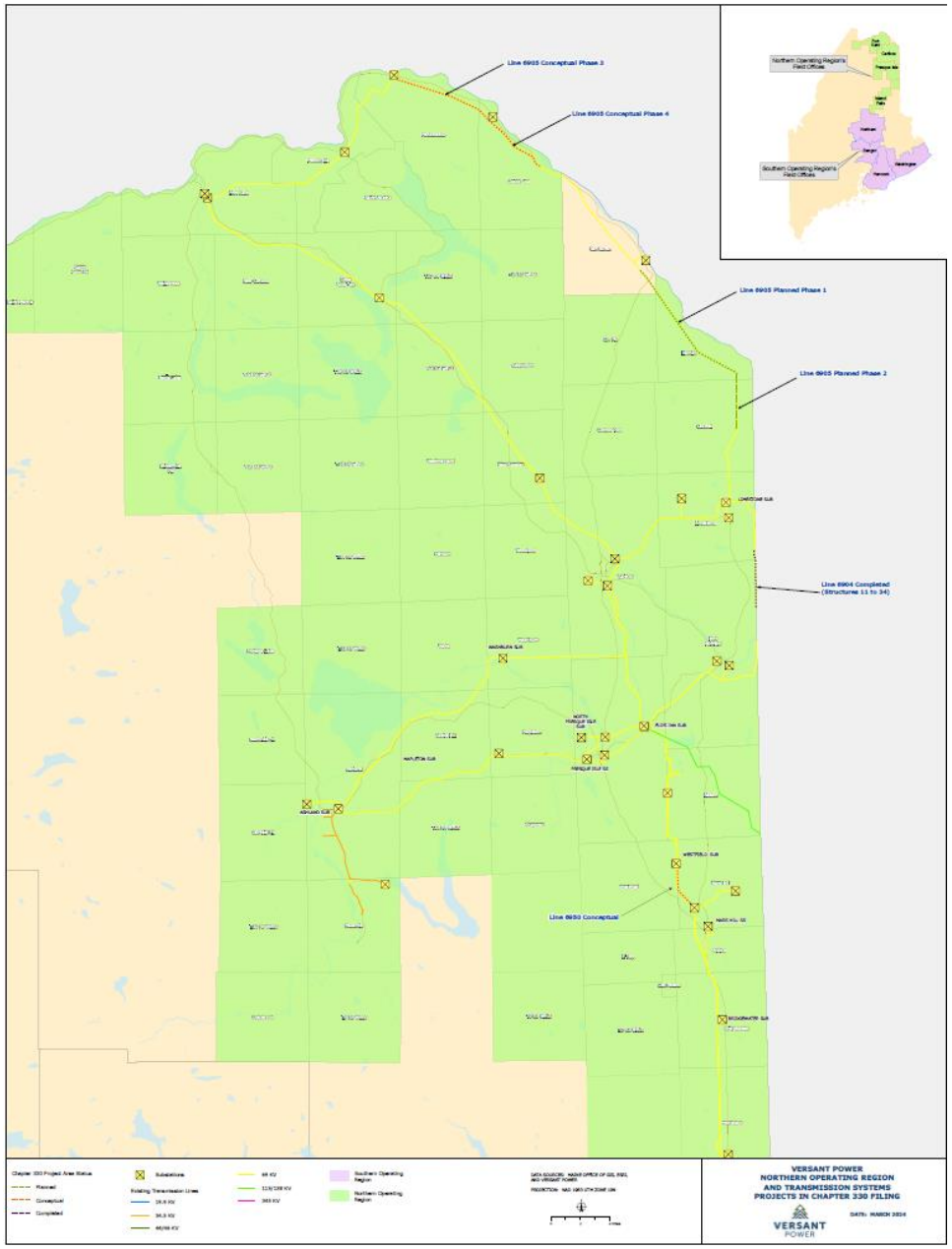
June 24, 2024

2024 Chapter 330 Report

Northern Maine Transmission System Chapter 330 Work Plan Map



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Transmission Planning Collaboration

- Adjusted based on customer feedback
- Intent: spread out remaining required MPD rebuild plan over 15-20 years (total rebuild program will span nearly 30 years)
- Final plan subject to enhanced inspection findings (visual, drone, resistograph, climbing, ultrasonic, thermal, etc...)
- Line and targeted line segment rebuilds will be necessary but targeted maintenance will be performed when it makes sense to delay complete line rebuilds

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Chapter 330 Plans & Adjustments

Summary of Past and Present Chapter 330 Reports												
	2021 Report			2022 Report			2023 Report			2024 Report		
Year	Project	Miles	Cost Range ($M)	Project	Miles	Cost Range ($M)	Project	Miles	Cost Range ($M)	Project	Miles	Cost Range ($M)
2021	6930 Dow to Maysville	2.5	1.2 - 1.3									
	1176 Str 42 - Border	7.2	6.0 - 6.5									
	1176 Str 3 to 41	4.8	3.3 - 3.8									
2022	69053 Van Buren Tap	1.2	0.8 - 1.2	69201 Mars Hill Tap	1.0	1.3 - 1.4						
	69201 Mars Hill Tap	1.6	2.2 - 2.6	6930 Dow to Maysville	0.5	0.2 - 0.3						
2023	69032 Loring Tap	1.6	0.9 - 1.1	6904 Str 11 to 34	3.5	1.8 - 2.0	6904 Str 11 to 34	3.5	1.8 - 2.0			
	6915 Flos to NPI	3.0	1.5 - 2.0	69032 Loring Tap	1.6	1.0 - 1.2						
2024	6950 Westfield to MHSS	3.4	3.0 - 3.5	6915 Flos to NPI	2.5	2.0 - 2.5	Line 63	0.4	0.6 - 0.8	6905 Ph 1 Str 104 - 153 Van Buren to Limestone	5.8	3.0 - 3.4
2025	6905 Phase 1	4.0	2.2 - 2.6	6950 Westfield to MHSS	3.4	3.0 - 3.5	6950 Westfield to MHSS	3.4	3.0 - 3.5	6905 Ph 2 Str 48 - 104 Van Buren to Limestone	6.0	4.2- 4.8
										Mullen Substation		1.6-1.8
2026				6905 Phase 1	4.0	2.6 - 3.0	6905 Phase 1	4.0	2.6 - 3.0	6905 Ph 3 Str 349 - 401 Madawaska to Grand Isle	6.2	4.0-4.4
2027							6905 Phase 2	4.0	2.8 - 3.2	6905 Ph 4 Str 296 to 349 Madawaska to Grand Isle	5.0	3.8-4.2
2028										6950 Westfield to MHSS	3.4	3.2-3.6
Total		29.3	21.1 - 24.6		16.5	11.9 - 13.9		15.3	10.8 - 12.5		26.4	19.8-22.2
Avg/Yr		5.9	4.2 - 4.9		3.3	2.4 - 2.8		3.1	2.2 - 2.5		5.3	3.7-4.2

Designates Project Under Construction at time annual Chapter 330 Report filed (April 1)

Designates a Project in BHD region, moved up in the schedule from Q1-2024 to Q4-2023, completed in 2023

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Chapter 330 Summary

	2020	2021	2022	2023	2024
Plan miles	33	29	17	15	26
Average Miles per year	6.7	5.9	3.3	3.1	5.3
Average Cost per year ($ M)	$5.3	$4.6	$2.6	$2.4	$4.2

Reasons for increase:

- Significant equipment inflation
- 6905 is worse than thought (mostly new photos)
- 6930 is not in the plan – but it's coming

- Moved out Line 6950-3

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2023 Project Work Completed

- Line 6903 Transmission Rebuild Per Inspection
- Line 69032 Transmission Rebuild Per Inspection
- Line 6904 Rebuild Structures 11 to 34
- Line 6913 Transmission Rebuild Per Inspection
- Lightning arrestor replacements on Lines 6910, 6912, 6913, 6916 and 6940
- Line 6903 and 6905 Manual Flopover
- Line 69051 Transmission Rebuild Per Inspection

** Yellow shading denotes Chapter 330 Project

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Emerging Issues

System Condition

- **Line 6905 – Line connects Madawaska Substation to Limestone Substation serving Grand Isle and Van Buren communities via tap lines. Constructed in 1964, the wood poles and wood pole crossarms are aging and weakening - rejects are increasing significantly. Phased rebuild of this line planned to begin in 2024 and to continue through 2030.**
- **Line 6930 – Line connects Caribou Substation to Ashland Substation with a tap serving the Washburn community. The line is 34 miles long, with 133 structures, 20% of structures have been replaced. The most recent drone inspection indicates 9 rejected poles, 94 have moderate decay, 24 low decay. TRPI in 2024 to replace 24 poles. Further TRPI work is likely in the near future.**
- **Mullen Substation Rebuild – Project is in study to determine path forward. Likely to convert Line 4407 from 44kV to 69kV.**
- **NESC Clearance – The Company is assessing conductor to ground clearances and expects projects will be needed to address issues found.**

