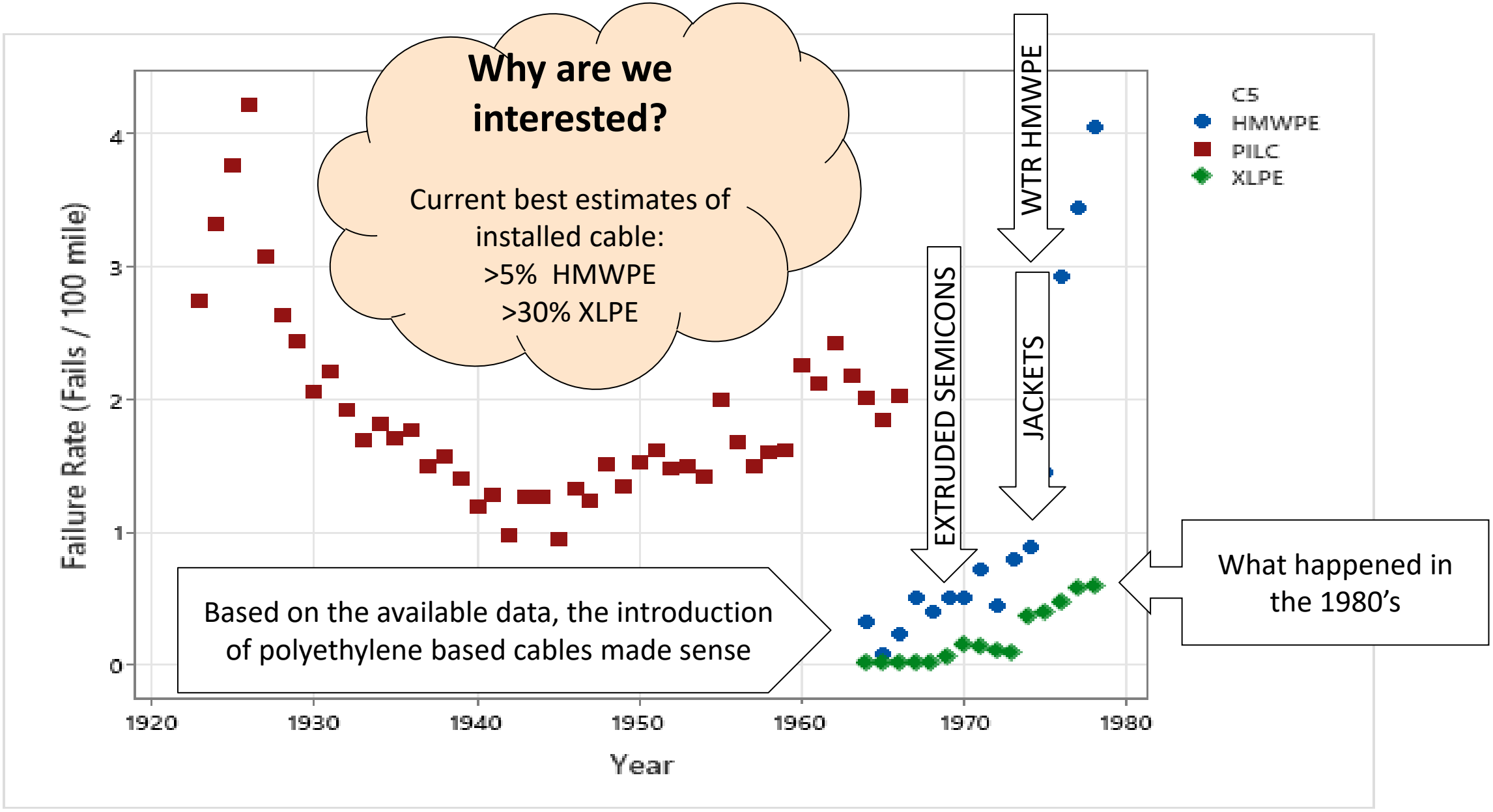
ELECTRIC POWER
RESEARCH INSTITUTE

EPR & WTRXLPE Service Performance by Datamining of ICC Minutes

Nigel Hampton, Josh Perkel, & Dexter Lewis

Fall 2024 ICC Meeting Subcommittee A - October 21, 2024

Recall: Lawson & Thue – AEIC Data



Recall: AEIC Reporting – huge kudos to Al Kong

1986 AEIC CABLE REPORT

HMWPE CABLE

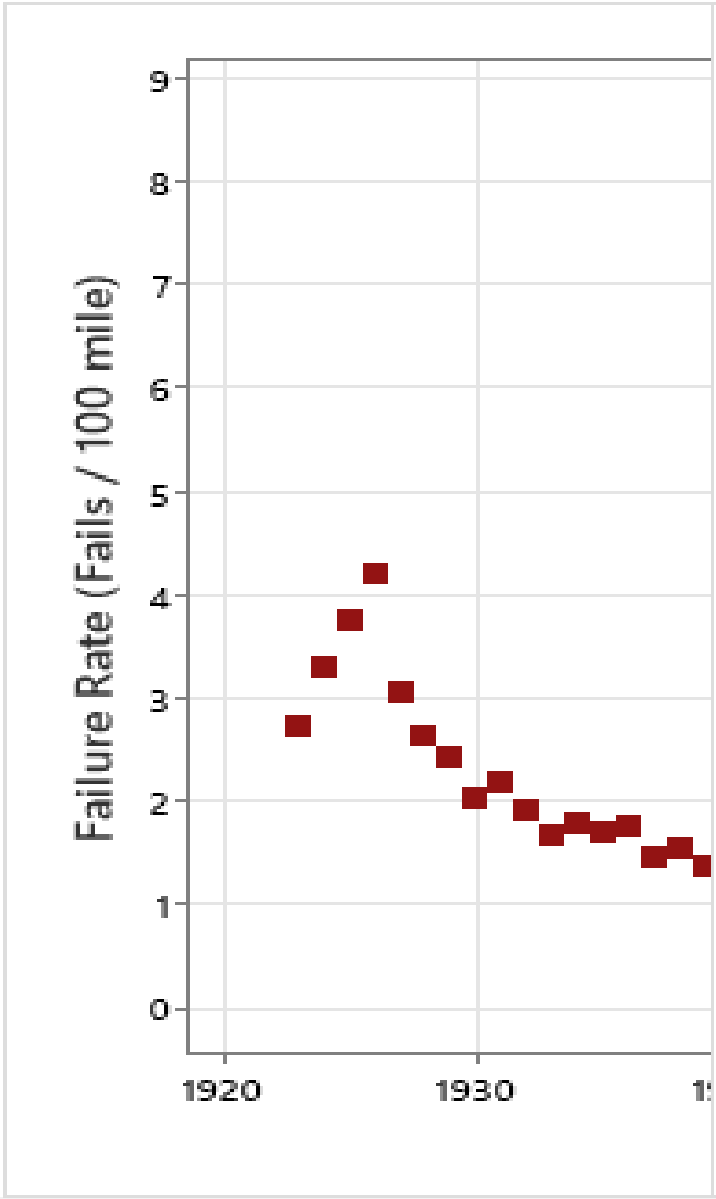
CATEGORY			NUMBER FAILURES	TOTAL MILES	NUMBER UTILITIES	FAILURES PER 100 MILES
JACKETED	DUCT	< 40V/M	3	79	1	3.80
