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# 2020 10-Year Assessment Preliminary Solutions – Asset Renewal

Stakeholder and Customer Presentation

May 12, 2020

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# Asset Renewal Program Objectives

- Safety – public and worker
- Minimize total life cycle cost (NPV from customer cost/rate perspective)
- Compliance
- Manage risk
- Reliability performance improvements
- Environmental performance improvements
- Coordination with Stakeholders

# Asset Renewal Program Criteria

## •Condition

- O&M Cost savings
- Health indexing
- Performance and projected deterioration

## •Obsolescence

- Manufacturer and Field technical support
- Spare parts availability
- Application

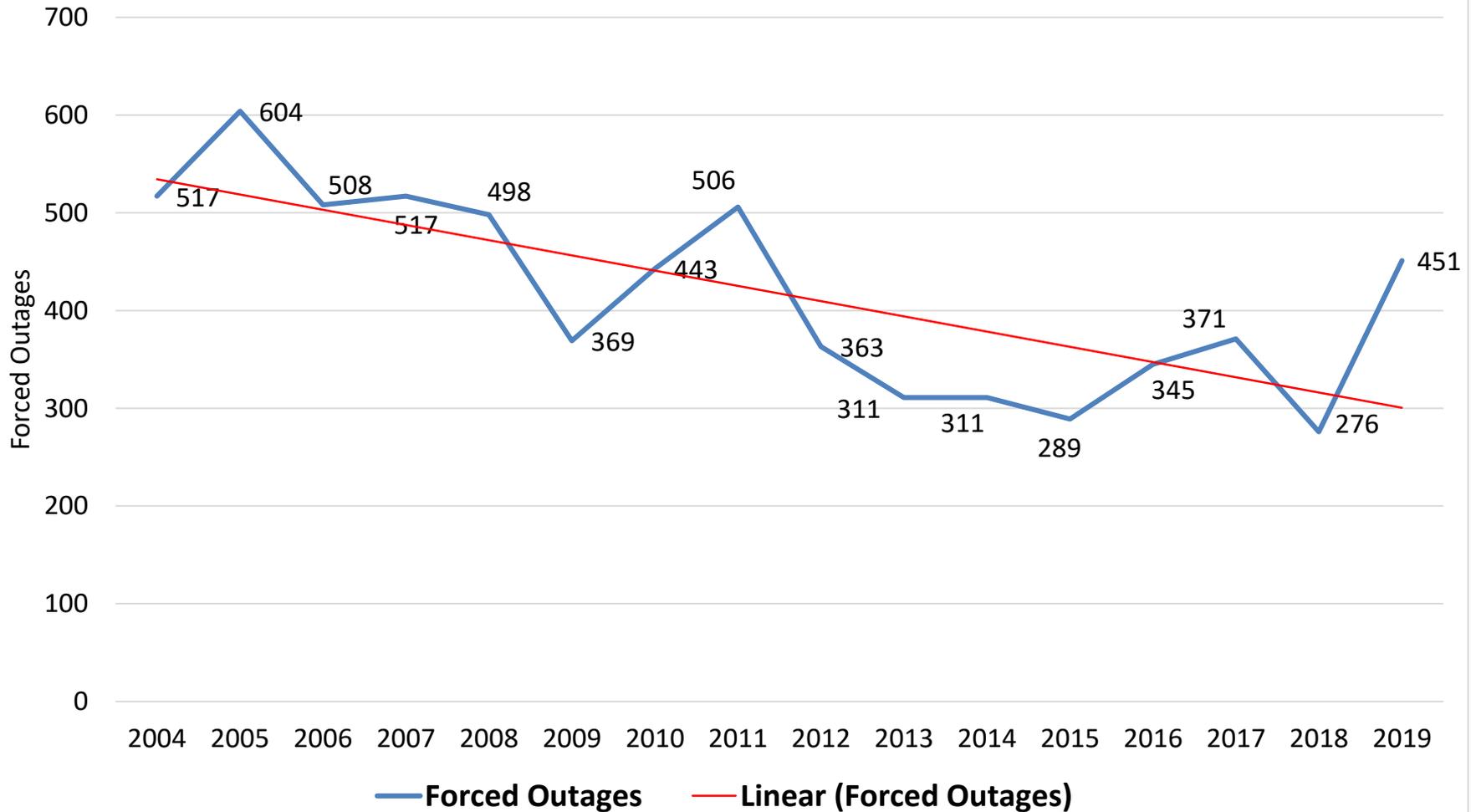
## •Reliability

- Industry failure rates
- Known design issues
- Single element failure and testing exposure
- Outage reduction
- Poor lightning performance
- Relay system misoperations, security, dependability
- Human performance issues

