

Measuring Performance Of Electric Power Distribution Systems – IEEE Std. 1366-2003

Presented at the NARUC

Staff Subcommittee on Electric Reliability

in Washington, DC

February 13, 2005

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Topics for Today

- ◆ **What changed between 2001 and 2003?**
- ◆ **Why use 1366-2003 - *Guide for Electric Power Distribution Reliability Indices***
- ◆ **The Major Event Day Definition**
- ◆ **Summary**
- ◆ **Potential Impact on Regulation**
- ◆ **Benchmarking**



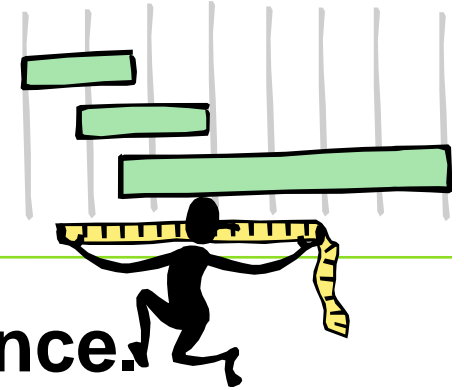
Industry Guidelines Developed

- ◆ **IEEE Std 1366, 2001 Edition, Revised in 2003**
 - ◆ **Refines definitions**
 - ◆ **Created the Major Event Day concept**
 - ◆ **Ballot passed w/98% affirmative**
 - ◆ **Approved by IEEE REVCOM in December 2003**
 - ◆ **Approved by ANSI April 2004**
 - ◆ **Published by IEEE SA June 2004**
 - Available at www.ieee.org

Major changes between 2001 & 2003

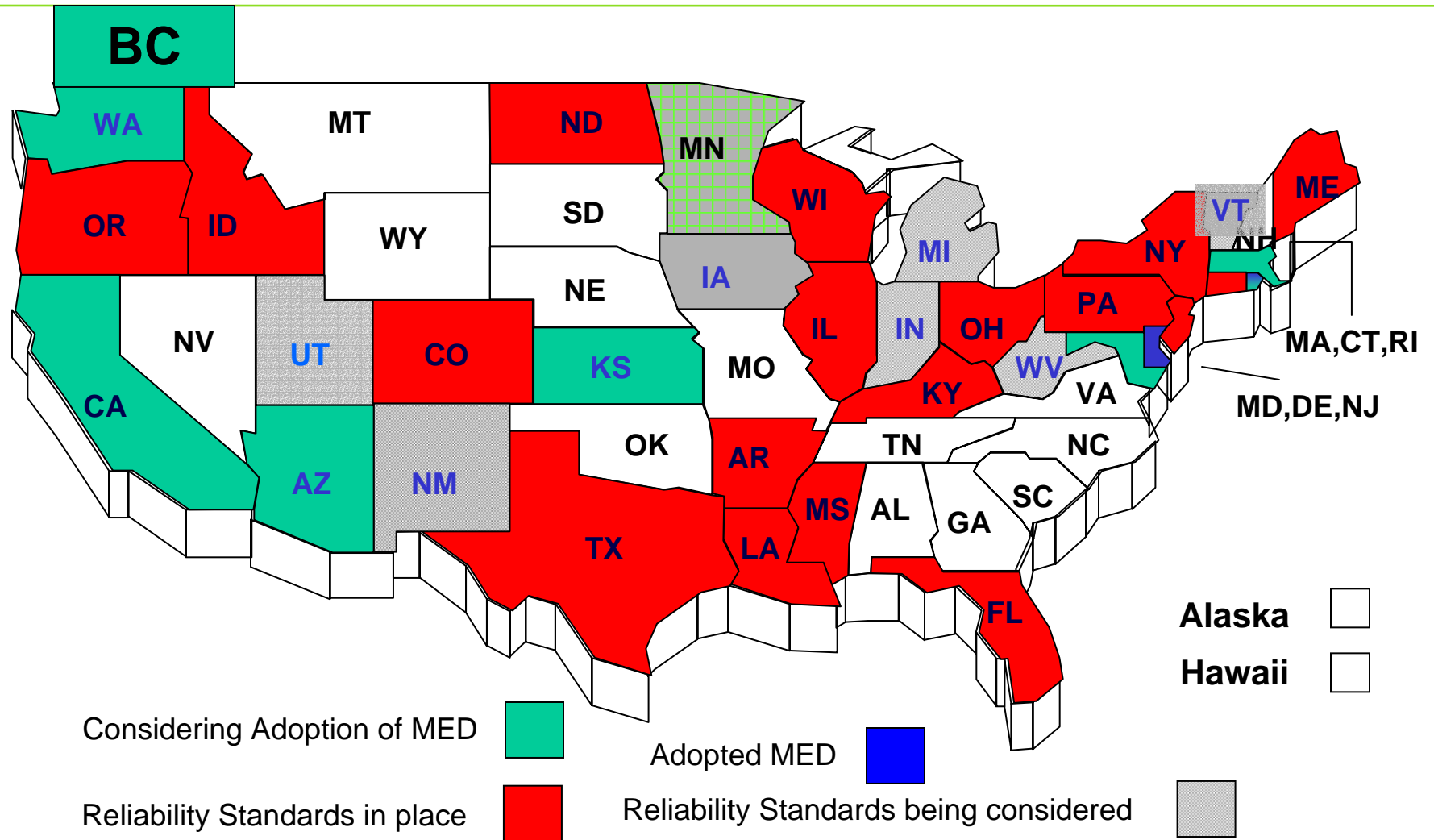
- ◆ **Tightened definitions.**
- ◆ **Created the Major Event Day Concept.**
- ◆ **A tool that can assist company decisions and regulatory policy making by standardizing engineering metrics and approaches.**
 - ◆ **Standard definitions are offered that will lead to better comparability.**
 - Still need to address data collection methods.
 - ◆ **Policy decisions are left to the regulatory community.**
 - ◆ **All Events are reviewed including Major Events.**

Why Use 1366-2003



- ◆ **Sound Basis for Measuring Performance.**
- ◆ **A clearer view of performance, both on a**
 - ◆ **Daily basis and**
 - ◆ **During Major Events**
- ◆ **Can form a solid basis for review of operational effectiveness, decision making and policy making.**
- ◆ **More consistent benchmarking.**

States are Moving Toward Reliability Regulation



**source NRRI 2001 survey & other regulatory documents*

Three State's Rules

◆ State 1

- ◆ Major Storms excluded if **15% of customers served** are interrupted over the duration of the event.