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Line 6905 Condition

Wood pole top rot

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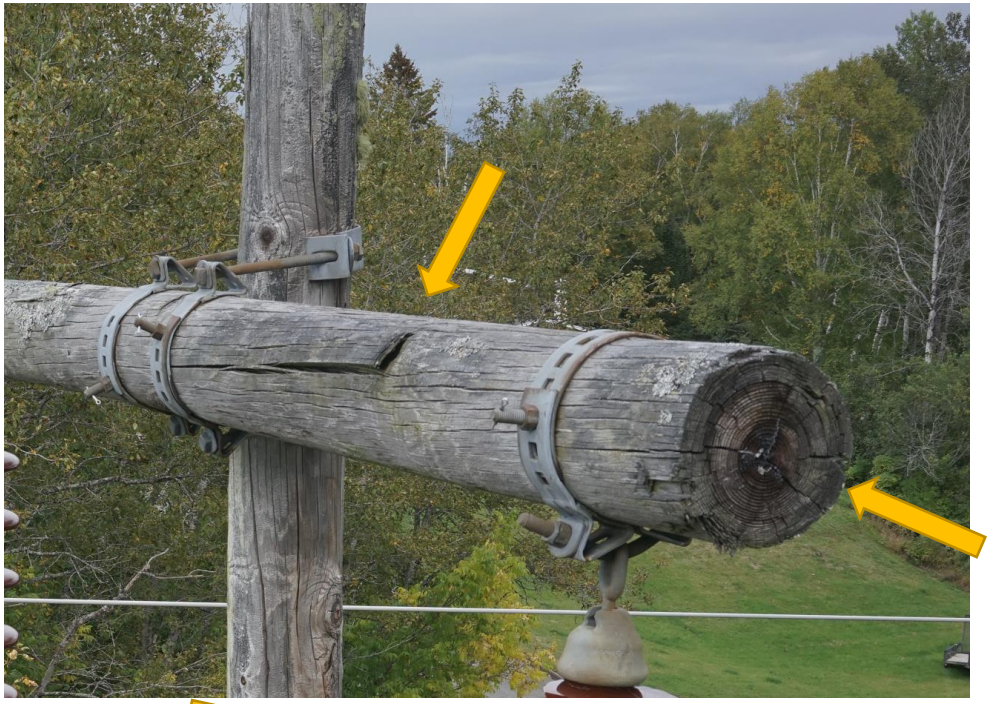
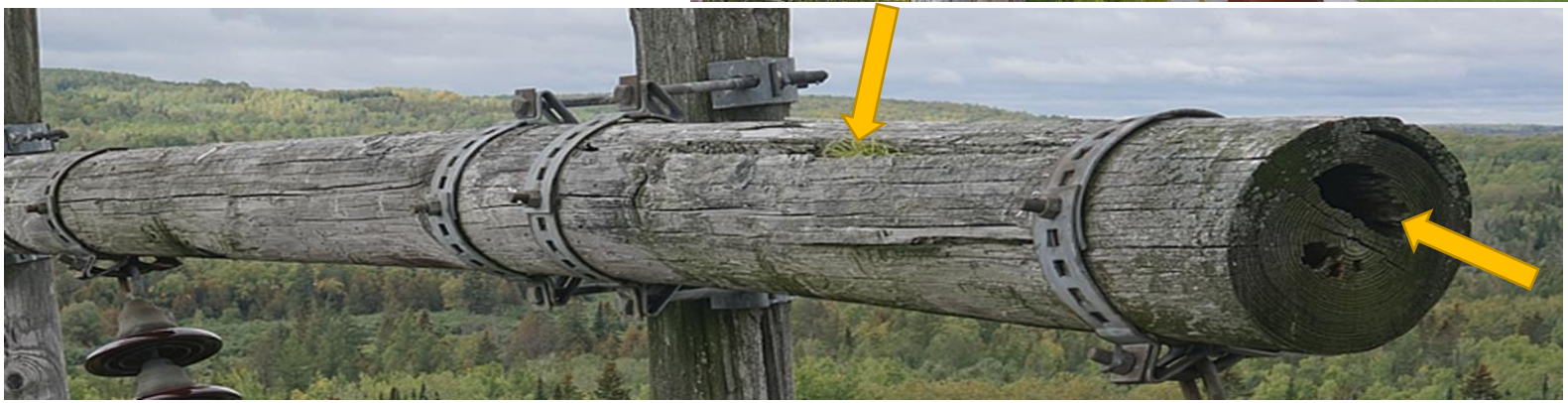
Line 6905 Condition continued…

Drooping crossarm under weigh of conductors likely caused by internal decay





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Line 6905 Condition continued…

Company inspectors are finding increased heart rot decay in wood poles reaching end of life, leading to structure replacements

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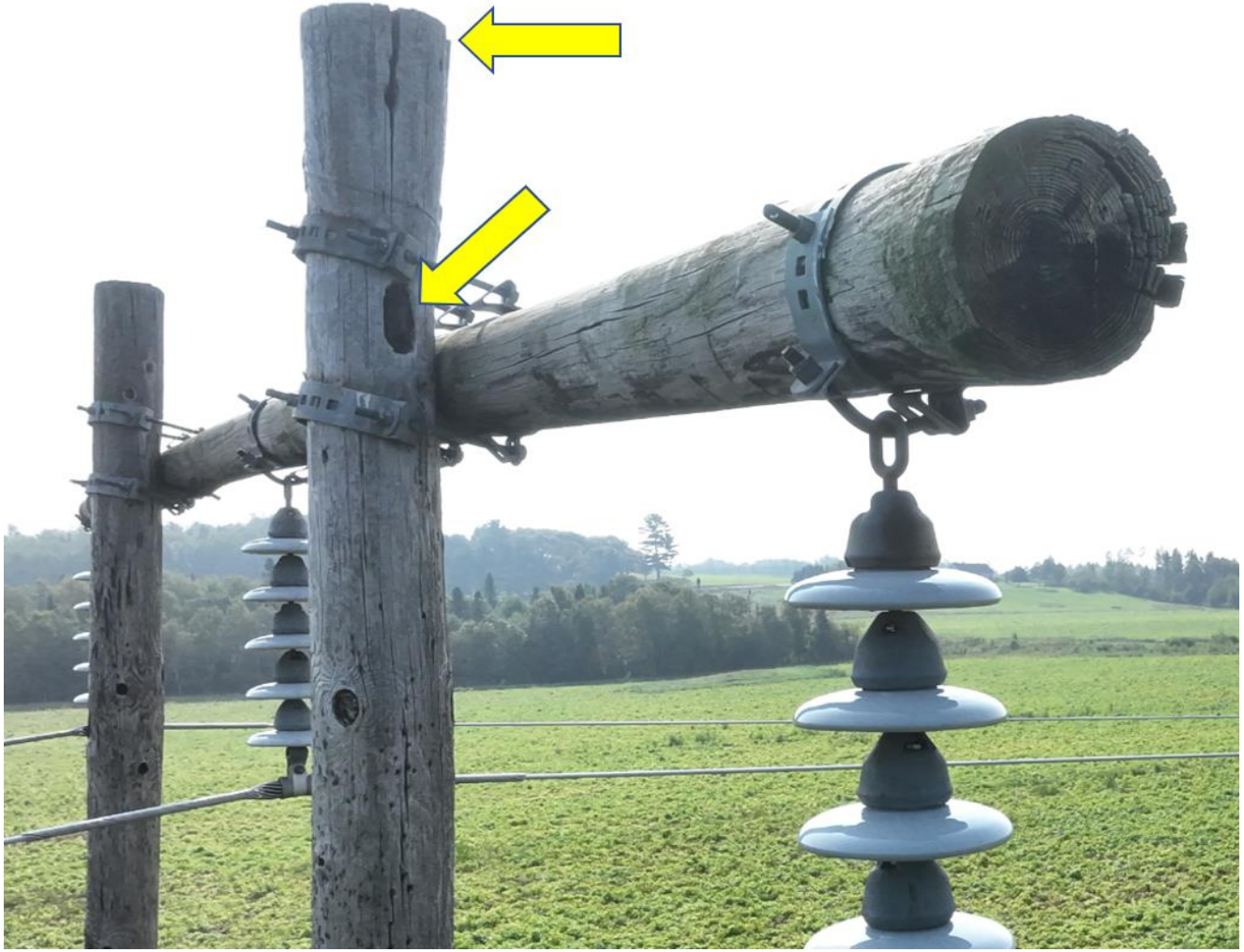
Line 6930 Condition