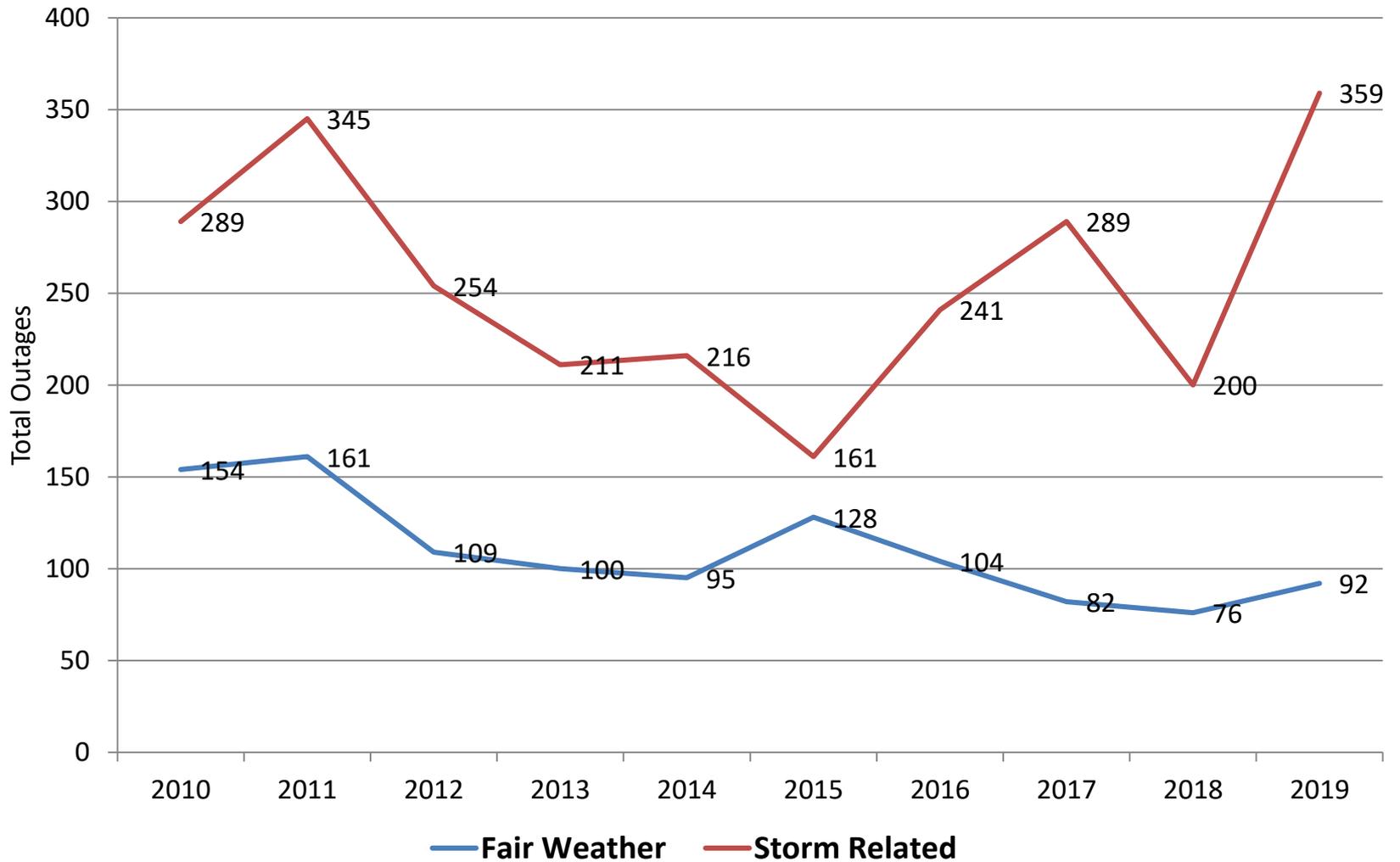
- Compliance,
- Safety,
- Environmental

- Ratings methodology (FAC-008)
- NESC clearance from grade and other structures
- NESC working clearances in control houses
- NESC structure strength
- Environmental impacts
- Operational risk

