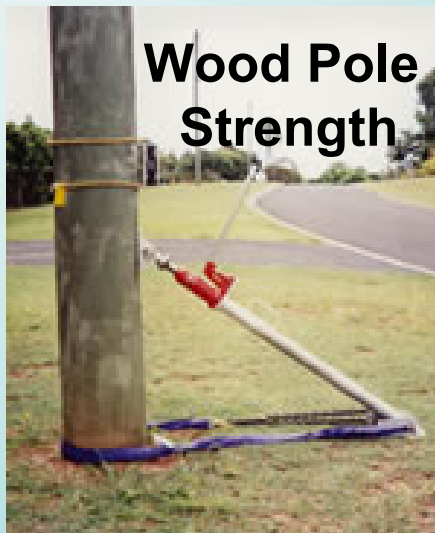




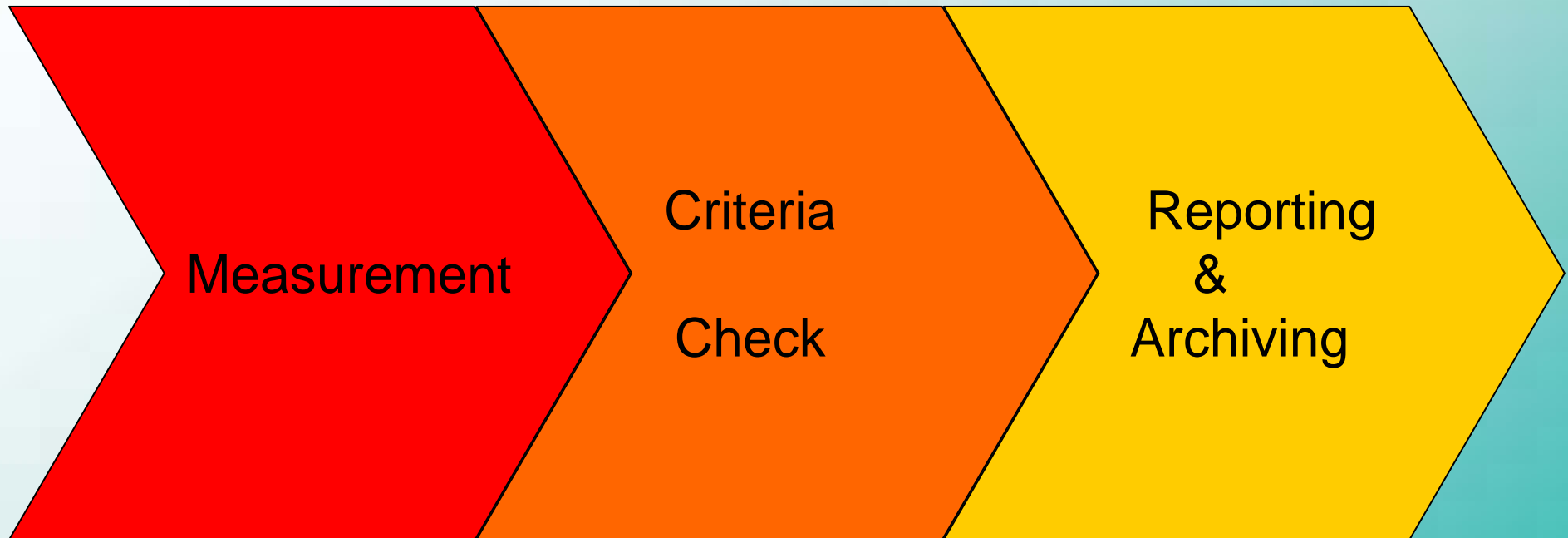
Methods to Determine Critical Levels for Diagnostic Tests

**J. Goldenburg, R.N. Hampton, J. Perkel, &
C.M. Riley
NEETRAC**

What diagnostics are we talking about



What is the diagnostic process



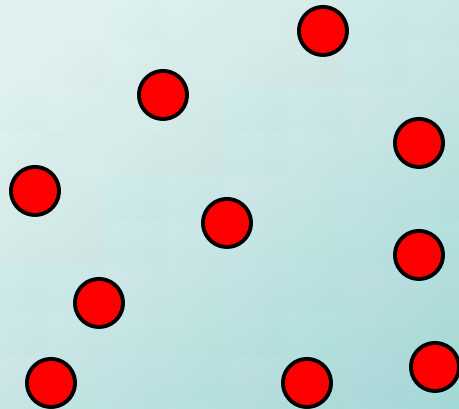
This talk is about how we determine the criteria

Objective of Diagnostic Tests

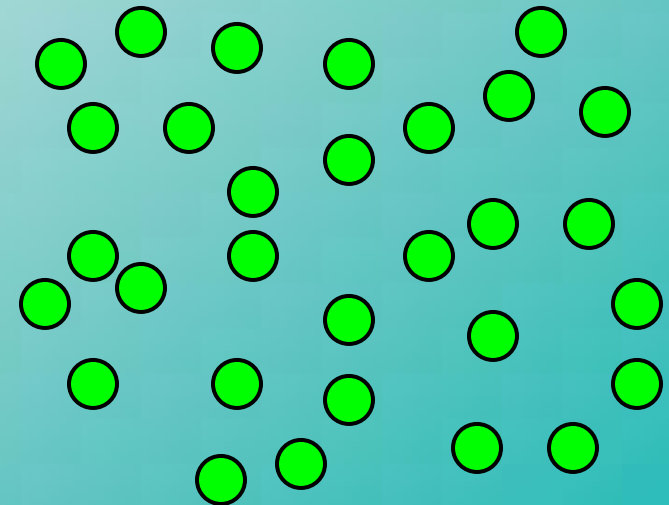
The target population contains both “Good” and “Bad” components

- “Good” – Will not fail within diagnostic time horizon
- “Bad” – Will fail within diagnostic time horizon