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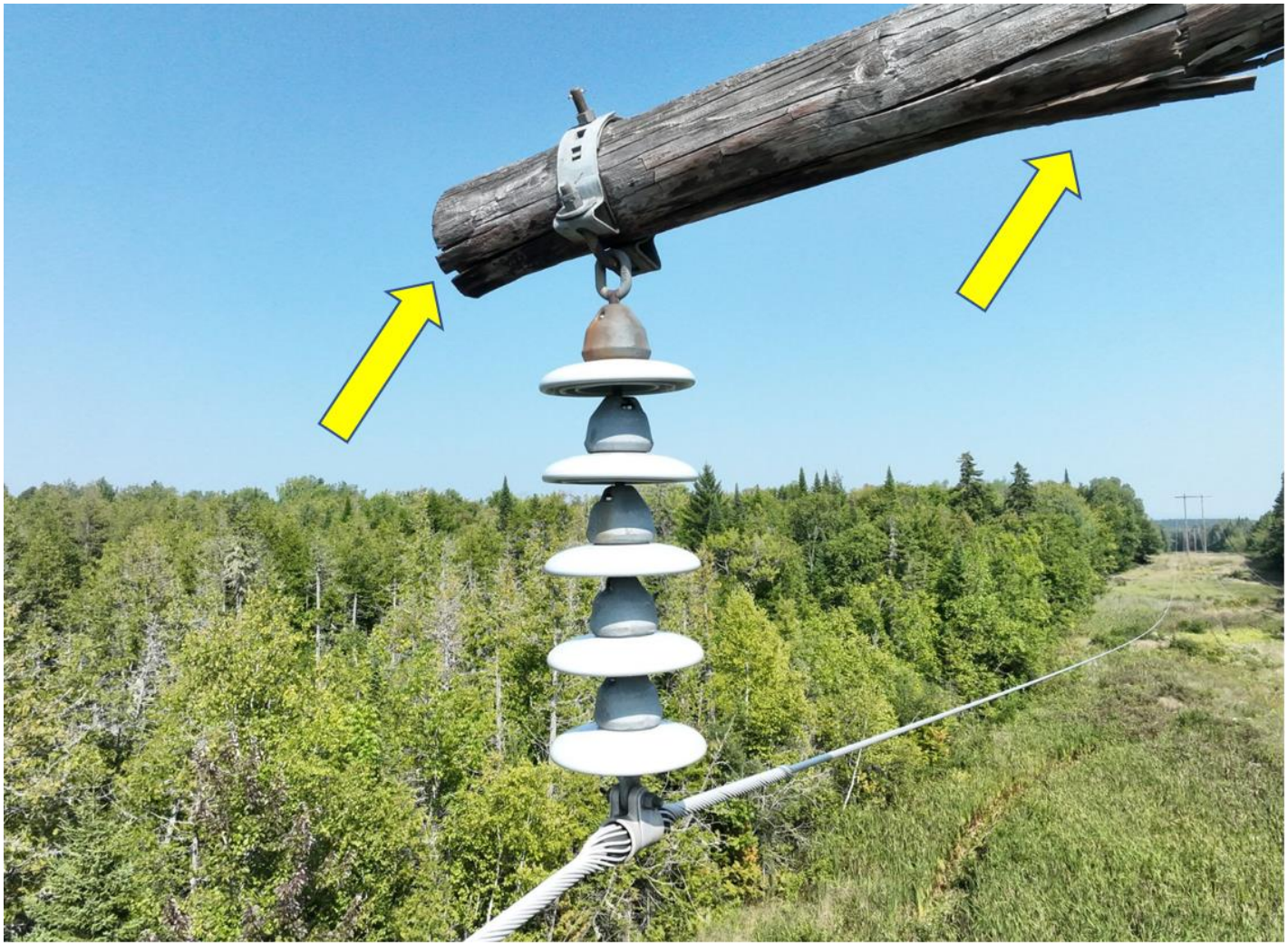
Line 6930 Condition continued…



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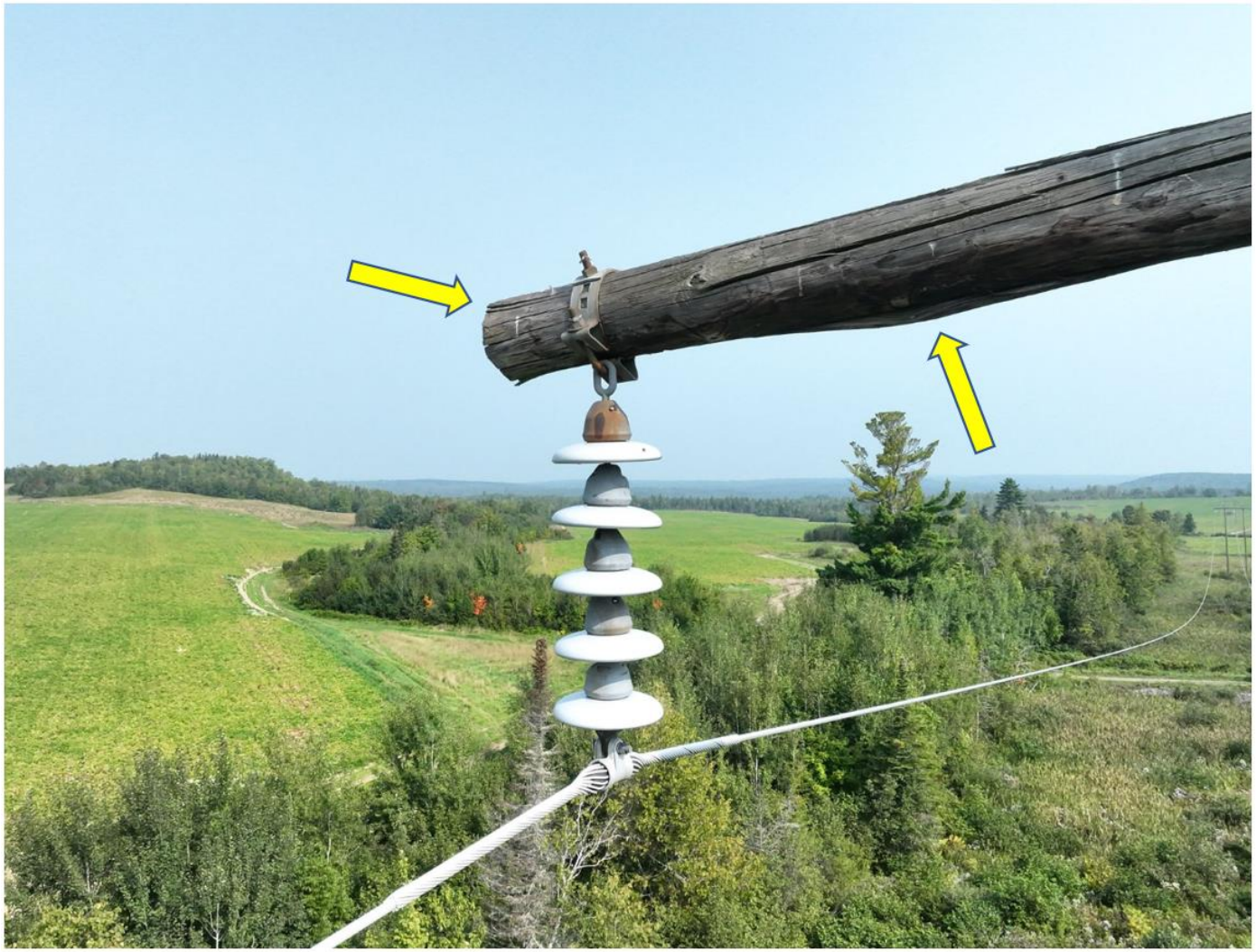
Line 6930 Condition continued…



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Line 6930 Condition continued…

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Enhanced Inspection Methods - Drones

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Example of a Closeup Drone Inspection Photo

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Enhanced Inspection Methods continued…Wood Pole Strength Assessment using Resistograph

Using a long thin needle the electric power consumption of the resistograph drilling device is measured and recorded. The resistance data gathered provides a high linear correlation between the measured values and the density of the penetrated wood.

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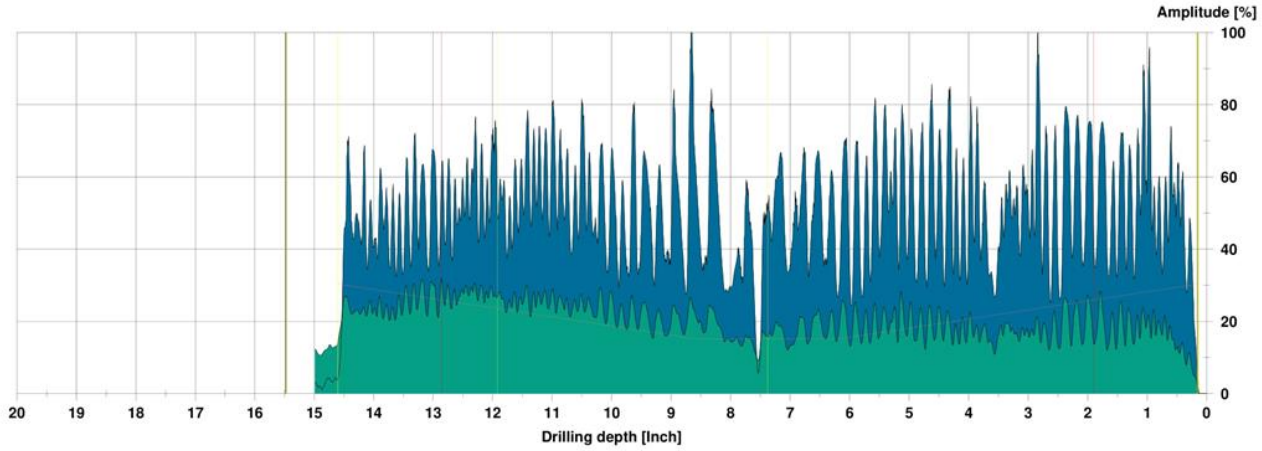
Resistograph Plot - Wood Pole in good condition

Measuring / object data

Measurement no.	47	Speed	3000 r/min	Diameter	13,25 in
ID number	20694	Needle state	---	Level	
Drilling depth	14,99 in	Tilt	-30°	Direction	
Date	01/15/2019	Offset	56 / 289	Species	
Time	11:33:03	Avg. curve	off / off	Location	
Feed	10 in/min			Name	

WoodInspector

Program	Pole - EMERA 1.00	Sum decay	0,0%	0,0%	0,0%
Pole type		Heart rot	0,0%	0,0%	0,0%
Measurement	Below soil level	Shell rot	No	No	
Defect pattern	No decay	Remaining wall	50,0%	50,0%	50,0%
Result (auto)	PASS	Strength	100,0%	100,0%	100,0%



