NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Measuring ERO Reliability Performance
Workshop Agenda

July 28, 2011 | 1:00PM – 5:00PM
NERC Atlanta Office
3353 Peachtree Road NE
Suite 600, North Tower
Atlanta, GA 30326
(404) 446-2560

Agenda

ERO Reliability Performance Measures Workshop		
Time	**Item**	**Moderator**
1:00 pm	**1. Administrative Matters**	
	a. Welcome and Introductions	Mark Lauby
	b. Antitrust Guidelines	Jessica Bian
	c. Arrangements and Logistics	Jessica Bian
	d. Agenda Review	Mark Lauby
1:15 pm	**2. Keynote 1: *Measuring ERO Reliability Performance***	Gerry Cauley, NERC CEO
1:30 pm	**3. Keynote 2: *Is Reliability Improving and How to Quantify?***	Robert Ivanauskas FERC Commissioner Staff
1:45 pm	**4. Success Stories: *How Current Measures Used to Improve Reliability***	Mark Lauby
2:00 pm	**5. Adequate Level of Reliability Definitions and Measures**	Allen Mosher American Public Power Association (APPA)

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ERO Reliability Performance Measures Workshop		
Time	**Item**	**Moderator**
2:15 pm	**6. Panel 1: *Composite Measures Used in Other Industries*** a. Integration of Risk Factors b. Practical Examples c. Does composite measure reflect industry performance? d. Regulator's perspectives	David Robinson Sandia National Lab Tim Geib, Institute of Nuclear Power Operations (INPO) Alan Stensland Federal Aviation Administration (FAA) Kimberly Jones, North Carolina Utilities Commission *Moderated by:* *Mark Lauby, NERC*
3:15 pm	**7. Panel 2: *Integrated Reliability Index (IRI)*** a. Any major risk factors missing from IRI? b. Measure intersection or union of risks? c. How to determine weighting factors for three components?	Bill Adams Georgia Power Joe Eto, Lawrence Berkeley National Laboratory Nicholas Ingman, IESO *Moderated by:* *Jessica Bian, NERC*
4:00 pm	**8. Panel 3: *IRI Components*** a. Consider CIP standards violations in SDI? b. Include weather-caused events in CDI? c. Treat differently - operated as designed versus operated not as designed? d. Consistent weighting factor calculation methods for EDI, CDI and SDI?	Heide Caswell PacifiCorp Orhan Yildiz, DOE Energy Information Administration Greg Pierce Entergy Corporation *Moderated by:* *Jessica Bian, NERC*
4:45 pm	**9. Review of Workshop Output and Next Steps**	Mark Lauby, NERC
5:00 pm	**Adjourn**	

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NERC Integrated Reliability Index Workshop

Panelist List and Discussion Topics

July 28, 2011 | 1:00PM – 5:00 PM

2:15 pm to 3:15 pm - Panel 1 – Composite Measures Used in Other Industries

In this session, NERC seeks information on risk assessment methods used by other industries for regulatory matters and how they measure outcomes – risk controlled, hazards eliminated, and problem identification along with solutions addressed. Staff will lead the panel in a discussion of the following topics:

- Can each risk factor be integrated into one outcome measure, given problem specific risk factors? If so, how should this be done? What considerations should be used?
- Are there reasonable example models (such as credit scoring or actuarial models) which could be used to enhance the understanding of integrated risks?
- How should the aggregated sum be presented? Does the positive change represent overall industry performance improvement? Do the change trends have any statistical significance? Can these trends be used to predict future outcomes?
- Have regulators in other industries used the integrated weighted sums to measure performance?

Panelists:

- David Robinson, Staff Scientist, Sandia National Lab
- Tim Geib, Institute of Nuclear Power Operations (INPO)
- Alan Stensland, Federal Aviation Administration (FAA)
- Kimberly Jones, Regulatory Consultant, North Carolina Utilities Commission

3:15 pm to 4:00 pm - Panel 2 – Integrated Reliability Index (IRI)

In this session, NERC seeks feedback on the proposed Integrated Reliability Index (IRI) concept, and seeks comment on weighting factor calculations for the three components. Staff will lead the panel in a discussion of the following topics:

- Are there any major risk components missing from current IRI definition? If yes, what are they? How should they be integrated into the IRI and how should the "baseline" performance be refreshed, as metric components change over time?
- Does the current IRI measure the intersection or the union of risks within the bulk power system?
- How should industry weight compliance risks versus historic event risks versus operational metrics that demonstrate the effectiveness of the system?

Panelists:

- Bill Adams, Georgia Power, Manager of System Operations, Georgia Power
- Joe Eto, Staff Scientist, Lawrence Berkeley National Laboratory
- Nicholas Ingman, Manager of Operational Excellence, Independent Electricity System Operator (IESO)

4:00 pm to 4:45 pm - Panel 3 – IRI Components

In this session, NERC seeks feedback on the Event Driven Index (EDI), Condition Driven Index (CDI), and Statute/Standards Driven Index (SDI), as well as seeks comment on weighting factor calculations for these three components. Staff will lead the panel in a discussion of the following topics:

- Should CIP standard violations be included in SDI? If yes, what are the criteria to be used to determine its impact to bulk power system reliability? Should they be weighted the same as the other categories of NERC Reliability Standard violations?
- Should EDI include weather-caused events? If yes, why? If not, why not?
- Should equipment or loss of load that functioned as designed or through predefined operating procedures be treated differently than those events which did not? If yes, how?
- Are there any consistent methods, beyond industry experience and strategic goal setting, to determine the weighting factors used in EDI, CDI and SDI? If yes, what are they?

Panelists:

- Heide Caswell, Director of Network Performance, PacifiCorp
- Orhan Yildiz, Industry Statistician, DOE Energy Information Administration
- Greg Pierce, Director of Transmission Compliance, Entergy Corporation

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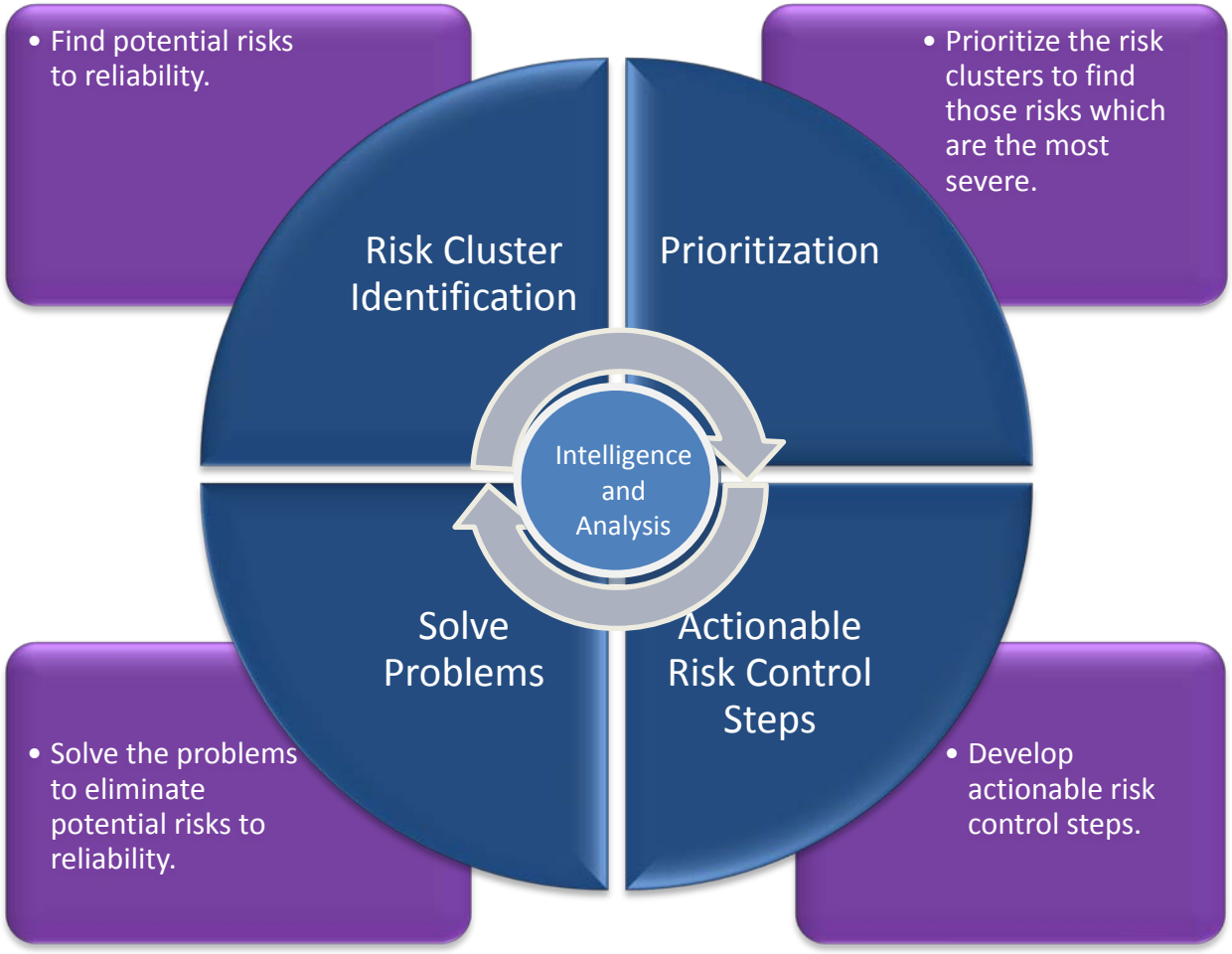
Measuring ERO Reliability Performance

Mark Lauby on Behalf of:
Gerry Cauley, NERC President & CEO

IRI Workshop, NERC Atlanta Office
July 28, 2011

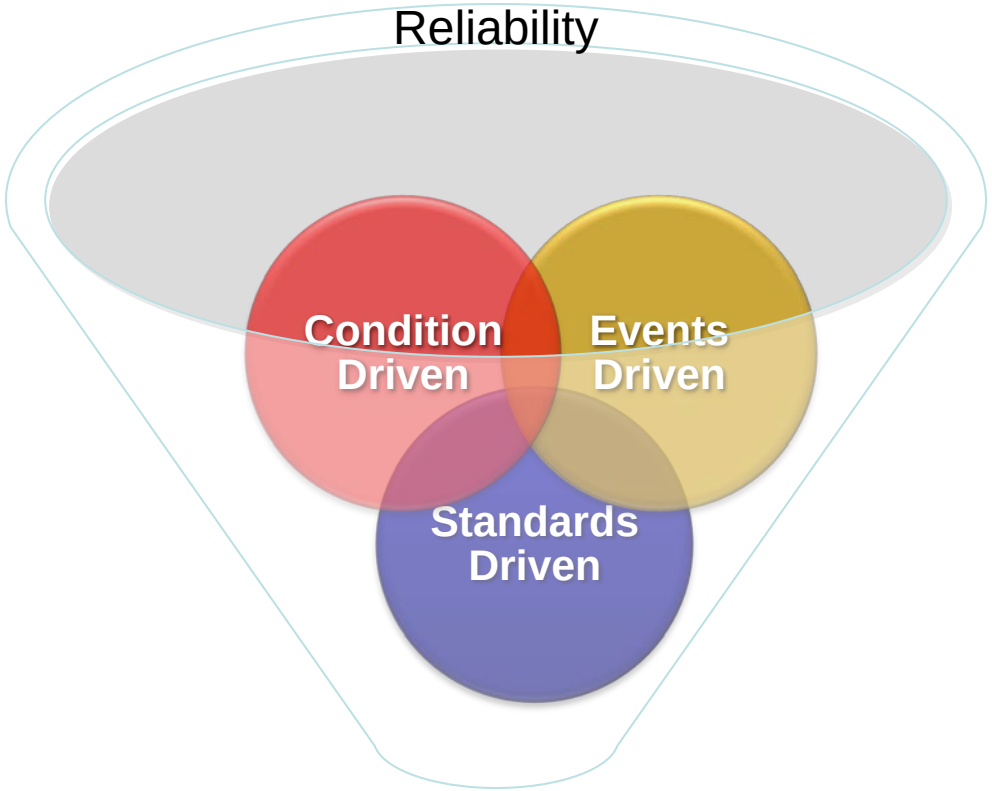
The Risk Control Reduction Cycle



Objective

- Provide the industry meaningful trends of the bulk system performance
- Guide on how to improve reliability and support risk control in decision making
- Inform, increase transparency, and quantify the effectiveness of risk control
- Actionable problem solving