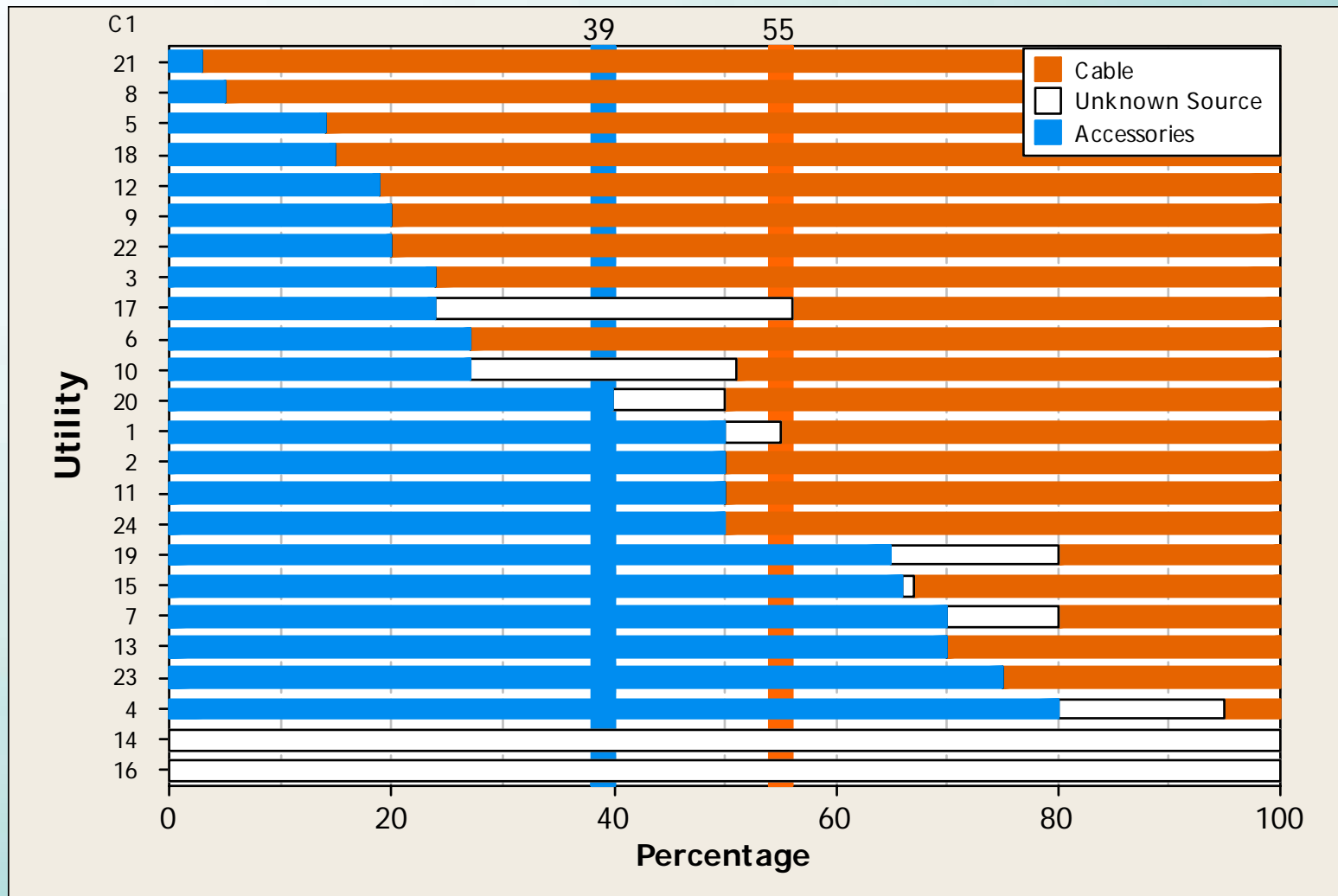
“Bad” Components



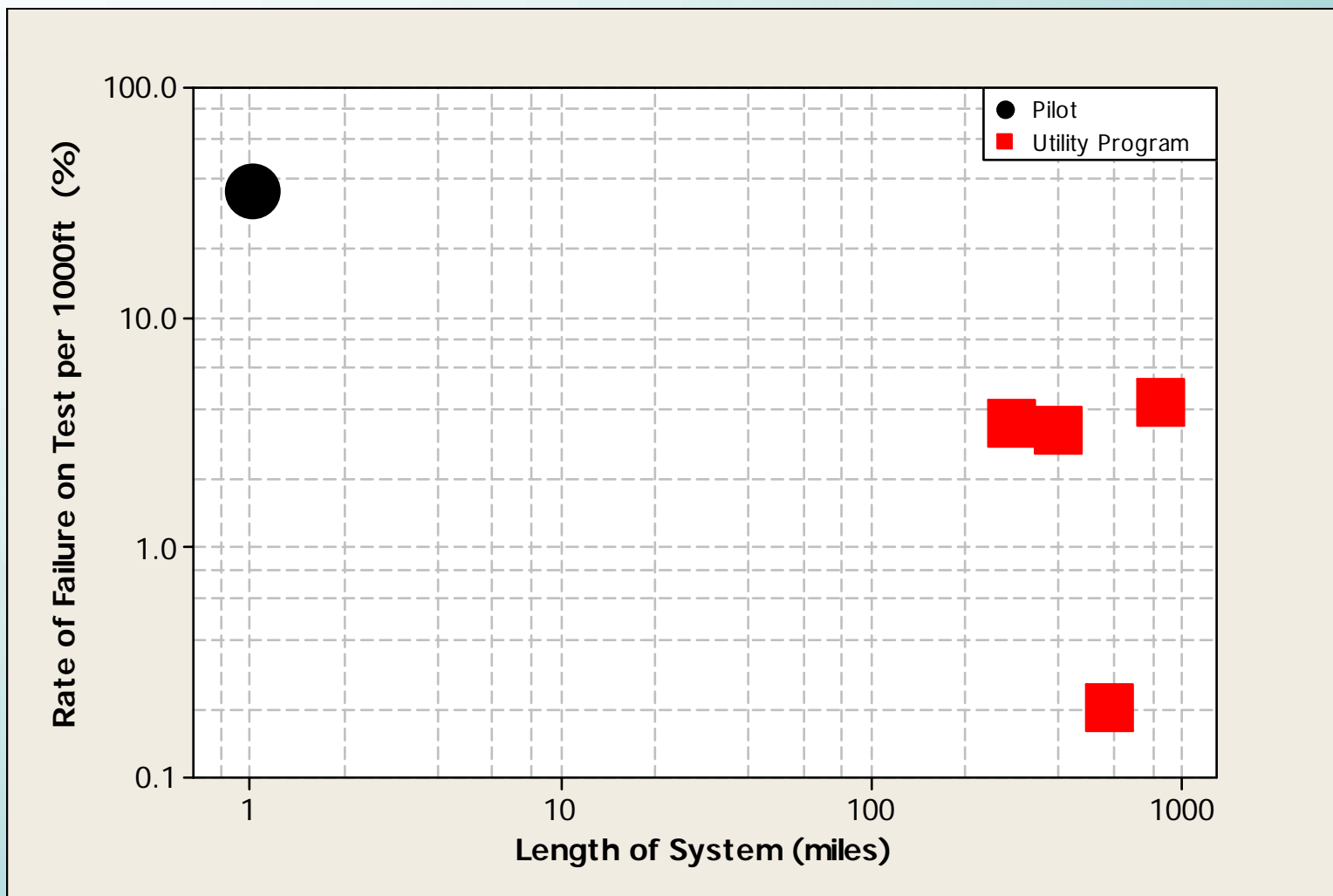
Target Population “Good” Components



Can we not use prior experience?