## 2004- 2019 Forced Outages

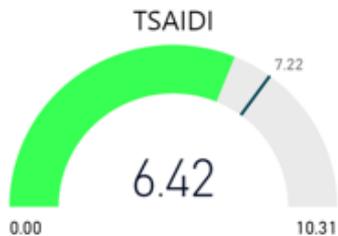


## 2010 - 2019 Fair Weather/Storm Outage Comparison



## Reliability Performance: January - December 2019

### Customer Impact

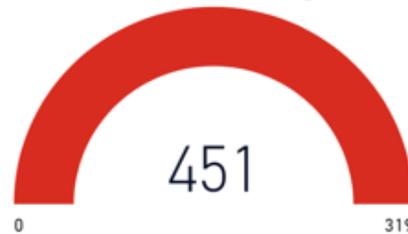


The 6.42 minute T-SAIDI YTD is .080 less than our YE five year average of 7.22 minutes.



The 0.080 T-SAIFI YTD has exceeded our YE five year average of 0.057.

### Total Forced Outages



The 451 total Forced Outages are 132 greater than our five year average of 319.

### 2019 Top impacting outages:

Weather and Lightning have accounted for 314 (70%) of the 451 forced outages in 2019.

The December 30th ice and snow storm accounted for 1.29 (20%) of the 6.42 minute T-SAIDI in 2019.

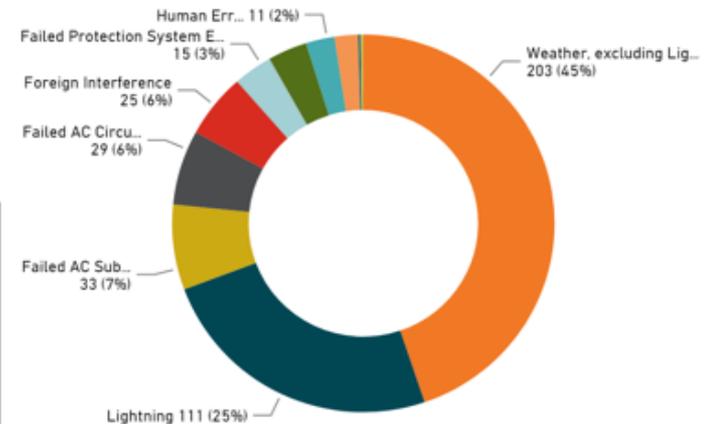
The Blount transformer failure accounted for 1.22 minutes (19%) of the 6.42 minute T-SAIDI in 2019.

An outage on a radial circuit in March accounted for .88 minutes (14%) of the 6.42 minute TSAIDI in 2019.

The 0.080 TSAIFI is mostly due to various weather related outages.

The customer impact data (TSAIDI & TSAIFI) from the July 19-20 storm are excluded from these metrics.

### Total Circuit Outages by Cause Code



# Asset Renewal – Preliminary 10 Year Forecast Substation Equipment Quantities

Location	2024	2025	2026	2027	2028	2029	2030	Grand Total	In Service Qty	Average Replaced Per Year	Average % Replaced Per Year
Arresters	32	6		12		18		68	7150	17	0.24%
Batteries and Chargers	35	18	21	12	24	18	14	142	330	20	6.06%
Breakers and Switchers	32	16	5	27	9	33	21	143	2530	20	0.79%
Capacitor Banks		1	1	1	3	6	10	22	219	2	0.91%
Control Houses	6	4	2	1	3	4	4	24	261	3	1.03%
Instrument Transformers	46	10	18	56	46	122	50	348	5609	50	0.89%
Power Transformers	3	5	3	3	4	3	3	24	198	4	1.77%
Reactors	5				3	1		9	440	3	0.68%
Relays	347	221	253	212	242	462	362	2099	6811	300	4.40%
SCADA	41	40	29	36	59	59	62	326	3099	47	1.52%
Switches	65	53	65	52	21	76	44	376	5694	54	0.95%
<b>Grand Total</b>	<b>612</b>	<b>374</b>	<b>397</b>	<b>412</b>	<b>414</b>	<b>802</b>	<b>570</b>	<b>3581</b>			