Control Risk and Ensure Reliability



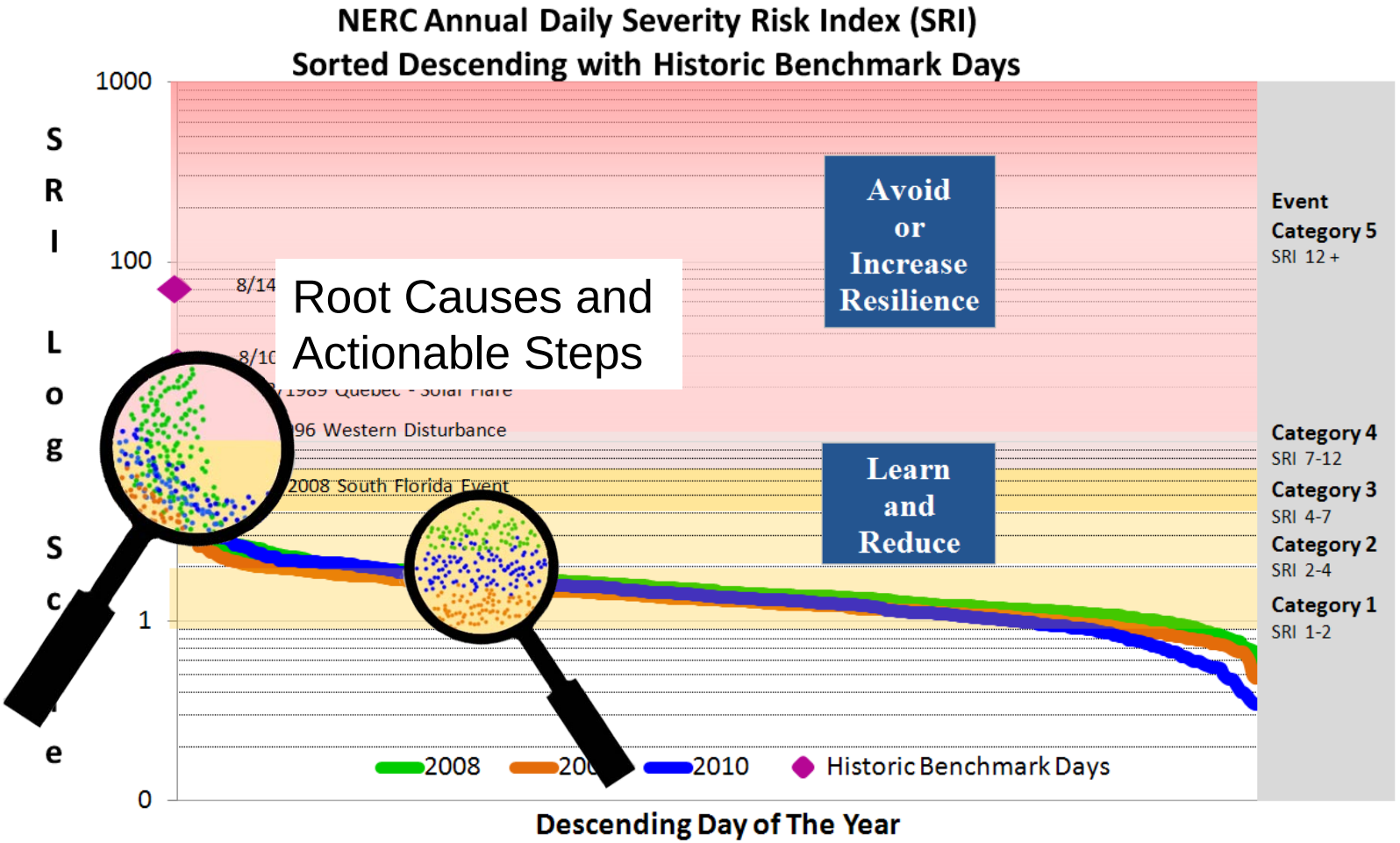
Σ Integration and Analysis

State of Reliability Report

Intelligence and Analysis

- Identify risk clusters that can have highest impact on reliability
- Develop targeted problem-solving strategies with measureable success
- Prioritize, and create actionable results for reliability improvement

Severity Risk Index and Risk Cluster



Decision Making Process

- Controlling risk and ensuring reliability is a process
  - Carried out by management
  - Aligned with the developed coordinated and multifunctional strategies
- Reasonable assurance for success of reliability improvement objectives

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Measuring ERO Reliability Performance

Robert Ivanauskas
Advisor to Philip D. Moeller, Commissioner
Federal Energy Regulatory Commission

Staff Communications

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- 18 CFR Section 388.104(a)

Questions

- Is Reliability Improving?
- How to Quantify?

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Success Stories: How Current Measures Used to Improve Reliability

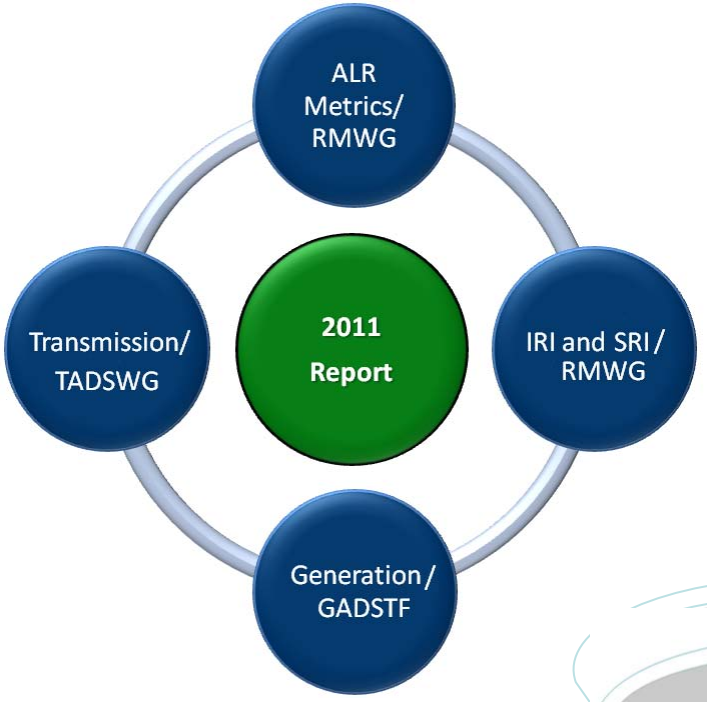
Mark Lauby, Vice President and Director,
NERC Reliability Assessments and
Performance Analysis

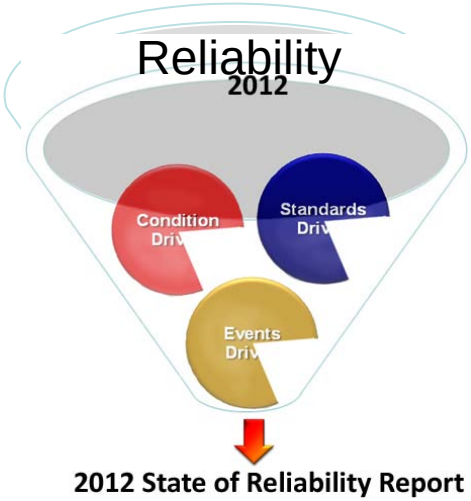
IRI Workshop, NERC Atlanta Office

July 28, 2011

to ensure the reliability of the bulk power system

2011 Risk Assessment of Reliability Performance





The report is available at: http://www.nerc.com/docs/pc/rmwg/2011RMWG_Annual_Report.pdf

Metrics Linkage to Standard Objectives and ALR Characteristics

Standard Objectives	ALR Characteristic					
	Boundary	Contingencies	Integrity	Protection	Restoration	Adequacy
Reliability Planning and Operating Performance		**ALR1-4**	**ALR3-5**	**ALR4-1**		**ALR1-3** **ALR6-1** **ALR6-11** **ALR6-12** **ALR6-13** **ALR6-14** **ALR6-15**
Frequency and Voltage Performance	**ALR1-5** **ALR1-12**	**ALR2-4** **ALR2-5**		**ALR2-3**		
Reliability Information						
Emergency Preparation						**ALR6-2** **ALR6-3**
Communications and Control						
Personnel						
Wide-area View						
Security						

Reliability Metrics

ALR1-5	**System Voltage Performance**
ALR1-12	**Interconnection Frequency Response**
ALR2-3	**UFLS Usage**
ALR6-11	**Automatic AC Transmission Outages Initiated by Failed Protection System Equipment**
ALR6-12	**Automatic AC Transmission Outages Initiated by Human Error**
ALR6-13	**Automatic AC Transmission Outages Initiated by Failed AC Substation Equipment**
ALR6-14	**Automatic AC Circuit Outages Initiated by Failed AC Circuit Equipment**
ALR 6-15	**Element Availability Percentage**
ALR 6-16	**Transmission System Unavailability due to Automatic Outages**