Assessment

Comment

20694M047 (PASS).rgp

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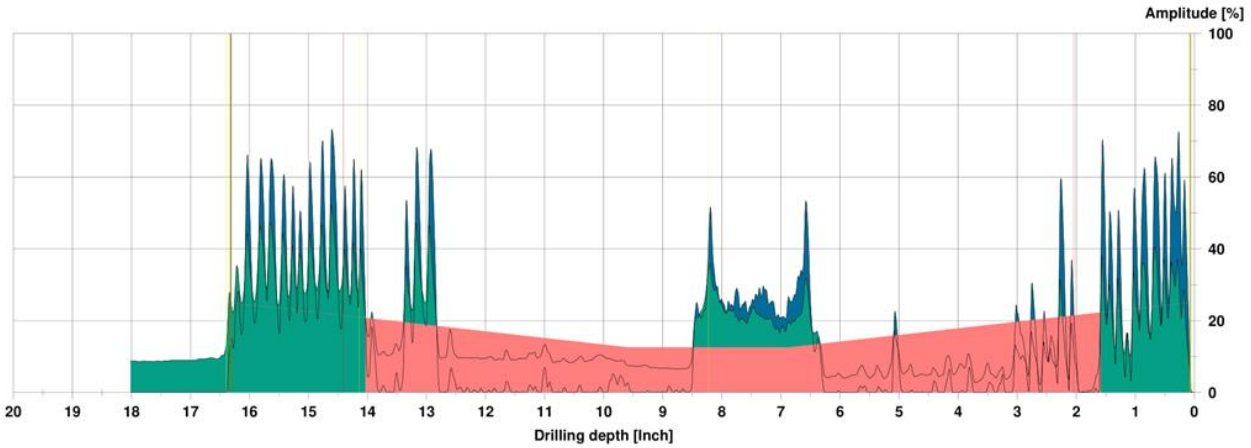
Rejected Wood Pole – Heart Rot

Measuring / object data

Measurement no.	: 13	Speed	: 3000 r/min	Diameter	: 16,25 in
ID number	: 20781	Needle state	: ---	Level	:
Drilling depth	: 18,01 in	Tilt	: -1°	Direction	:
Date	: 10/23/2018	Offset	: 93 / 388	Species	:
Time	: 09:24:24	Avg. curve	: off / off	Location	:
Feed	: 40 in/min			Name	:

WoodInspector

Program	: Pole - EMERA 1.00	Sum decay	: 40,7% | 35,6% | 76,3%
Pole type	:	Heart rot	: 40,7% | 35,6% | 76,3%
Measurement	: Auto diameter	Shell rot	: No | No
Defect pattern	: Heart rot	Remaining wall	: 9,3% | 14,4% | 11,8%
Result (auto)	: REJECT	Strength	: 56,1% | 74,3% | 65,2%



Assessment

Comment

20781M013 (REJECT).rgp

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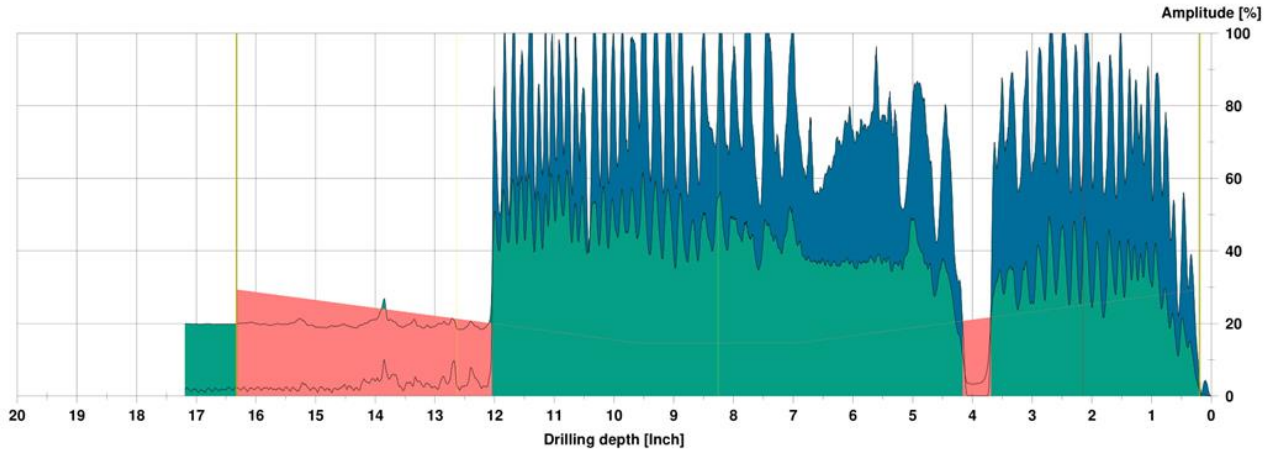
Rejected Wood Pole – Heart Rot & Shell Rot

Measuring / object data

Measurement no.	: 46	Speed	: 3000 r/min	Diameter	: 14,00 in
ID number	: 20705	Needle state	: ---	Level	:
Drilling depth	: 17,19 in	Tilt	: -30°	Direction	:
Date	: 01/17/2019	Offset	: 111 / 415	Species	:
Time	: 10:57:14	Avg. curve	: off / off	Location	:
Feed	: 40 in/min			Name	:

WoodInspector

Program	: Pole - EMERA 1.00	Sum decay	: 2,9% | 0,0% | 2,9%
Pole type	:	Heart rot	: 2,9% | 0,0% | 2,9%
Measurement	: Below soil level	Shell rot	: No | Yes
Defect pattern	: Heart+shell rot	Remaining wall	: 21,7% | ---
Result (auto)	: REJECT	Strength	: 89,7% | ---



Assessment

Comment

20705M046 (REJECT).rgp

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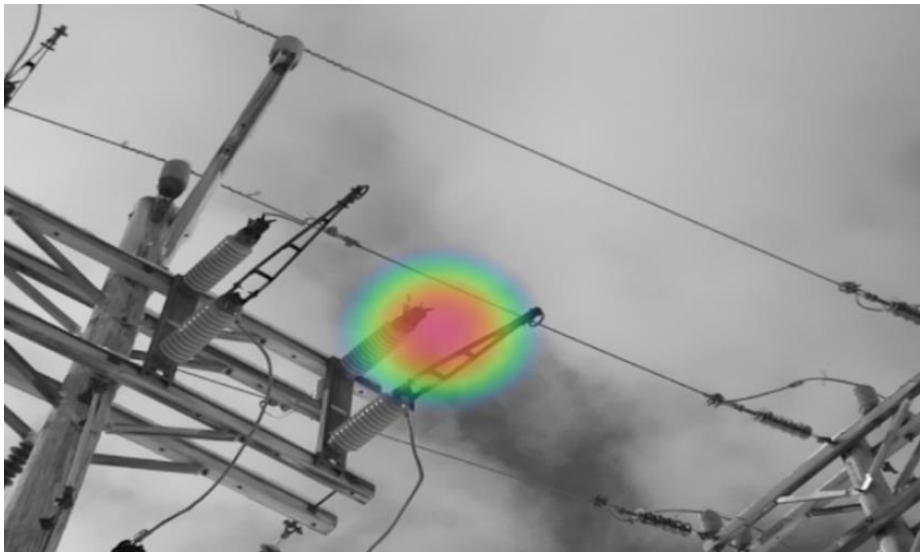
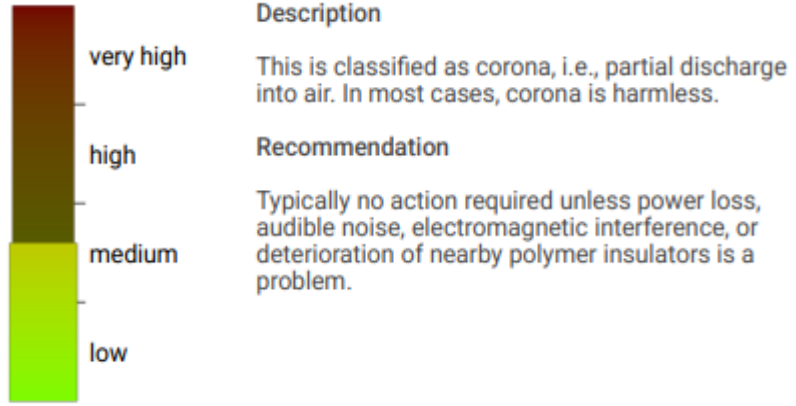
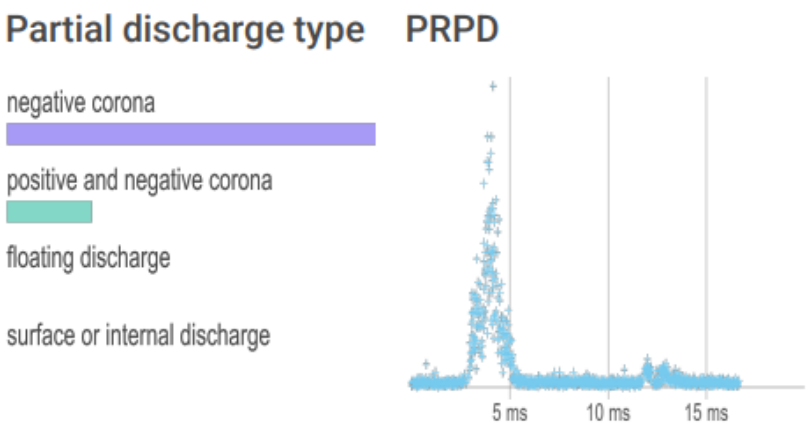
Handheld Acoustic Condition Assessment







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Handheld Acoustic Condition Assessment

Severity

very high

high

medium

low

Description

This is classified as a surface or internal discharge. The discharge appears to be strong and might rapidly escalate to complete insulation breakdown.

Recommendation

Immediate action. Visual inspection. Cleaning of polluted surfaces. Repair or replacement of the components.