		> 40V/M	0	0	0	—
				0	0	—
				0	0	—
				13,313	4	1.20
				3,772	2	2.80
				6,412	8	10.90
				5,391	4	17.40

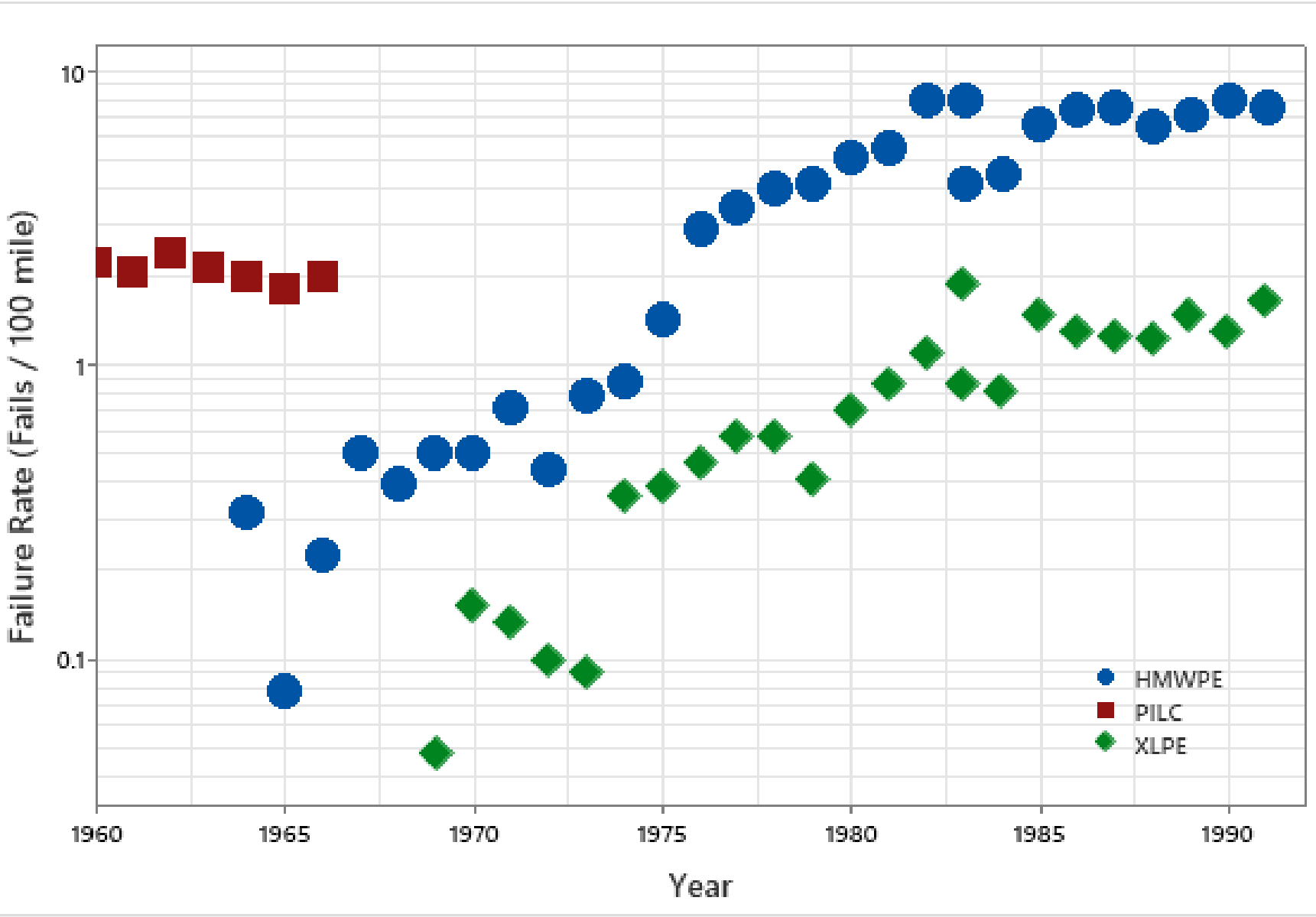
1986 AEIC CABLE REPORT

XLP CABLE

CATEGORY			NUMBER FAILURES	TOTAL MILES	NUMBER UTILITIES	FAILURES PER 100 MILES
JACKETED	DUCT	< 40V/M	21	22,927	7	0.10
		> 40V/M	15	8,985	12	0.20
	DB	< 40V/M	1	488	2	0.20
		> 40V/M	58	8,717	10	0.70
UNJACKETED	DUCT	< 40V/M	36	3,570	2	1.00
		> 40V/M	11	1,051	4	1.10
	DB	< 40V/M	35	2,561	3	1.40
		> 40V/M	835	21,712	12	3.90