Care required with experience



How to Establish Levels

Darwinian

Utilize all available knowledge and new data to update levels as needed

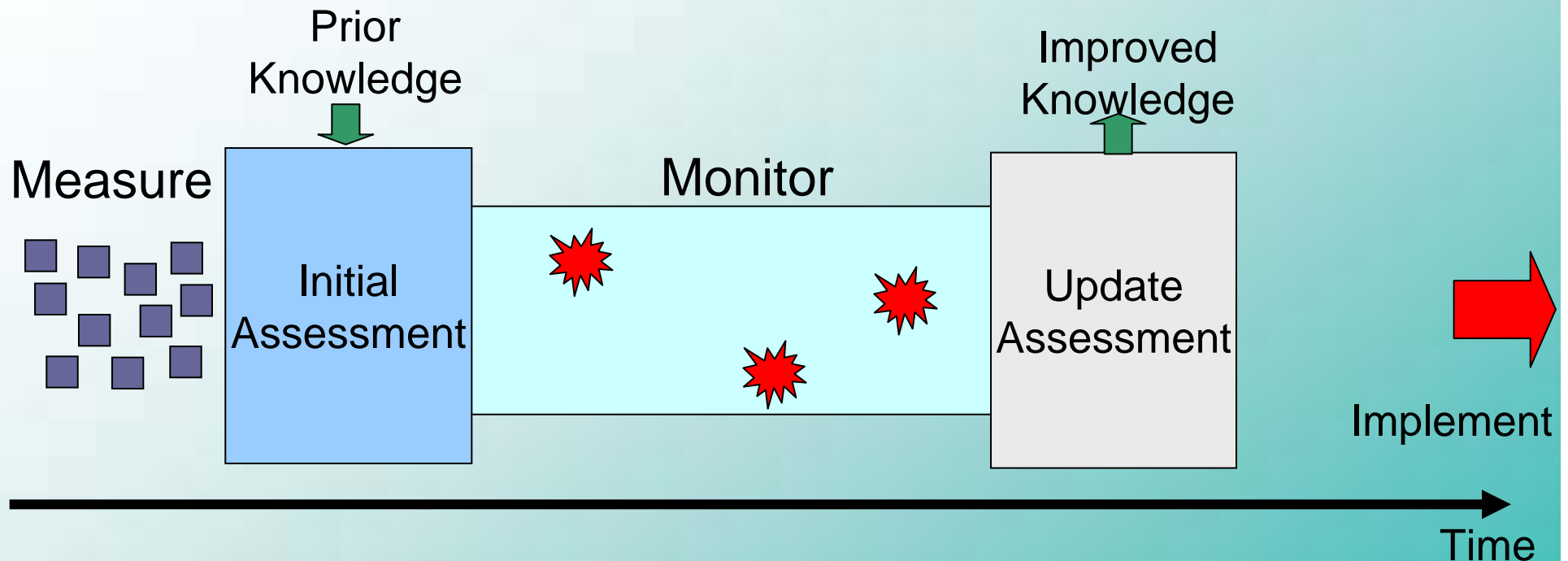
Outcome Segregation

Use service performance after measurement to segregate measurement data

Data Driven

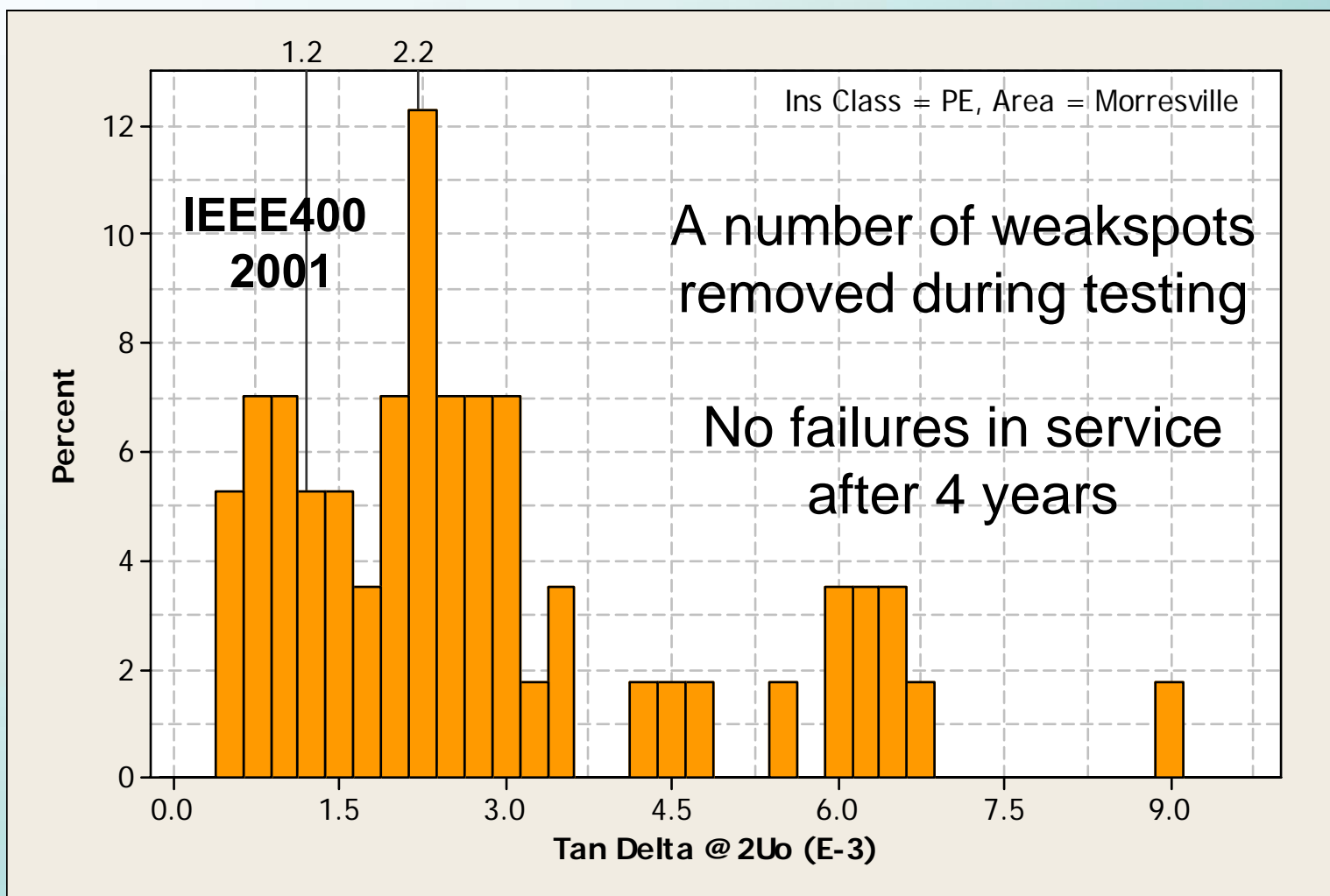
Measurement data “naturally” segregate themselves into distinct classes

Darwinian

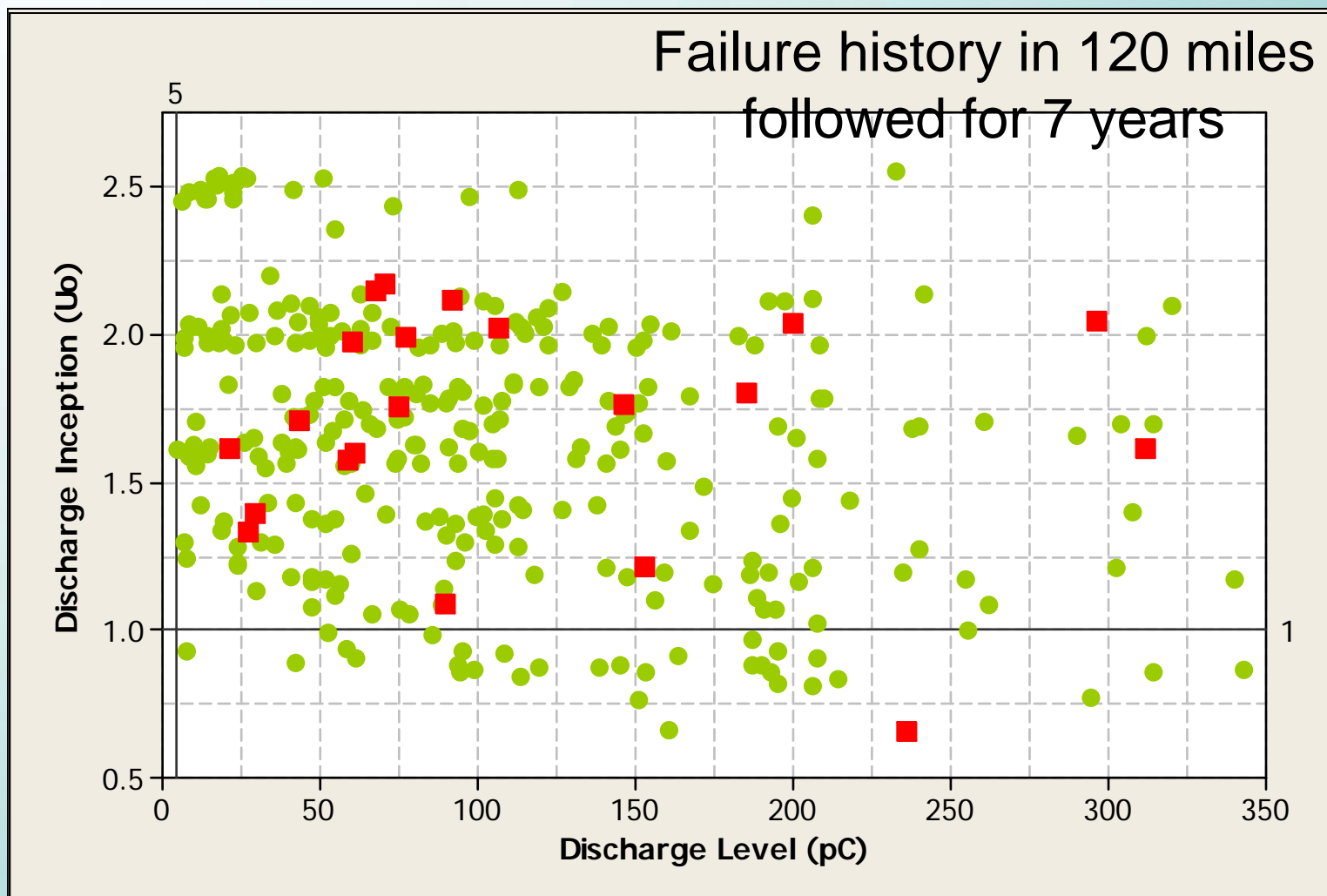


- Prior knowledge used to generate initial assessments
- Levels updated based on service performance or other factors
- Accuracies cannot be determined until levels have stabilized