# Asset Renewal Program

## Asset Renewal Estimate - 10 Year Forecast (\$000's)

### In-Service Dates

	2024	2025	2026	2027	2028	2029	2030	Grand Total
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## Asset Renewal Estimate - 10 Year Forecast (\$000's)

### In-Service Dates

	2024	2025	2026	2027	2028	2029	2030	Grand Total
<b>Arresters</b>	\$280	\$50	\$0	\$110	\$0	\$170	\$0	\$610
<b>Batteries and Chargers</b>	\$3,400	\$1,800	\$2,170	\$1,280	\$2,630	\$2,030	\$1,630	\$14,940
<b>Breakers and Switchers</b>	\$17,700	\$3,220	\$1,030	\$5,880	\$1,860	\$7,970	\$4,630	\$42,290
<b>Capacitor Banks</b>	\$0	\$420	\$430	\$440	\$1,370	\$2,820	\$3,390	\$8,870
<b>Control Houses</b>	\$15,996	\$9,270	\$4,780	\$2,460	\$7,600	\$10,440	\$10,750	\$61,296
<b>Instrument Transformers</b>	\$1,380	\$270	\$530	\$1,680	\$1,480	\$3,610	\$1,670	\$10,620
<b>Physical Security</b>	\$20,330	\$2,220	\$2,500	\$3,320	\$6,030	\$4,640	\$2,090	\$41,130
<b>Power Transformers</b>	\$16,500	\$13,550	\$11,850	\$12,260	\$18,360	\$13,010	\$15,720	\$101,250
<b>Reactors</b>	\$250	\$0	\$0	\$0	\$420	\$140	\$0	\$810
<b>Relays</b>	\$20,920	\$15,240	\$17,490	\$16,530	\$19,340	\$37,580	\$30,470	\$157,570
<b>SCADA</b>	\$4,900	\$5,170	\$4,510	\$5,310	\$6,890	\$9,910	\$8,420	\$45,110
<b>Switches</b>	\$6,500	\$2,810	\$3,550	\$2,980	\$1,230	\$4,620	\$2,750	\$24,440
<b>Substation</b>	<b>\$108,156</b>	<b>\$54,020</b>	<b>\$48,840</b>	<b>\$52,250</b>	<b>\$67,210</b>	<b>\$96,940</b>	<b>\$81,520</b>	<b>\$508,936</b>
<b>IT/OT Equipment</b>	\$9,000	\$4,640	\$4,780	\$3,690	\$3,800	\$3,910	\$4,030	\$33,850
<b>OPGW Asset Renewal</b>	\$0	\$0	\$0	\$3,690	\$0	\$0	\$2,690	\$6,380
<b>IT/OT/Fiber</b>	<b>\$9,000</b>	<b>\$4,640</b>	<b>\$4,780</b>	<b>\$7,380</b>	<b>\$3,800</b>	<b>\$3,910</b>	<b>\$6,720</b>	<b>\$40,230</b>
<b>Transmission Line</b>	<b>\$64,000</b>	<b>\$91,000</b>	<b>\$120,000</b>	<b>\$96,000</b>	<b>\$100,000</b>	<b>\$100,000</b>	<b>\$100,000</b>	<b>\$671,000</b>
<b>Grand Total</b>	<b>\$181,156</b>	<b>\$149,660</b>	<b>\$173,620</b>	<b>\$155,630</b>	<b>\$171,010</b>	<b>\$200,850</b>	<b>\$188,240</b>	<b>\$1,220,166</b>