◆ State 2

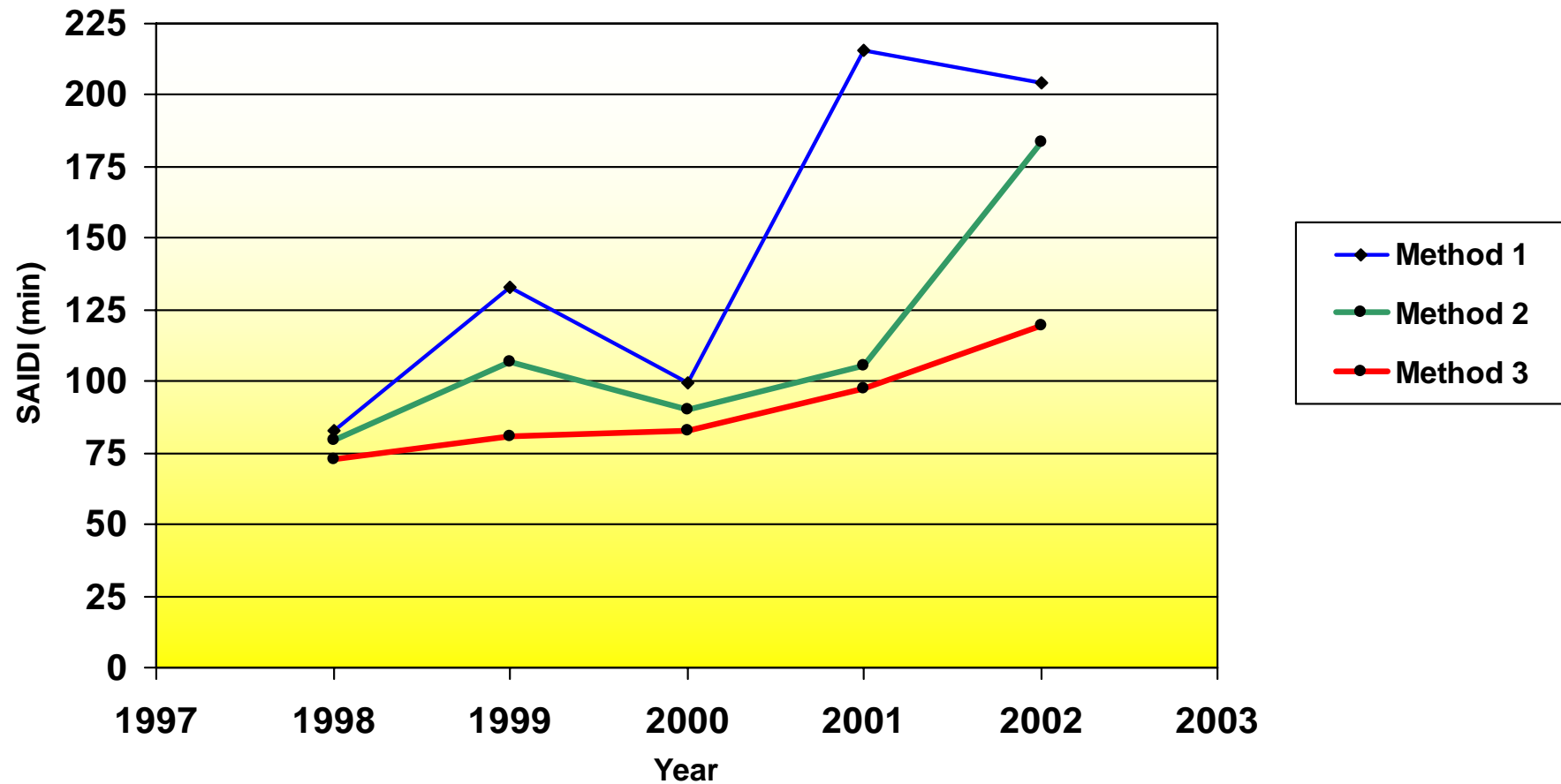
- ◆ A Major Storm is a period of adverse weather during which service interruptions affect at least **10 percent of the customers in an operating area and/or** result in customers being without electric service for durations of **at least 24 hours**.

◆ State 3

- ◆ It was the result of a major weather event which caused more than **10% or a district or total company customers** to be without service at a given time.

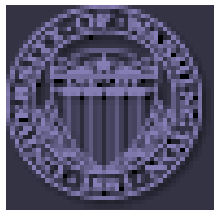
SAIDI Performance

Different Measurement Methods - Same Company



Methodology Development

- ◆ **IEEE WG on System Design, that has over 130 members, developed the “2.5 Beta methodology” in IEEE Std 1366 - 2003.**
 - ◆ **Members include utility employees, regulatory staff, employees from manufacturers, consultants and academics.**
 - ◆ **Seven members stepped up to perform the analysis.**



Foundations of the Process

- ◆ **Definition must be understandable by all and easy to apply.**
- ◆ **Definition must be specific and calculated using the same process for all utilities.**
- ◆ **Must be fair to all utilities.**
 - ◆ **Large and small, urban and rural....**
- ◆ **SAIDI was chosen as the indicator...**
 - ◆ **because it is size independent and**
 - ◆ **it is the best indicator of system stresses beyond those that utility's staff, build, design and operate to minimize.**

Foundations of the MED Definition

- ◆ **To allow appropriate review of both operating conditions partition the data into**
 - ◆ daily performance and
 - ◆ major event day performance.
- ◆ **Major event days are days where the system operational and/or design limits are exceeded.**
- ◆ **We suggest:**
 - ◆ Using day-to-day events for trending, internal goal setting, and Commission mandated targets.
 - ◆ Separately report performance during major events (no exclusions).

