



## **Asset Renewal**

The Asset Management Department of Power Delivery is focused on the life cycle management of ATC's transmission assets. The program objective is to ensure assets perform the required function in a sustainable manner, at the lowest whole life cost without compromising health, safety, reliability or environmental performance.

The coordination of design, commissioning, operation, maintenance and replacement strategy is necessary 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 performance as defined by criticality, and environmental stewardship.

### **State of the system**

ATC benchmarks its transmission line performance with 27 other transmission operators across the United States. This comprises 54 percent of the transmission grid based upon NERC bulk power mileage. In 2009, ATC lines rated 345 kV were in the second quartile for reliability performance. ATC lines operating at 115 and 138 kV were in the top decile and ATC 69-kV transmission lines were top quartile for reliability performance. As evidenced by reliability data, our lines are generally performing well. However, significant investment will be required to maintain reliability as a number of facilities have been identified as nearing end of life or having components at end of life.

ATC operates a fleet of 175 transformers, and 40 percent of these were installed prior to 1975. We have not experienced a high failure rate of these aging transformers but our Assessment anticipates an investment to maintain reliability and manage risk.

Our protective relay systems are critical to the safe and reliable operation of the transmission system. We plan to continue to modernize our relay systems to improve operational information, minimize inadvertent operation, and increase the speed of restoration when an outage occurs.

ATC has a fleet of 1,850 circuit breakers. Of these, 1,100 use sulfur hexafluoride (SF<sub>6</sub>) as an arc quenching and insulating medium. The remaining circuit breakers are oil circuit breakers. Asset renewal, as applied to circuit breakers will target units that have specific reliability problems and SF<sub>6</sub> circuit breakers that have environmental issues.

Our asset renewal plans for the 10-year horizon have an estimated cost of \$750 million. Please note that this dollar figure includes both asset renewal and protection projects. Also refer to the [2009 Asset Renewal Financial Table](#) for costs of specific asset renewal projects outlined in this Assessment.

## **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 to maintain public and worker safety and reliability performance. ATC Operations and Asset Management personnel monitor the reliability of all our lines. Aerial surveys are performed to improve the facility information



# 10-Year Assessment

An annual report summarizing proposed additions and expansions to the transmission system to ensure electric system reliability.

2009

October 2009 10-Year Assessment  
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and to confirm ratings capability. The inspection, reliability performance and aerial survey programs are the initial drivers for considering asset renewal upgrades to a facility.

Once a line shows condition or operational history indicating it may not perform the required function in a sustainable manner, discussions with Planning begin to determine what system reliability needs may exist for this line or geographic area. The line is analyzed for structural- and clearance-related issues to complete the list of possible drivers. If Planning and Asset Management both have drivers for a project, a primary need driver is agreed upon and the project progresses as a network (Planning driven) or asset renewal (Asset Management driven) project. Asset renewal transmission line project scopes will vary from complete rebuilds to replacements of problematic elements (poles, cross arms, insulators). The extent of renewal driven work is determined by line criticality and customer impact. When a decision is made, net present value (NPV) analysis may be used to evaluate various options and determine the least cost means of maintaining the required 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)	.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 and are included in the ten year plan. 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.

Asset renewal investment is anticipated for the transmission line facilities identified in



Table AR-1. Scopes described may be modified as the scope development is refined. Our plan to maintain safe transmission line facilities and improve reliability performance over the 10 year horizon is approximately \$400 million.

### **Transformer Asset Renewal**

The intent of the transformer asset renewal program is to make an assessment for each transformer in the fleet based upon condition, criticality and the probability of failure. This assessment is used to determine a spare or renewal strategy such as a site spare, system spare, or renewal candidate (Please refer to Figure AR-1).

- Healthy units with high criticality and high probabilities of failure based upon age may warrant site spares or a system spare in the area to minimize transport times.
- Units with poor health, high criticality and high or low probability of failure based upon age are candidates for renewal.
- Healthy units with low criticality and a low or high probability of failure based upon age will be backed up with a system spare.
- Units with poor health and low criticality will be backed up with system spares regardless of the probability of failure based upon age.

Condition is monitored as part of the asset maintenance program through off-line electrical tests, on-line oil tests, infrared inspection, vibration analysis and acoustic condition assessments.