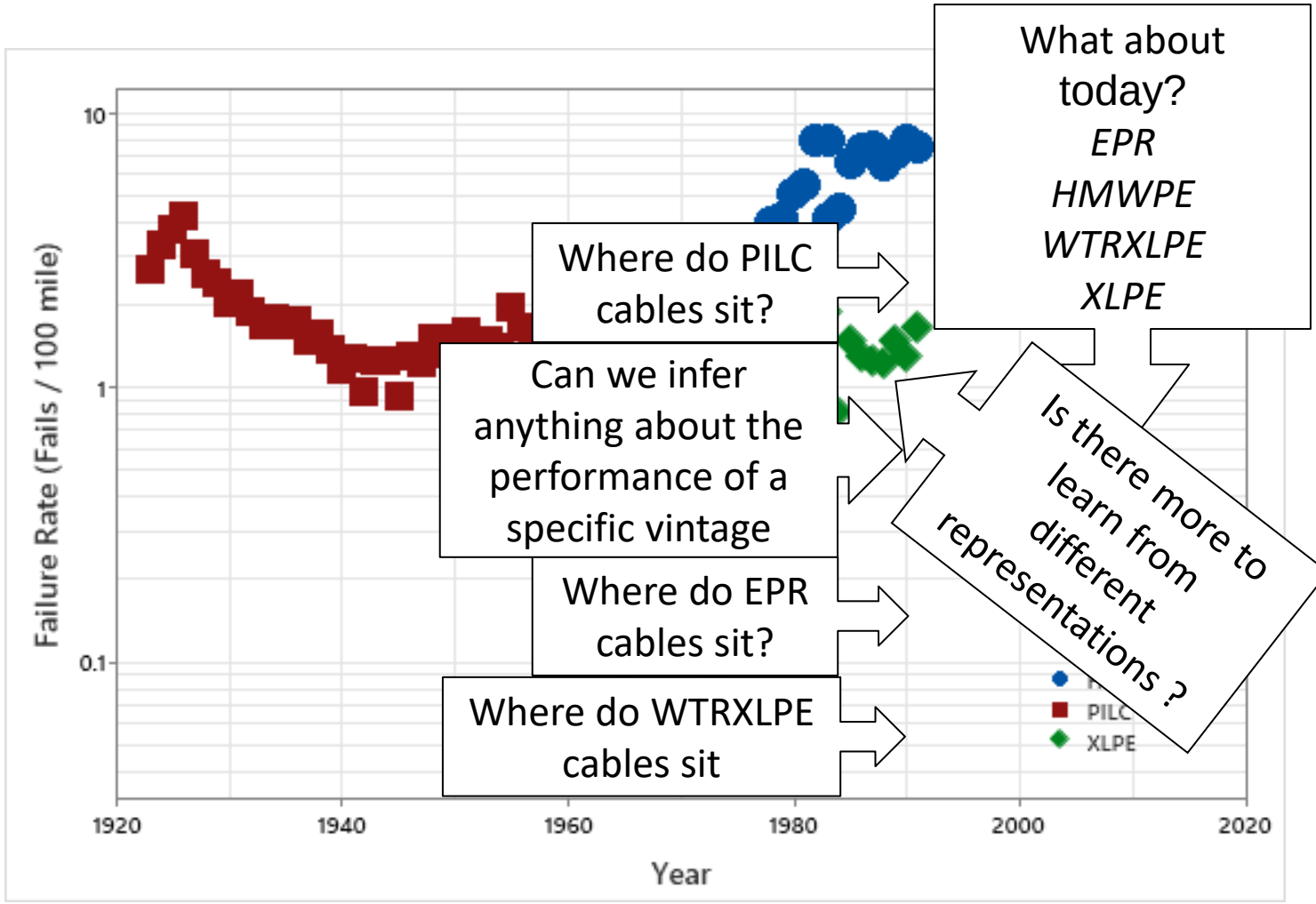
Recall: AEIC Data Added





Recall: Wrap Up

- We still operate and rely on legacy systems (>35%), datamining can help us with the understanding of what might happen when we operate them differently
- There is useful knowledge within the ICC Minutes – *findability is important*
- There are still questions