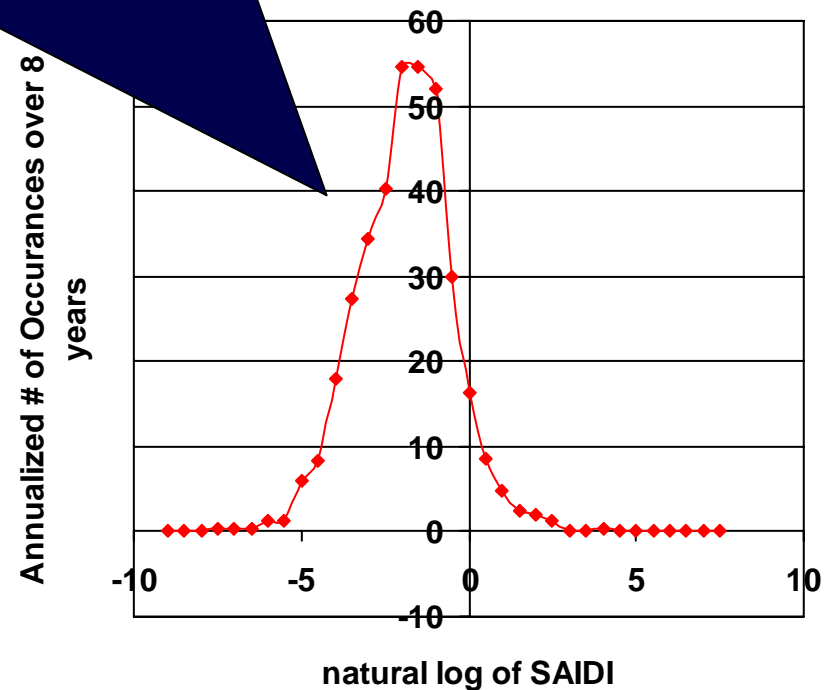
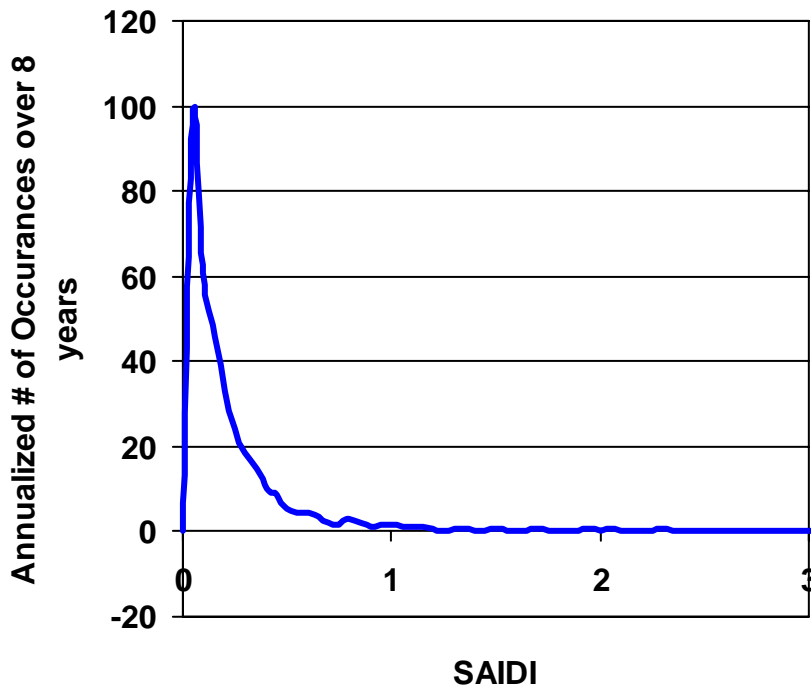
Methodology Development

- ◆ **Several methods were tested and rejected because they did not meet the basic requirements stated in foundations of the process.**
- ◆ **Epiphanies**
 - ◆ **SAIDI is a good indicator of major events.**
 - ◆ **Interruption data is most closely represented by the log normal distribution.**

Log-normal nature of the data

68.3% of population is covered by the mean + 1 std. dev.;
95.4% of population is covered by the mean + 2 std. dev.;
99.7% of population is covered by the mean + 3 std. dev.;