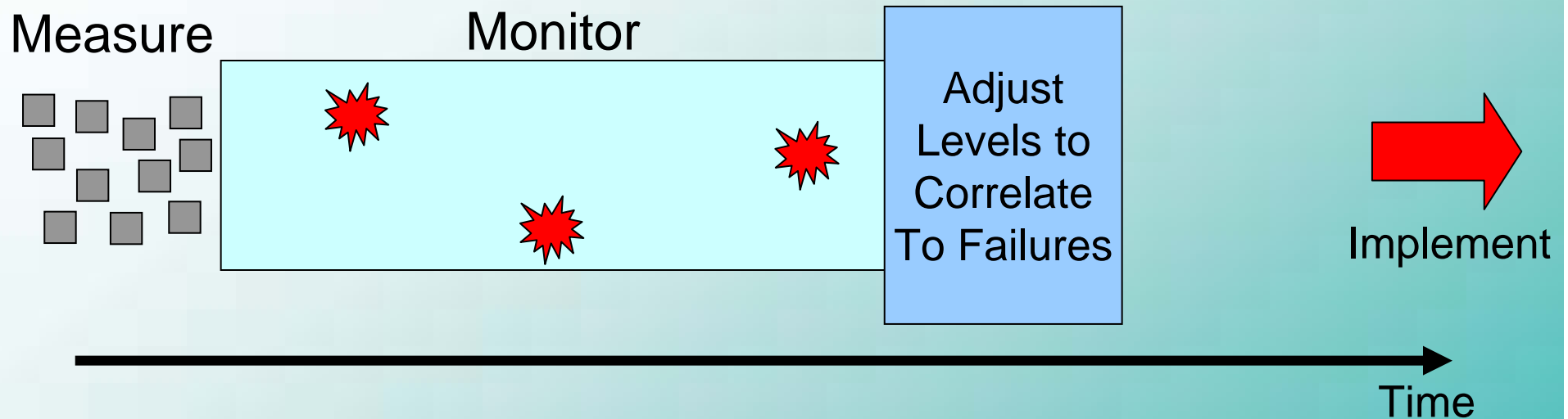
Dielectric Loss Measurements



Partial Discharge Measurements



Outcome Segregation

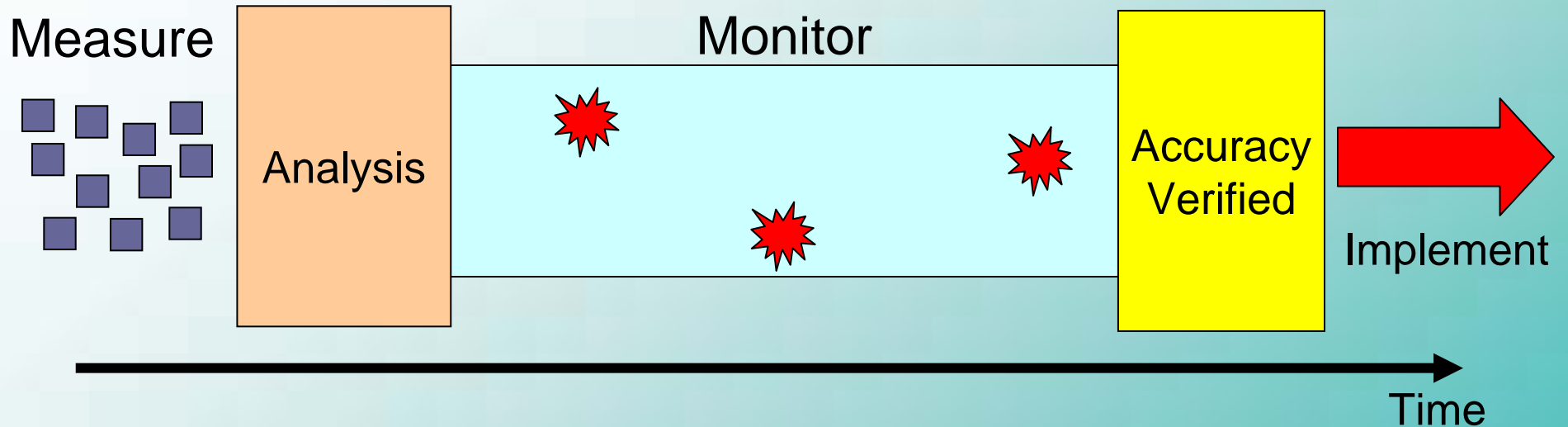


- No prior knowledge of how measurements correlate with failures
- Levels determined after sufficiently long monitoring period
- Accuracies cannot be determined until levels have been set

Problems in the Monitor Phase

- Requires time – you cant implement your diagnostic straight out of the box
- Requires utility discipline
 - Accurate monitoring and communication in the field
 - Hands Off approach
- Requires that you get the selection correct
 - The area has to be bad enough
 - You have to have enough
 - Sufficient diversity

Data Driven

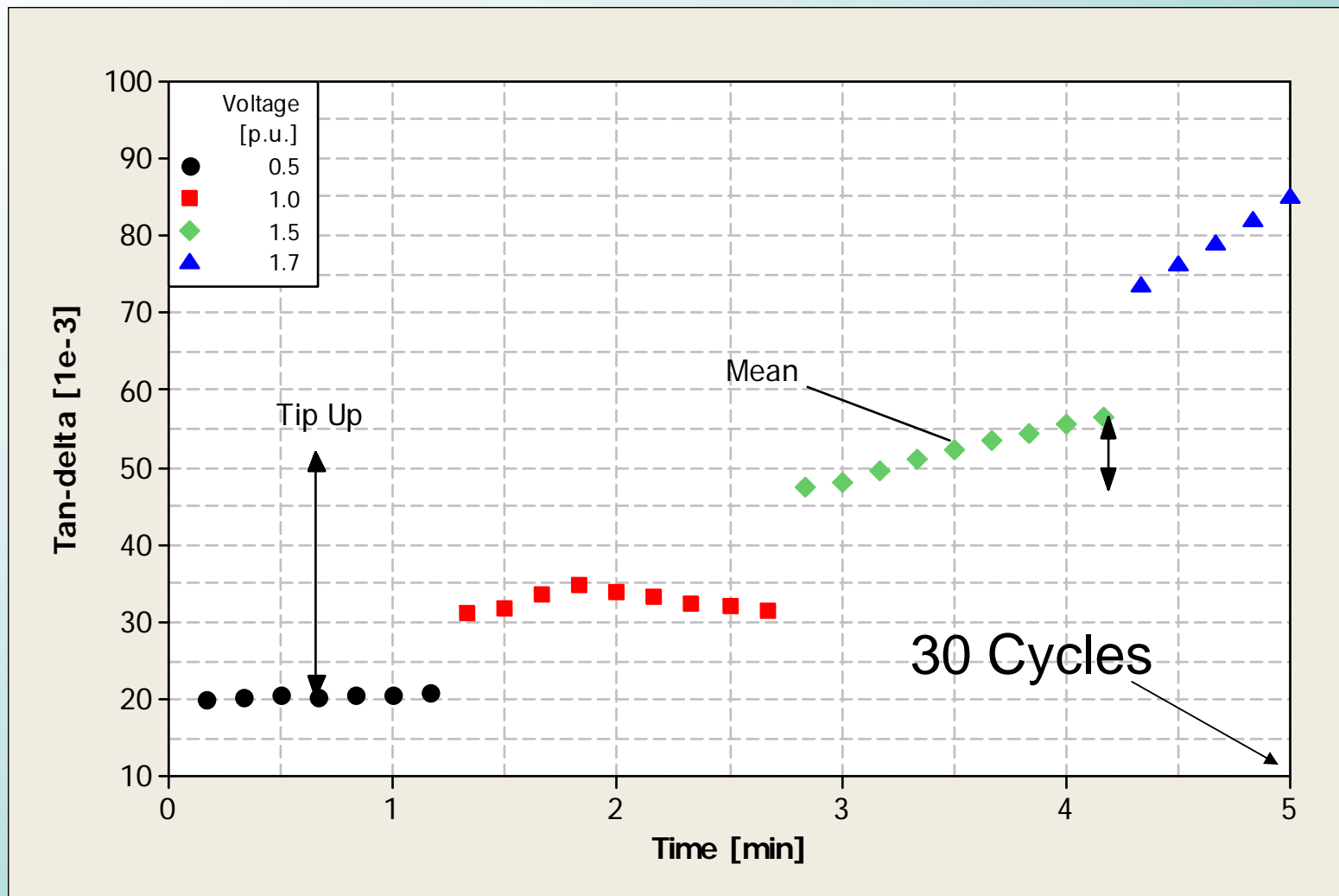


- Data distributions define levels – multiple modes characterize different mechanisms
- Levels determined before monitoring phase
- Accuracies can be determined after monitoring

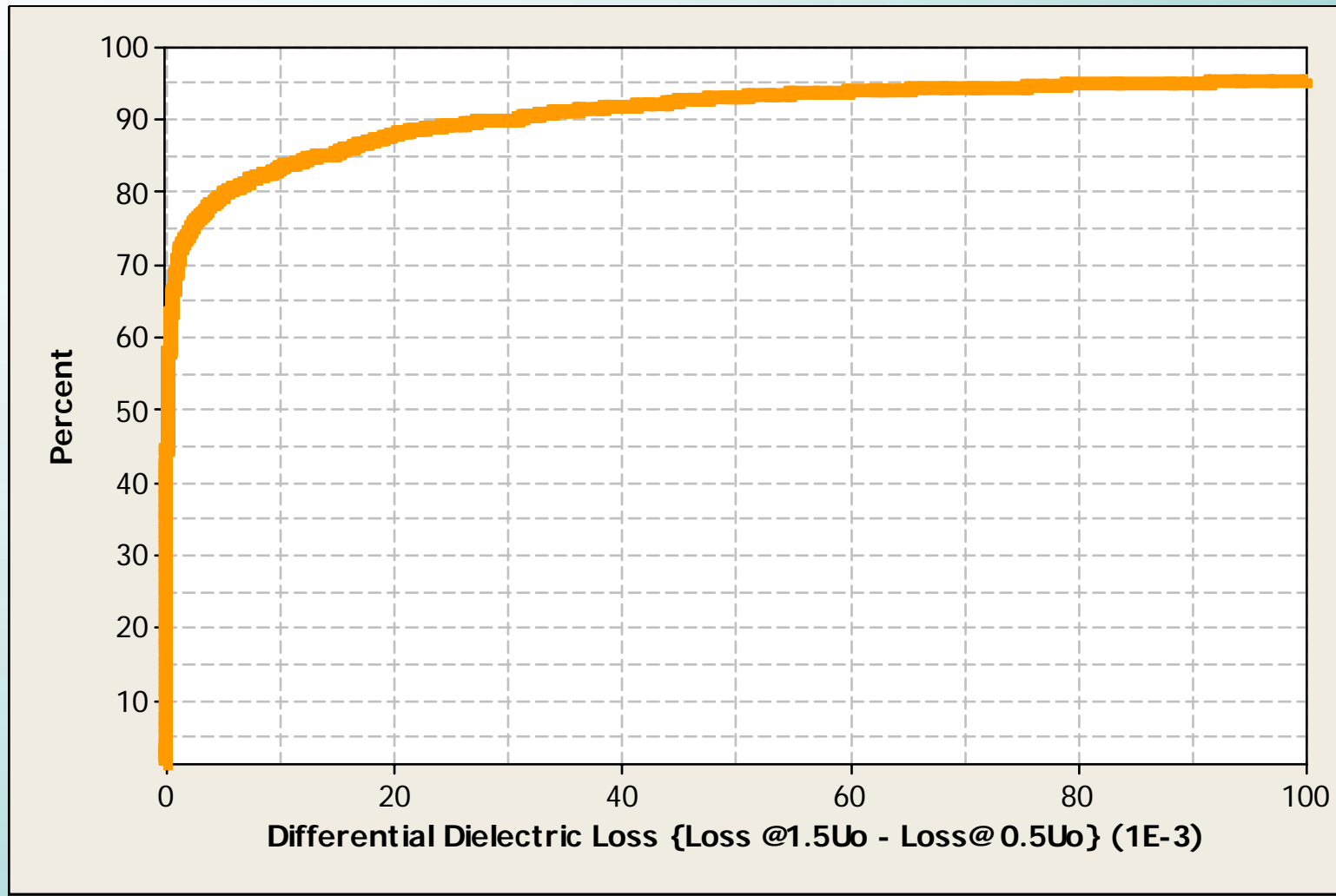
Data Driven

- The Monitor Phase plays a central role
- But not essential
- Understanding becomes important
 - Understanding the structure of the results
 - Understanding the physical concepts