The criticality of a particular transformer to the network is based upon a series of planning studies that look at the severity of the contingencies following the failure of a unit. Given the long lead and transportation times for auto transformers of the size used by ATC, these double-contingency studies provide guidance for the operation impact.

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. Assuming a level aggregate probability of failure equates to the existing level of reliability, the expected investment will be approximately two 138/69-kV transformers per year in the 10-year horizon. For 345/138-kV transformers, the expected investment will be one transformer every two years. The cost estimate for this program over the 10 year horizon is \$140 million. Actual replacement will be based on the results of our condition monitoring program and assessments of criticality. Please refer to Table AR-2 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. We are able to improve relay performance with microprocessor based relays by eliminating over-reaching while maintaining adequate back up protection. The improved performance of the microprocessor relays allows us to increase system reliability and security via the expanded use of carrier and fiber optic communication. The newer technology has better factory support and we are able to minimize the risk of relay failure due to availability of spare parts



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and minimize repair times due to lack of factory support or software upgrades. Additionally, we are able to replace relay systems that limit line ratings.

Microprocessor based relays offer valuable information for operations. System operations is able to direct field resources to the problem area of a line based upon fault location information provided by the microprocessor based relays. Additionally, fault location information is used with the lightning detection network to correlate lightning strikes with line outages. This enables us to direct patrols to sites of potentially damaging lightning strikes and detect problems that occur during lightning storms that are not lightning related.

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

Approximately 12,000 relays protect our network. The asset renewal program is prioritized by replacing the least reliable relays by type and relays at end-of-life and relay locations with schemes that have a higher inadvertent operation history. This includes single relays that require remote back-up, electromechanical relays that do not provide fault location, do not self alarm and have a higher tendency of inadvertent operation than microprocessor relays. In addition, obsolete schemes without spare parts availability and/or no technical support from vendor are targeted. Other asset renewal candidates are relay schemes that limit loading or use only directional over current elements that increase coordination complexity and raise the likelihood of inadvertent operation.

ATC plans to spend approximately \$130 million for relay renewal in the 10 year horizon. This equates to about 40 relay panels per year. Please refer to Figure AR-2 for details.

### **Circuit Breaker Asset Renewal**

Circuit breakers are essential to the reliability and safety of the network. We own and operate over 1,850 gas and oil circuit breakers. The goal of the circuit breaker renewal program is to improve reliability and environmental performance by reducing maintenance outage requirements (duration, # of outages) thereby increasing availability, reducing SF<sub>6</sub> emissions, and increasing safety by reducing the number of unplanned eventful outages. Our plan to maintain the safety and improve the environmental performance of our circuit breaker fleet over the 10 year horizon is approximately \$80 million. Please refer to Table AR-3 for details.

ATC 2009 10-Year Assessment  
Summary of Asset Renewal Capital Expenditures (2009-2018)  
10-Year Assessment Asset Renewal Project Detail

FP	10-Year Assessment Asset Renewal Project Description	Sum of Future Expenditures 2009-2018
F1444	Rebuild Boscobel-Gran Grae 69-kV line Y-40	\$4,427,807
F1602	Rebuild Dane-Dam Heights 69-kV line Y-8	\$5,818,223
F1656	Rebuild Stage Coach-Spring Green 69-kV line Y-62	\$5,550,035
F1699	Rebuild Plainfield-Chaffee Creek 69-kV line Y-90	\$4,087,436
F1715	Rebuild Forward-Rock Branch 69-kV line Y-135	\$4,239,108
F1732	Rebuild Auburndale-Sigel 69-kV line Y-107	\$1,658,478
F2024	Replace Ellinwood transformer T2	\$4,889,534
F2037	Improve clearances, install arresters on portions of line, replace select components on Roberts-9 Mile 69-kV line 6952	\$18,469,973
F2252	Rebuild Rocky Run-Arpin 345-kV line W-8	\$21,835,450
F2340	Replace Council Creek transformer T31	\$3,211,169
F2343	Replace North Fond du Lac transformers T31 and T32	\$2,764,913
F2345	Rebuild Mauston-Hilltop 69-kV line Y-89	\$536,380
F2346	Rebuild Miner-Hillman 69-kV line Y-130	\$1,120,709
F2383	Replace shield wire on Stiles-Pulliam 138-kV lines KK64441-64451	\$5,573,752
F2386	Rebuild Wautoma-Berlin 69-kV line Y-95	\$2,122,857
F2389	Rebuild Pardeeville Tap-North Randolph/Rio 69-kV line Y-64	\$2,193,027
F2410	Rebuild Deer Trail-Whitcomb 69-kV line Y-86	\$3,063,639
F2419	Replace Aurora transformer T3	\$2,149,695
F2604	Replace Bluemound transformer T3	\$4,921,925
F2684	Rebuild and reconductor Sauk Trail-20 <sup>th</sup> Street 138-kV line X-37	\$2,768,169
F2761	Remove the wishbone arms and install HLP insulators on Venture-Janesville 138-kV line X-24	\$7,929
F2765	Re-insulate South Fond du Lac-Edgewater 345-kV line W1	\$3,042,882
F2786	Re-insulate top phase and add additional arresters on Chandler-Forsyth 69-kV line (Chandler line)	\$733,028
F2799	Replace Bluemound transformer T1	\$4,949,504
F2801	Rebuild Sawyer-Dykesville 69-kV line DYKY21	\$11,143,982
<b>2009 TYA Asset Renewal Projects Reported</b>		<b>\$121.3M</b>
<b>Plus other Asset Renewal projects (includes Protection)</b>		<b>\$628.7M</b>
<b>Total 10-Year Asset Renewal Capital Expenditures</b>		<b>\$750M</b>