DI per Day

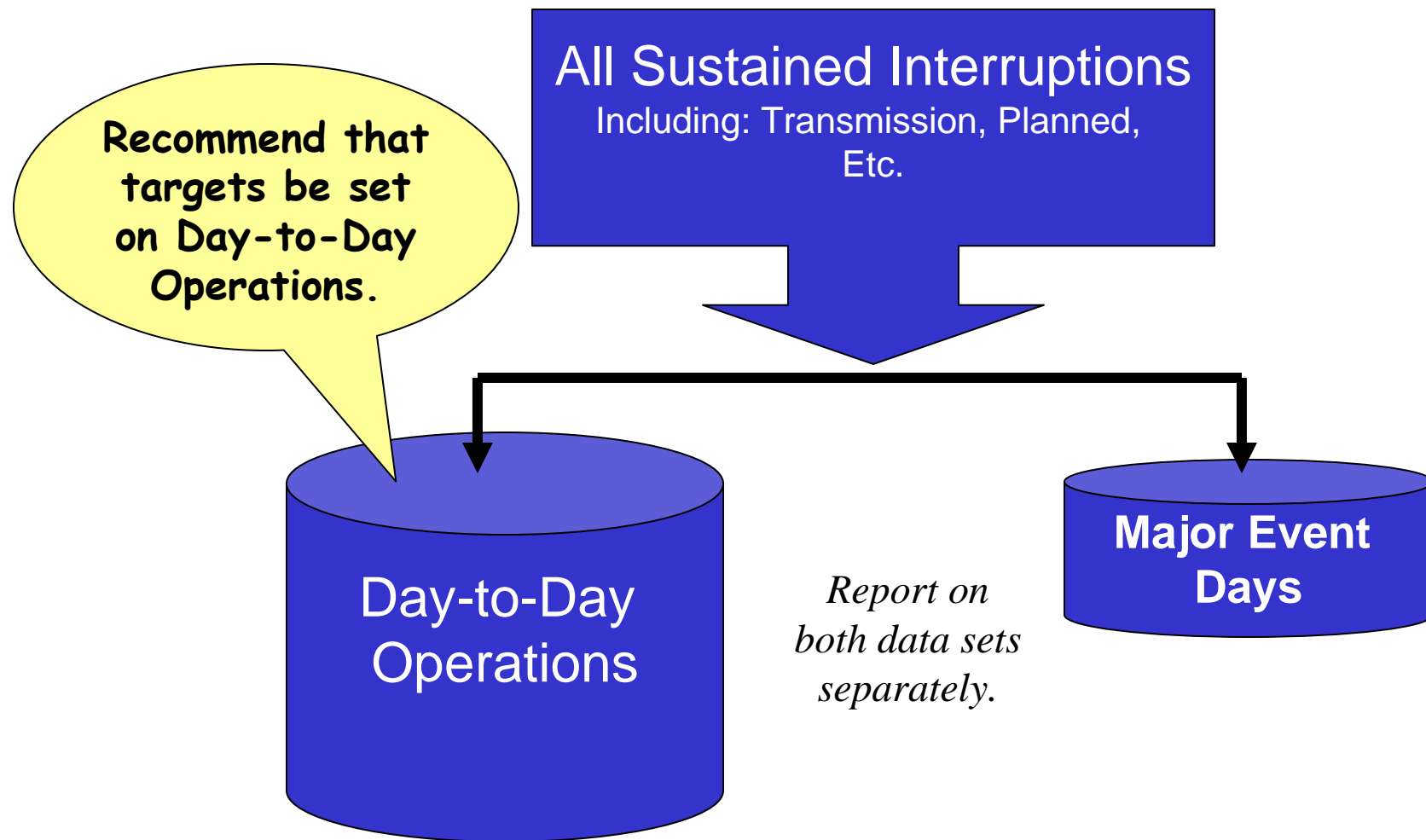


Allows Mathematicians to use their statistical toolkits.

Two Categories for Measurement

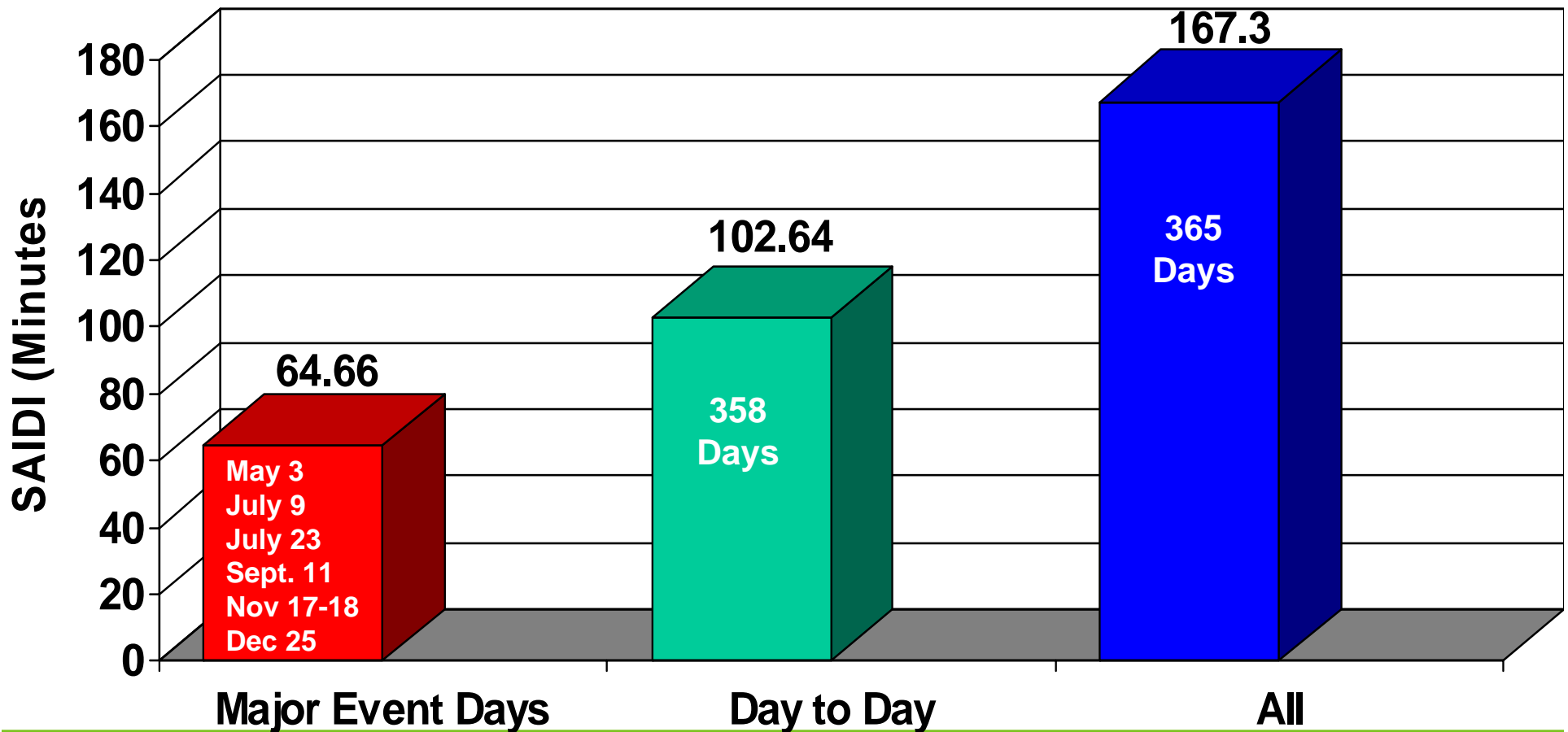
- ◆ The 2.5 Beta Methodology allows segmentation of reliability data into **two** distinct sets for review.
 - ◆ One set represents those events of such a reliability magnitude that a **crisis mode** of operation is required to adequately respond. (**major events**).
 - ◆ The other set represents the reliability impact of those events that a company has built the system to withstand and staffed to respond to in a manner that does not require a crisis mode of operation. (**day-to-day operation**).

