

VLF/AC Withstand Testing at NEETRAC

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Test Objective

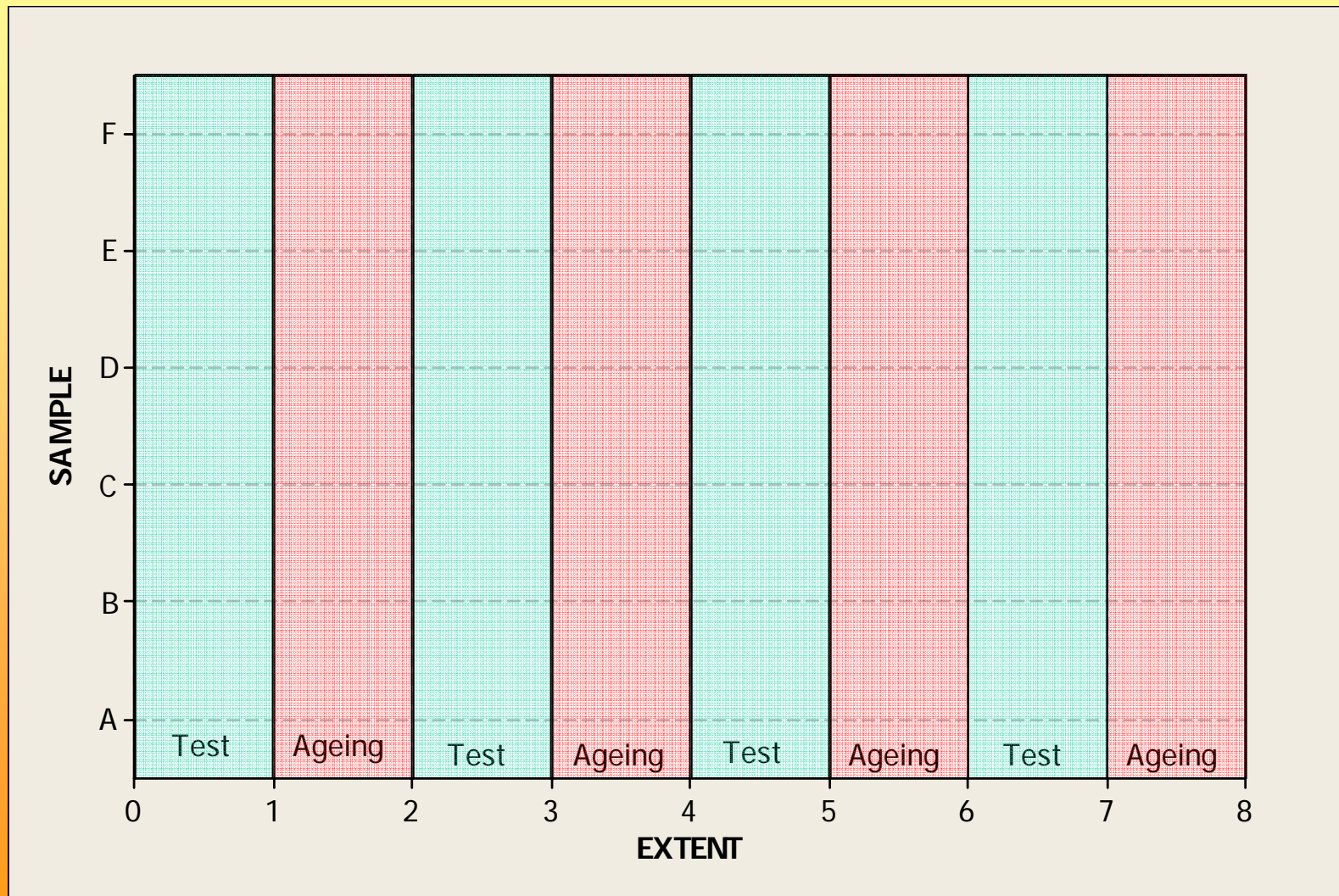
- To understand the appropriate withstand voltages and durations.
 - Existing standards unclear (IEEE 400 / 400.2)
 - Current practices vary greatly between utilities.
- To investigate the possibility that VLF voltages could deteriorate otherwise healthy cable (hypothesized from effect of DC voltage on XLPE insulation and anecdotal reports)