Partial discharge type

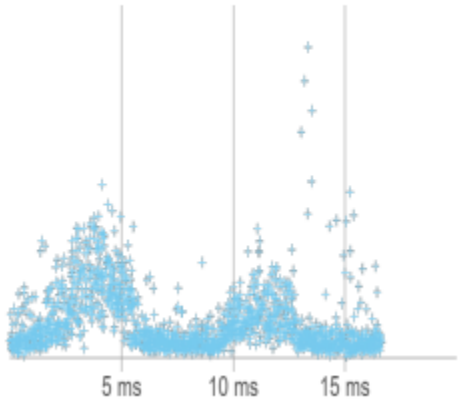
negative corona

positive and negative corona

floating discharge

surface or internal discharge

PRPD



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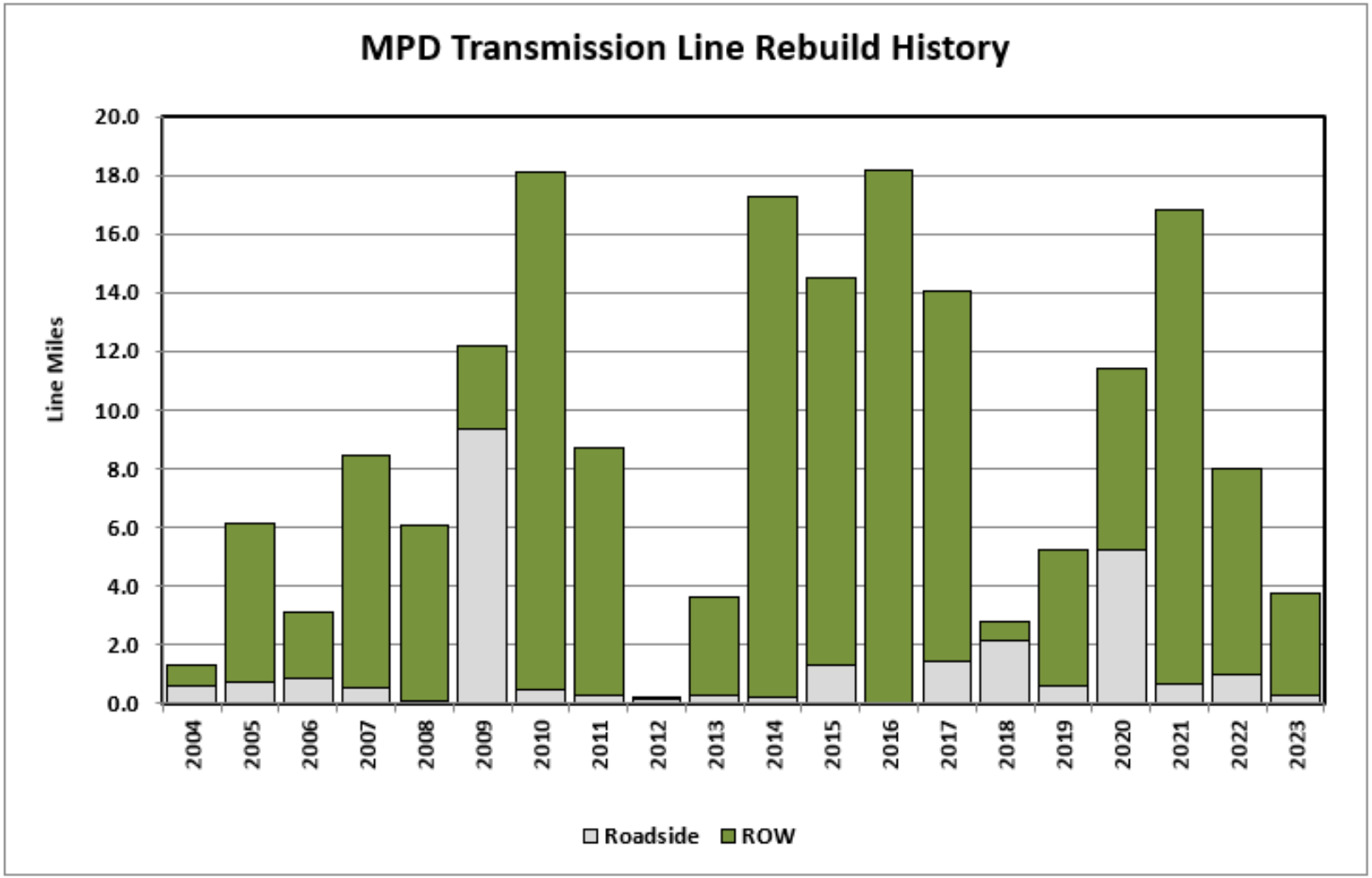
20-Year MPS Transmission Line Rebuild History



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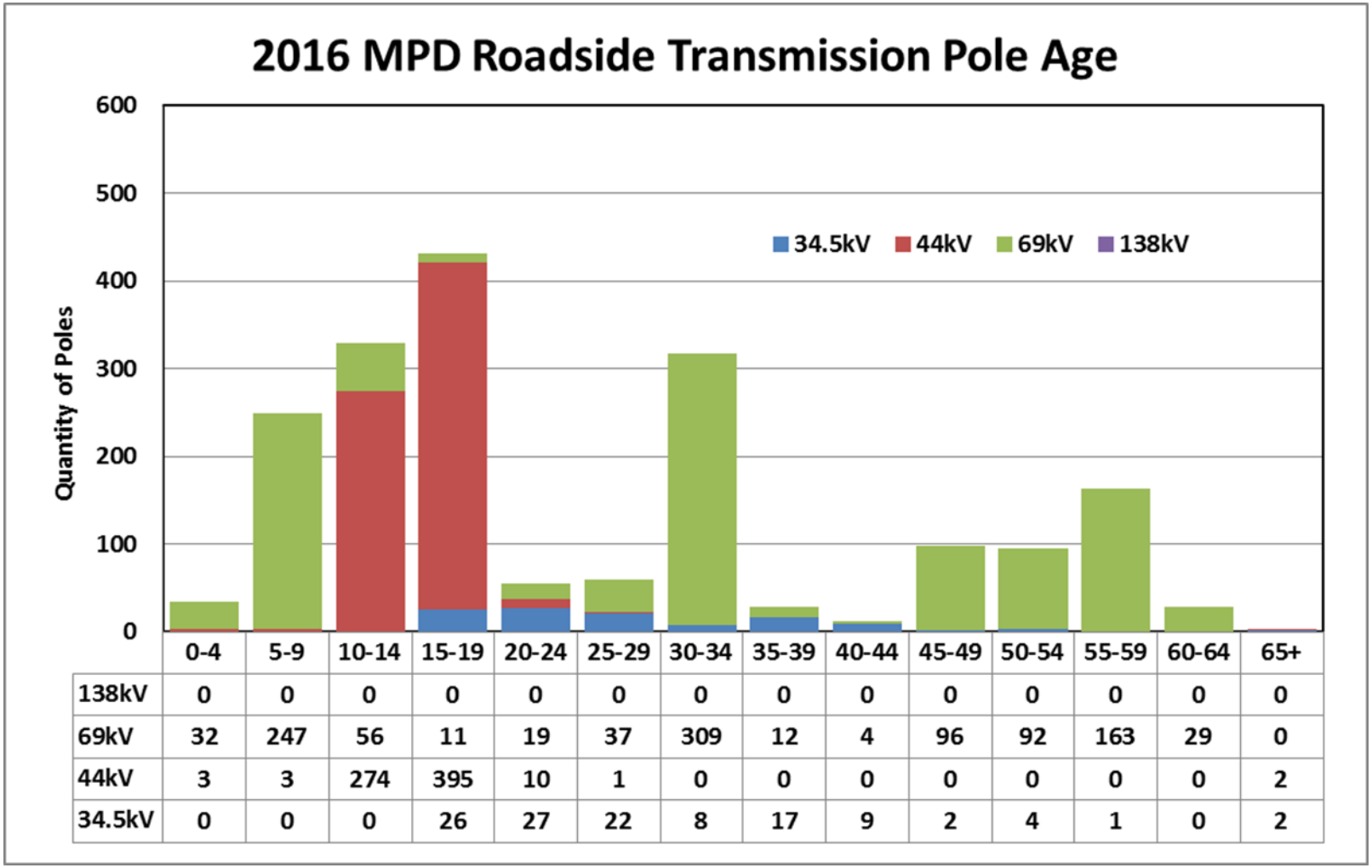
MPD Roadside Transmission Line Pole Age – 2016



	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65+
138kV	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69kV	32	247	56	11	19	37	309	12	4	96	92	163	29	0
44kV	3	3	274	395	10	1	0	0	0	0	0	0	0	2
34.5kV	0	0	0	26	27	22	8	17	9	2	4	1	0	2