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

<b>System Additions</b>	<b>Projected In-Service Year</b>	<b>Planning Zone</b>	<b>Need Category</b>	<b>Cost Estimate - Refer to Funding Project and Sum of Total (2009-2018) in Asset Renewal Financial Table</b>
Rebuild Plainfield-Chaffee Creek 69-kV line Y-90	2010	1	Improve condition and increase reliability performance of existing line	F1699
Rebuild Auburndale-Sigel 69-kV line Y-107	2010	1	Improve condition and increase reliability performance of existing line	F1732
Rebuild Rocky Run-Arpin 345-kV line W-8	2010	1	Improve condition and increase reliability performance of existing line	F2252
Rebuild Deer Trail-Whitcomb 69-kV line Y-86	2010	1	Improve condition and increase reliability performance of existing line	F2410
Rebuild Mauston-Hilltop 69-kV line Y-89	2010	1	Improve condition and increase reliability performance of existing line	F2345
Rebuild Wautoma-Berlin 69-kV line Y-95	2011	1	Improve condition and increase reliability performance of existing line	F2386
Re-insulate Winneconne-Berlin 69-kV line Y-80	2012	1	Improve condition and increase reliability performance of existing line	TBD
Re-insulate Harrison-Iola 69-kV line Y56 CWEC Iola Tap	2012	1	Improve condition and increase reliability performance of existing line.	TBD
Rebuild North Point-Rocky Run 115-kV line T-20	2016	1	Improve condition and increase reliability performance of existing line.	TBD

*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>	<b>Cost Estimate - Refer to Funding Project and Sum of Total (2009-2018) in Asset Renewal Financial Table</b>
Rebuild Wautoma-Portage 69-kV line Y17	2017	1	Improve condition and increase reliability performance of existing line	TBD
Planning to reconfigure with Fairwater/Ripon to North Randolph, 69-kV line Y26	2018	1	Improve condition and increase reliability performance of existing line	TBD
Rebuild Whiting Avenue-Plover 115-kV line B-106	2019	1	Improve condition and increase reliability performance of existing line	TBD
Replace select poles on Coyne-Saratoga 115-kV line T-72	2020	1	Improve condition and increase reliability performance of existing line	TBD
Re-insulate top phase and add additional arresters on Chandler-Forsyth 69-kV line (Chandler line)	2010	2	Improve condition and increase reliability performance of existing line	F2786
Improve clearances, install arresters on portions of line, replace select components on Roberts-9 Mile 69-kV line 6952	2011	2	Improve condition and increase reliability performance of existing line	F2037
Re-insulate and improve grounding on Munising-Forsyth 138-kV line (Munising 138 line)	2012	2	Improve condition and increase reliability performance of existing line	TBD
Reinsulate, add arresters, replace select poles on Munising-Gwinn 69-kV line (Autrain line)	2013	2	Improve condition and increase reliability performance of existing line	TBD
Reinsulate, add arresters, replace select poles on Blaney Park-Munising 69-kV line (Inland line)	2014	2	Improve condition and increase reliability performance of existing line	TBD