This presentation tackles

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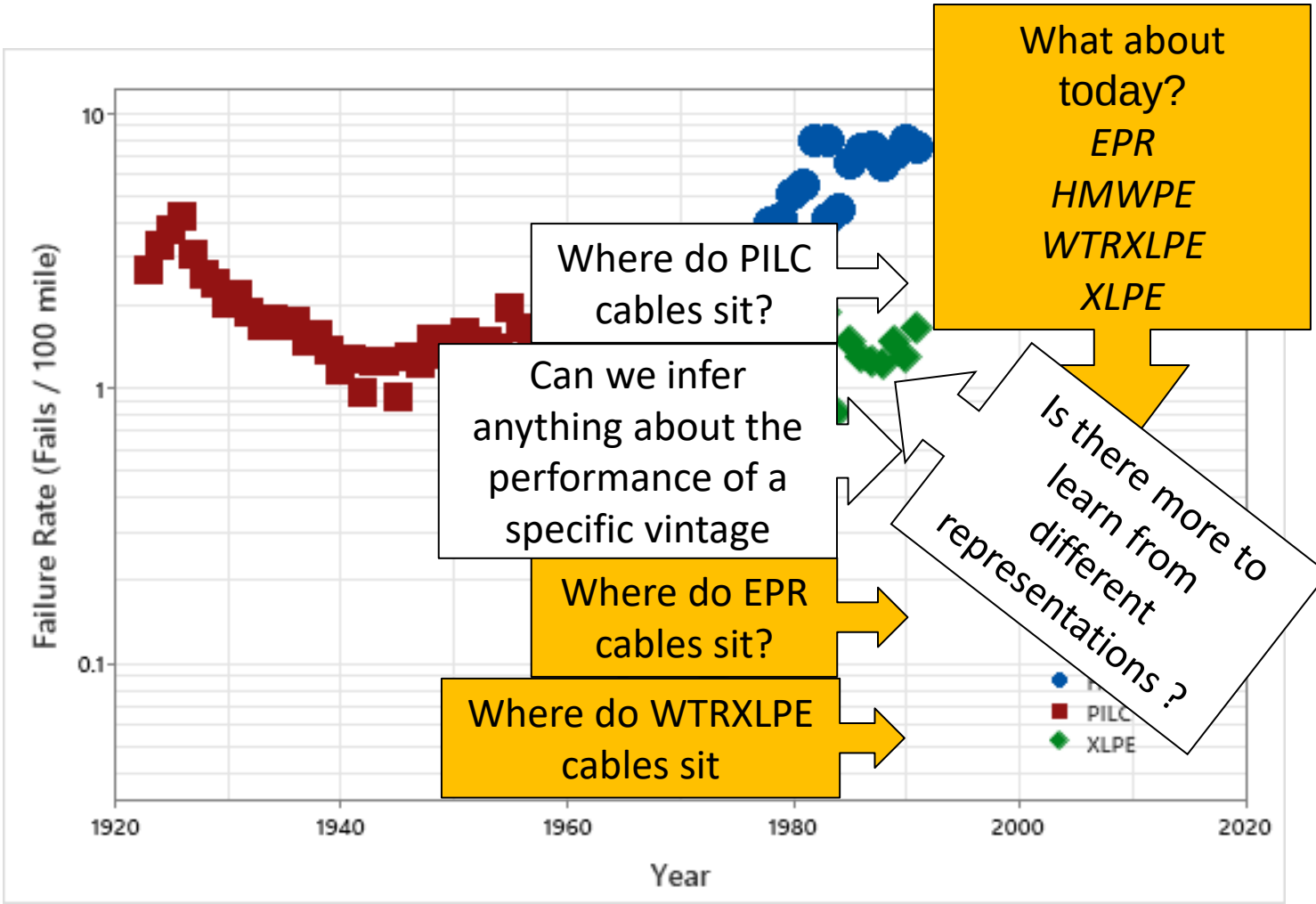

“Findability Challenge” - No EPR / WTRXLPE Processing

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Fall 1990
Subcommittee V
Page 28 of 378 in the minutes

Repeat for 1985, 86, 87, 88, 89, 91

V - c

P. Bolin reported that CIGRE has produced a draft paper on arc by-products. The paper recommends that IEC put together a guide on handling of arc by-products. T. Aabo reported that the failure of the EPRI tubular insulated cable test section was most likely caused by contamination. The economics for a cable of this type is not favorable, and the project has been terminated. D. Nichols reported on a fault of a BPA 500 kV gas bus, 350 ft. long. Inspection showed a broken insulator, but no indication of a fault associated with this. Connectors at the fault site had melted and a hole burnt in the conductor. A temporary overhead by-pass was arranged. D. Nichols also reported on the progress of the BPA/ABB testing of DC Gas Insulated Substation equipment, now in progress at the Dalles. The equipment is undergoing a +/- 500 kV soak test with polarity reversals every seven days. A paper provided by Mr. Nichols describing the BPA test program is attached (see Appendix V-A). S. Dale reported that CIGRE TG 15-03, Insulating Gases, has determined that the most important subject for gas insulated equipment now is diagnostic techniques. A round robin test on various partial discharge and particle detectors was discussed, including a UHF coupler developed by B.F. Hampton in the UK. S. Dale also reported on the formation of a cooperative research and development agreement to investigate detection techniques, sampling methods and mitigation methods for S_2F_{10}, a toxic by-product that can be formed under corona and arcing in gas insulated equipment. The research will be funded by the U.S. DOE, EPRI, ESEERCO, Canadian Electrical Association, BPA, TVA, and Ontario Hydro, and will be performed at the National Institute of Standards and Technology, Oak Ridge National Laboratory and Ontario Hydro.

A new project will be started which will determine reliability of SF_6 gas cables in North America.