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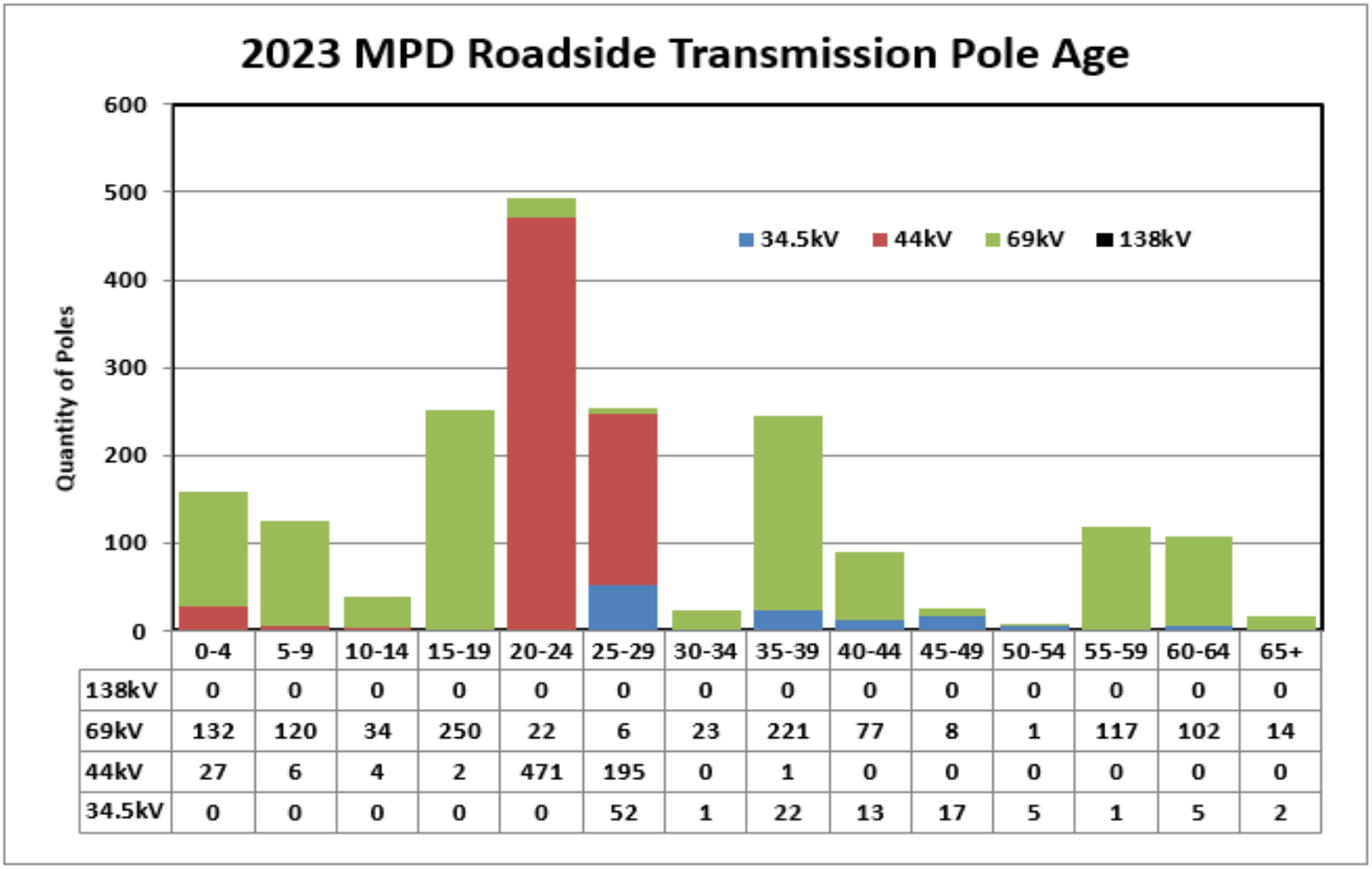
MPD Roadside Transmission Line Pole Age – 2023



	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65+
138kV	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69kV	132	120	34	250	22	6	23	221	77	8	1	117	102	14
44kV	27	6	4	2	471	195	0	1	0	0	0	0	0	0
34.5kV	0	0	0	0	0	52	1	22	13	17	5	1	5	2

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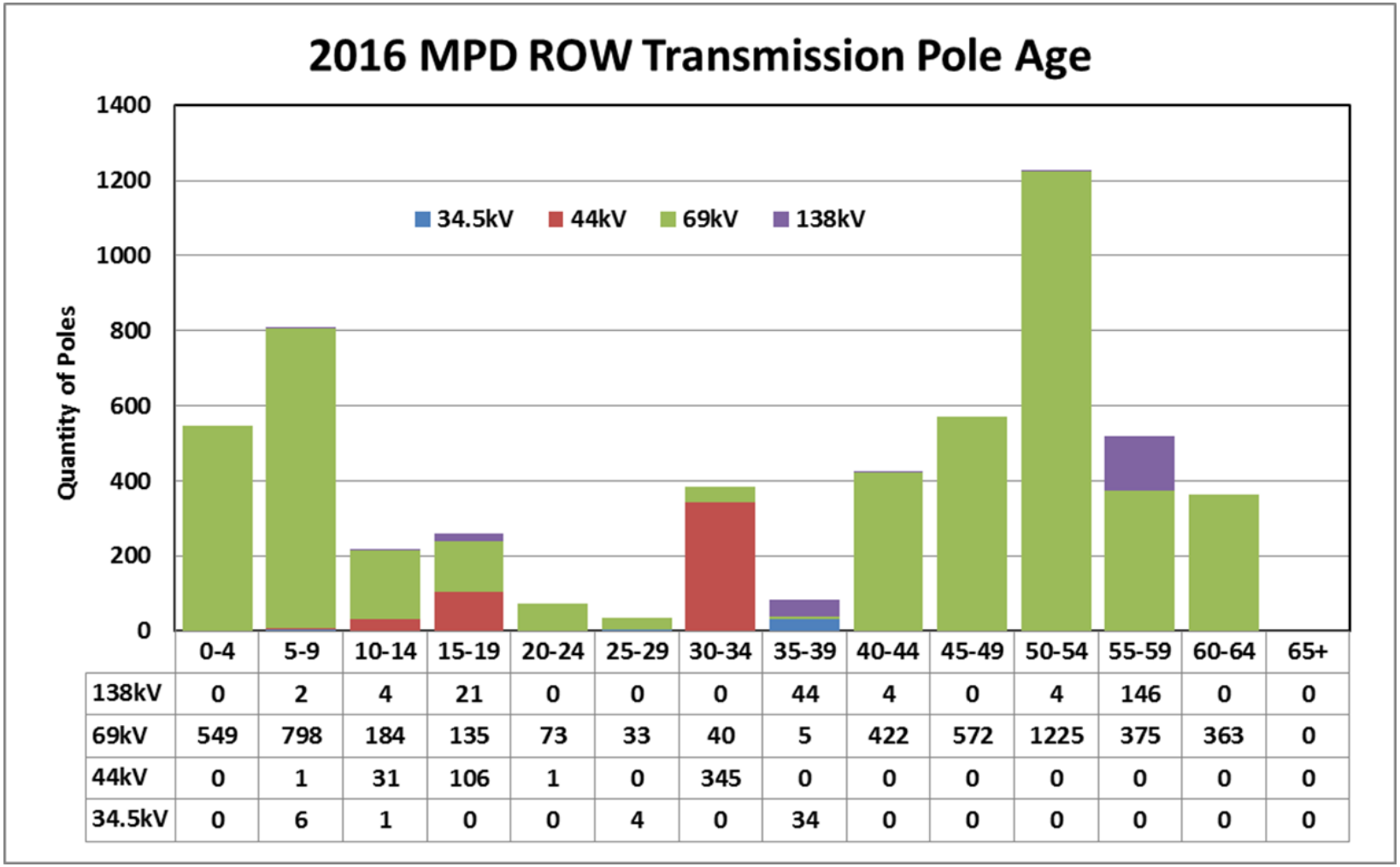
MPD ROW Transmission Line Pole Age - 2016



	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65+
138kV	0	2	4	21	0	0	0	44	4	0	4	146	0	0
69kV	549	798	184	135	73	33	40	5	422	572	1225	375	363	0
44kV	0	1	31	106	1	0	345	0	0	0	0	0	0	0
34.5kV	0	6	1	0	0	4	0	34	0	0	0	0	0	0

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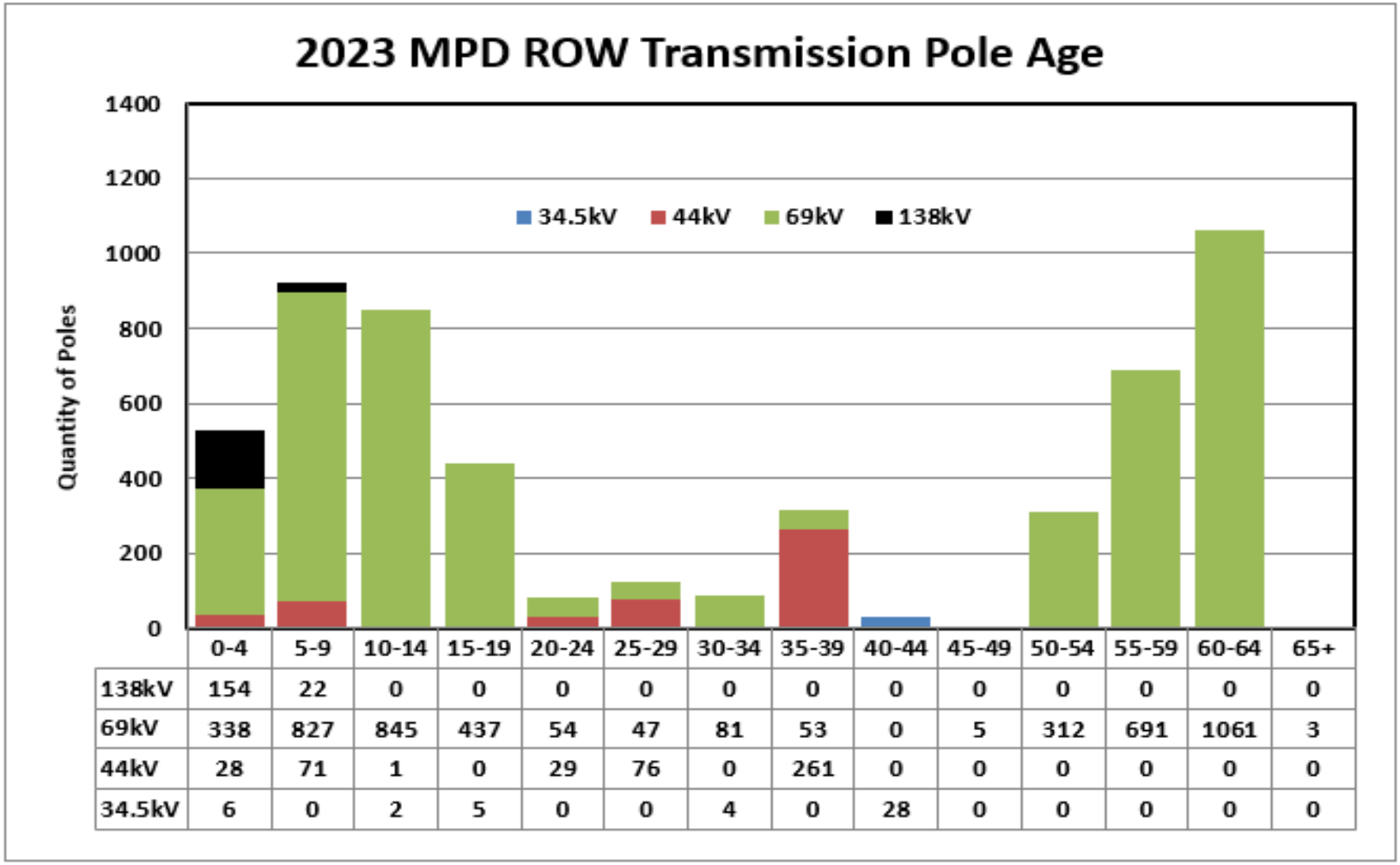
MPD ROW Transmission Line Pole Age - 2023