**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>	<b>Cost Estimate - Refer to Funding Project and Sum of Total (2009-2018) in Asset Renewal Financial Table</b>
Re-insulate Portage-9 Mile 69-kV lines 6901/6902	2014	2	Improve condition and increase reliability performance of existing line	TBD
Re-insulate and install arresters on KI Sawyer-Gwinn 69-kV line (Sawyer line)	2014	2	Improve condition and increase reliability performance of existing line	TBD
Install new cross arms on Atlantic-M38 69-kV line (Atlantic 69 line)	2014	2	Improve condition and increase reliability performance of existing line	TBD
Replace select poles and cross arms on Rexton-Hiawatha 69-kV line ESE_6908	2015	2	Improve condition and increase reliability performance of existing line	TBD
Replace underground cable on Magazine-Nine Mile/Three Mile 69-kV line ESE_6903	2015	2	Improve condition and increase reliability performance of existing line	TBD
Replace select poles and re-insulate Conover-Mass 69-kV line 6530	2018	2	Improve condition and increase reliability performance of existing line	TBD
Replace select poles and re-insulate Powers-Chalk Hill 69-kV line 6910	2018	2	Improve condition and increase reliability performance of existing line	TBD
Replace one circuit with new 3C XPLE submarine cable on McGulpin-Straits 138-kV line 9901	2020	2	Improve condition and increase reliability performance of existing line	TBD
Replace one circuit with new 3C XPLE submarine cable on McGulpin-Straits 138-kV line 9903	2020	2	Improve condition and increase reliability performance of existing line	TBD



**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>	<b>Cost Estimate - Refer to Funding Project and Sum of Total (2009-2018) in Asset Renewal Financial Table</b>
Remove the wishbone arms and install HLP insulators on Venture-Janesville 138-kV line X-24	2009	3	Improve condition and increase reliability performance of existing line	F2761
Rebuild Miner-Hillman 69-kV line Y-130	2010	3	Improve condition and increase reliability performance of existing line	F2346
Rebuild Forward-Rock Branch 69-kV line Y-135	2010	3	Improve condition and increase reliability performance of existing line	F1715
Rebuild Stage Coach-Spring Green 69-kV line Y-62	2010	3	Improve condition and increase reliability performance of existing line	F1656
Rebuild Dane-Dam Heights 69-kV line Y-8	2010	3	Improve condition and increase reliability performance of existing line	F1602
Rebuild Boscobel-Gran Grae 69-kV line Y-40	2010	3	Improve condition and increase reliability performance of existing line	F1444
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	TBD
Rebuild Pardeeville Tap-North Randolph/Rio 69-kV line Y-64	2011	3	Improve condition and increase reliability performance of existing line	F2389
Replace underground cable on East Towne-Sycamore 69-kV line 6987	2012	3	Improve condition and increase reliability performance of existing line.	TBD

**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>	<b>Cost Estimate - Refer to Funding Project and Sum of Total (2009-2018) in Asset Renewal Financial Table</b>
Replace underground cable on East Towne to Sycamore 69-kV line 6988	2012	3	Improve condition and increase reliability performance of existing line.	TBD
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	TBD
Rebuild Portage-Dam Heights 69-kV line Y16	2013	3	Improve condition and increase reliability performance of existing line.	TBD
Rebuild Rubicon-Concord 138-kV line 9061	2013	3	Improve condition and increase reliability performance of existing line	TBD
Rebuild Eden-Hillman 69-kV line Y105	2018	3	Improve condition and increase reliability performance of existing line.	TBD
Replace underground cable on Stagecoach-West Middleton 69-kV line 6927	2019	3	Improve condition and increase reliability performance of existing line	TBD
Rebuild and reconductor Sauk Trail-20 <sup>th</sup> Street 138-kV line X-37	2009	4	Improve condition and increase reliability performance of existing line.	F2684
Re-insulate South Fond du Lac-Edgewater 345-kV line W1	2010	4	Improve condition and increase reliability performance of existing line	F2765
Replace shield wire on Stiles-Pulliam 138-kV lines KK64441-64451	2011	4	Improve condition and increase reliability performance of existing line	F2383