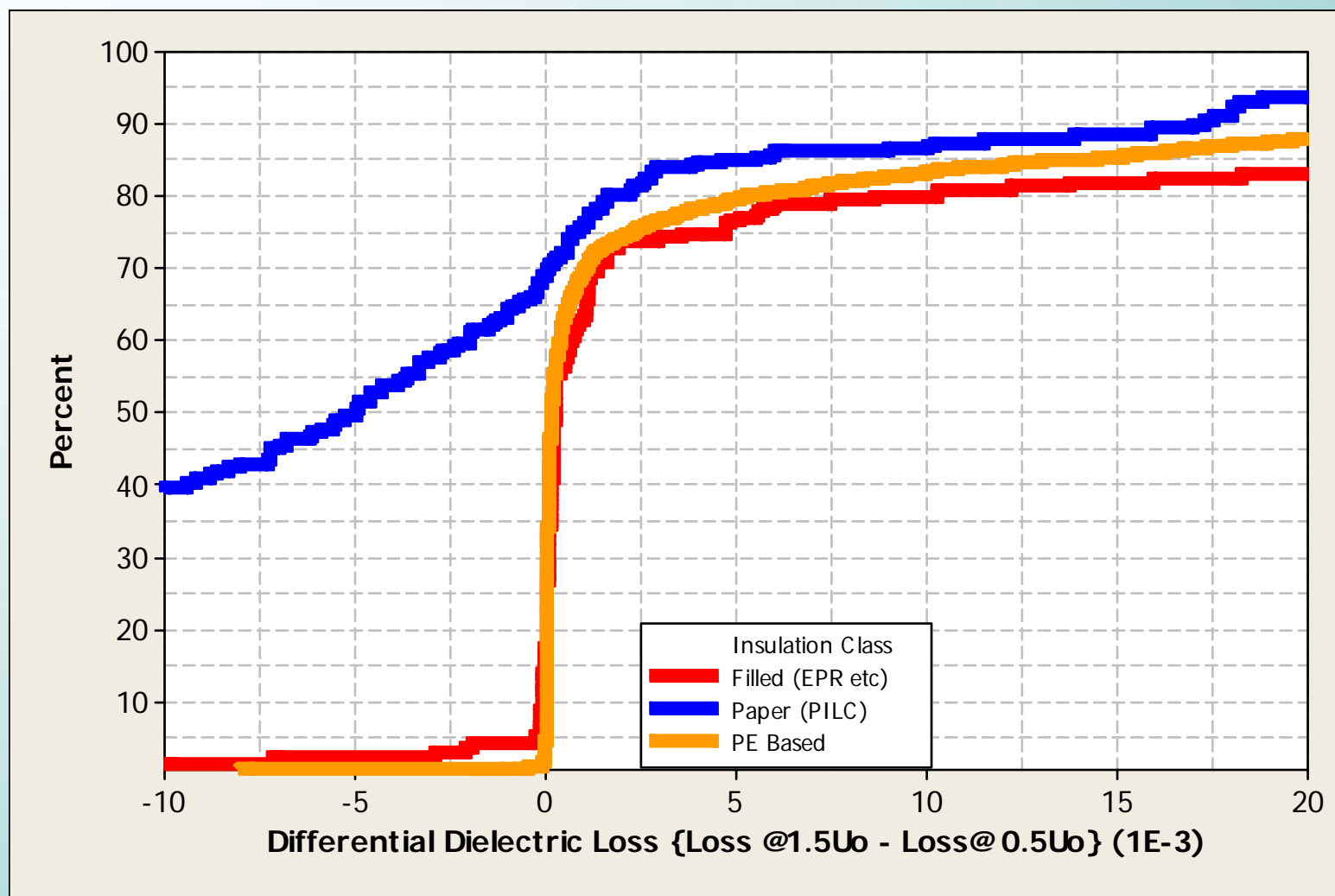
Tan δ Ramp Test Data



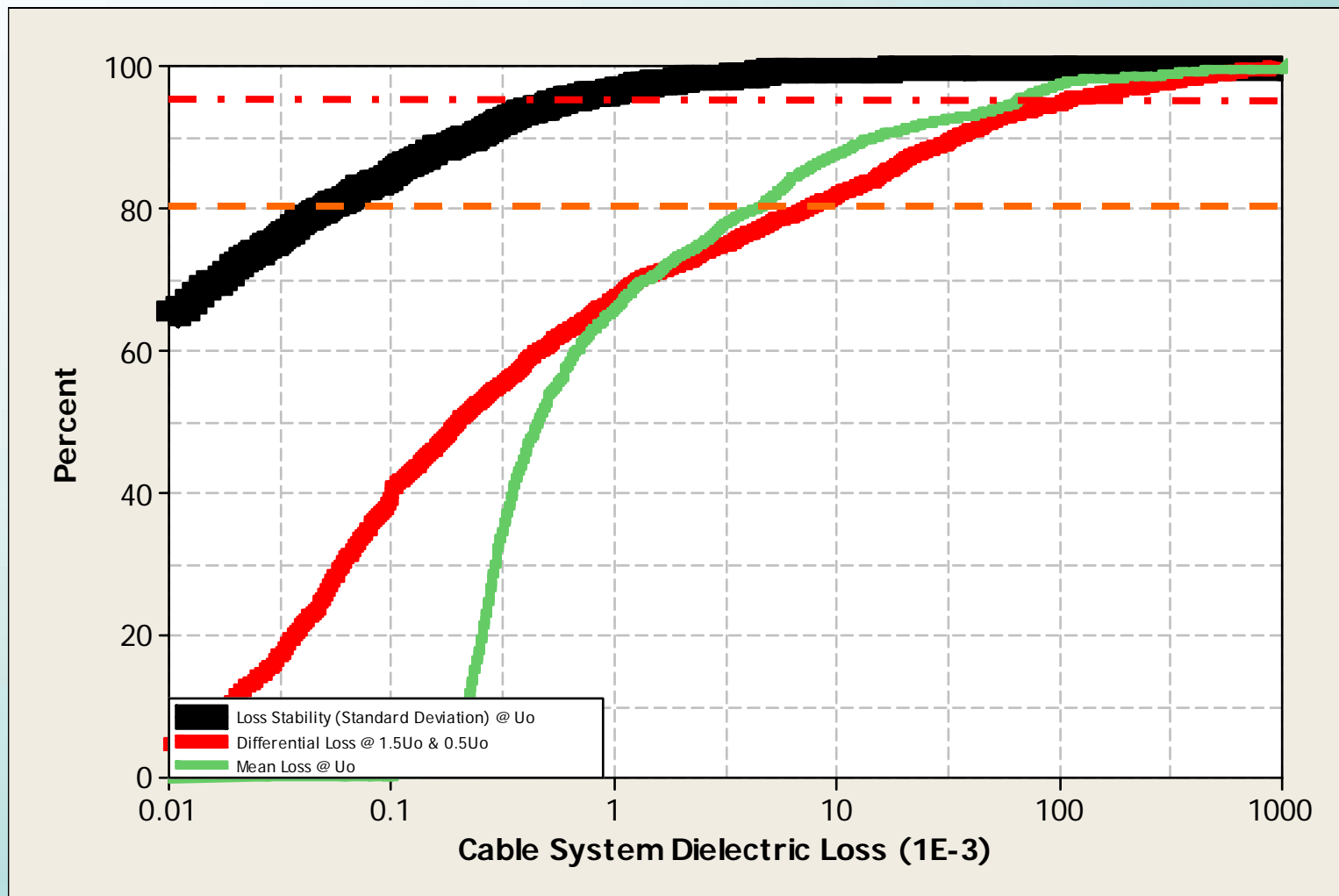
VLF Differential Tan δ of Cable Systems



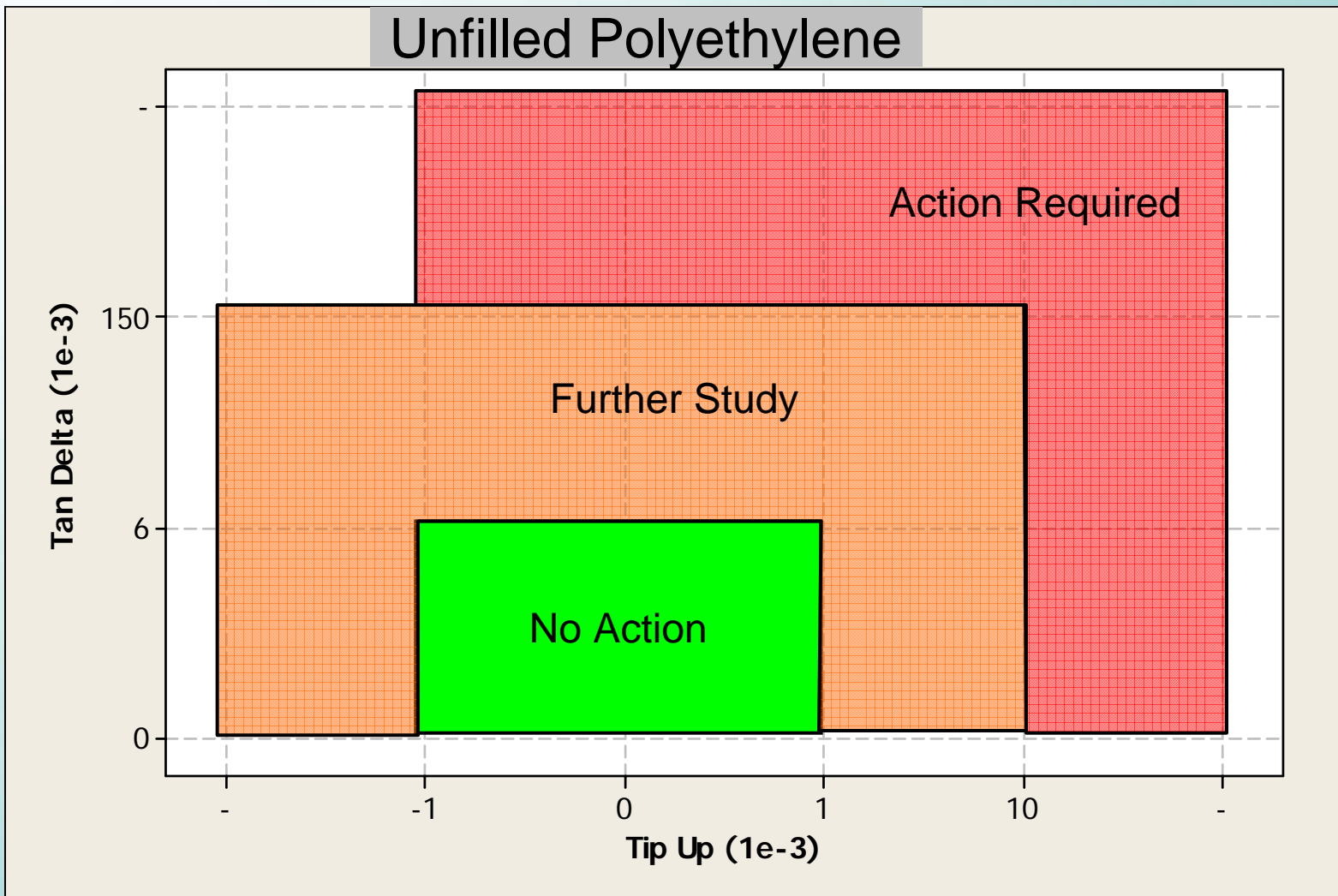
VLF Differential Tan δ of Cable Systems



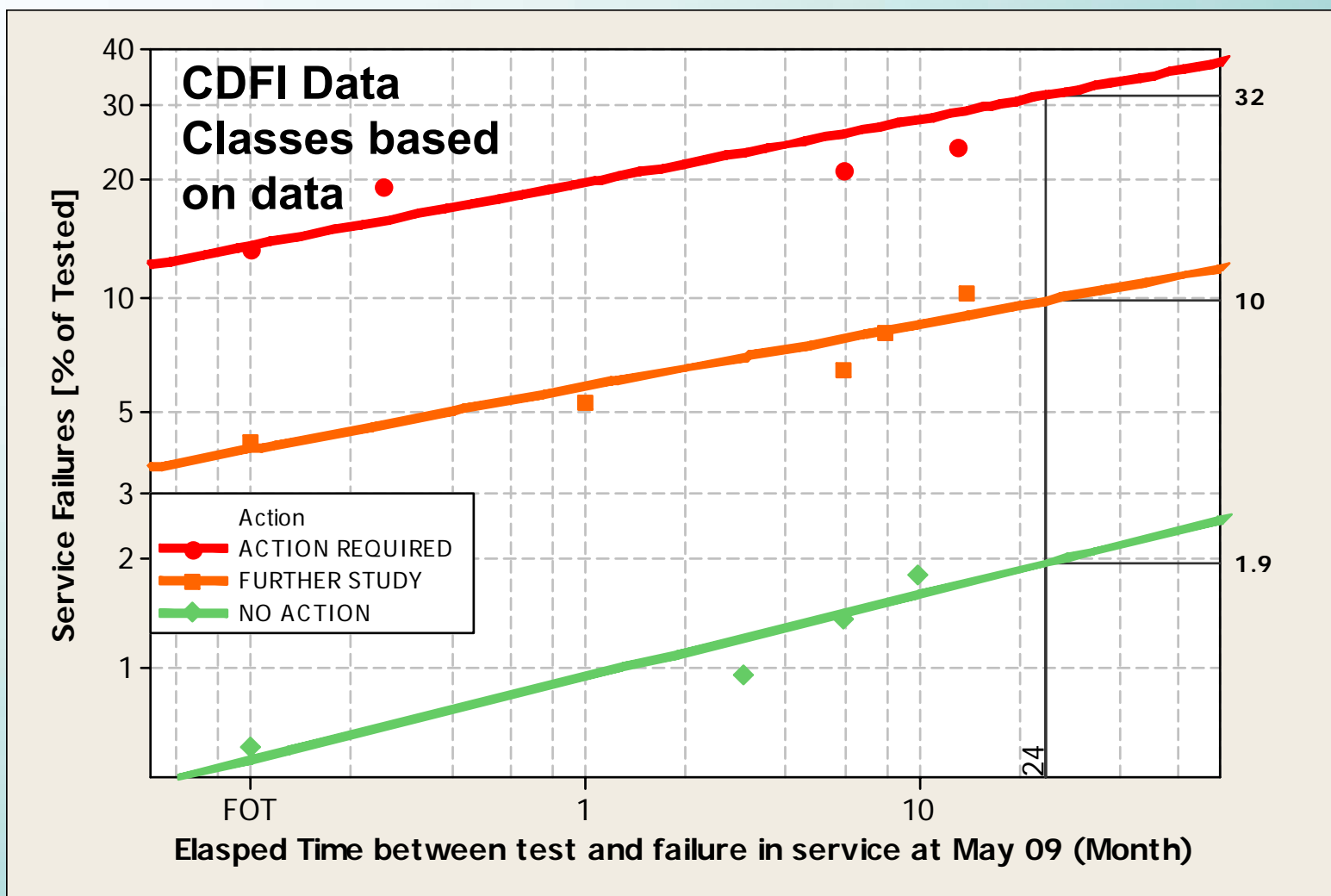