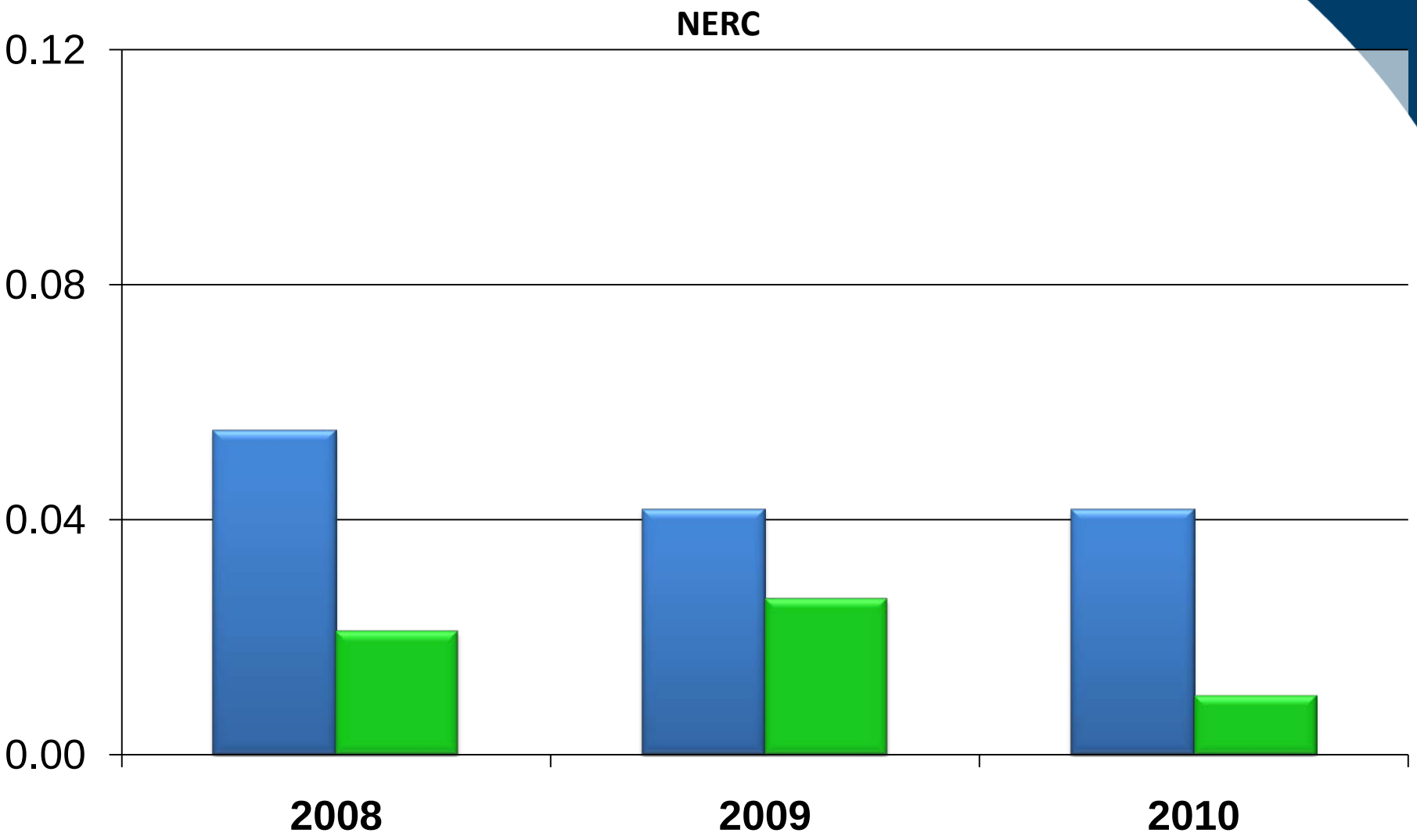
Reliability Metrics (cont'd)

ALR 1-3	**Planning Reserve Margin**
ALR 1-4	**BPS Transmission Related Events Resulting in Loss of Load**
ALR 2-4	**Disturbance Control Standard Failures (DCS Failures)**
ALR 2-5	**Disturbance Control Events Greater than Most Severe Single Contingency (MSSC)**
ALR 3-5	**IROL/SOL Exceedance**
ALR 4-1	**Protection System Misoperations**
ALR 6-1	**Transmission Constraint Mitigation**
ALR 6-2	**Energy Emergency Alert 3 (EEA 3)**
ALR 6-3	**Energy Emergency Alert 2 (EEA 2)**

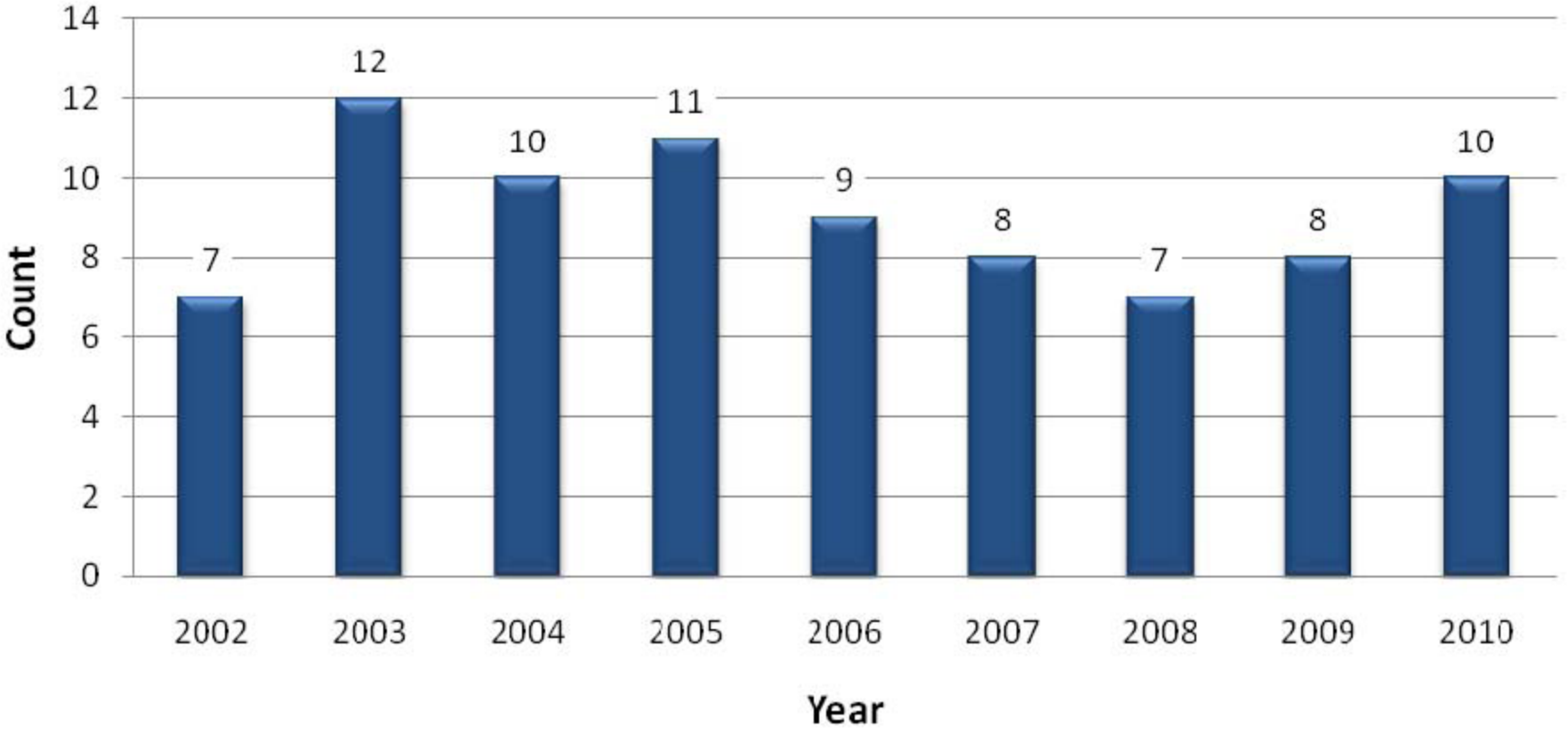
Story #1 – Improvement Areas

- ALR1-3: Planning Reserve Margin
- ALR1-4: BPS Transmission Related Events Resulting in Loss of Load
- ALR2-5: Disturbance Control Events Greater than Most Severe Single Contingency
- ALR6-2: Energy Emergency Alert 3 (EEA3)
- ALR6-3: Energy Emergency Alert 2 (EEA2)
- ALR6-11: Automatic Transmission Outages Initiated by Failed Protection System Equipment
- ALR6-13: Automatic Transmission Outages Initiated by Failed AC Substation Equipment

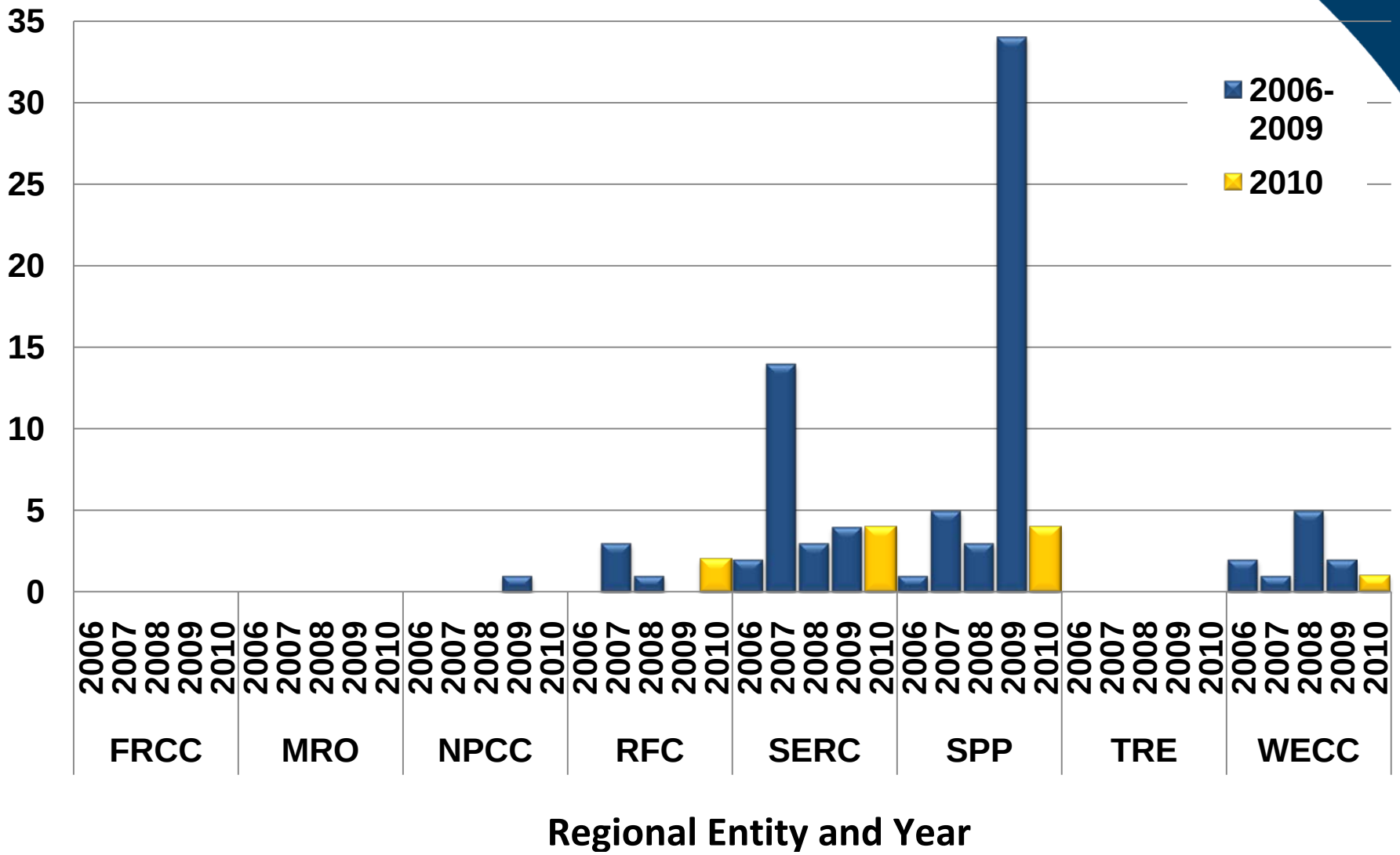
ALR6-11 Automatic Outages Initiated by Failed Protection System Equipment