Major Events versus Day to Day Operations



Results from One Company

SAIDI



Seven Simple Steps

1. Collect values of daily SAIDI for five sequential years ending on the last day of the last complete reporting period. If fewer than five years of historical data are available, use all available historical data
2. If any day in the data set has a value of zero for SAIDI, do not include that day in the analysis.
3. Take the natural logarithm (ln) of each daily SAIDI value in the data set.
4. Find α (Alpha), the average of the logarithms (also known as the log-average) of the data set.
5. Find β (Beta), the standard deviation of the logarithms (also known as the log-standard deviation) of the data set.
6. Compute the major event day threshold, T_{MED} , using the equation:

$$T_{MED} = e^{(\alpha + 2.5\beta)}$$

7. Any day with daily SAIDI greater than the threshold value T_{MED} that occurs during the subsequent reporting period is classified as a major event day.

Major Event Days – A few facts

- ◆ **A day in which the daily system SAIDI exceeds a threshold value, T_{MED} that is determined by using the 2.5 beta method.**
 - ◆ *For example, if $T_{MED} = 3$ minutes, than any day where more than 3 minutes of SAIDI is accrued is declared a major event day*
- ◆ **Activities that occur on major event days should be separately analyzed and reported. Nothing is “Excluded”!!**

Benefits of the Approach

- ◆ **Adoption of the 2.5 Beta methodology**
 - ◆ will allow for consistent calculation of reliability metrics,
 - ◆ provide companies and commissions with a more accurate indication of a Company's controllable service quality results,
 - ◆ allow a clear review of company response to crisis mode events, and
 - ◆ provide a less distorted indication of the reliability results for companies of all sizes.

Summary of IEEE 2.5 Beta Methodology

- ◆ **Improves the ability to view system reliability performance, thereby making goal setting and trending more meaningful.**
- ◆ **Provides a mechanism for reporting on both day-to-day performance and performance during major events. A mechanism that:**
 - ◆ **allows for review of day-to-day performance without considering the outliers that often mask it.**
 - ◆ **AND, meaningfully focuses on major event performance in its own right to give a clear view of this very different operating condition.**
- ◆ **Consistent method that can be applied by all.**

Beyond the Standard...

PBR and Benchmarking

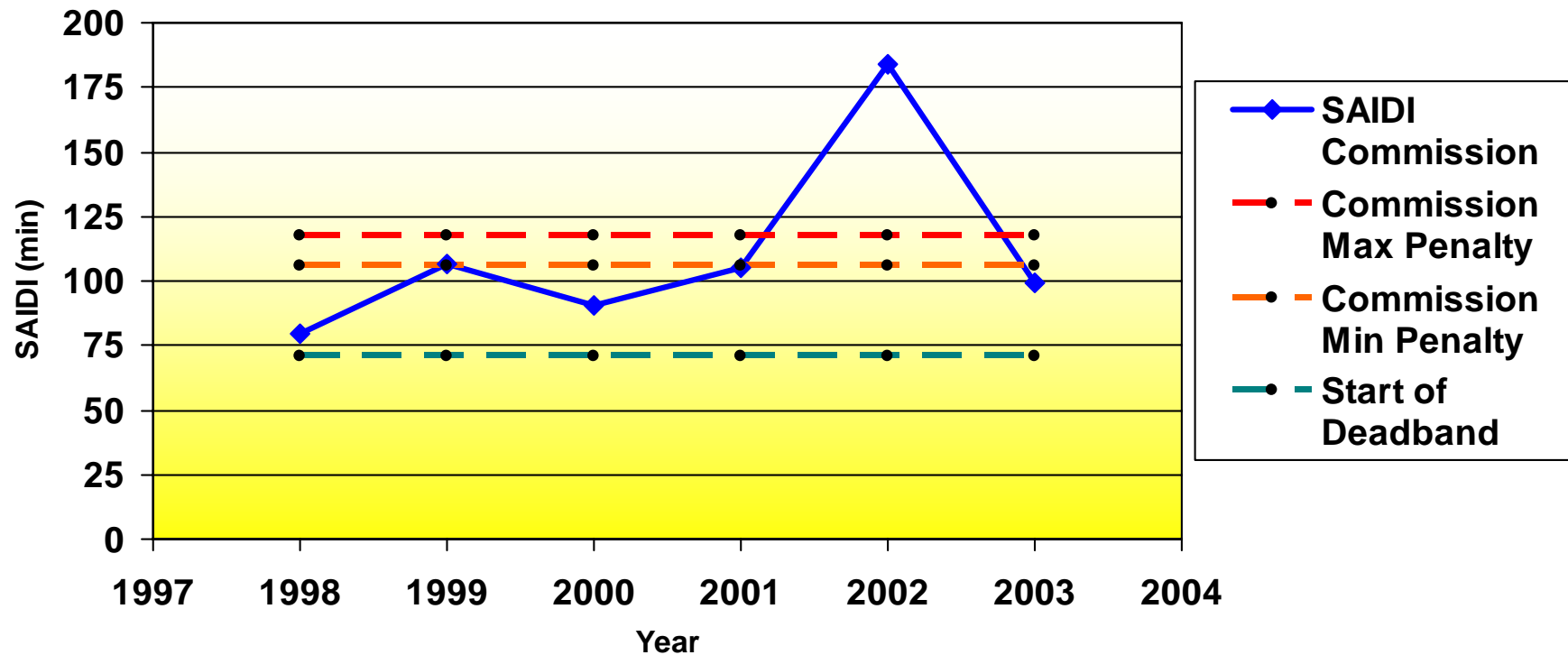


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Ramifications on Commission Mandated Targets