*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>	<b>Cost Estimate - Refer to Funding Project and Sum of Total (2009-2018) in Asset Renewal Financial Table</b>
Rebuild Mears-Woodenshoe 138-kV line A-79	2012	4	Improve condition and increase reliability performance of existing line	TBD
Rebuild Sunset Point-Mears 138-kV line MCRG21	2012	4	Improve condition and increase reliability performance of existing line	TBD
Rebuild Highway V-Oak Street 69-kV line Z-26	2013	4	Improve condition and increase reliability performance of existing line	TBD
Rebuild Manrap-Wesmark 69-kV line R-44	2013	4	Improve condition and increase reliability performance of existing line	TBD
Rebuild Finger Road-Highway V 69-kV line U-47	2014	4	Improve condition and increase reliability performance of existing line	TBD
Rebuild Sawyer-Dykesville 69-kV line DYKY21	2015	4	Improve condition and increase reliability performance of existing line	F2801
Replace the submarine cable on First Avenue-Redwood 69-kV line T-46	2015	4	Improve condition and increase reliability performance of existing line	TBD
Rebuild Neevin-Butte Des Morts 138-kV line 43021	2015	4	Improve condition and increase reliability performance of existing line	TBD
Rebuild Pioneer-Sobieski 69-kV line E-83 Tap	2016	4	Improve condition and increase reliability performance of existing line	TBD

*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>	<b>Cost Estimate - Refer to Funding Project and Sum of Total (2009-2018) in Asset Renewal Financial Table</b>
Rebuild Sobieski-Bayport 69-kV line T-98	2016	4	Improve condition and increase reliability performance of existing line	TBD
Rebuild Danz-Finger Road 69-kV line L-64	2016	4	Improve condition and increase reliability performance of existing line	TBD
Rebuild Woodenshoe-Neevin 138-kV line 80952	2016	4	Improve condition and increase reliability performance of existing line	TBD
Replace underground cable on University-Danz Avenue 69-kV line O-15	2017	4	Improve condition and increase reliability performance of existing line	TBD
Rebuild Butte des Morts-North Appleton 138-kV line 6853	2017	4	Improve condition and increase reliability performance of existing line	TBD
Rebuild Custer-New Holstein 69-kV line P-68	2019	4	Improve condition and increase reliability performance of existing line	TBD
Rebuild Goodman-Caldron Falls 69-kV line J-88	2019	4	Improve condition and increase reliability performance of existing line	TBD
Replace select poles on Howard-Pulliam 138-kV line D-82	2019	4	Improve condition and increase reliability performance of existing line	TBD
Replace underground cable on Erdman-Lodestar 138-kV line X-48	2019	4	Improve condition and increase reliability performance of existing line	TBD

*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>	<b>Cost Estimate - Refer to Funding Project and Sum of Total (2009-2018) in Asset Renewal Financial Table</b>
Replace underground cable on Edgewater-Erdman 69-kV line Y-31	2021	4	Improve condition and increase reliability performance of existing line	TBD
Shield wire replacement Norwich-43 <sup>rd</sup> St Terminal 138-kV line NWHG61	2012	5	Improve condition and increase reliability performance of existing line	TBD
Re-insulate Racine-Somers 138-kV line 1645	2012	5	Improve condition and increase reliability performance of existing line	TBD
Re-insulate Racine-Kenosha 138-kV line 1651	2012	5	Improve condition and increase reliability performance of existing line	TBD
Replace shield wire on Granville-Tosa 138-kV line 3452	2013	5	Improve condition and increase reliability performance of existing line	TBD
Replace shield wire on Butler-Bluemound 138-kV line 5061	2013	5	Improve condition and increase reliability performance of existing line	TBD
Replace shield wire on Tosa-Bluemound 138-kV line 5041	2013	5	Improve condition and increase reliability performance of existing line	TBD
Rebuild St. Martins-Edgewood 138-kV line 3013	2014	5	Improve condition and increase reliability performance of existing line	TBD
Rebuild and add breaker on Edgewood-Mukwonago 138-kV line 671K61	2014	5	Improve condition and increase reliability performance of existing line	TBD

*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>	<b>Cost Estimate - Refer to Funding Project and Sum of Total (2009-2018) in Asset Renewal Financial Table</b>
Rebuild Hartford-St. Lawrence 138-kV line 8031	2014	5	Improve condition and increase reliability performance of existing line	TBD
Rebuild Cooney-Concord 138-kV line 9042	2014	5	Improve condition and increase reliability performance of existing line	TBD
Rebuild Summit-Waukesha 138-kV line 7021	2015	5	Improve condition and increase reliability performance of existing line	TBD
Rebuild Summit-Merrill Hills 138-kV line 3551	2017	5	Improve condition and increase reliability performance of existing line	TBD
Rebuild Albers-Paris 138-kV line 3124	2018	5	Improve condition and increase reliability performance of existing line	TBD