ALR1-4 Bulk Power System Transmission Related Events Resulting in Loss of Load



ALR6-2 Trends
Energy Emergency Alert 3 (EEA3)



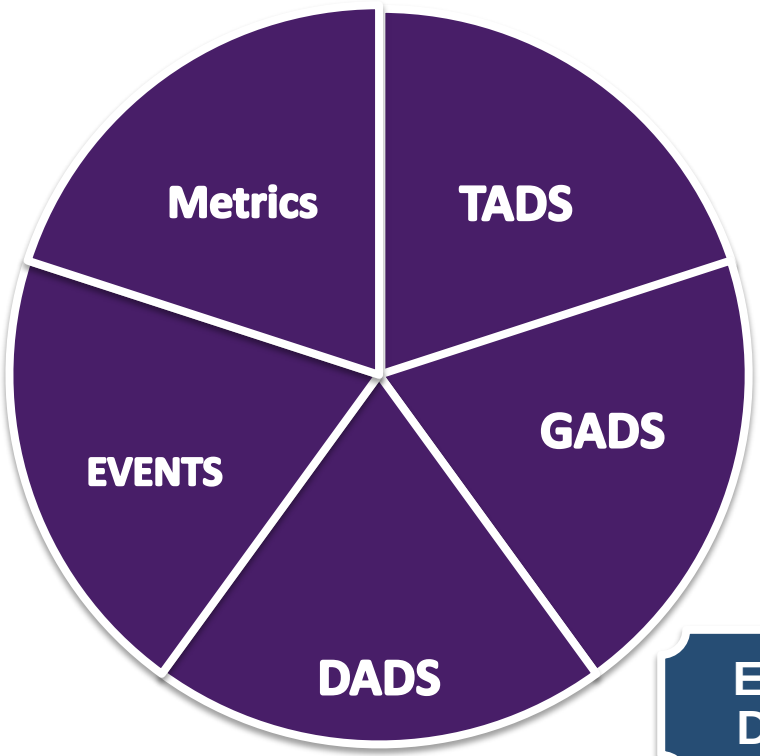
Success Story #2

- Identify risk clusters that could potentially have highest impact on bulk power system reliability
- Protection System Misoperations – Top Reliability Issue
- Nearly all major system failures include relay misoperations as a factor contributing to the propagation of the events.

Intelligence and Analysis

- ALR4-1 Protection System Misoperations
- First time established industry-wide consistent cause categories and cause codes
- Results served as input for PRC-004 revision
- Create actionable results for reliability improvement

Information Transparency



Integration and Analysis

Events Driven

Condition Driven

Standards Driven

Critical Infrastructure Protection

Standards Dev & Prioritization

Compliance

Events Analysis

NERC Integrated Reliability Index Workshop

David Robinson

Sandia National Laboratories

28 July 2011

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Research Focus: Predictive Analytics

Focus is primarily on statistics with the objective of merging information from a variety of sources to understand extremely complex scenarios and make predictions about future events.

Typical Problems

- Pattern recognition and anomaly detection
- Risk prediction for high consequence events
- Cyber security (identify malware, insider threat detection)
- Complex system modeling w/uncertainty; e.g. climate predictions, resilient high performance computing

Integrated Reliability Metrics

Critical Characteristics

Risk metrics are unique to every problem, but the most effective and useful metrics have some common characteristics:

Intuitive be understandable without fully understanding the underlying mathematics

Scalable metric should be applicable to systems regardless of size

Integrable should be able to combine risk metrics from lower level indenture into a system level metric. Most efficient use of all available information. (bottom up)

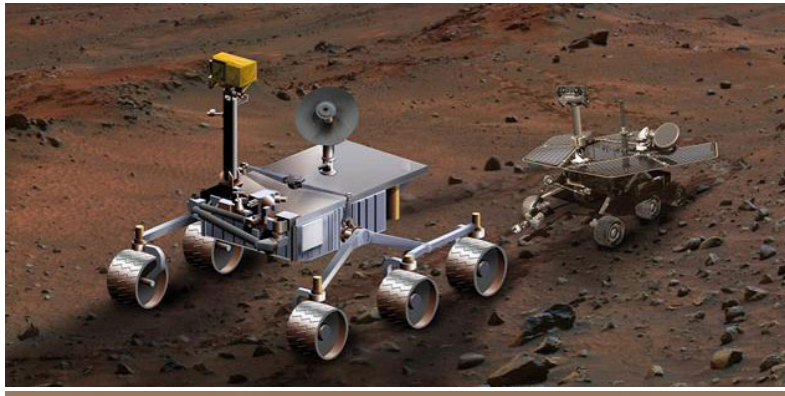
Accountable should be able to relate system level metric to lower level sources of uncertainty/risks (what is causing the system risk to be high? This is critical for decision making, planning, etc. (top down)

Launch Risk Analysis: Mars Science Lab

launch November 2011

High level integrated risk metrics related to Mean Health Effects

- Extended popular NASA/JPL risk metrics with a new methodology that permits integration of uncertainties/risks at various levels of analysis: from inhalation of sub-micron size particles through full scale simulation of Earth-Mars sling-shot and re-entry into Earth atmosphere
- Higher level risk metrics are traceable back through the system to identify where the sources of risk are and how important they are relative to the final risk assessment.
- Use something called mixture modeling to combine risks with various launch phases. Weighted sum where the weights are random variables.
- Methodology will be applied to all future high consequence launches regardless of size or complexity (risk metric remains meaningful regardless of the underlying source of launch risk).



Risk analysis metrics will be used by the Executive Branch to support launch authorization.

- Risk of loss of off-site power critical consideration of safe operation of nuclear plant
- BRIIE is currently a common risk measure for summarizing LOOP risk and
- ... is a very simplified version of the MSL risk measure.
- Risk metric is a random variable and changes in CDF are quantified through importance measures.
- Other groups are working on more complicated risk models that could eventually extend BRIIE.

BRIIE demonstrates that It is not necessary to jump in completely and come up with the perfect metric the first time around. You need to lay the foundation and be flexible as data collection, modeling, and analysis capabilities mature.

FAA - Eastern Service Area
Disaster Response
Risk Minimization Techniques

Integrated Reliability Index Conference

Atlanta, Ga.

North American Electric Reliability Corporation

July 28, 2011

FAA Participants:

Alan Stensland

- Senior Engineer
- Bachelor Civil Engineering, Georgia Tech
- Master Geotechnical Engineering, Georgia Tech
- 16 Years Manager Environmental and Occupational Safety and Health Program
- 19 Years Field Incident Response.
  - Developed FAA FIR concept.
  - Member International Association of Emergency Managers

- Views expressed do not represent the FAA.

ESA FIR Earthquake Awareness Part 1

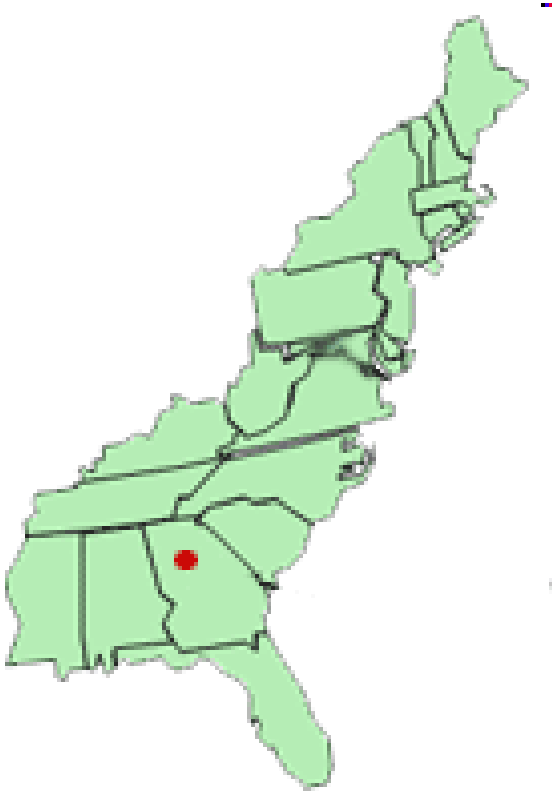
- **What is the Risk ?**
  - **Define Risk !**
  - Define the New Madrid Seismic Zone.
  - Demonstrate historical damage to FAA Facilities and Equipment.
    - Hurricane Andrew
  - Define expected levels of Damage
    - how will ESA determine the levels and expected actions.
- What is our Plan ?
  - Risk Management Zones
  - Linear Facility recovery concept

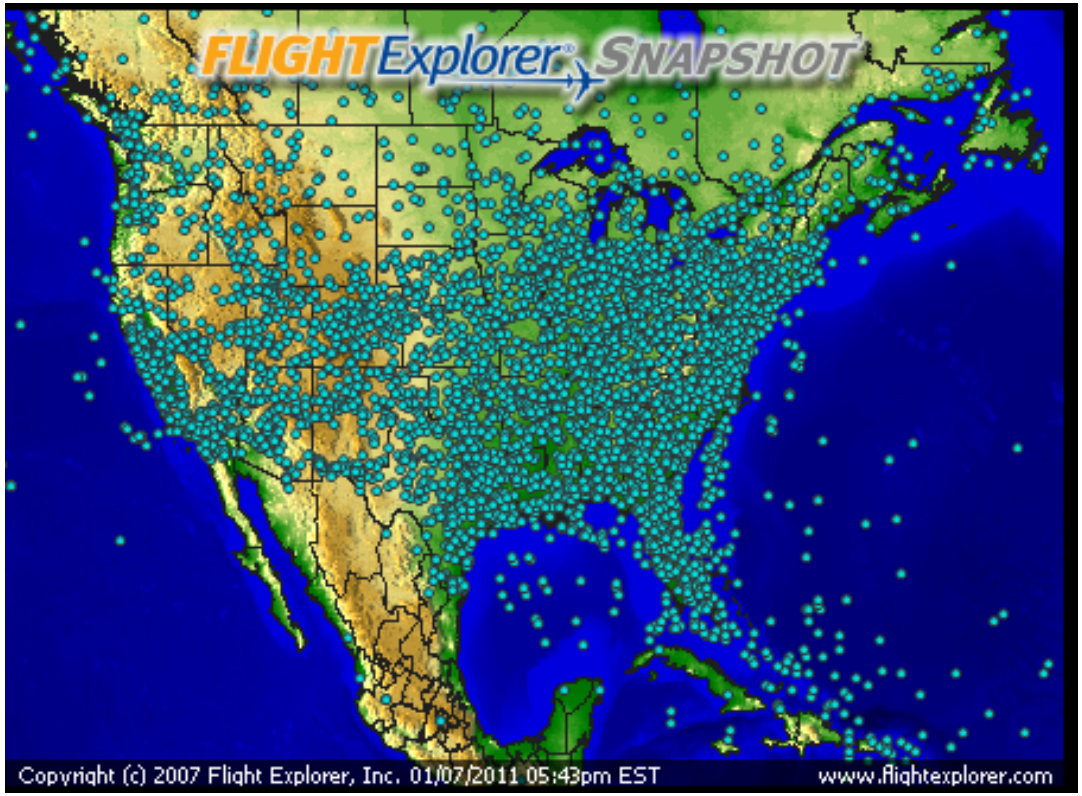
ESA FIR Earthquake Awareness

- Federal Aviation Administration (FAA)
  - Eastern Service Area (ESA)
  - Central Service Area (CSA)
  - Western Service Area (WSA)
- Field Incident Response (FIR)
  - Systematic processes and procedures to recover and restore FAA Facilities and Equipment when impacted on a macro level.
  - Hurricanes, Earthquakes, Floods, etc.