	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65+
138kV	154	22	0	0	0	0	0	0	0	0	0	0	0	0
69kV	338	827	845	437	54	47	81	53	0	5	312	691	1061	3
44kV	28	71	1	0	29	76	0	261	0	0	0	0	0	0
34.5kV	6	0	2	5	0	0	4	0	28	0	0	0	0	0

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Reliability Performance

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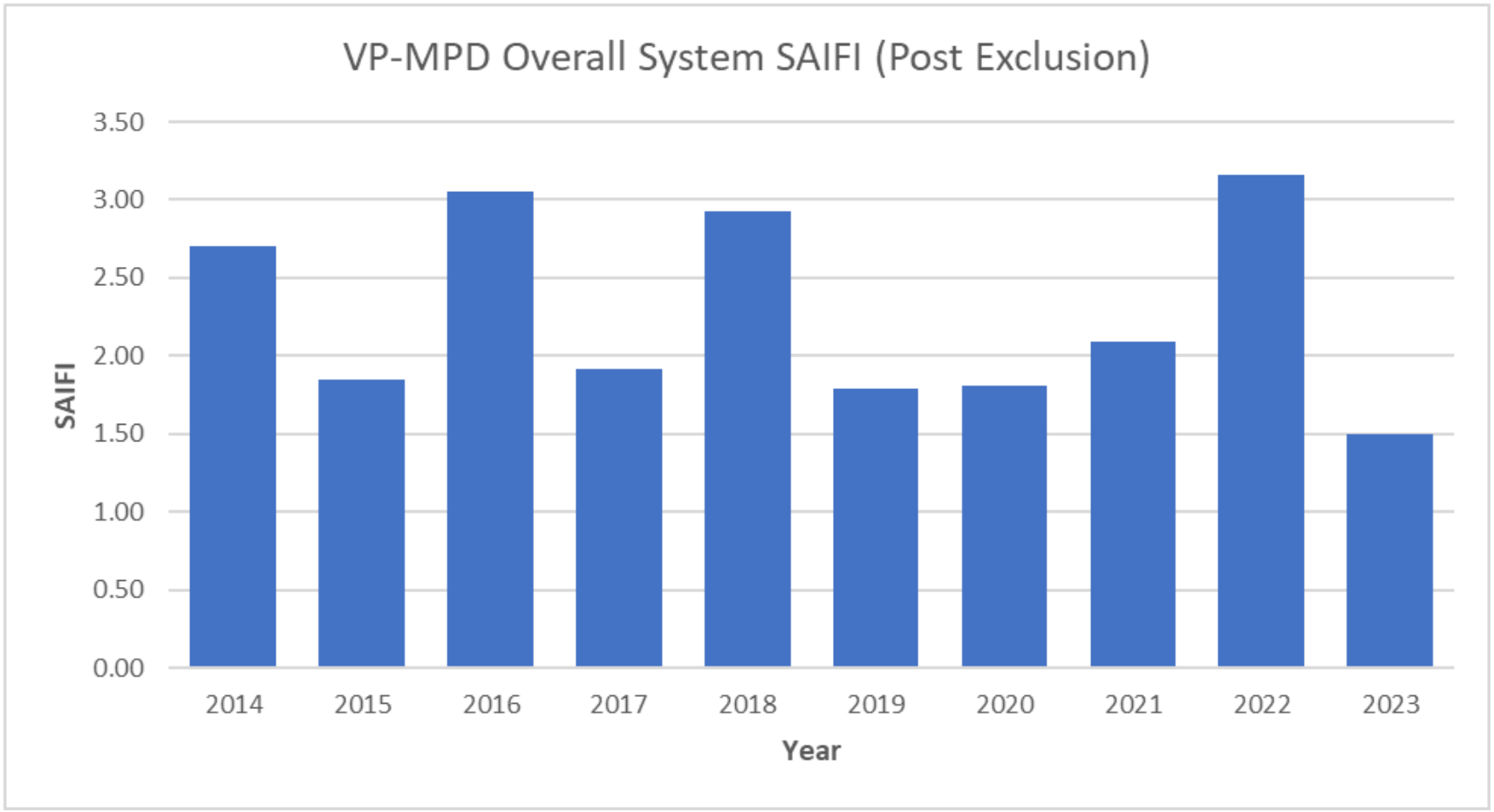
MPD Reliability Performance - Frequency



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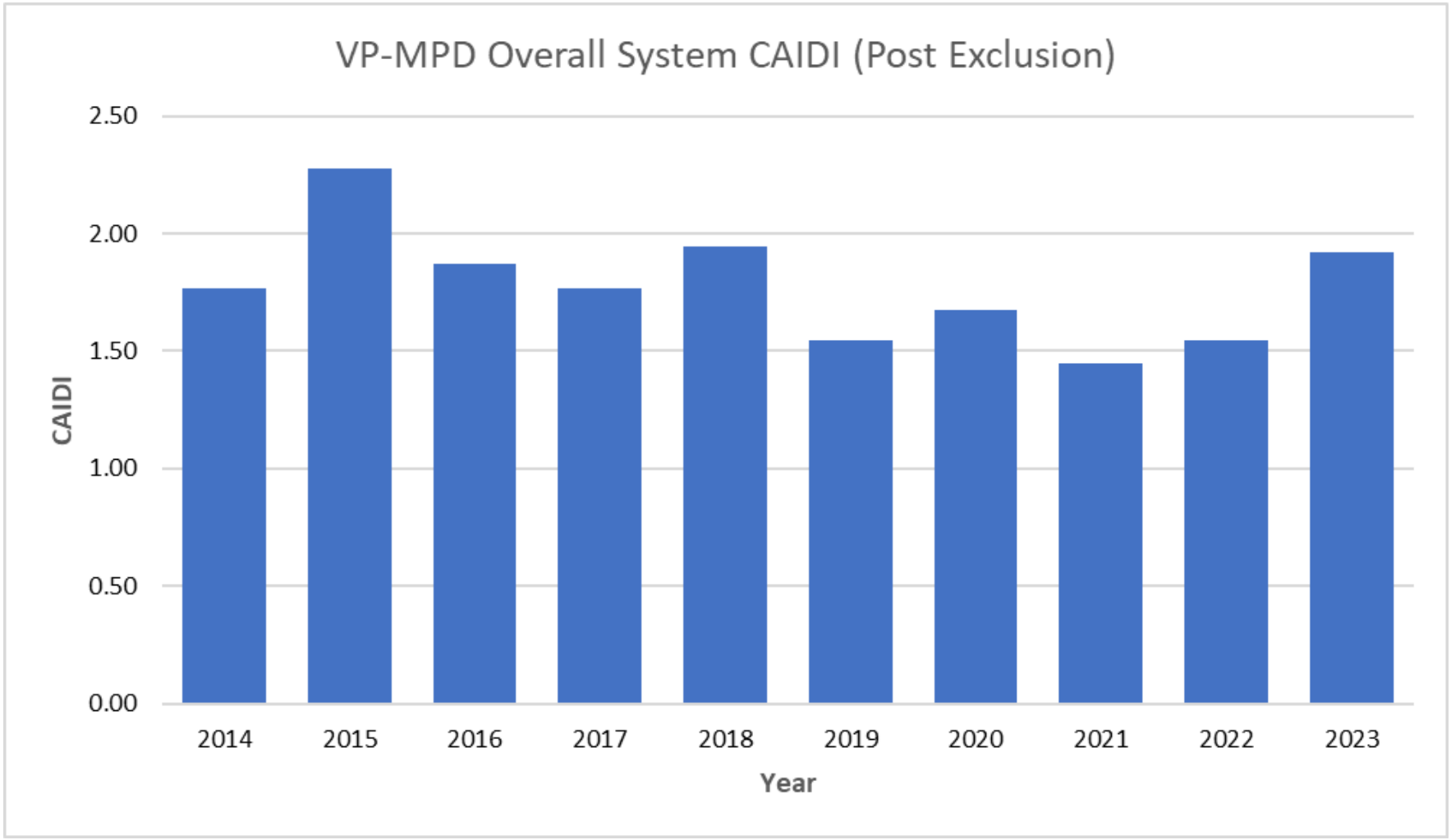
MPD Reliability Performance - Duration