Table AR-2  
Asset Renewal Transformer Replacements

System Upgrade	Projected In-Service Year	Voltage	Planning Zone	Need Category	Cost Estimate – Refer to <i>Funding Project</i> and Sum of Total (2009-2018) in Asset Renewal Financial Table
Council Creek T31	2010	138/69-kV	1	Improve condition, reliability	F2340
North Fond du Lac T31 and T32	2010	138/69-kV	4	Improve condition, reliability	F2343
Ellinwood T2	2011	138/69-kV	4	Improve condition, reliability	F2024
Aurora T3	2011	138/69-kV	1	Improve condition, reliability	F2419
Bluemound T3	2011	230/138-kV	5	Improve condition, reliability	F2604
Bluemound T1	2012	230/138-kV	5	Improve condition, reliability	F2799
Edgewater T31 and T32	2012	138/69-kV	4	Improve condition, reliability	TBD
North Appleton T3	2012	345/138-kV	4	Improve condition, reliability	TBD
Replace two transformers	2013	138/69-kV	various	Improve condition, reliability	TBD
Replace two transformers	2014	138/69-kV	various	Improve condition, reliability	TBD
Replace one transformer	2014	345/138-kV	various	Improve condition, reliability	TBD
Replace two transformers	2015	138/69-kV	various	Improve condition, reliability	TBD
Replace two transformers	2016	138/69-kV	various	Improve condition, reliability	TBD
Replace one transformer	2016	345/138-kV	various	Improve condition, reliability	TBD
Replace two transformers	2017	138/69-kV	various	Improve condition, reliability	TBD
Replace two transformers	2018	138/69-kV	various	Improve condition, reliability	TBD
Replace one transformer	2018	345/138-kV	various	Improve condition, reliability	TBD
Replace two transformers	2019	138/69-kV	various	Improve condition, reliability	TBD
Replace two transformers	2020	138/69-kV	various	Improve condition, reliability	TBD
Replace one transformer	2020	345/138-kV	various	Improve condition, reliability	TBD

**Table AR-3**  
**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>	<b>Cost Estimate - Refer to Funding Project and Sum of Total (2009-2018) in Asset Renewal Financial Table</b>
Circuit breaker replacements	2010	Various	CT Deficiency, Control scheme incompatibility (2 units) 69 kV	Various
Circuit breaker replacements	2010	Various	End of life, parts obsolescence (1 unit) 69 kV	Various
Circuit breaker replacements	2010	Various	Mechanism design issues (2 units) 69 kV	Various
Circuit breaker replacements	2010	Various	Type S bushings (1 unit) 69 kV	Various
Circuit breaker replacements	2010	Various	Type U bushings (29 units) 69 kV	Various
Circuit breaker replacements	2010	Various	End of life, part obsolescence (4 units) 138 kV	Various
Circuit breaker replacements	2010	Various	Type U bushings (17 units) 138 kV	Various
Circuit breaker replacements	2010	Various	CT deficiency, control scheme incompatibility (1 unit) 230 kV	Various
Circuit breaker replacements	2010	Various	Type U bushing (9 units) 230 kV	Various