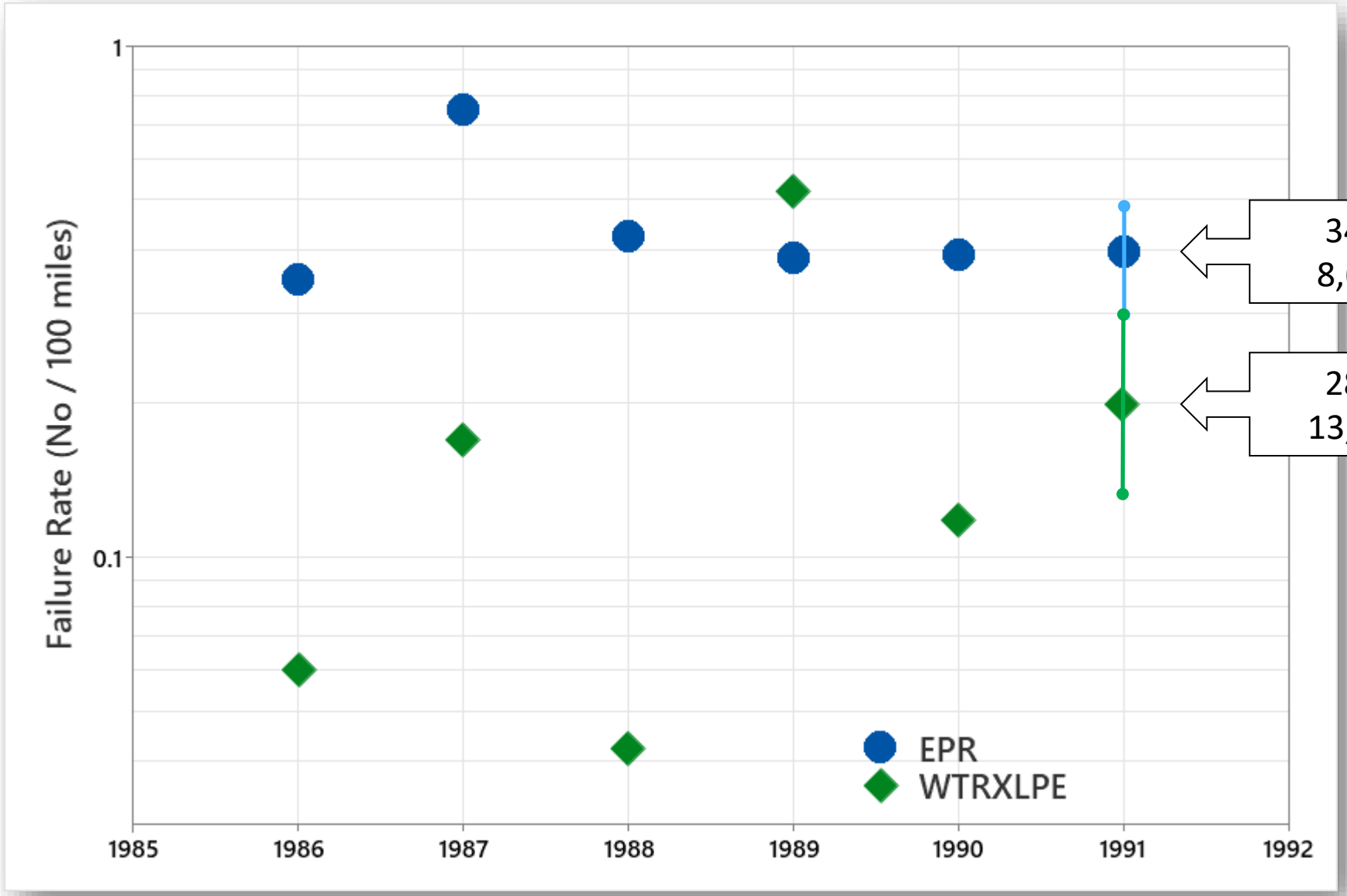
5-25 - PERFORMANCE OF EXTRUDED DIELECTRIC MATERIALS - DR. JOHN TANAKA

John Tanaka, University of Connecticut, reported that the November 5, 1990 meeting of Working Group 5-25 was called to order at 10:00 am. The number of members and guests signing the attendance sheets was 271. Seventy nine (79) of those signing the attendance sheets were first time attendees based on the present attendance records which were initiated in the Spring of 1983. Because of the tight schedule, the introduction of attendees was not done.

John Smith of CPI-Reynolds pointed out that the minutes of the previous meeting should be corrected in the first sentence of paragraph two of page V-c to read ". . . for the room temperature of 35°C +/- 2°" rather than +/- 4° as stated in the minutes.

Al Kong of Pacific Gas & Electric reported on the AEIC cable failure survey results for 1989. There were 23 utilities responding. The survey did not include dig-ins, splice and termination failures, or cables operating under 5 kV. The data are shown in Appendix V-B. The classifications used are the insulation type, jacketed or unjacketed, duct or direct buried, less than 40 V/mil or greater than 40 V/mil. The data indicates that for cross-linked polyethylene cables, the jacketed constructions are doing much better than the unjacketed. For unjacketed cross-linked polyethylene cables in duct or direct buried, the failure rates were higher for those cables operating at a higher stress. The 1989 data for unjacketed HMWPE showed that stress is a significant factor. Failure rates were higher for those cables at higher stress. The unjacketed HMWPE cables in ducts were performing better than those which were direct buried. The three year averages from 1987 to 1989 were plotted. For tree retardant jacketed cable in duct greater than 40 V/mil, there were two failures for 815 conductor miles. For tree retardant cable, jacketed, direct buried, and operated at greater than 40 V/mil, there were 49 failures for 9001 conductor miles. For tree retardant XLPE cables unjacketed, direct buried, greater than 40 V/mil, there were 10 failures for 2286 conductor miles. For EPR cable jacketed, direct buried, and operated at greater than 40 V/mil, there were 19 failures for 4129 conductor miles. For EPR cables which were unjacketed, direct buried, and operated at less than 40 V/mil, there were 10 failures for 539 conductor miles. For EPR cables which were jacketed, in duct, and greater than 40 V/mil, there were two failures for 1086 conductor miles.