One Company's Performance

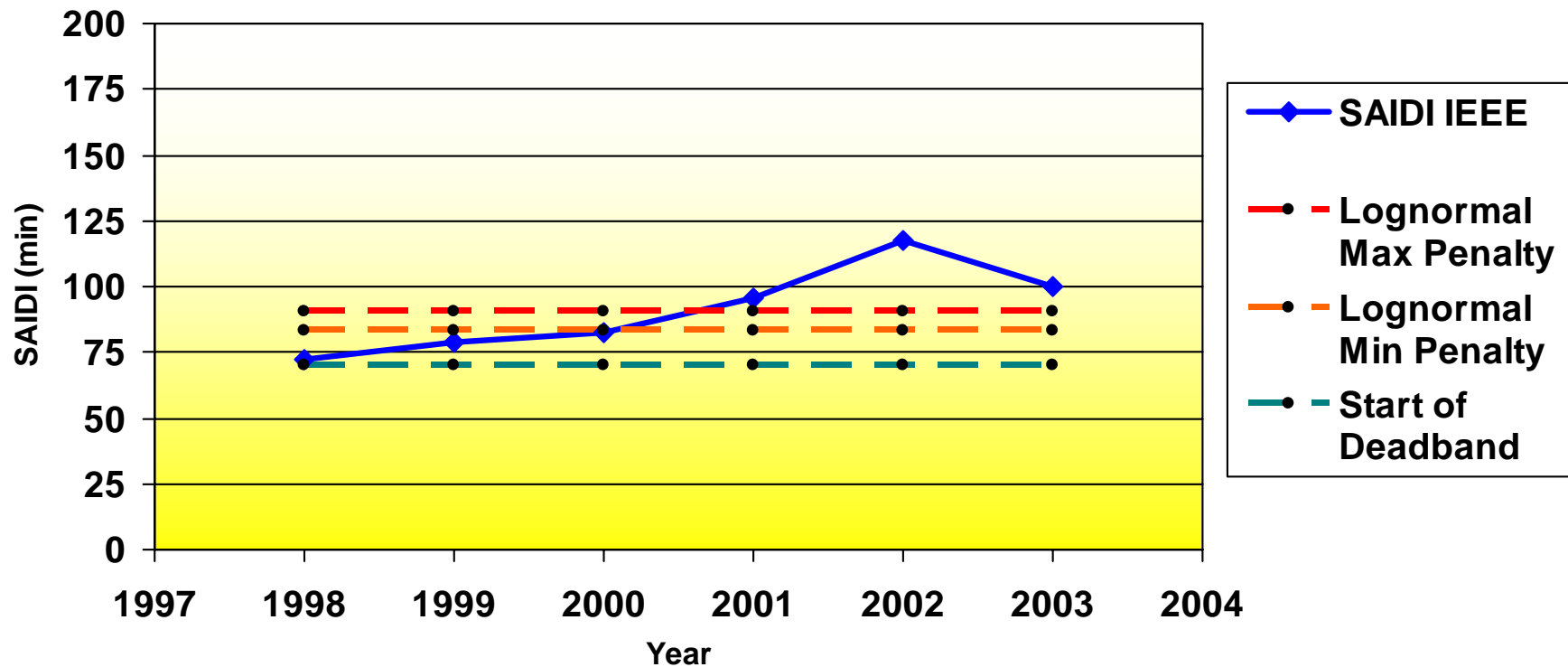
Exclusion Criteria:
Commission- 15% System,



Ramifications on Commission Mandated Targets

One Company's Performance

Major Event Criteria:
IEEE2.5 β Method



Ramifications on Commission Mandated Targets

- ◆ **The existing PBR targets will require adjustment if lognormal nature of data is considered.**
 - ◆ **The *variability in year to year performance* should be *significantly reduced* by using the IEEE methodology, therefore performance bands should be adjusted.**
 - Minor weather events will be captured in the day-to-day performance that will still lead to some variability.
 - ◆ **Since we know that reliability data is most closely represented by the *log-normal distribution*, performance bands should be developed using the log-normal data.**
- ◆ **Targets should also be reviewed if OMS systems/processes are introduced.**

Basis for Target Setting

- ◆ **It's appealing to use an industry average (benchmark data) to set targets for utilities in your state.**
- ◆ **It's not practical to do so because:**
 - ◆ **Each utility has historical rates, maintenance and operating practices, system design, customer density, etc.**
 - These factors set the underlying performance level of the system.
 - ◆ **Forcing utilities to change to a radically different performance level has serious rate implications.**
- ◆ **Using the companies own historical performance is a reasonable approach.**
 - ◆ **Issues: Introduction of an OMS, changing weather patterns, mergers and acquisitions.**

Benchmarking

- ◆ **Data is Never exactly the same!**
- ◆ **Two main reasons for differences:**
 - ◆ **Data Collection Process/System Differences**
 - ◆ **Exclusion Criteria Differences (Basis)**
- ◆ **IEEE 1366-2003**
 - ◆ **addresses data basis issues by clearly defining the rules.**
 - ◆ **It DOES NOT address the data collection issues**