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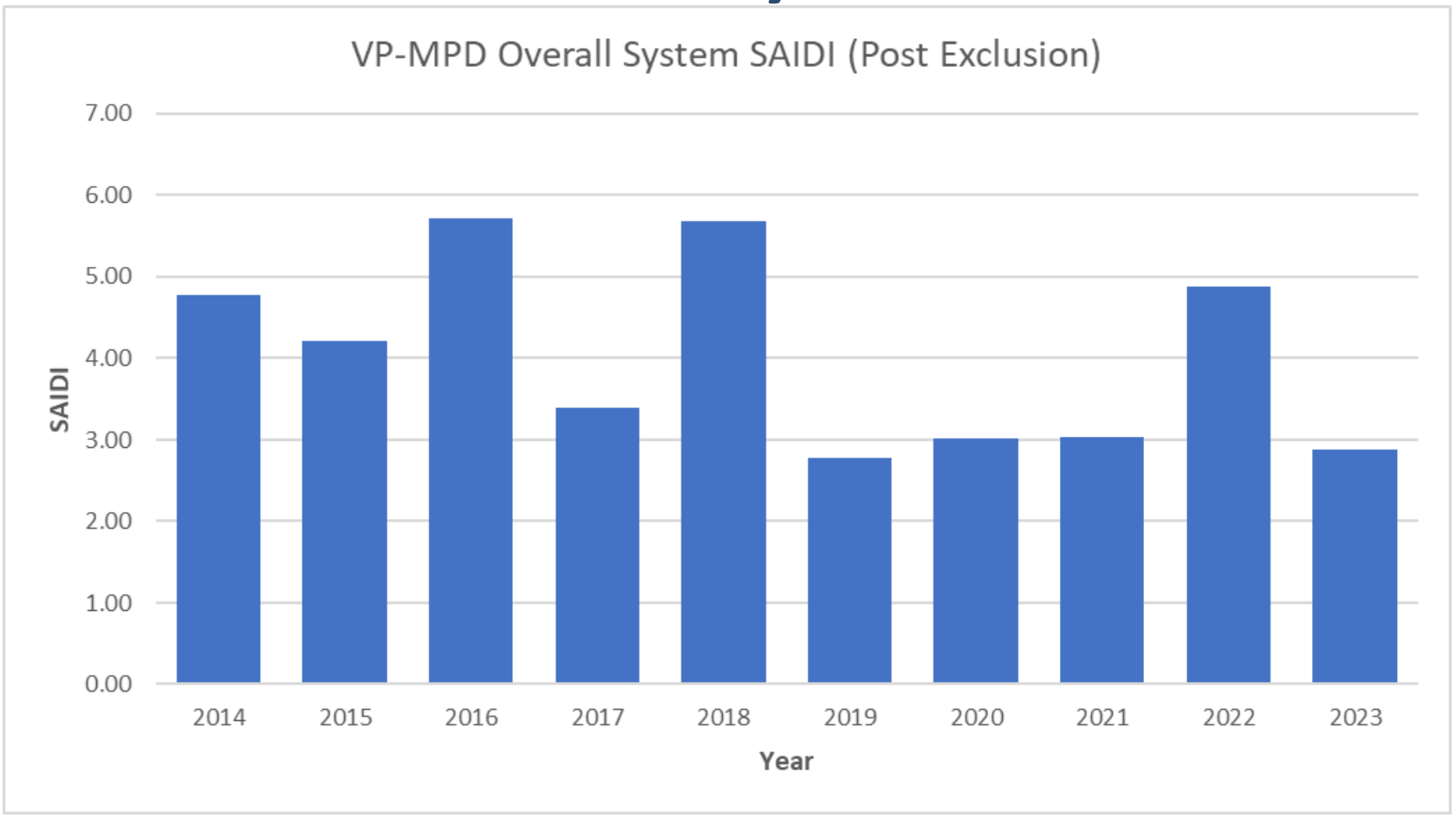
MPD Overall Reliability Performance



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Integrated Grid Plan and Solar Updates

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Integrated Grid Plan Update

- Commission Order expected soon in Docket 2022-00322
- Workshops were conducted in late 2023 – feedback will be used in expected Order
- Order will include direction for IGP – 18 month clock will start
- Versant has been gathering load and generation data in preparation

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Solar Generation Update

- About 47 MWs operating (both metered and BTM)
- 14 projects expected to go operational between now and October – 46 additional MWs
- MPD Solar Penetration: operating plus queued generation as a % of Peak Load – 172%
- Compare to Hawaii at 110% and California at 122%
- If all projects expected by October go operational, MPD will have about the same solar percentage of peak load as Hawaii -
- Challenges this will bring (voltage, reactive power)

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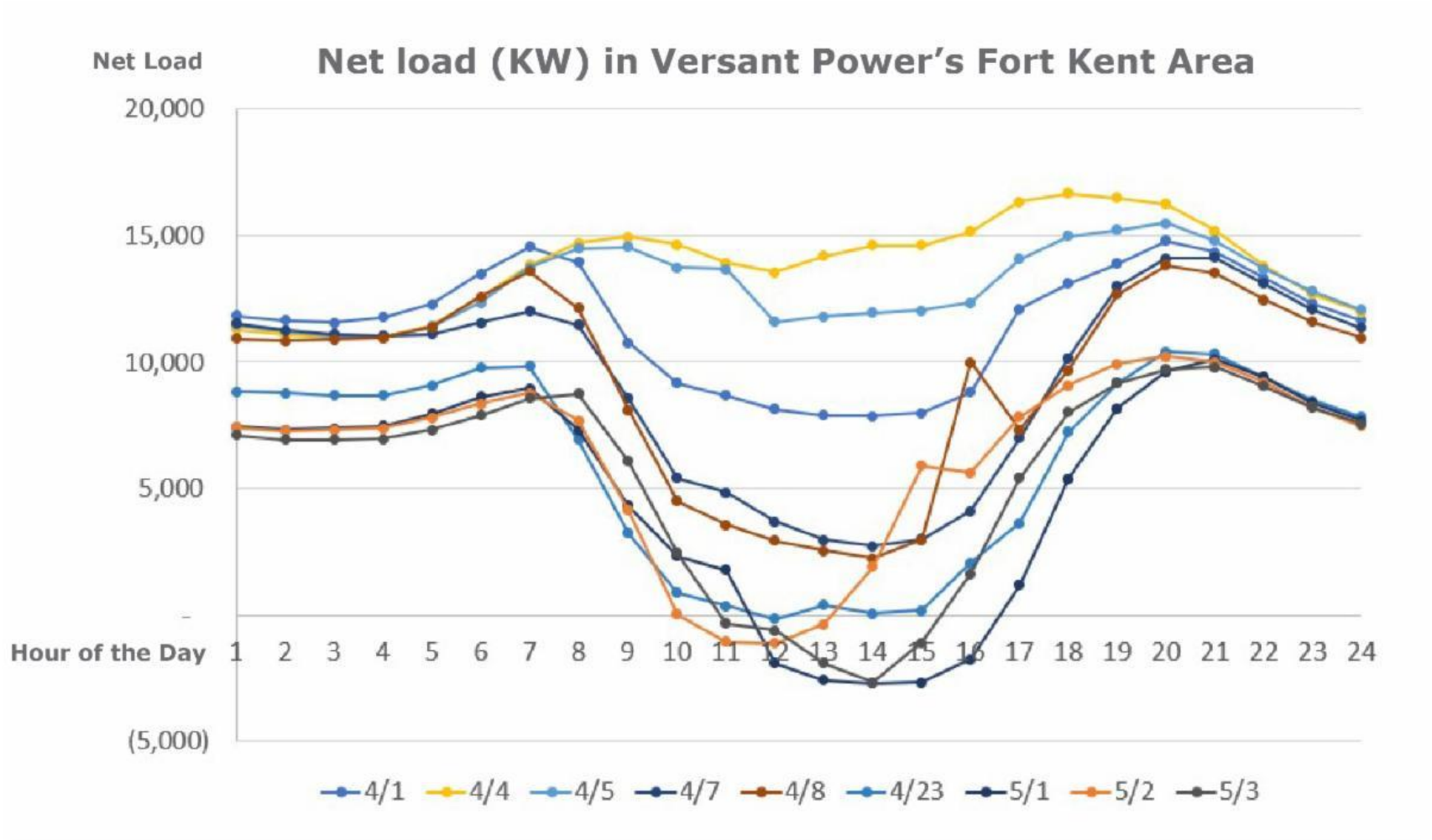
“Madawaska Mallard” – Duck Curve



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Inertia and Grid Forming vs. Grid Following

Fig. 2. Bears on bicycles showing conceptually that with high levels of grid-following PECs, the system becomes unstable simply because sufficient levels of grid-forming assets are not present [13]. Here, the full bicycle is any grid-forming asset, either SGs or grid-forming PECs, whereas the tagalong bicycle is a grid-following asset, with or without grid-supporting functionality.

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System Improvements

- Increased Transmission capability (Line 1176) allowed the last cluster study (137 MW total solar) to pass
- But it barely passed: next cluster study appears uncertain depending on size – number of project ready for study

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