# Projects by Station

2024 In Service Date

Location	Total (Thousands)
Amberg	\$97
Badger	\$1,506
Brick Church	\$1,376
Cardinal	\$5,542
Caroline	\$648
Cedarburg South	\$97
Cedarsauk / Saukville	\$914
Center	\$637
Clintonville	\$144
Colley Road	\$986
Combined Locks	\$31
Cooney	\$97
Cornell (WE)	\$1,582
Coyne / Grand Rapids (CWP)	\$712
Crivitz	\$3,255
Dane	\$300
Darlington	\$349
Dead River	\$4,847
Edgewater	\$97
Elkhart Lake	\$889
Forward Energy Center	\$97
Fox River Switchyard	\$194
Granville	\$28,000
Harbor	\$1,769

Location	Total (Thousands)
Haymarket Square	\$1,211
Hiawatha	\$97
Highway V	\$553
Hillman	\$1,376
Hodag	\$26
Janesville General	\$1,047
Kegonsa	\$97
Kewaunee	\$1,990
Kirkwood	\$7,571
Lakefront	\$97
Lancaster	\$4,000
Land O Lakes	\$97
Maplewood	\$144
McCue	\$921
Neevin	\$1,014
Nelson Dewey	\$6,200
North Appleton	\$5,722
North Fond du Lac	\$487
Ohmstead	\$97
Parkland	\$144
Plains	\$97
Portage	\$588
Portage St	\$97
Pulliam	\$97

Location	Total (Thousands)
Reiner Rd	\$961
Ripon	\$97
Rocky Run	\$2,102
Roosevelt Rd	\$923
Saratoga	\$5,777
Sheboygan Energy Center Switchyard	\$144
Sigel	\$97
South Sheboygan Falls	\$97
Spring Green	\$1,075
Stiles	\$97
Sunset Point	\$2,199
Tamarack	\$144
Tosa	\$144
Town Line Road	\$1,027
Trienda	\$2,140
Physical Security (small projects)	\$978
Venus	\$250
Verona	\$983
Walworth	\$203
Wells St	\$144
West Marinette	\$397
West Middleton	\$0
West Shawano	\$144
Zobel	\$97
<b>Grand Total</b>	<b>\$108,156</b>

Projects over \$3M will have separate MTEP IDs

# Granville Substation – Overview

- 345kV to 138kV transformation and distribution
- Located in Milwaukee
- Constructed circa 1968
- Important station functions
  - Network hub serving Milwaukee Metro area
  - Key network switching station connecting north with south
- 3x 345kV Lines
- 7x 138kV Lines
- Project Cost \$29M, 2024 In Service Date

# 345kV System



# Asset Renewals

- 345kV
  - 4 Oil Breakers
  - 7 Disconnect Switches
  - 3 Arresters
- 138kV
  - 7 Oil Breakers
  - 12 Arresters
- Building and Equipment
  - Control House
  - 21 Relay Panels (not including remote end replacements)
  - 2 RTU's
  - 3 Batteries, 5 Chargers
- All asset renewals are based on performance and reliability



# Breakers

## • 345kV

- 4 1970-vintage Westinghouse 3450-GW-25000 oil breakers
  - Breaker is in “obsolete” status per ABB, no longer supported for engineering or parts
  - Type “O” bushings are prone to leaks and have been problematic at this site
  - Large volumes (3,465 gallons) of oil per tank, three tanks, have tendency to leak due to their large physical size. No oil containment system for existing breakers.
  - Skill of the craft is diminishing for this asset type with only a few left on our system.



## • 138kV

- 7 1969 vintage Westinghouse 1380-GM-15000 oil breakers
  - Breaker is in “limited” status per ABB, minimal support for engineering or parts
  - Type “O” bushings are prone to leaks and have been problematic at this site
  - Gaskets and O-rings have a finite life, dresser fittings and control valves develop leaks over time, may prevent breaker from closing



# Relay Panels

- 21 relay panels
  - Replacing obsolete technology with modern standardized schemes delivers superior protection, performance, redundancy, alarming, remote fault investigation, root cause analysis and restoration
  - 46 electromechanical relays
    - Parts are no longer available
    - Limited craft labor for maintenance
    - Originally installed in 1969 and 1970
    - Relays can fail without alarming and awareness by Operations
  - 27 microprocessor and solid state relays
    - Microprocessor relays have a 25-year life of power supply and internal capacitors which can lead to failure without awareness by Operations



# Bus Design Upgrade for System Resiliency

- The extent of the 345kV asset renewal work makes this an opportune time to revisit bus configuration needed for the next 50 years
- Reliable constructability plan is key!