VLF Tan Delta Data of Cable Systems



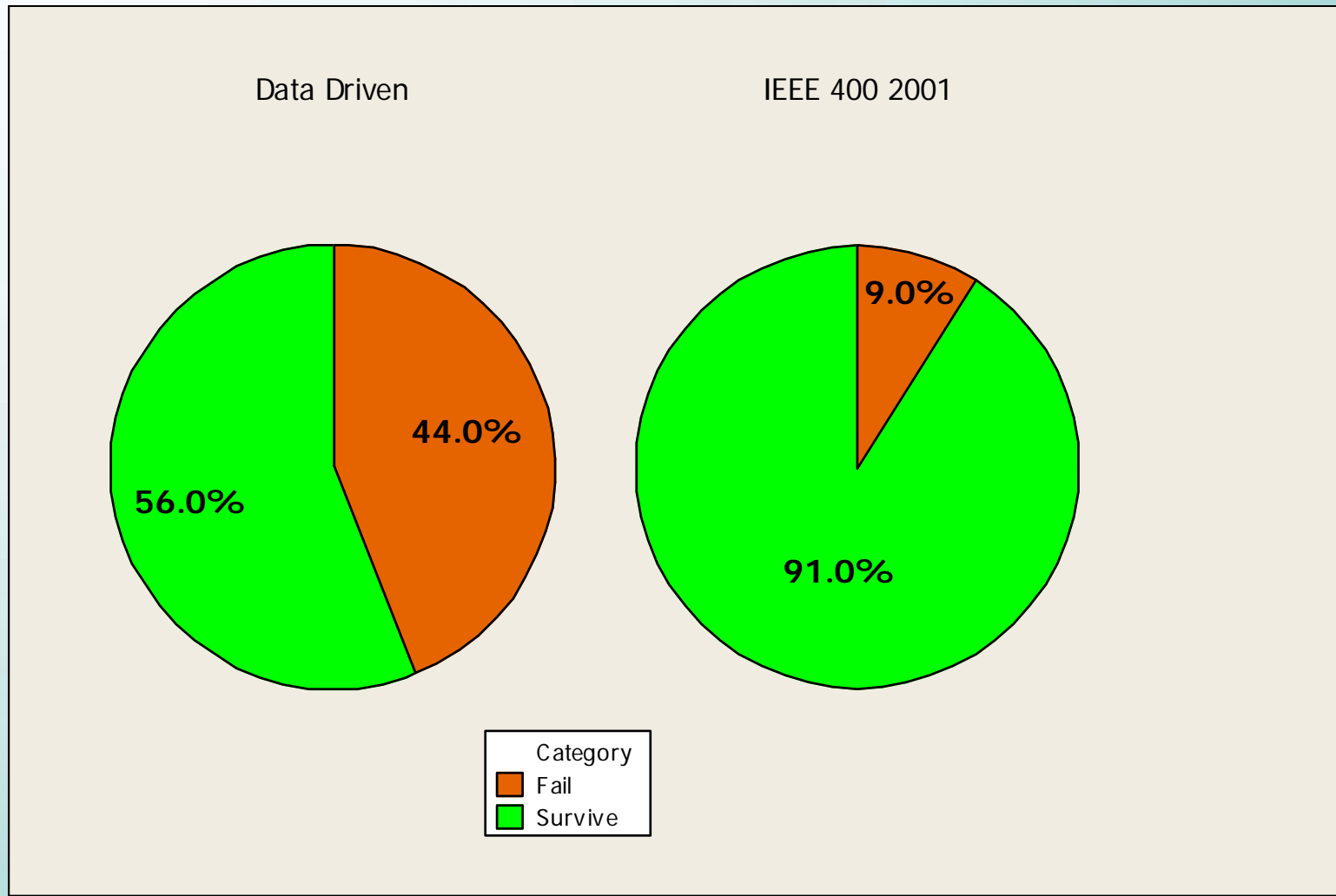
Cable System – Treatment



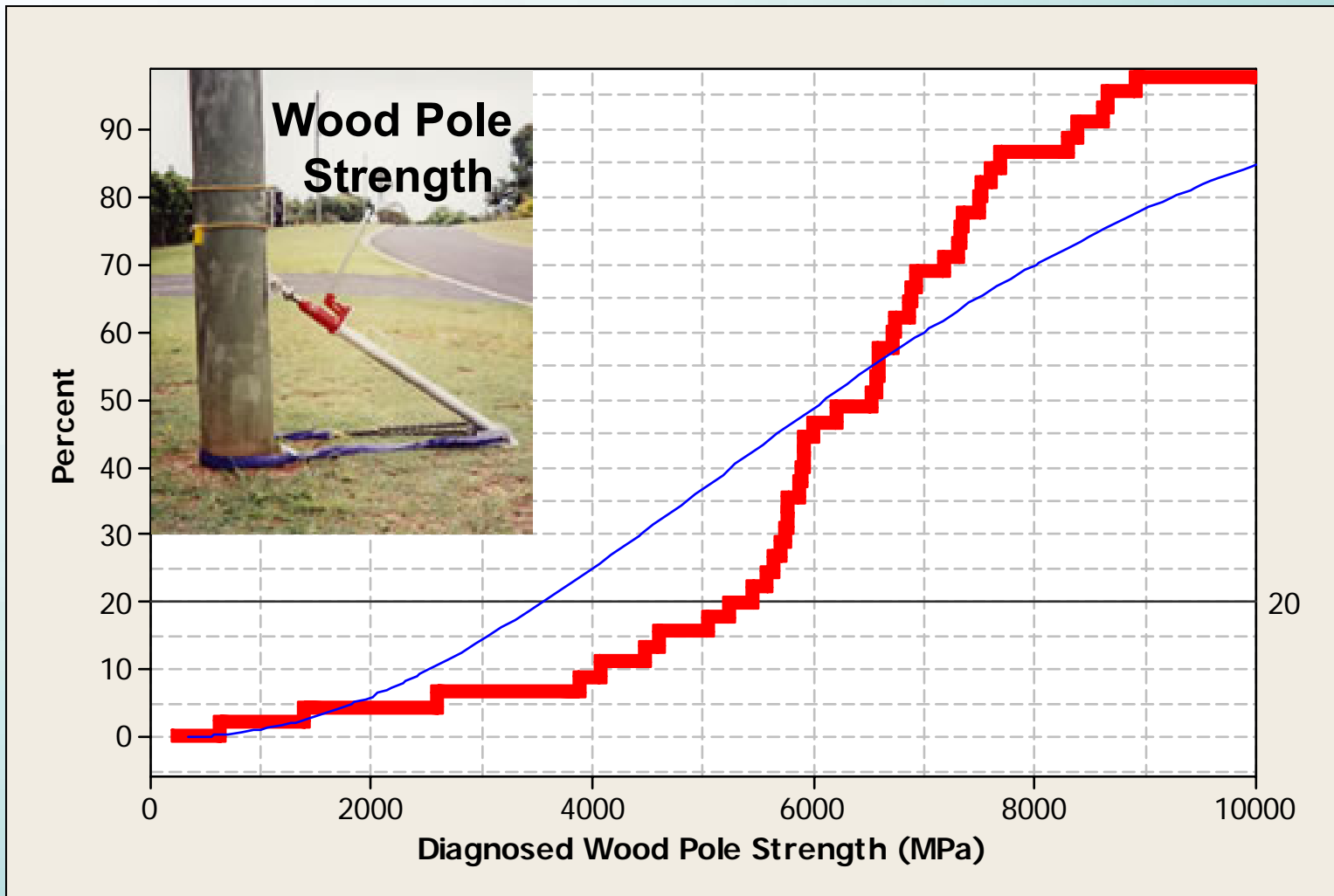
Results of Tan δ Testing



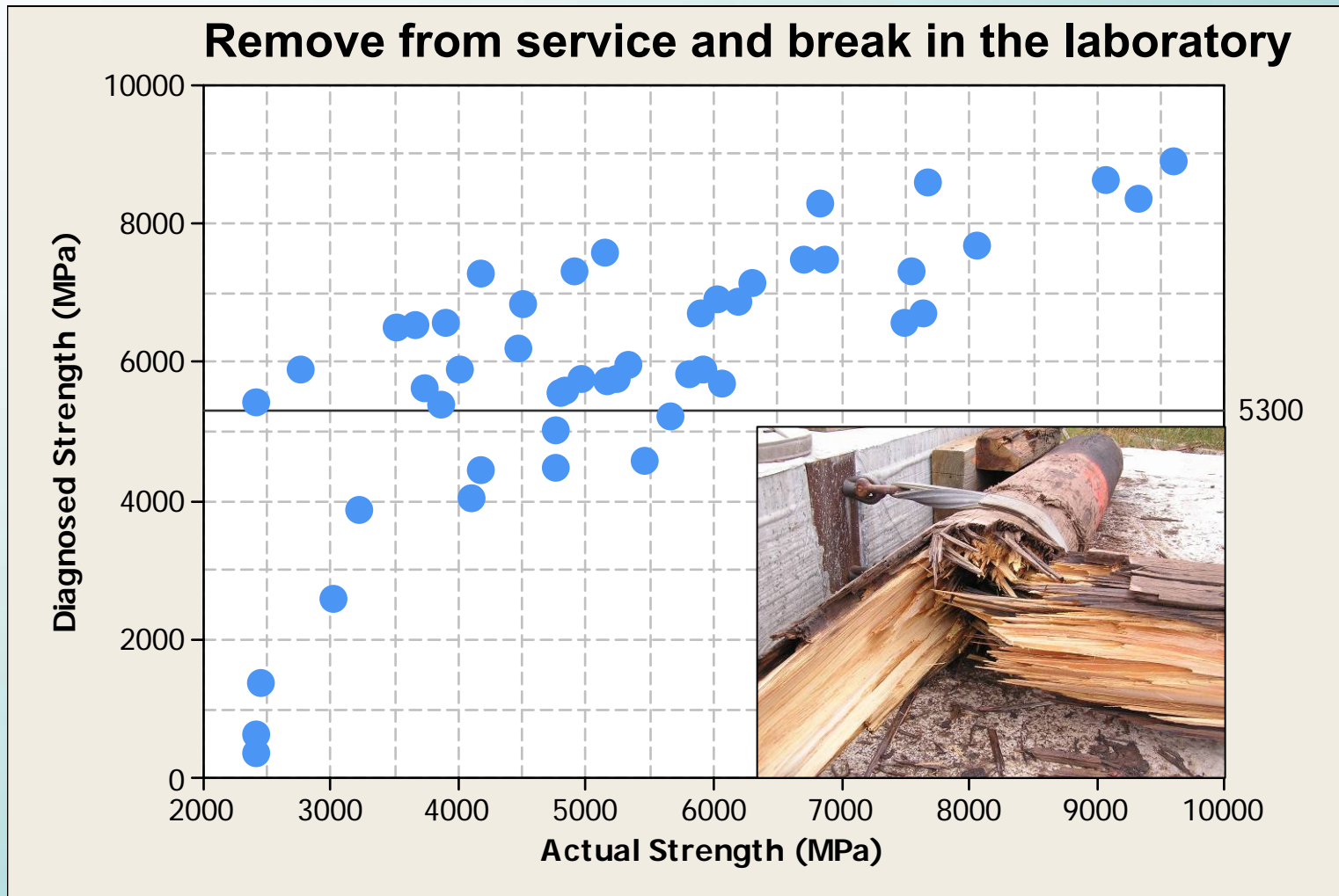
Improvement in Performance vs Standard