FAA Eastern Service Area

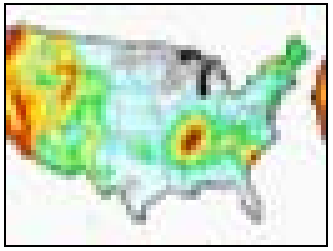
FAA Eastern Service Area consist of 21 States, D.C. and the Caribbean.

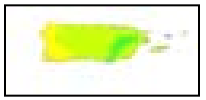




ESA FIR Earthquake Awareness

- Earthquakes are a known Risk
- No advanced notice
- PLAN ahead !!!
- Follow the plan.
- Learn what to expect and what to do.
- Learn the different levels of Damage based on the initial Magnitude and what to expect from After Shocks.





Wait !!!

- Doesn’t the FAA handle “interruptions” every day?
  - Yes to a certain level. Usually weather related but it includes 911.
  - These adjustments are based on available Equipment and Facilities to provide services.
- Doesn’t the field deal with equipment outages every day ?
  - Yes, but again to a certain level.
  - What happens when the field is overwhelmed, or part of the incident ?
  - That’s when FIR begins.

We need to understand Risk, as it pertains to Disaster Response.

- Risk is calculated from probability of occurrence and the expected severity from the occurrence.
  - Risk=Probability * Severity.
- You deal with Risk every day:
  - this airspace is too crowded, etc.

PROB				
	High	Acceptable ??	Warning Will Robinson ??	Warning Will Robinson !!!
	Medium	Acceptable	Warning Will Robinson ??	Warning Will Robinson ??
	Low	Acceptable	Acceptable ??	Acceptable ?? ZME FTI
		Low	Medium	High
	SEVERITY			

Severity Reduction Concept:

We usually can't control the probability so we reduce the severity to control Risk.

- Step 1: Remove Hazards
- Step 2: Engineer Solutions
- Step 3: PPE
- The initial FAA responders can only remove Hazards with their normal PPE.
- So we will base our initial Field Operations on a series of decision Tactical Decision Points.
- NMSZ Field OPS will require two persons.

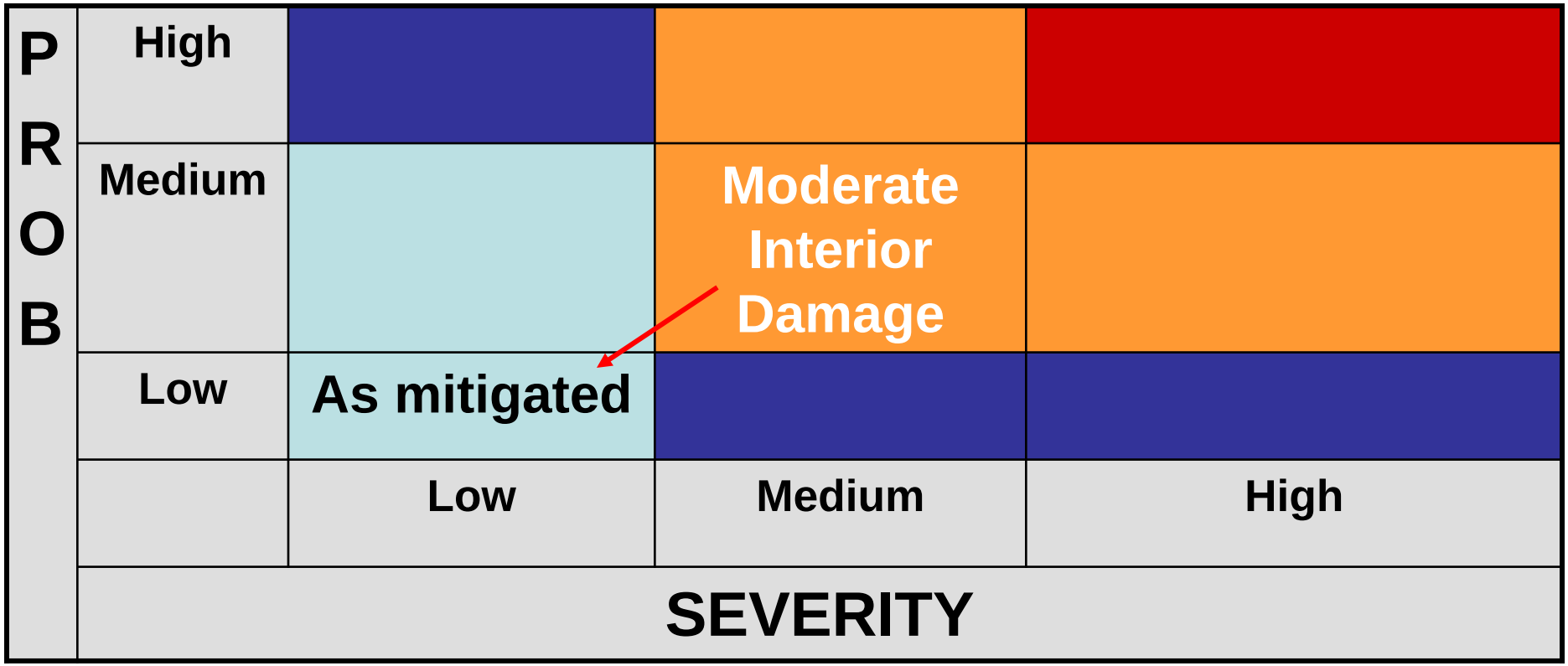
Severity Reduction:

- You arrive at a VOR, the Teepee looks OK, no external indications of problems – proceed.
- You open the door and have to “force” it open due to debris (ceiling tiles, etc) but the Racks appear OK.

PROB				
	High			
	Medium		Moderate Interior Damage	
	Low			
		Low	Medium	High
	SEVERITY			

Severity Reduction (Cont):

- Step 1: Eliminate the Hazard.
  - Clear a Path, includes ceiling Hazards
- Step 2: Engineering Controls
  - Place temporary shoring
- Step 3: PPE
  - Hard Hat, Gloves, 2 person rule, etc



Threats due to Earthquake

- Initial Earthquake
- Aftershocks
- “Sand Plumes”
- Falling objects
- Hazardous “plumes” from fires, etc
- Lack of provisions
- Lack of Communications

Aftershocks and The 10 hour rule

- Based on aftershocks and the Risk to responders:
  - No actions for NAS recovery for 10 hours after initial Earthquake. (this is discussed in more depth later)

Aftershocks						
Time (Hours)	Number	Magnitude				
0	1	6.00	6.50	7.50	8.00	100%
1	1	5.40	5.85	6.75	7.20	90%
10	**10**	4.86	5.27	6.08	6.48	80%
100 (4 days)	100	4.37	4.74	5.47	5.83	70%
1000 (40 days)	1000	3.94	4.26	4.92	5.25	60%
Red - No NAS Recovery		Orange - Extreme Caution		Yellow - Caution		

Threats due to Earthquake

- Aftershocks have the following Risk potentials that have to be assessed and mitigated for every occurrence:
  - Further damage to the structure
  - Further damage to power, fuel, water etc
  - Falling objects
  - New fires, etc
  - Loss of roads and bridges.
    - Lack of provisions
    - Lack of Communications
- We will always assume an aftershock is immanent. The magnitude is as per the previous table.

ESA FIR Earthquake Awareness Part 4

- What is the Risk ?
  - Define Risk !
  - Define the New Madrid Seismic Zone.
  - Demonstrate historical damage to FAA Facilities and Equipment.
    - Hurricane Andrew
  - **Define expected levels of Damage**
    - **how will ESA determine the levels and expected actions.**
- What is our Plan ?
  - Risk Management Zones
  - Linear Facility recovery concept

For an Earthquake

- Interior and Architectural damage is proportional to Structural damage !
- You will have significant Interior and Architectural damage prior to any Structural damage.
- Interior and Architectural damage begins at a Magnitude 5.5.
- Structural at a Magnitude 6.5.
- **How can we use this to our advantage ?**
- By training our Field Responders to recognize the levels of Interior and Architectural damage have standards on when and how to proceed and when to back off and call for further assessment.

Light Damage

Little to no mitigation for safe egress

Moderate Damage

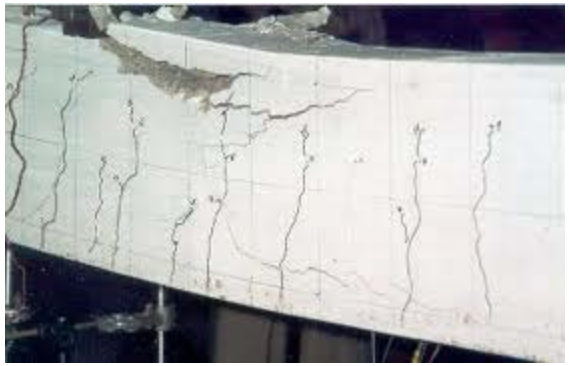
Light to moderate mitigation for safe egress

Moderate Damage

Severe Damage

No go until assessed for Structural integrity.