Voltage Withstand Test Program

Utilized 12 lengths of 1973 vintage,
15 kV, XLPE cables from Exelon

Sample Set	Length [ft]	Samples Tested	Withstand Test Condition			
			Test Voltage [U ₀]	Sinusoidal Freq (Hz)	Application Duration	
					Time [mins]	Cycles
A	280	Field Aged XLPE Insulated Cable	Control – aging only			
B	280		2.2	0.1	15	90
C	280		2.2	0.1	120	720
D	280		2.5	0.1	60	360
E	280		3.6	0.1	120	720
F	280		3.6	60	0.25	900

Test Sequence



Elevated Voltage Test Equipment



Voltage up to to 26 kV

Voltage up to 40kV



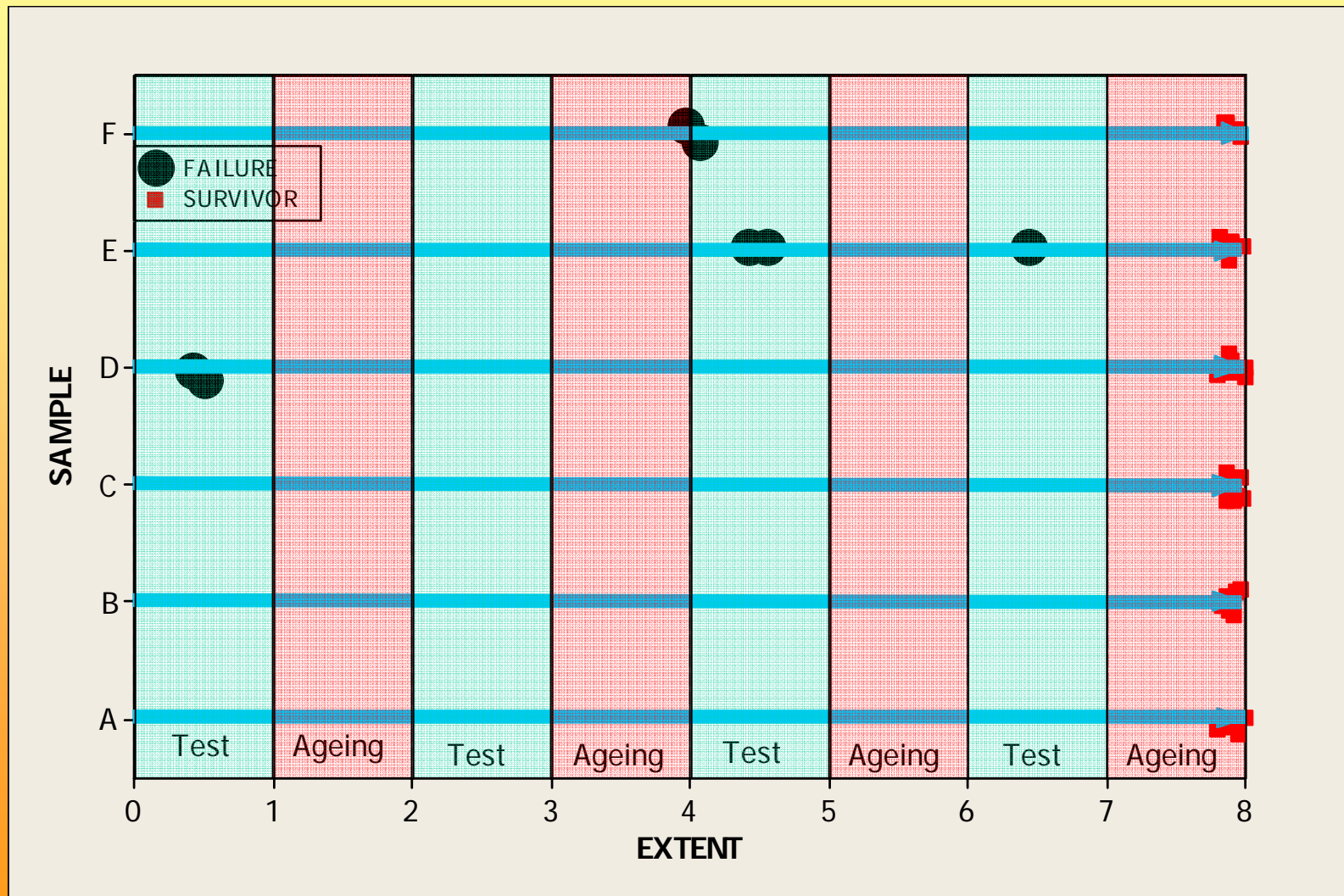
Test Underway

Samples

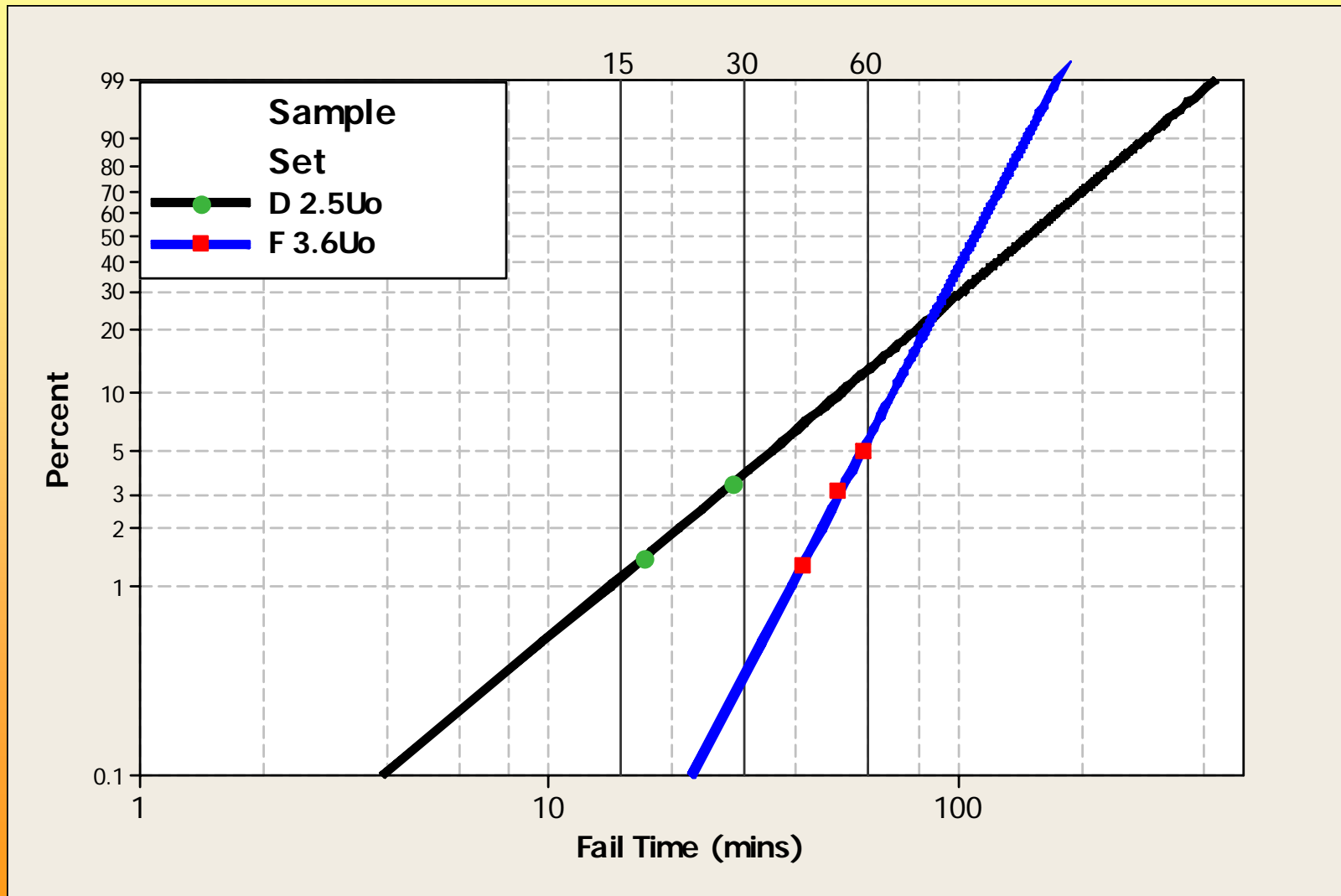


Test
Tanks

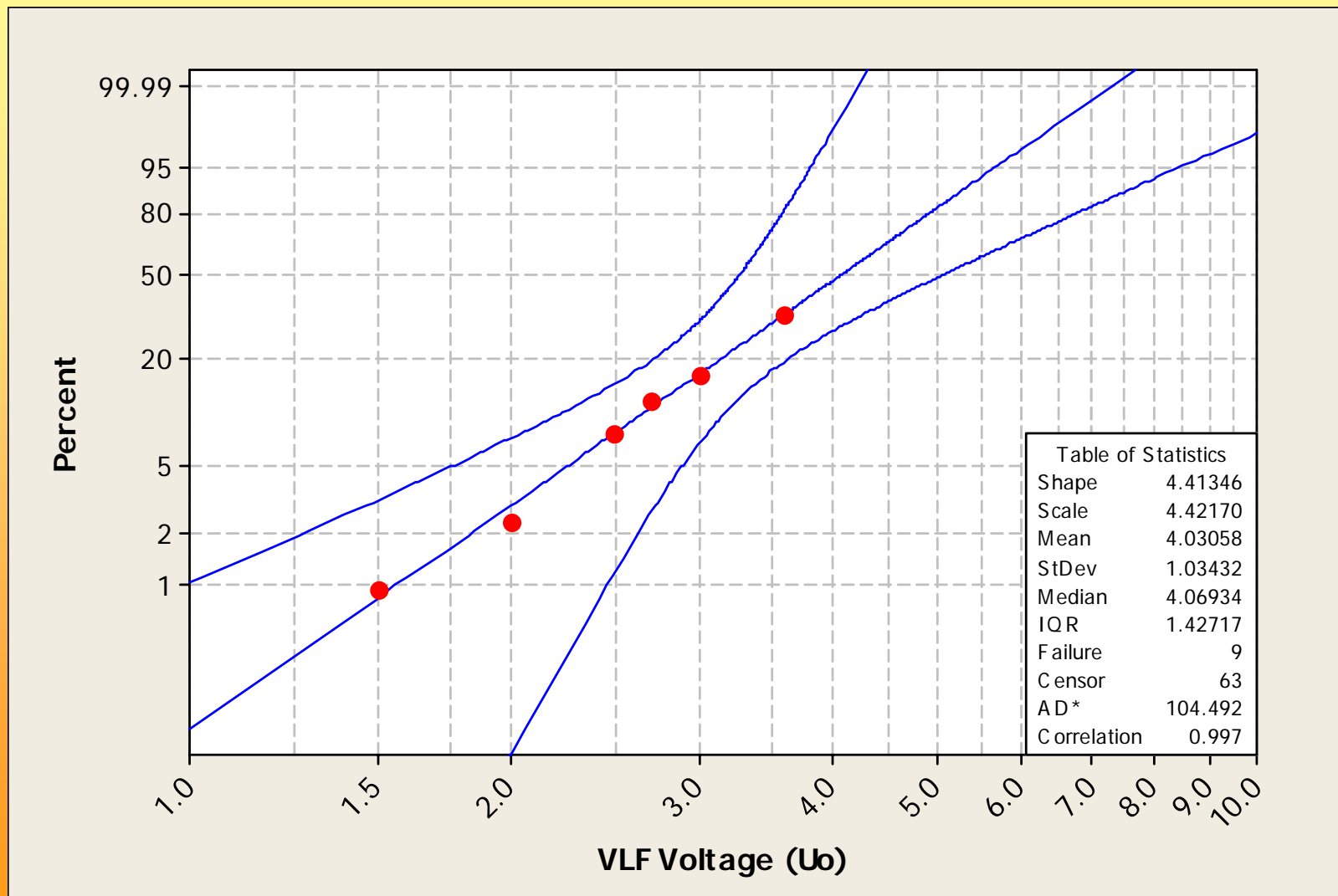
Failure Data



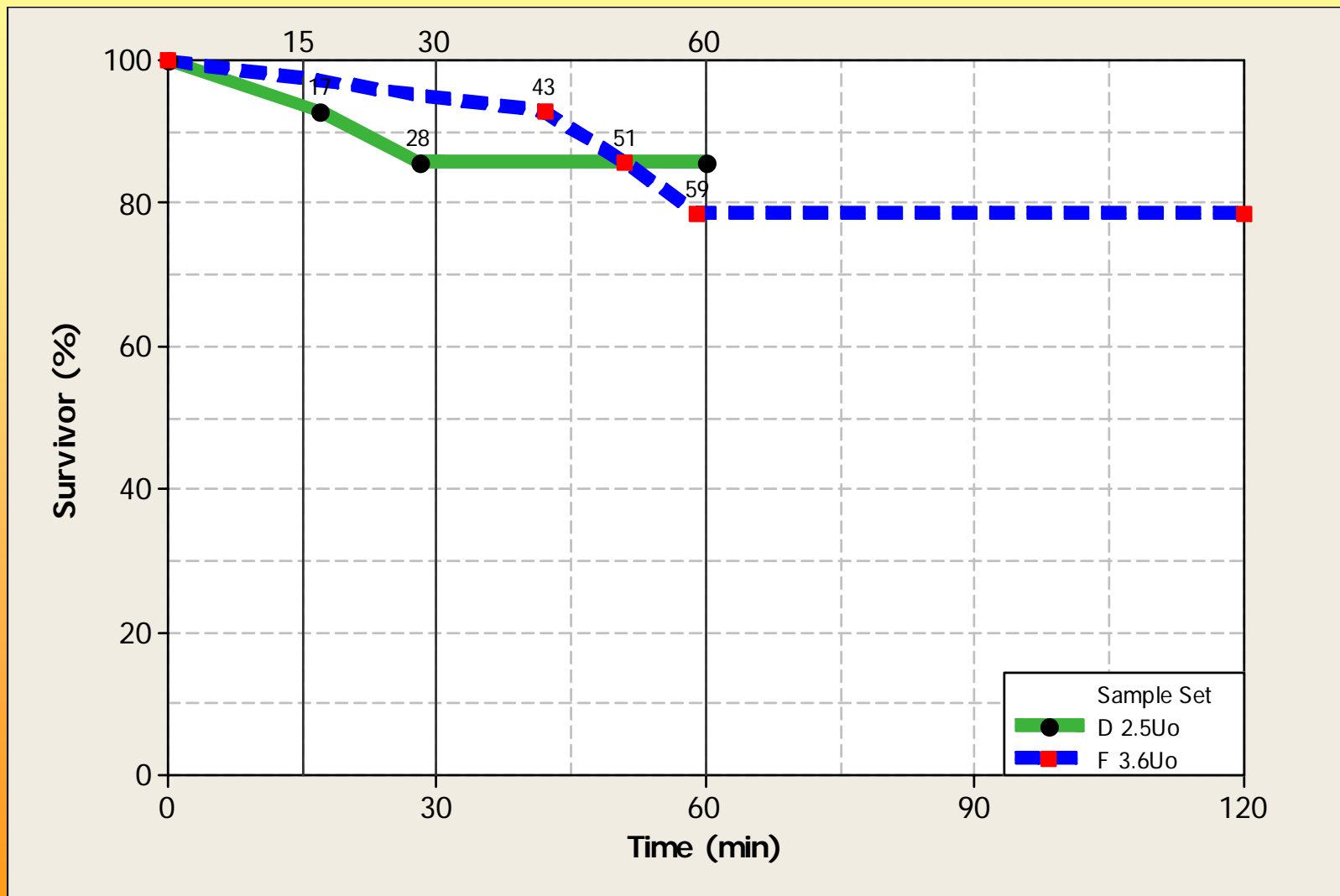