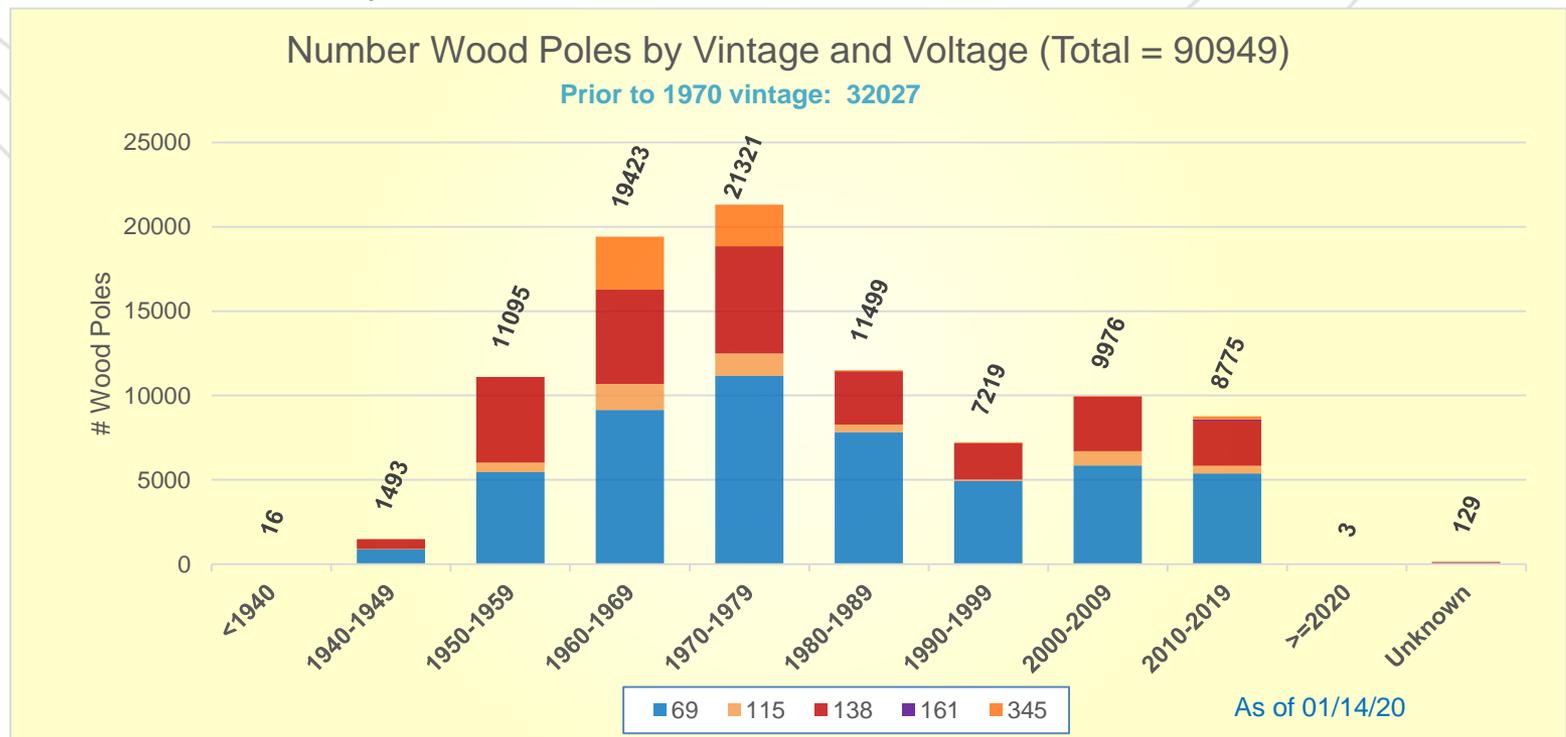


# Granville Substation Strategic Outlook

- Long Range (2024 and beyond) Strategic Outlook
  - High-priority local delivery role will continue
  - High-priority regional 345kV network facility for power transfer
  - Need for a robust bus configuration
  - Need to ensure station and equipment reliability