Severe Damage



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NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Integrated Reliability Index

Bill Adams, RMWG Chair, Georgia Power Company

IRI Workshop, Atlanta, GA

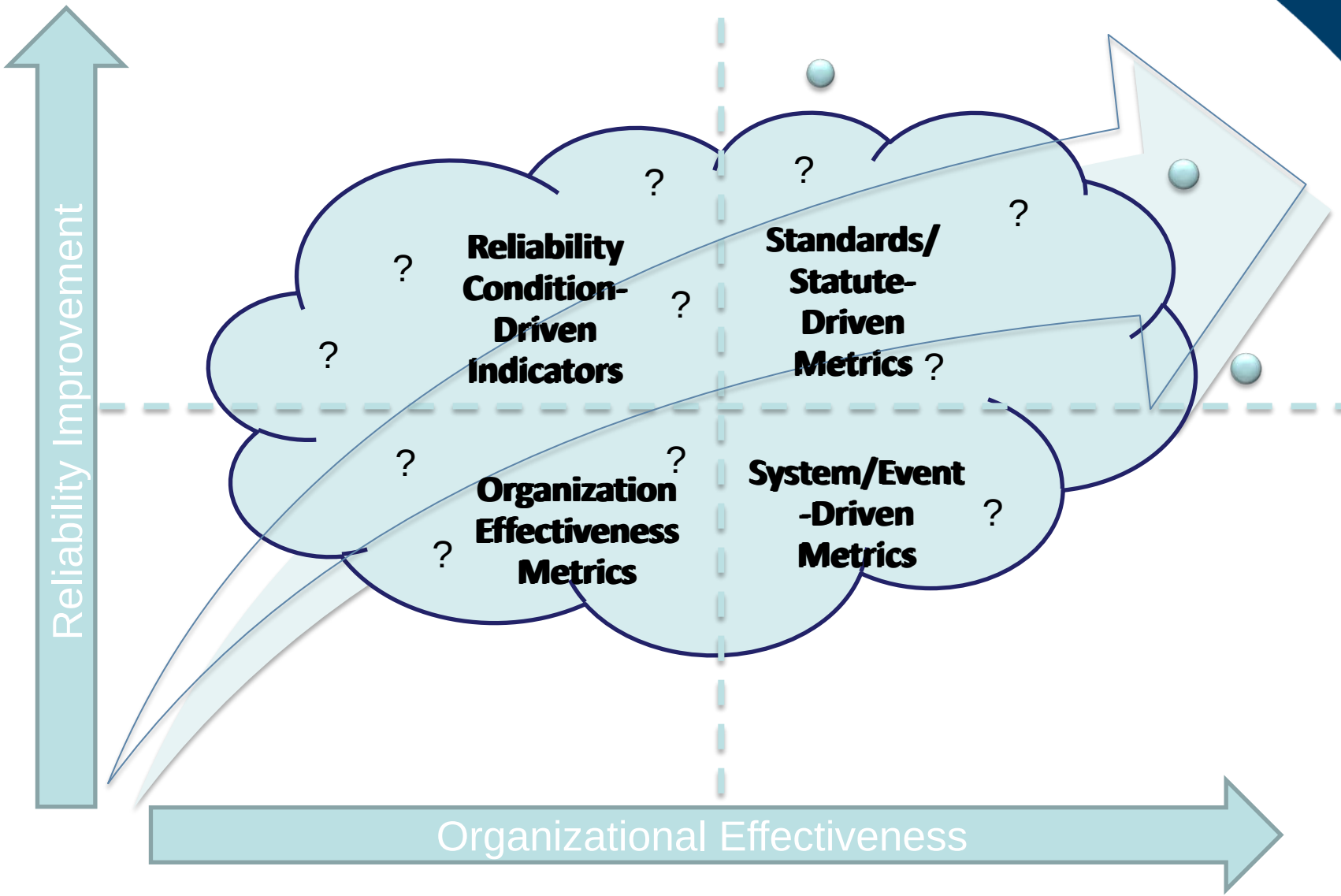
July 28, 2011

to ensure the reliability of the bulk power system

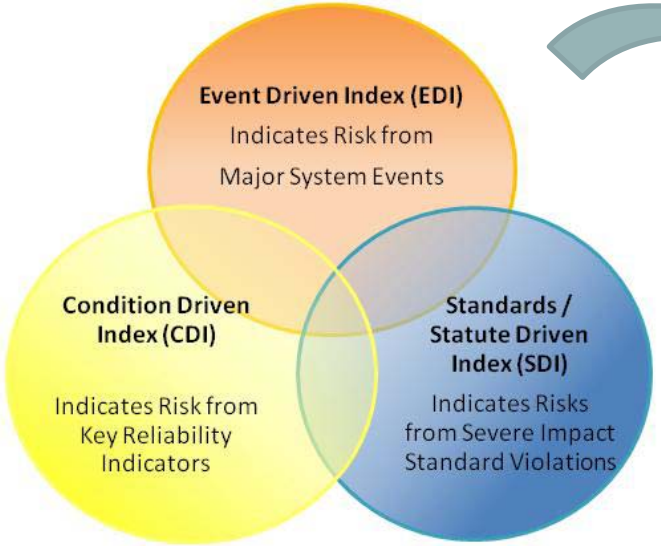
IRI Objective

- Provide meaningful trends on bulk system performance
- Try to address “How reliable is reliable enough?”
- Establish measures for determining achievement of reliability improvement
- Support risk-informed decision making
- Estimate the effectiveness of risk reduction and/or mitigation

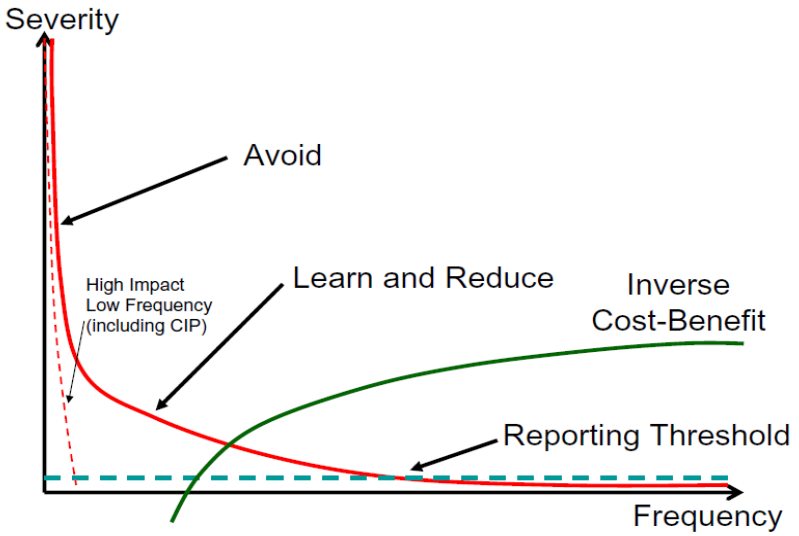
Reliability Performance Measures



Key Concepts



Cornerstone of risk-management concepts



IRI Concept

- **BPS Integrated Reliability Index (IRI):**
  - **Event Driven Index (EDI) -** The risk value associated with significant events, and uses the severity risk index (SRI) as a basis
  - **Condition Driven Index (CDI) -** A subset of metrics covering major factors to reliability
  - **Standards/Statute Driven Index (SDI) -** A subset of standards that have highest impact to reliability
- **IRI = EDI x WF + CDI x WF + SDI x WF**
- Weighting factors should be set based on sensitivity studies and field experience

Measuring ERO Reliability Performance Workshop

Remarks on the Formulation of an Integrated Reliability Index

28 July 2011

Buckhead, GA

Joe Eto

Lawrence Berkeley National Laboratory

Starting Point

Metrics are tools to improve performance through the collection, analysis, and tracking of quantitative measures of aspects of reliability performance.

The purpose is to monitor, track, forecast, and compare performance to benchmarks or trends in order to assess and initiate corrective actions to improve performance

The Most Important Consideration

Ensure metrics provide a meaningful basis for management actions to improve performance

This Means

- **Performance must be adequately defined so that an individual metric or set of metrics provides an unambiguous measure of that performance**
- **Both leading (proactive) and lagging (reactive) measures of performance may be important**
- **Metrics must be selected carefully to ensure highest priorities are targeted because metrics naturally focus management attention on these priorities at the expense of others**
- **Metrics must be carefully designed in order to separate the influence of deliberate actions to improve performance from other (especially, uncontrollable or unpredictable) influences on performance**
- **An adequate historical record is required to establish trends for performance**

Which Leads to Specific Considerations

- **Attention should be paid to potential conflicts among metrics that target different aspects of performance**
- **Attention should be paid to potential duplication among metrics that apparently target different aspects of performance (double-counting)**
- **Scarcity of management resources places practical limits on the total number of metrics that can be considered at any one time**
- **However, the list of metrics considered can evolve over time**

And, Finally, Here Are Specific Suggestions to Consider

- **Iteration/evolution will likely be required to solidify index elements and weightings among them**
- **Back-casting and "front-page" testing with panels of experts or key advisors may be useful means for calibrating/guiding these efforts**
- **Periodic re-assessment as management actions are undertaken and their performance is evaluated should be an explicit part of the process**