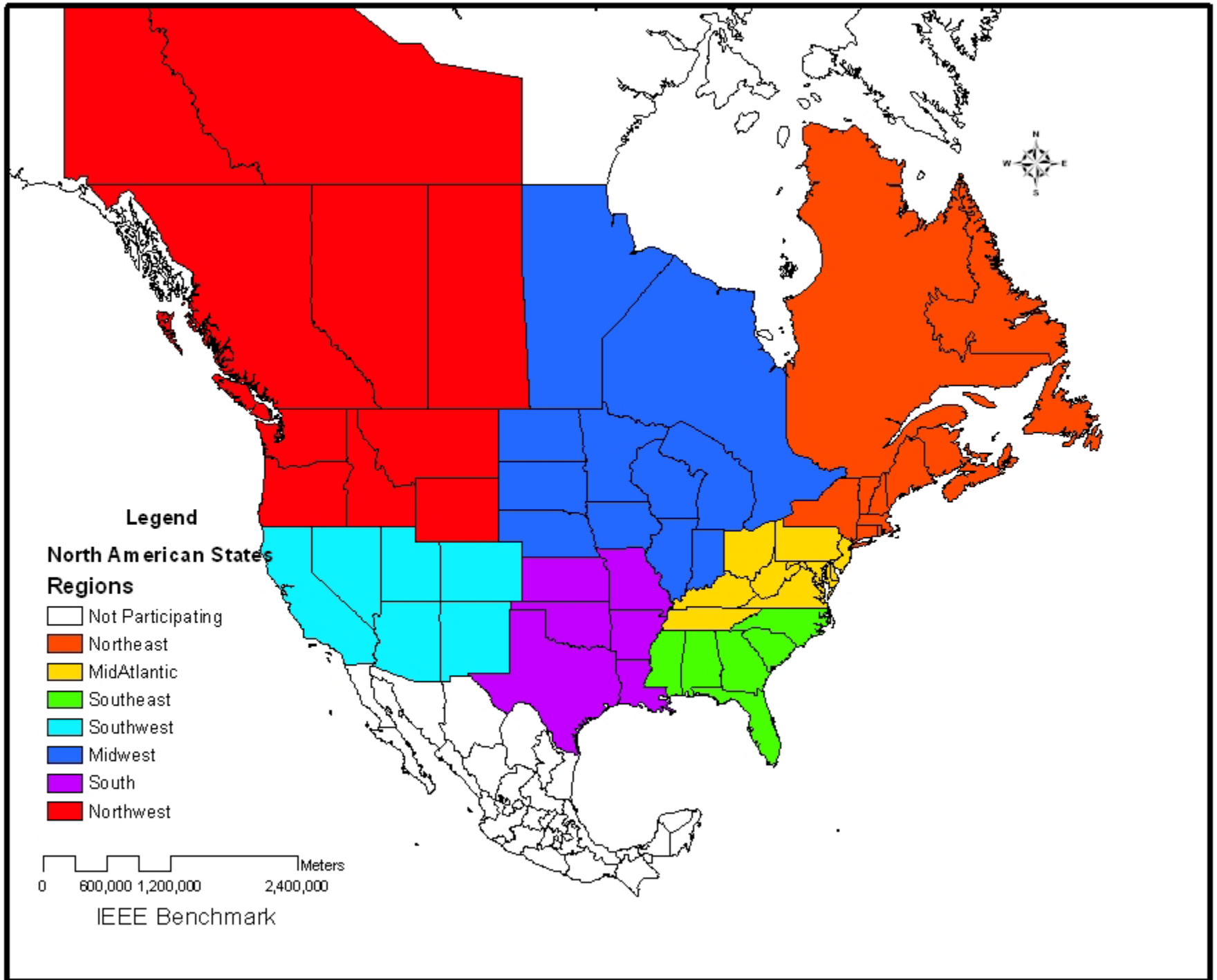
Benchmark

- ◆ We have anonymously analyzed data for 95 companies throughout the US & Canada for companies that range from rural electric co-ops to IOUs.
- ◆ Basic Results for 2003.

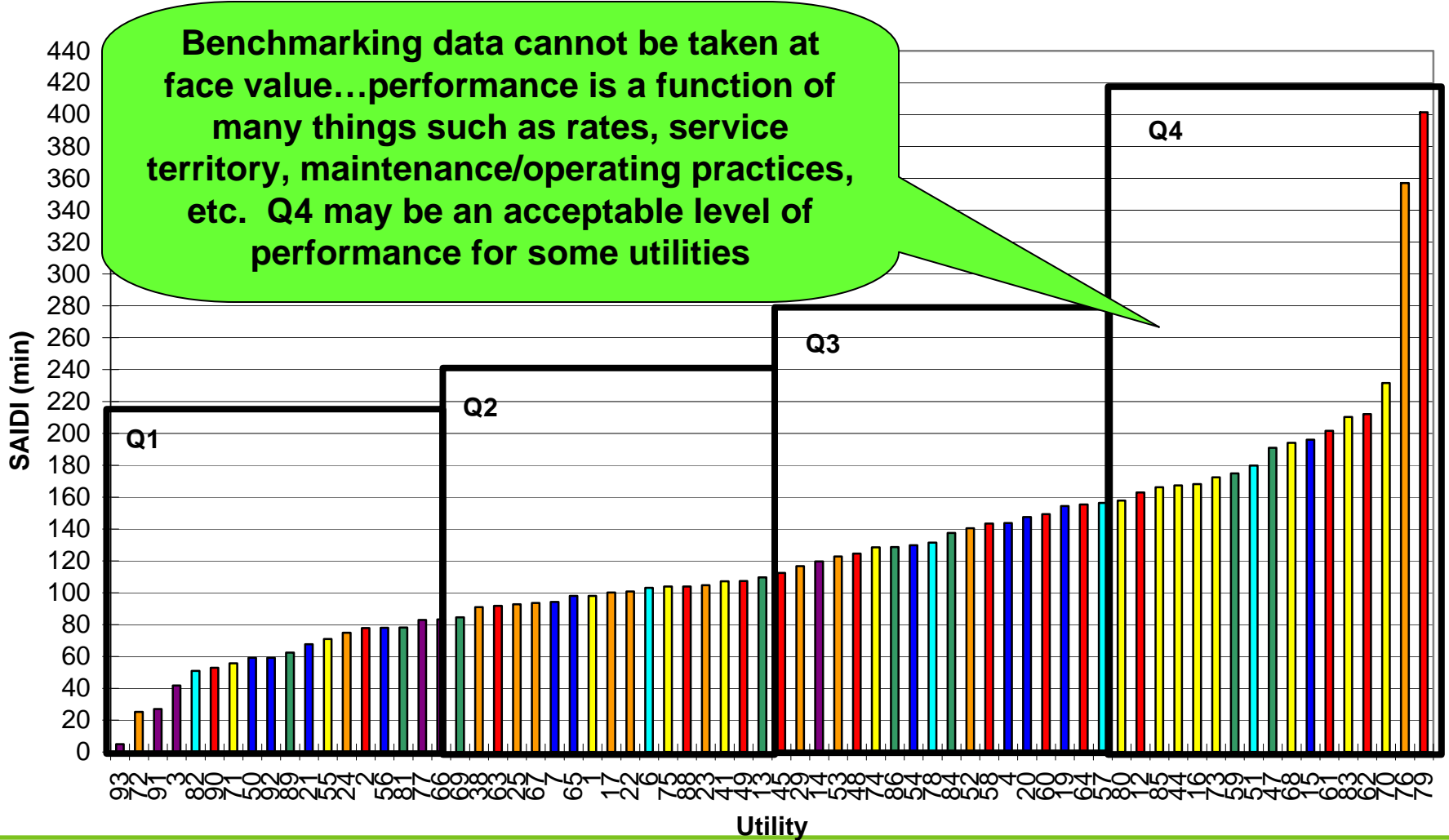
All Respondents						
Quartile	SAIDI IEEE	SAIDI All	SAIFI IEEE	SAIFI All	CAIDI IEEE	CAIDI All
1	83.59	119.45	0.94	1.29	71.04	84.77
2	110.99	223.68	1.23	1.59	93.69	146.73
3	156.10	400.24	1.50	2.14	121.77	211.73
4	401.55	2352.29	3.15	5.53	424.74	1154.85