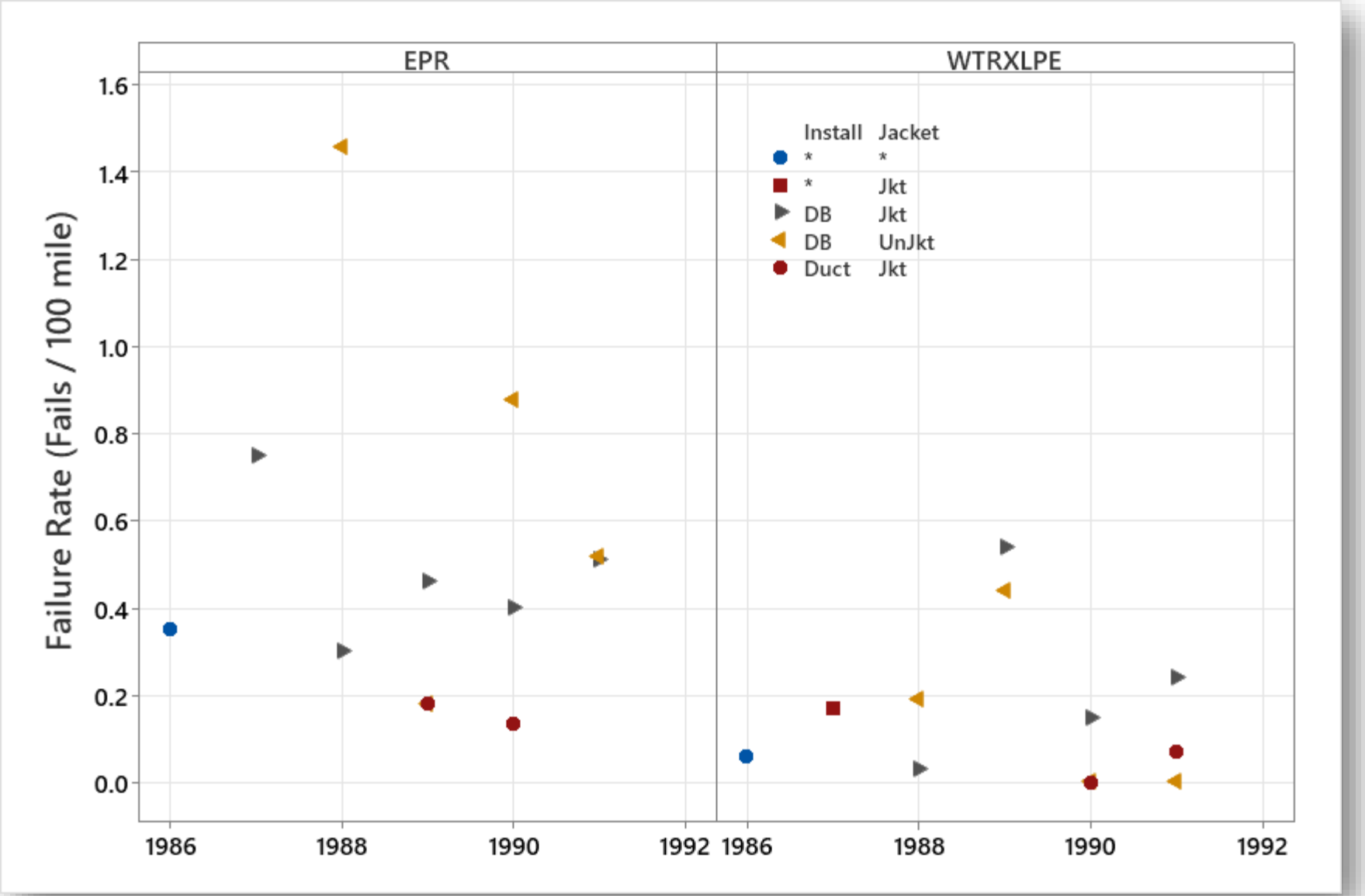
Failure Rate Estimates



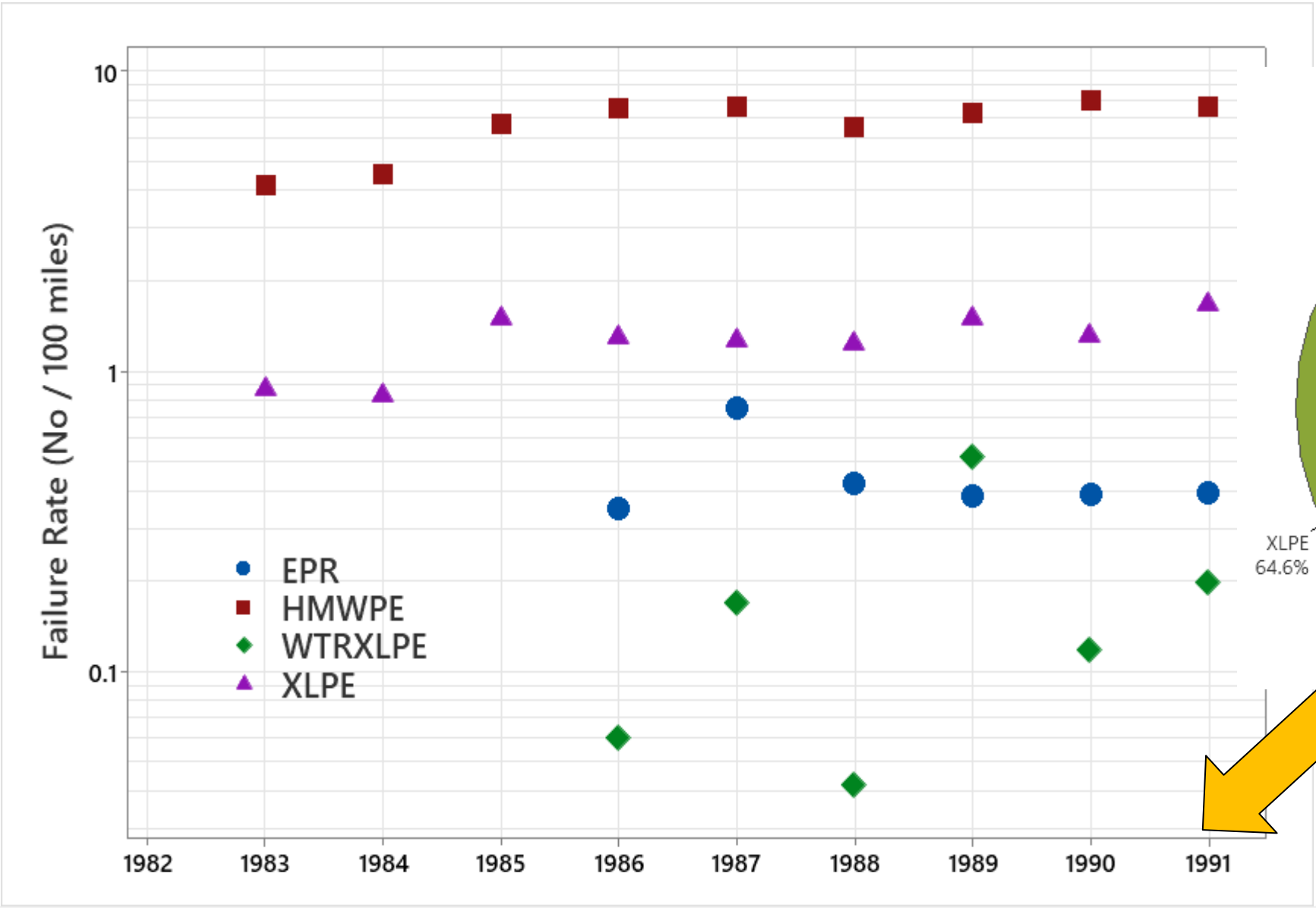
34 failures
8,600 miles

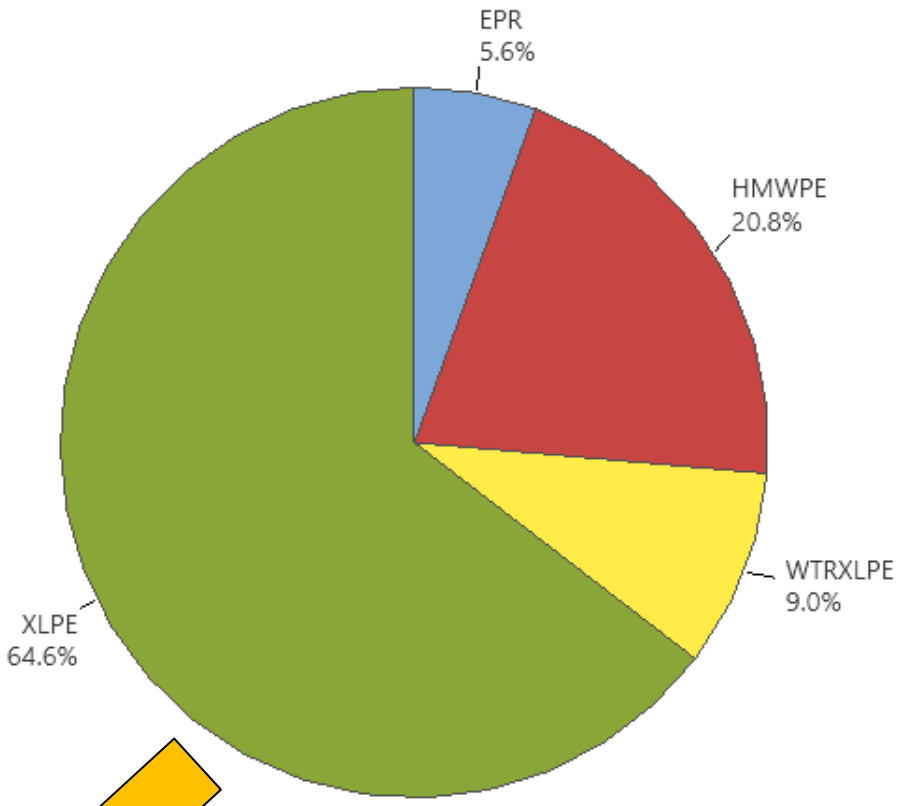
28 failures
13,900 miles

Some Information on Design & Installation



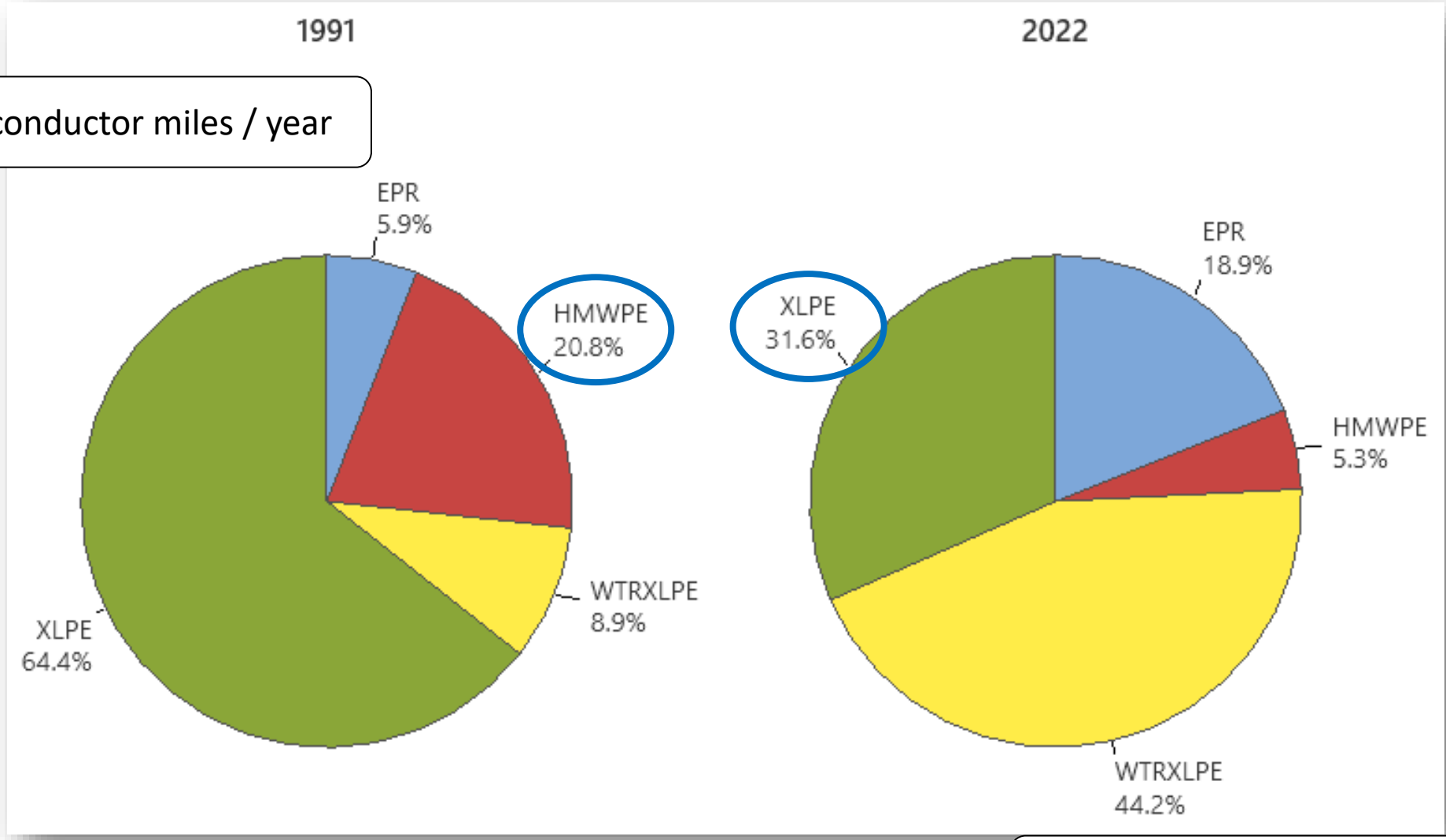
Complete AEIC data





Population Comparison

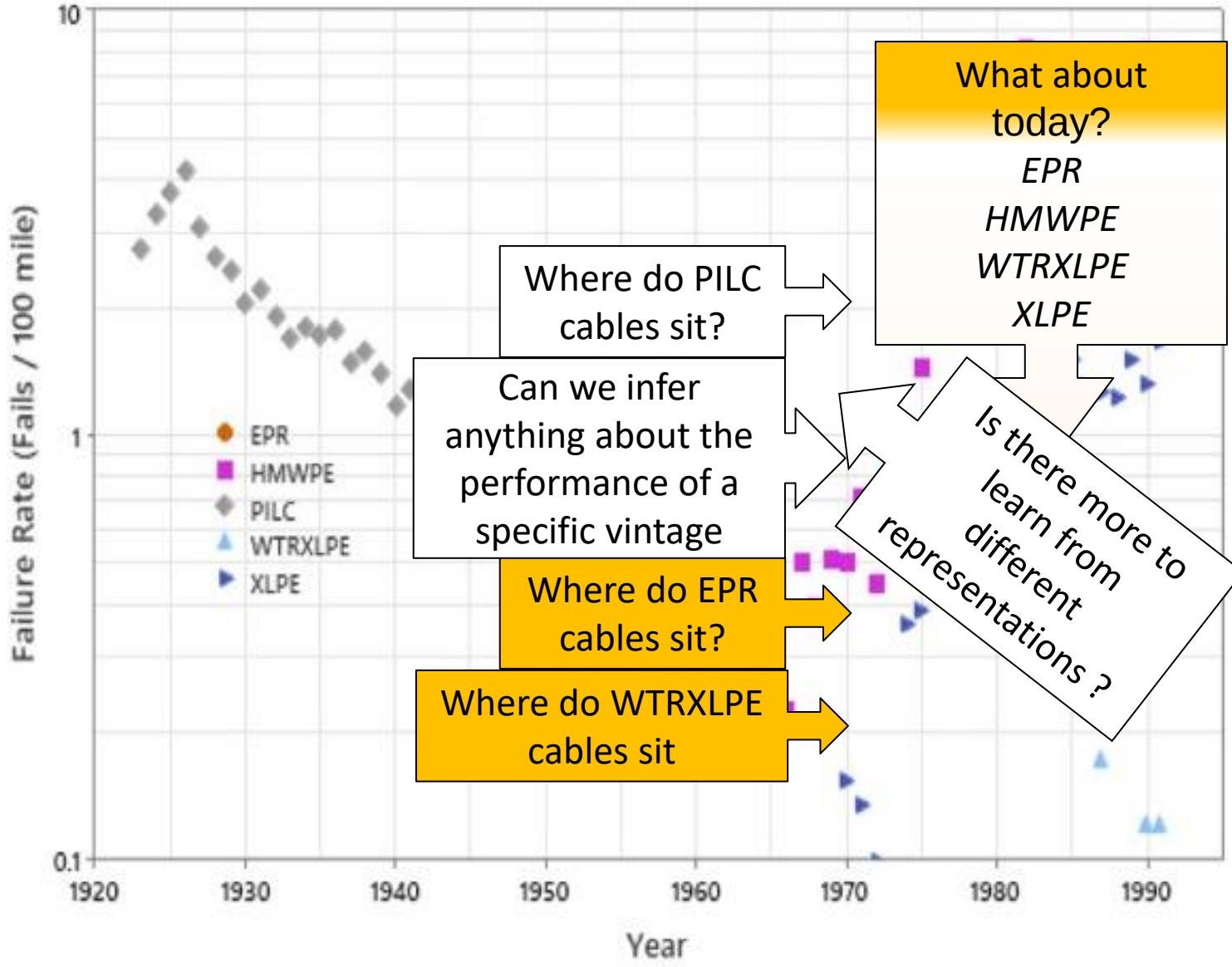
2.7 failures / 100 conductor miles / year



<2 failures / 100 conductor miles / year

Wrap Up

- Legacy systems (>35%) remain important
- We need to understand their performance
- **ELECTRIFICATION** means that we will be operating them quite differently in the near future
- Work is required in this area
- Knowledge within the ICC Minutes can assist – *findability is important*
- There are still questions



Nigel Hampton has more than 30 years of experience in the MV, HV & EHV cable field at BICC in the United Kingdom, Borealis in Sweden, NEETRAC, UL Solutions and currently EPRI in the United States.
Nigel currently

- Chairs IEEE400.0 Field Testing Techniques and IEEE400.2 Field Testing using VLF Sources.
- Serves as the Technical Advisor to the AEIC Cable Engineering Committee since 2008.
- Is the US Member of the CIGRE B1 RAG