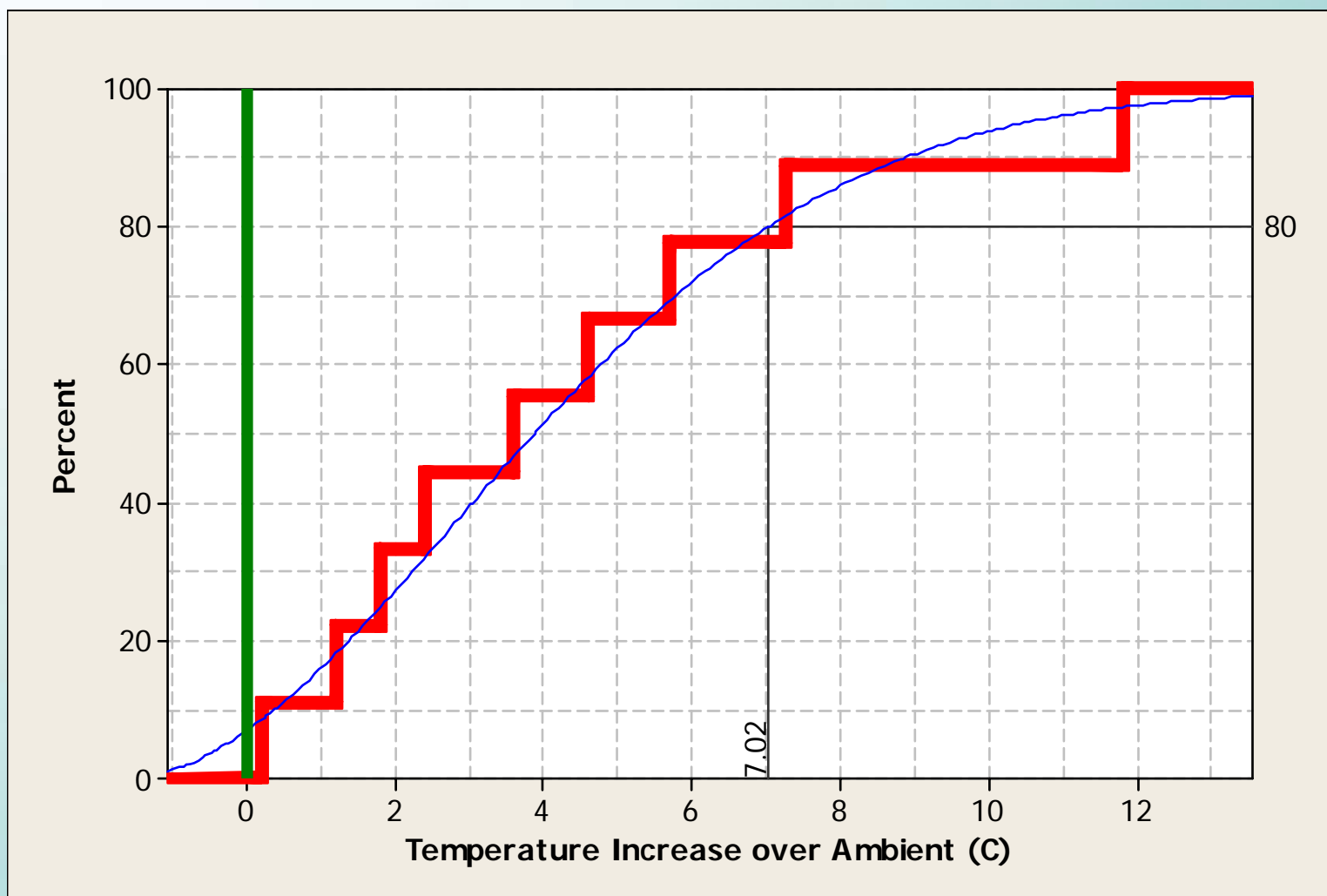
Wood Pole Strength Tests



Wood Pole Monitor Phase



Thermography



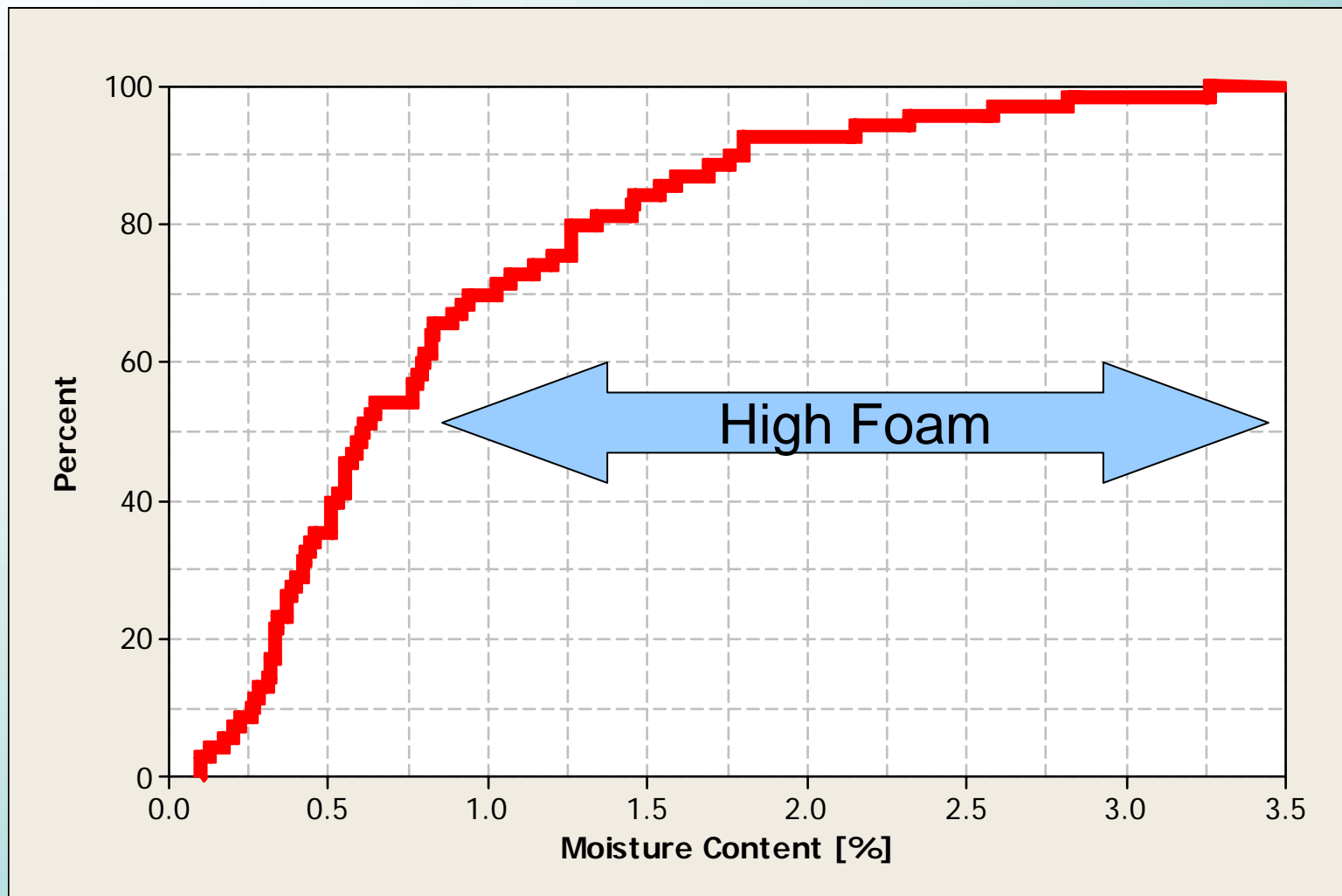
Estimates Moisture in Paper



High Foaming

One utility spends >\$5,000,000 pa
on replacements
Is this too little?
Is this too much?

Estimates Moisture in Paper



Conclusions

- Setting criteria is a central part of the of the diagnostic process
- Utilities should be engaged in the process
 - Awareness
 - Experience
 - Knowledge Transfer
- Large gains can be made through minimal effort BUT some effort is required