**includes results from 70 respondents.*

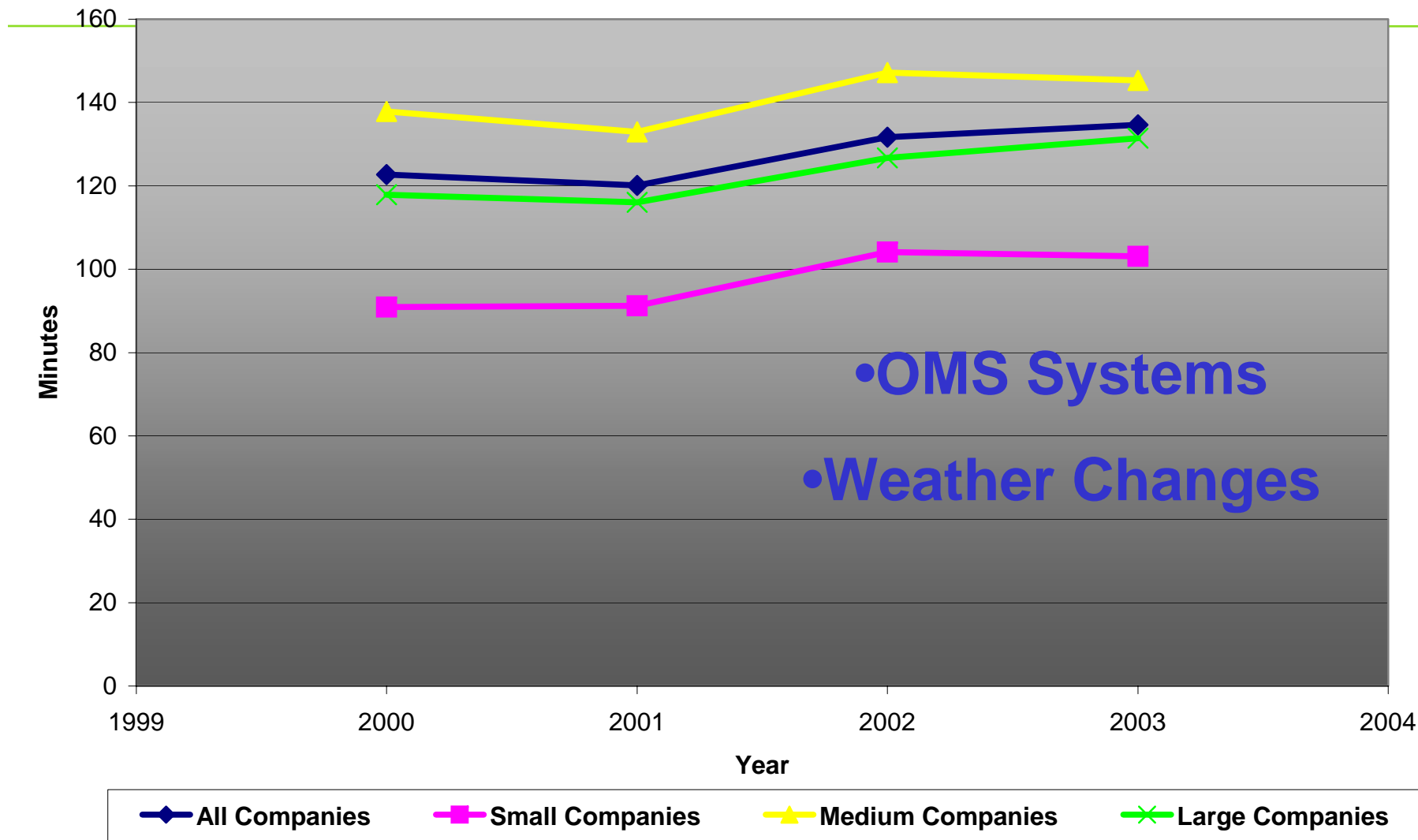
Performing another benchmark in 2005.



IEEE - SAIDI (2003)



SAIDI IEEE Trends



Questions...

