/138-kV     | various              | Improve condition, reliability |
| Replace two transformers              | 2019                             | 138/69-kV      | various              | Improve condition, reliability |
| Replace two transformer               | 2020                             | 138/69-kV      | various              | Improve condition, reliability |
| Replace one transformer               | 2020                             | 345/138-kV     | various              | Improve condition, reliability |

*Table AR-3  
Asset Renewal Instrument Transformer and Arrester Replacements*

| <b>System Upgrade</b>                         | <b>Projected In-Service Year</b> | <b>Voltage</b> | <b>Planning Zone</b> | <b>Need Category</b>           |
|---|----------------------------------|----------------|----------------------|--------------------------------|
| Replace Instrument Transformers and Arresters | 2011                             | various        | various              | Improve condition, reliability |
| Replace Instrument Transformers and Arresters | 2012                             | various        | various              | Improve condition, reliability |
| Replace Instrument Transformers and Arresters | 2013                             | various        | various              | Improve condition, reliability |
| Replace Instrument Transformers and Arresters | 2014                             | various        | various              | Improve condition, reliability |
| Replace Instrument Transformers and Arresters | 2015                             | various        | various              | Improve condition, reliability |
| Replace Instrument Transformers and Arresters | 2016                             | various        | various              | Improve condition, reliability |
| Replace Instrument Transformers and Arresters | 2017                             | various        | various              | Improve condition, reliability |
| Replace Instrument Transformers and Arresters | 2018                             | various        | various              | Improve condition, reliability |
| Replace Instrument Transformers and Arresters | 2019                             | various        | various              | Improve condition, reliability |
| Replace Instrument Transformers and Arresters | 2020                             | various        | various              | Improve condition, reliability |

*Table AR-4  
Asset Relay Replacements*

| <b>System Upgrade</b>   | <b>Projected In-Service Year</b> | <b>Voltage</b> | <b>Planning Zone</b> | <b>Need Category</b>           |
|-------------------------|----------------------------------|----------------|----------------------|--------------------------------|
| Replace 40 Relay Panels | 2011                             | various        | various              | Improve condition, reliability |
| Replace 40 Relay Panels | 2012                             | various        | various              | Improve condition, reliability |
| Replace 66 Relay Panels | 2013                             | various        | various              | Improve condition, reliability |
| Replace 50 Relay Panels | 2014                             | various        | various              | Improve condition, reliability |
| Replace 50 Relay Panels | 2015                             | various        | various              | Improve condition, reliability |
| Replace 50 Relay Panels | 2016                             | various        | various              | Improve condition, reliability |
| Replace 50 Relay Panels | 2017                             | various        | various              | Improve condition, reliability |
| Replace 50 Relay Panels | 2018                             | various        | various              | Improve condition, reliability |
| Replace 50 Relay Panels | 2019                             | various        | various              | Improve condition, reliability |
| Replace 50 Relay Panels | 2020                             | various        | various              | Improve condition, reliability |

*Table AR-5  
Transmission System Additions – Asset Renewal Circuit Breakers*

| <b>System Additions</b>      | <b>Projected In-Service Year</b> | <b>Planning Zone</b> | <b>Need Category</b>                            |
|------------------------------|----------------------------------|----------------------|---|
| Circuit breaker replacements | 2011                             | Various              | Mechanism design issues (5 units) 69 kV         |
| Circuit breaker replacements | 2011                             | Various              | Type U bushings (17 units) 69 kV                |
| Circuit breaker replacements | 2011                             | Various              | End of life, parts obsolescence (2 unit) 138 kV |
| Circuit breaker replacements | 2011                             | Various              | Type U bushings (15 units) 138 kV               |
| Circuit breaker replacements | 2011                             | Various              | Ratings (5 units) 69 kV                         |
| Circuit breaker replacements | 2012                             | Various              | End of life, parts obsolescence (4 units) 69 kV |
| Circuit breaker replacements | 2012                             | Various              | Type U bushings (37 units) 69 kV                |
| Circuit breaker replacements | 2012                             | Various              | Ratings (6 units) 69 kV                         |
| Circuit breaker replacements | 2012                             | Various              | Mechanism design issues (1 units) 69kV          |
| Circuit breaker replacements | 2012                             | Various              | Type U Bushings (9 units) 138kV                 |
| Circuit breaker replacements | 2012                             | Various              | Planning stability issues (3 units) 138 KV      |

| System Additions             | Projected In-Service Year | Planning Zone | Need Category                                       |
|------------------------------|---------------------------|---------------|---|
| Circuit breaker replacements | 2012                      | Various       | Ratings (3 units) 138kV                             |
| Circuit breaker replacements | 2013                      | Various       | Type U Bushings (12 units)<br>69kV                  |
| Circuit breaker replacements | 2013                      | Various       | Planning stability issues (1<br>units) 69 KV        |
| Circuit breaker replacements | 2013                      | Various       | Type S bushings (1 unit) 69 kV                      |
| Circuit breaker replacements | 2013                      | Various       | Type U Bushings (4 units)<br>138kV                  |
| Circuit breaker replacements | 2013                      | Various       | End of life, part obsolescence<br>(6 units) 138 kV  |
| Circuit breaker replacements | 2013                      | Various       | EPA SF6 emission reduction<br>(7units) 345 kV       |
| Circuit breaker replacements | 2014                      | Various       | End of life, parts obsolescence<br>(7 units) 138 kV |
| Circuit breaker replacements | 2014                      | Various       | Mechanism design issues (11<br>units) 69 kV         |
| Circuit breaker replacements | 2014                      | Various       | Type U Bushings (4 units)<br>138kV                  |
| Circuit breaker replacements | 2014                      | 3             | Type U Bushings (1 unit) 69kV                       |

| System Additions             | Projected In-Service Year | Planning Zone | Need Category                                    |
|------------------------------|---------------------------|---------------|--|
| Circuit breaker replacements | 2014                      | 5             | Over duty rating (1 unit) 138 kV                 |
| Circuit breaker replacements | 2015-2020                 | Various       | Mechanism design issues (30 units) 69 kV         |
| Circuit breaker replacements | 2015-2020                 | Various       | End of life, parts obsolescence (7 units) 69 kV  |
| Circuit breaker replacements | 2015-2020                 | Various       | Mechanism design issues (3 units) 138 kV         |
| Circuit breaker replacements | 2015-2020                 | Various       | End of life, parts obsolescence (5 units) 138 kV |
| Circuit breaker replacements | 2015-2020                 | Various       | Bushing flange oil leak (21 units) 345 kV        |
| Circuit breaker replacements | 2015-2020                 | Various       | End of life, parts obsolescence (8 units) 345 kV |