Failure Time Data



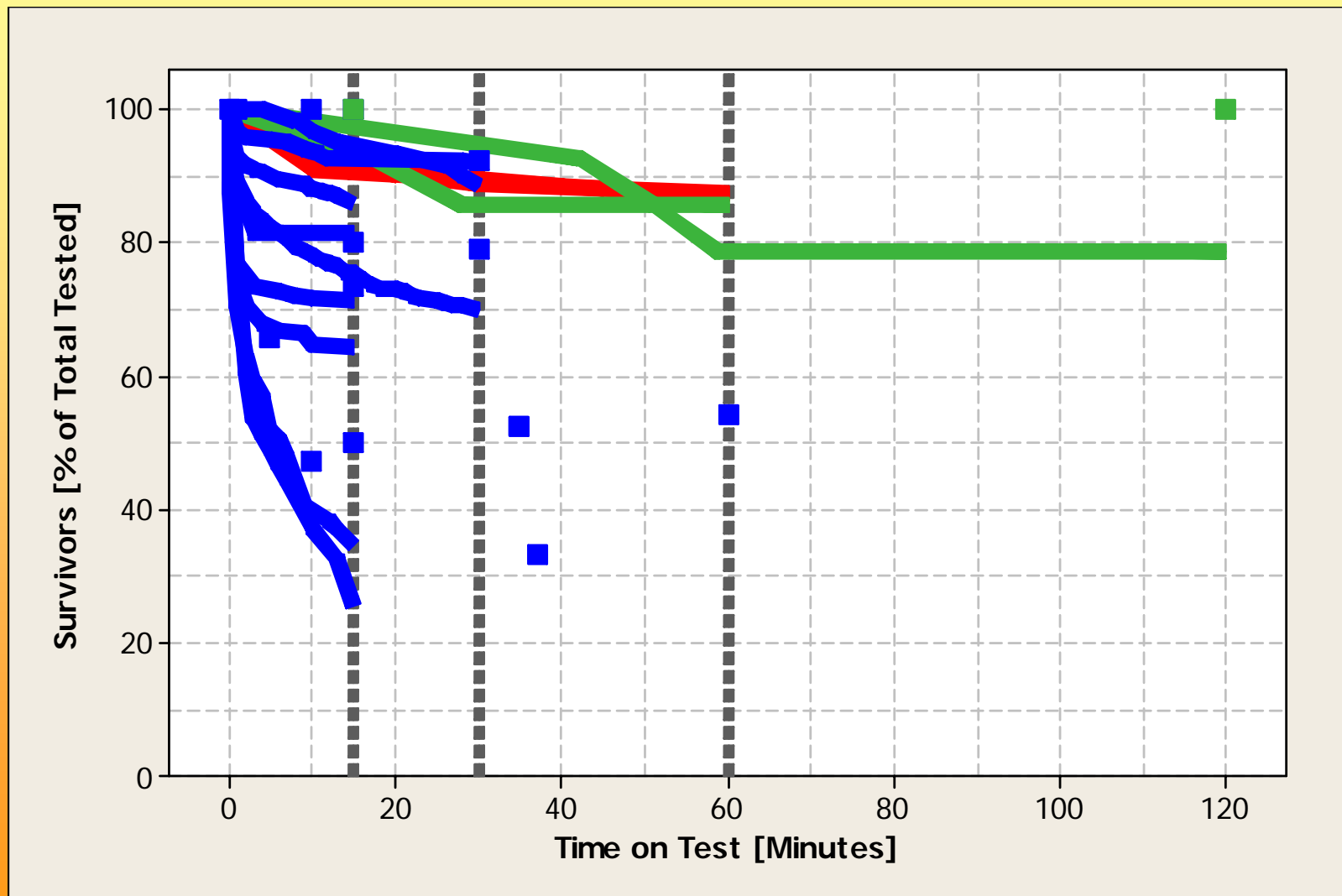
NEETRAC VLF Failure Data



Survival Curve



Failure data in utility context



60 Hz Failures

- These are useful in understanding the condition of the cable samples
- Unintended failures occurred at 28 kV and 32 kV.
- For 15 kV cables, this suggests breakdown strengths of approximately 160 to 180 V/mil.
- These values would be considered characteristic of **well-aged cable**.

Summary

- 5 failures on test.
 - All failures occurred between 15 and 60 minutes.
 - Withstand tests were conducted out to 120 minutes
- No samples failed during the aging periods.
- Time of failure data has been germane.
 - Ageing mechanism is responsible for failures on test.
 - Lab data may fit well with field data.
- Cable samples contain trees and have low strengths.

Acknowledgements

- Exelon – supply of cable samples
- HV Inc (Mike Peschel) – loan of VLF test equipment
- Martin Baur, Craig Goodwin, Ben Lanz, Frank Petzold, Henning Oetgen – valuable discussions
- This material is based upon work supported by the Department of Energy under Award No DE-FC02-04CH1237