# Wood Pole Transmission Lines 20 year Outlook

- Objective is to manage condition and preserve reliability and safety as these assets reach end of life.
- Pre-1970 vintage wood poles are likely to be replaced in the next 20 - 25 years.



# Asset Management Renewal Needs - T-Line

- ATC will need to rebuild approximately 100 miles per year of original wood construction.

- Future needs include;

- Rebuild of steel poles and lattice structures with some of the oldest vintages from early 1900's

- Asset renewal of line insulators and more minor hardware to ensure adequate performance

## 20 Year Outlook - Estimated Wood Poles Installed on ATC System Prior 1970

Voltage Class	Mono Wood Poles	Multi - Wood Pole Structures *	Number of Wood Poles on Multi-Wood Pole Structures	Grand Total Number of Wood Poles	Grand Total Number of Wood Structures	Average Span Length (ft.)	Number of Miles per Year Next 20 Year
69	14075	653	1428	15503	14728	300	42
115	7	1036	2135	2142	1043	650	6
138	964	4924	10280	11244	5888	650	36
345	0	1528	3146	3146	1528	950	14
<b>Grand Total</b>	<b>15046</b>	<b>8143</b>	<b>16989</b>	<b>32035</b>	<b>23189</b>		<b>101</b>

\* Multi - Wood Pole Structure is comprised of two (H-Frame) or more wood pole structures. As of 1/20/2020.



# Asset Renewal T-line Needs Example (past vs. project complete)

- **Portage – Dam Heights 69kV Rebuild**
  - Project Background
    - Approximately 25 of miles of rebuild
  - Past Needs
    - Condition and Performance Issues
    - Replace 1910's vintage lattice structures
    - Outages: One of the most frequently outage ATC lines
      - On average about 4 outages per year
      - Need to update to avian friendly design
      - Improved lightning performance
  - Current status
    - Project went in-service Fall of 2017
    - No outages since the new design went into service



# Major T-Line Asset Renewal Projects

Project Name	Current Estimated ISD	Fiber	Sum of Planned Cost (Millions)	Sum of # Of Miles	Count of Line #
Academy - Columbus 69 kV (Y-21), Rebuild	2024	No	\$ 4	3	1
Darlington - Rock Branch 69 kV (Y-109), Rebuild	2025	Yes	\$ 17	14	1
Falcon - Darlington 138 kV (X-101), Rebuild	2026	Yes	\$ 12	6	1
Hillman - Falcon 138 kV (X-14), Rebuild	2026	Yes	\$ 17	12	1
Rock Branch - Dodgeville 69 kV (Y-35), Rebuild	2025	Yes	\$ 9	7	1
Lincoln Pumping Station - McKenna 69 kV (Y-145), Rebuild	2025	Yes	\$ 9	6	1
McKenna - Castle Rock 69 kV (Y-47), Rebuild	2025	Yes	\$ 11	9	1
Danz Ave - University Green Bay 69 kV (O-15), Partial Rebuild	2023	Yes	\$ 15	13	1
Edgewater - Erdman 69 kV (Y-31), Partial Rebuild	2022	Yes	\$ 5	1	1
Lodestar - Erdman 138 kV (X-48), Partial Rebuild	2022	No	\$ 13	1	1
Lincoln - 43rd Street Terminal 138 kV (5053), Rebuild	2024	No	\$ 31	2	1
Fitchburg - 138 kV Pumping Plant Addition	2023	No	\$ 1	n/a	
Reinsulate – Various Small Projects	Varies	No	\$ 5	n/a	
<b>Grand Total</b>			<b>\$ 149</b>	<b>75</b>	<b>11</b>

# Questions/Comments

- Questions/Comments

For more information, please contact

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