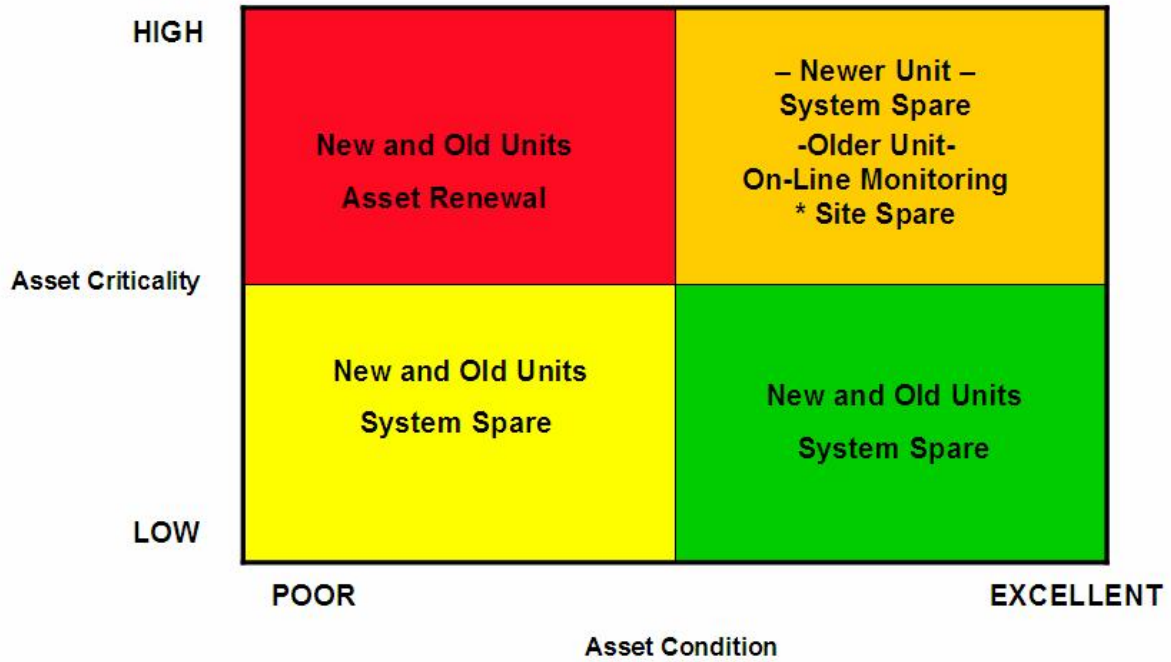
**Table AR-3**  
**Transmission System Additions – Asset Renewal Circuit Breakers (continued)**

<b>System Additions</b>	<b>Projected In-Service Year</b>	<b>Planning Zone</b>	<b>Need Category</b>	<b>Cost Estimate - Refer to Funding Project and Sum of Total (2009-2018) in Asset Renewal Financial Table</b>
Circuit breaker replacements	2010	Various	EPA SF6 emission reduction (2 units) 345 kV	Various
Circuit breaker replacements	2011	Various	Mechanism design issues (4 units) 69 kV	Various
Circuit breaker replacements	2011	Various	Type U bushings (26 units) 69 kV	Various
Circuit breaker replacements	2011	Various	End of life, parts obsolescence (1 unit) 138 kV	Various
Circuit breaker replacements	2011	Various	Type U bushings (18 units) 138 kV	Various
Circuit breaker replacements	2011	Various	CT deficiency, control scheme incompatibility (2 units) 230 kV	Various
Circuit breaker replacements	2011	Various	Over duty rating (2 units) 230 kV	Various
Circuit breaker replacements	2012	Various	End of life, parts obsolescence (2 units) 69 kV	TBD
Circuit breaker replacements	2012	Various	Type U bushings (40 units) 69 kV	TBD

**Table AR-3**  
**Transmission System Additions – Asset Renewal Circuit Breakers (continued)**

<b>System Additions</b>	<b>Projected In-Service Year</b>	<b>Planning Zone</b>	<b>Need Category</b>	<b>Cost Estimate - Refer to Funding Project and Sum of Total (2009-2018) in Asset Renewal Financial Table</b>
Circuit breaker replacements	2012	Various	Type U bushings (8 units) 138 kV	TBD
Circuit breaker replacements	2012-2020	Various	End of life, parts obsolescence (12 units) 69 kV	TBD
Circuit breaker replacements	2012-2020	Various	Mechanism design issues (64 units) 69 kV	TBD
Circuit breaker replacements	2012-2020	Various	End of life, parts obsolescence (13 units) 138 kV	TBD
Circuit breaker replacements	2012-2020	Various	Over duty rating (4 units) 138 kV	TBD
Circuit breaker replacements	2012-2020	Various	Bushing flange oil leak (27 units) 345 kV	TBD
Circuit breaker replacements	2012-2020	Various	End of life, parts obsolescence (8 units) 345 kV	TBD
Circuit breaker replacements	2012-2020	Various	EPA SF6 emission reduction (8 units) 345 kV	TBD

Figure AR-1  
Transformer Asset Renewal Methodology



\* Under Development

*Figure AR-2*  
*Relay Renewal Plans by Zone*