NERC

NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

IRI Workshop: Panel 3

Atlanta, GA

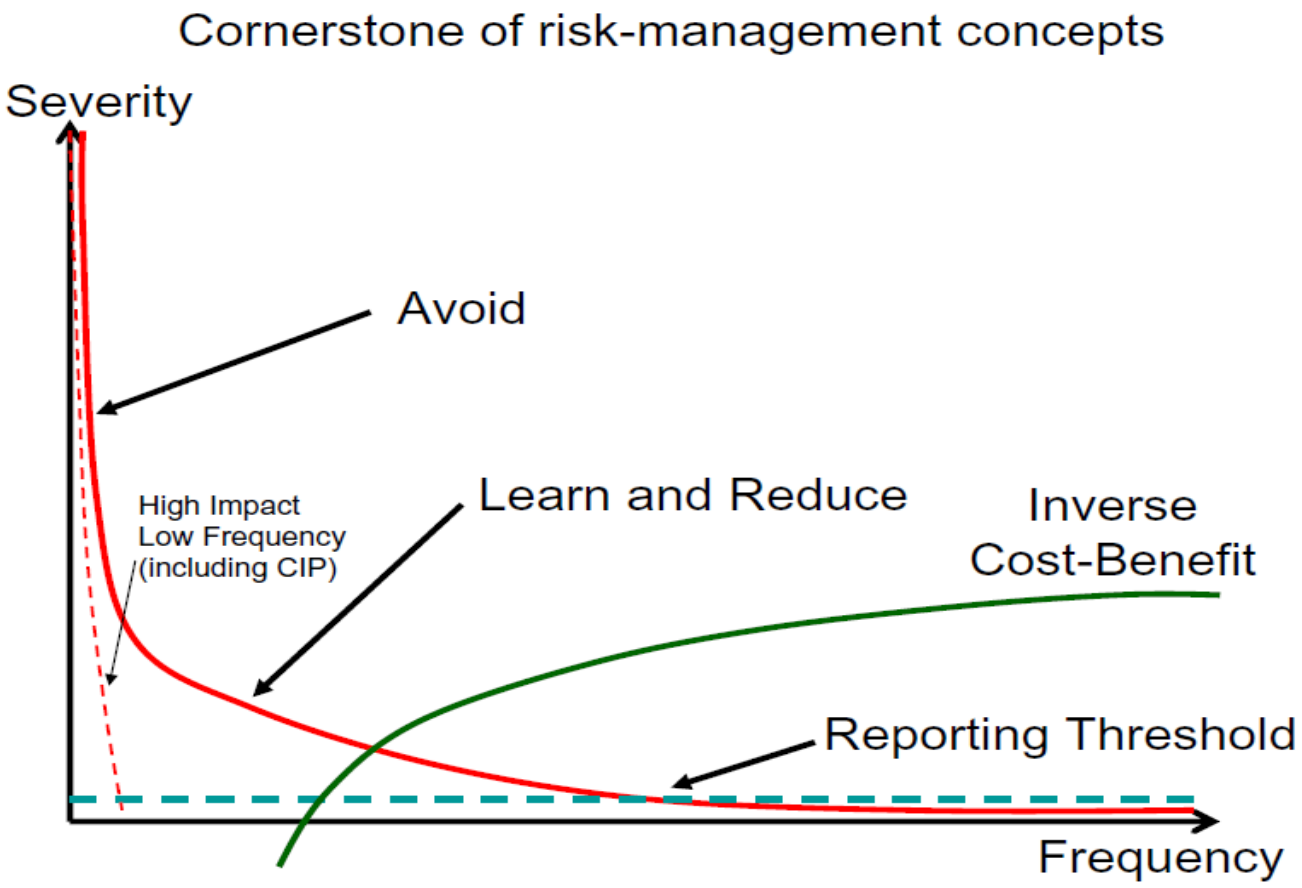
July 28, 2011

to ensure the reliability of the bulk power system

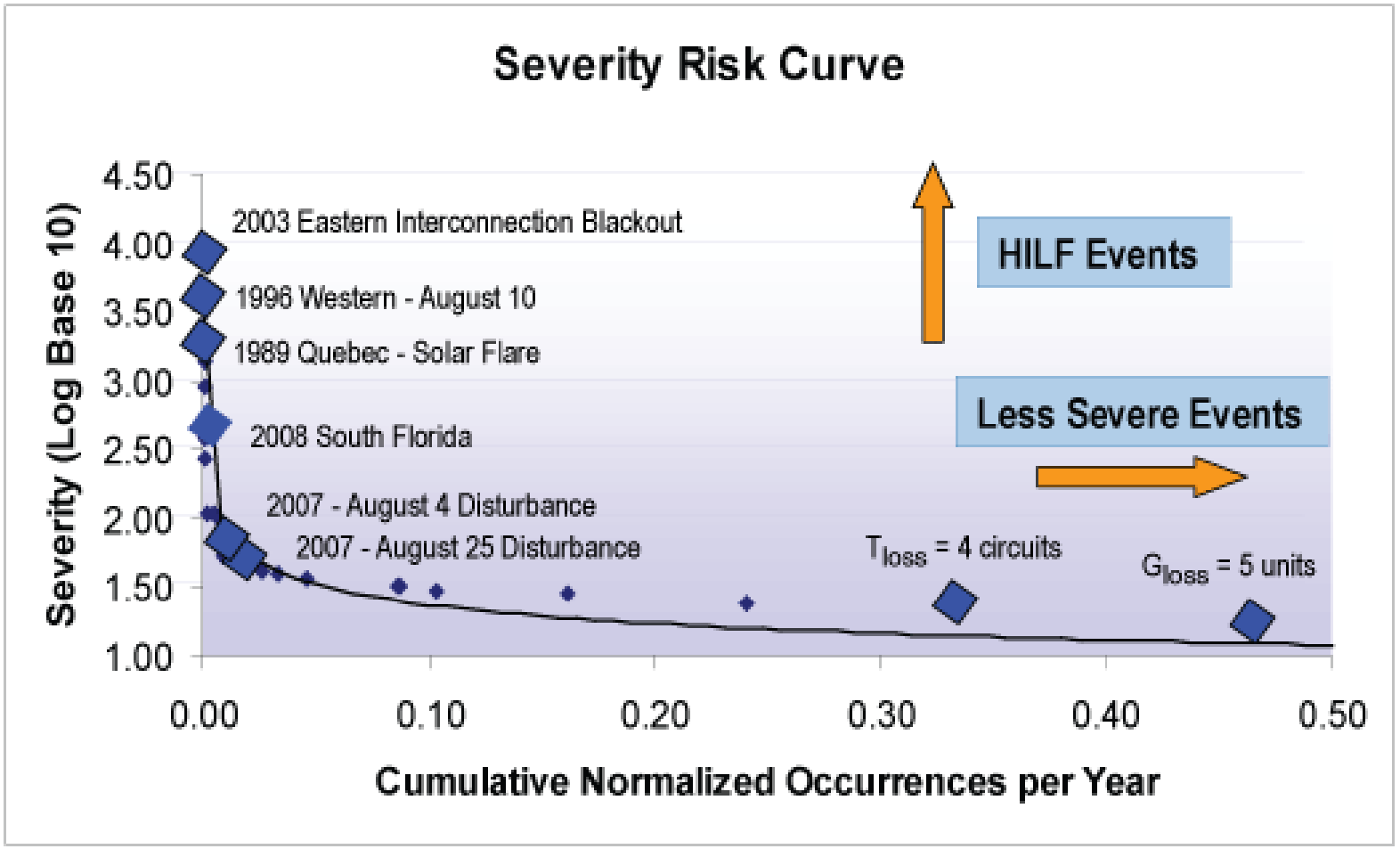
Topics

- High Impact/Low Frequency Events and Considering Low Impact/High Frequency
- Severity Risk Index and Its Evolution
- Integrated Reliability and the Conceptual Model
- Challenge to RMWG to Develop Essential Metrics…How Many Do We Need?
- Elements and their Current Derivation
- Issues Yet to be Resolved

Risk Management Concept



Severity Risk Index (SRI) Original Concept



Event Driven Index (EDI)

- Focus on significant events and quantify the inherent system risk using historic outage and event data
  - Use the risk value associated with SRI
  - GADS and TADS daily outages
  - MW load loss and restoration duration from disturbance event reports
- Recognize that this is a lagging indicator but with sufficient history may correlate to create a leading indicator…perhaps linking into CDI and SDI components

Event Severity Risk Index (SRI)

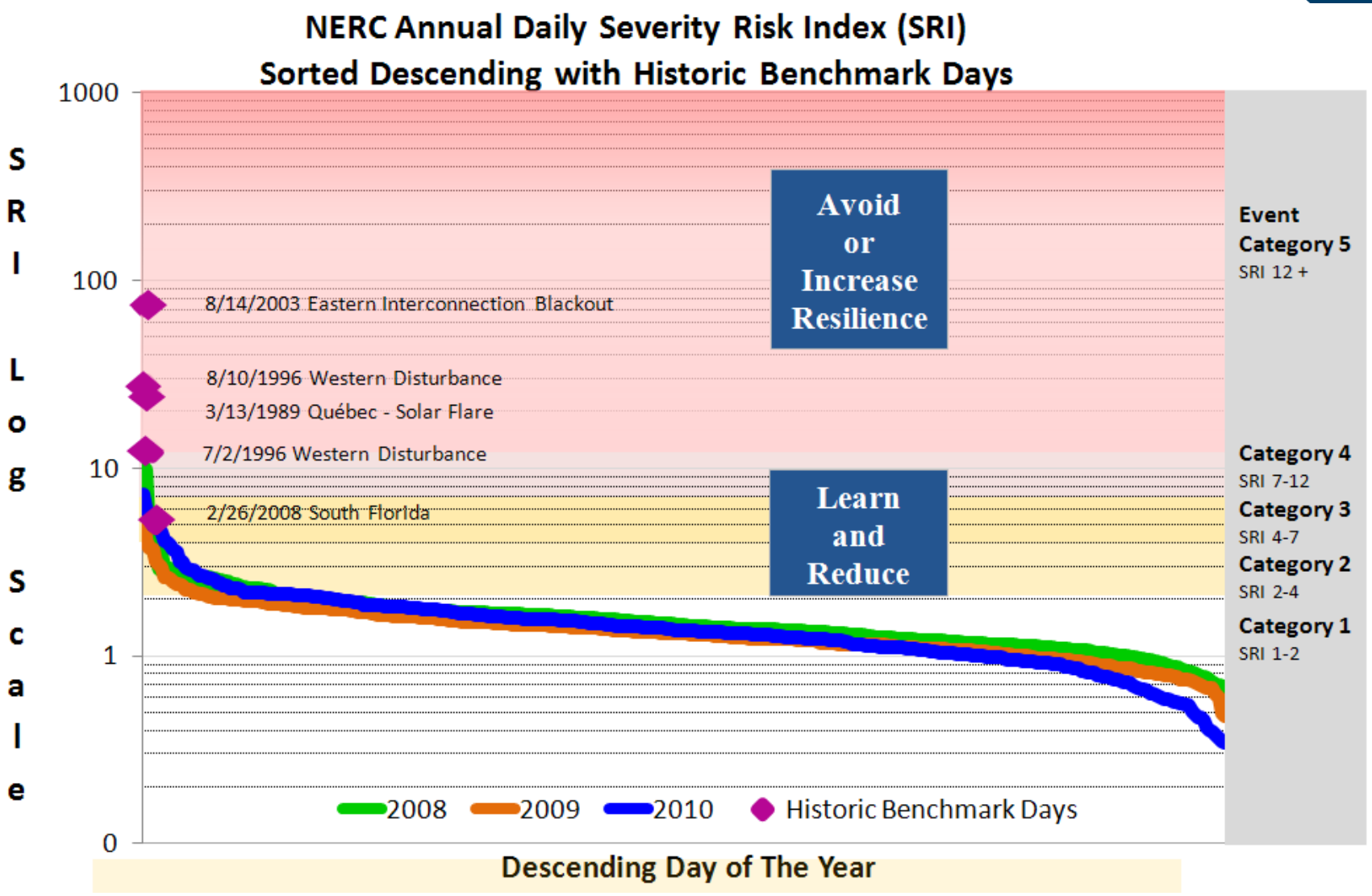
$$SRI_{event} = (RPL)*w_L*(MW_L) + w_T*(N_T) + w_G*(N_G) \quad (2)$$

Where:

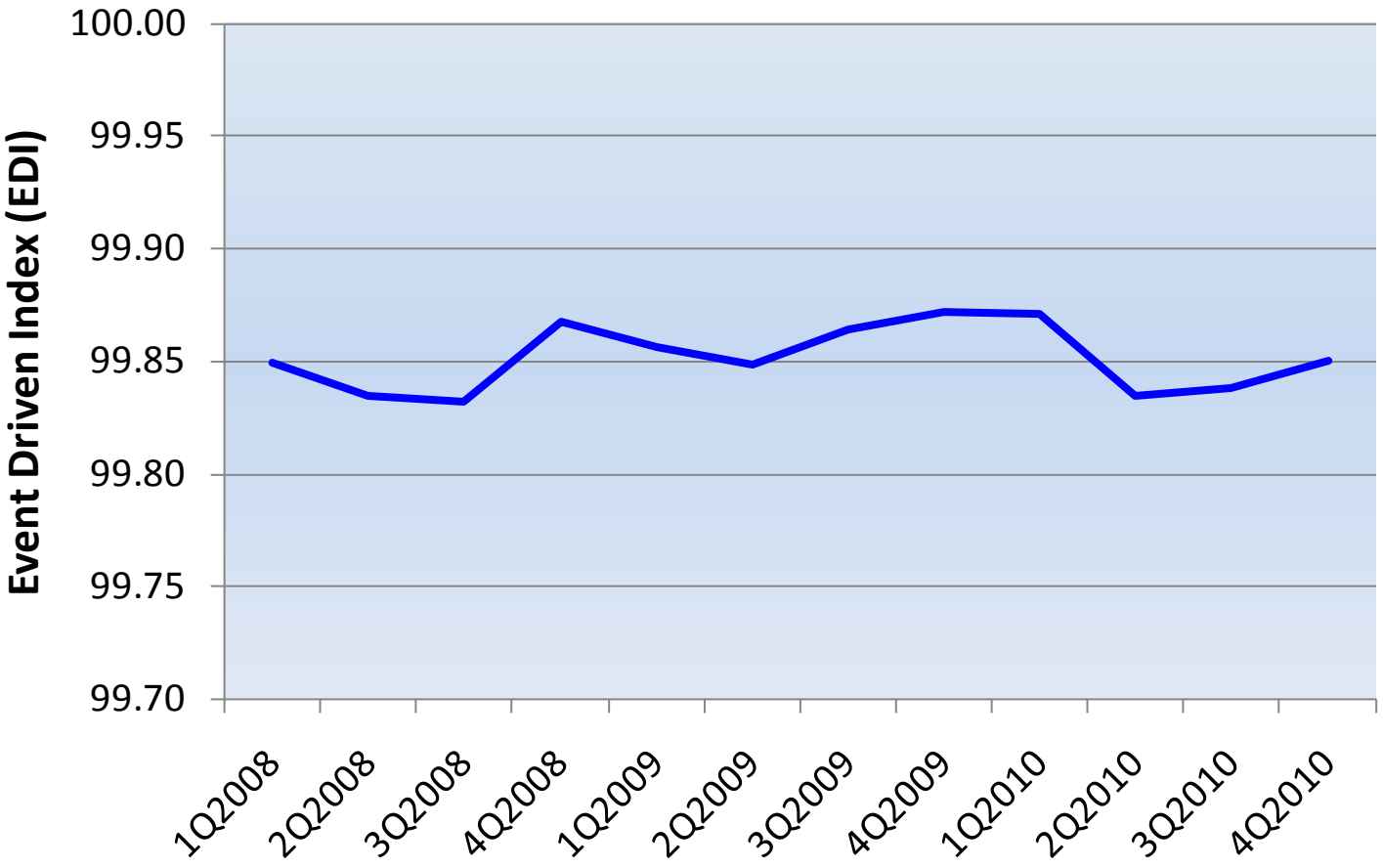
SRI_{event} = severity risk index for specified event (assumed to span one day),
w_L = 60%, weighting of load loss,
MW_L = normalized MW of Load Loss in percent,
w_T = 30%, weighting of transmission lines lost,
N_T = normalized number of transmission lines lost in percent,
w_G = 10%, weighting of generators lost,
N_G = normalized number of generators lost in percent,
RPL = load Restoration Promptness Level:

- RPL = 1/3, if restoration < 4 hours,
- RPL = 2/2, if 4 <= restoration < 12 hours,
- RPL = 3/3, if restoration >=12 hours

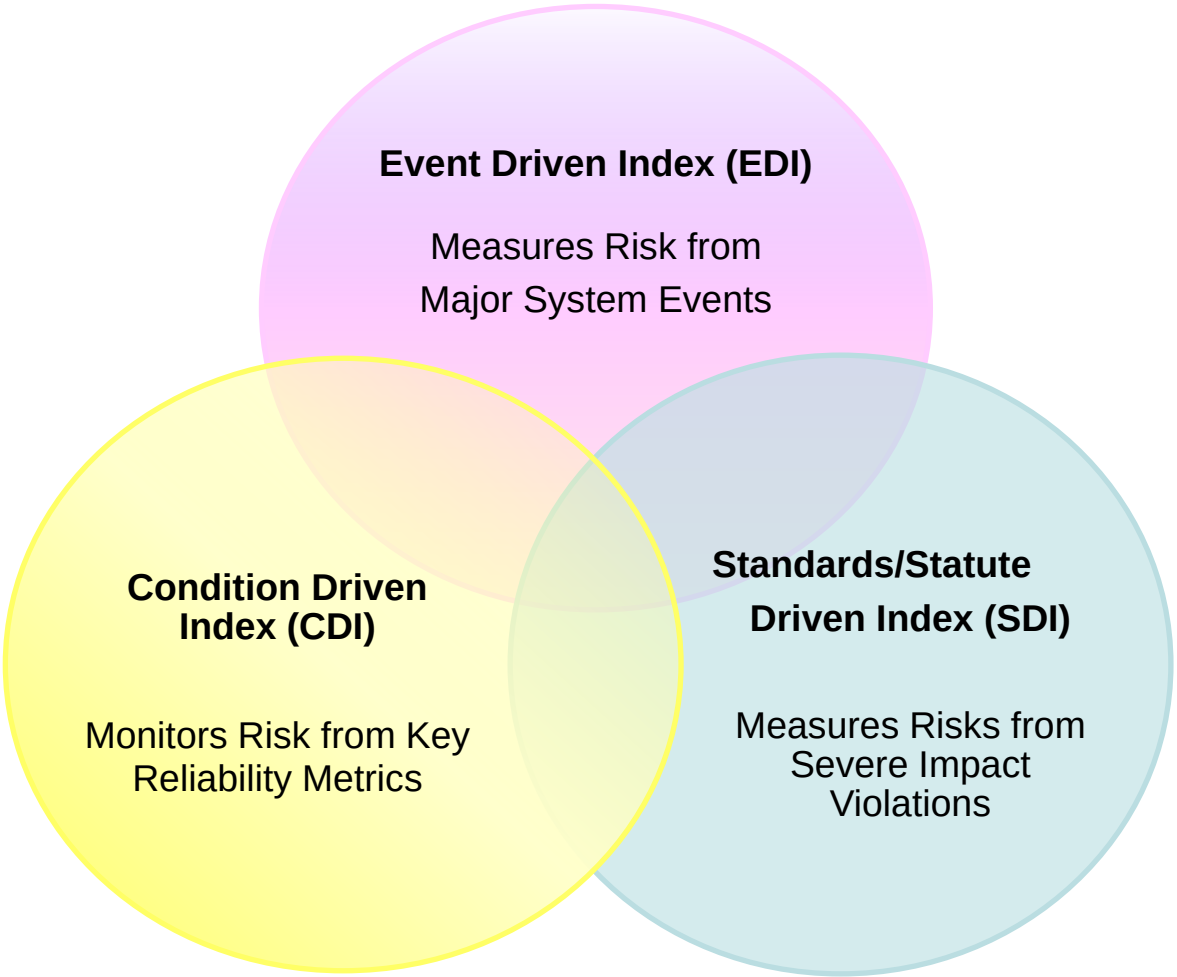
Event Severity Risk Index (SRI)



EDI Trends by Quarter



Integrated Risk Assessment Conceptual



IRI Concept

- **BPS Integrated Reliability Index (IRI):**
  - **Event Driven Index (EDI):** Based on event severity risk index (SRI) values
  - **Condition Driven Index (CDI):** Use a subset of metrics based on selection criteria
  - **Standards/Statute Driven Index (SDI):** Identify a subset of standards that have highest impact to reliability and create an index of standards violations

Metrics Linkage to Standard Objectives and ALR Characteristics

Standard Objectives	ALR Characteristic					
	Boundary	Contingencies	Integrity	Protection	Restoration	Adequacy
Reliability Planning and Operating Performance		**ALR1-4**	**ALR3-5**	**ALR4-1**		**ALR1-3** **ALR6-1** **ALR6-11** **ALR6-12** **ALR6-13** **ALR6-14** **ALR6-15**
Frequency and Voltage Performance	**ALR1-5** **ALR1-12**	**ALR2-4** **ALR2-5**		**ALR2-3**		
Reliability Information						
Emergency Preparation						**ALR6-2** **ALR6-3**
Communications and Control						
Personnel						
Wide-area View						
Security						

Standards/Statute Driven Index (SDI)

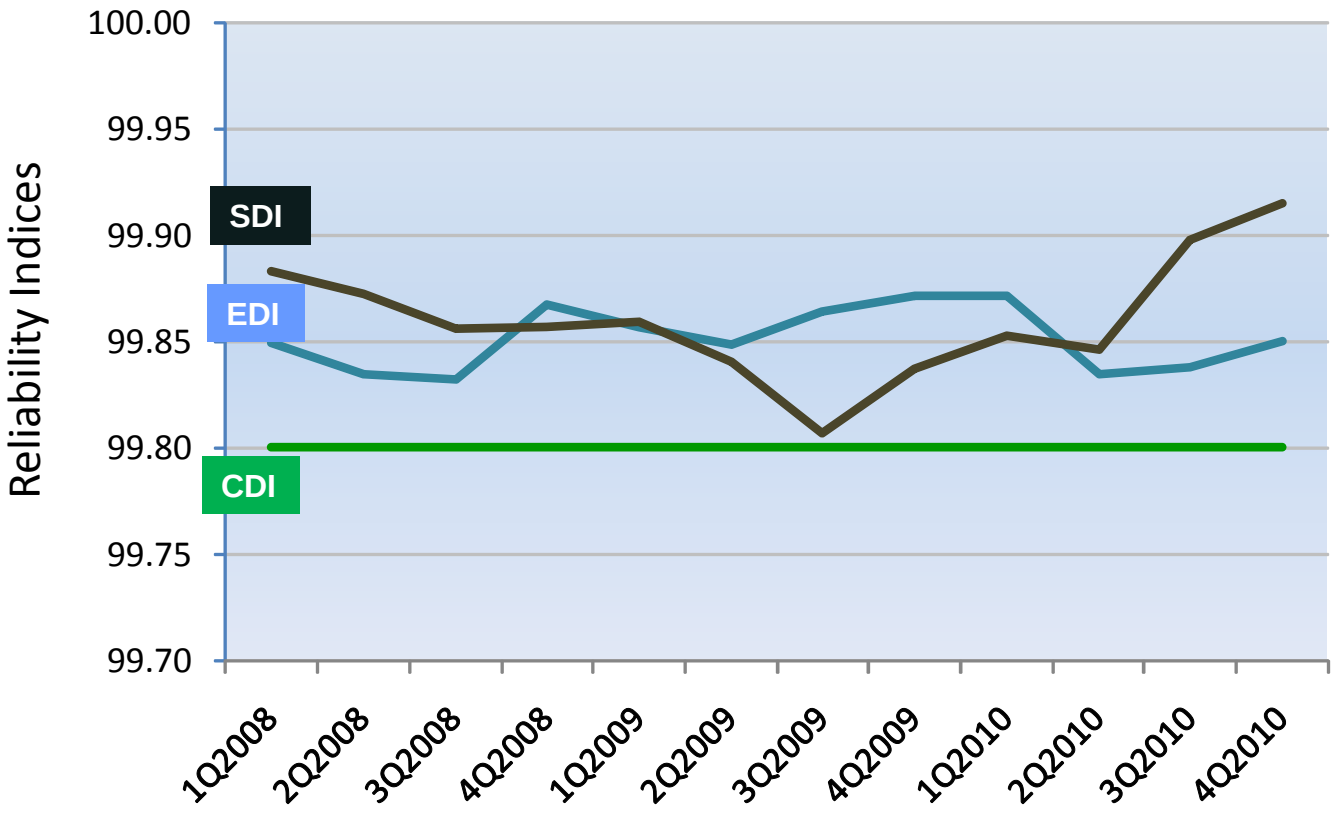
- 26 standard requirements
- Severe Reliability Impact Statement (RIS)
  - RIS indicates significance of impact on BPS (slide 19)
- Violation Risk Factor (VRF)
- Violation Severity Level (VSL)
- Standard applicability used as exposure (denominator)
- Similar to daily SRI calculation

26 Requirements*

Standard	Req.	Standard	Req.	Standard	Req.	Standard	Req.	Standard	Req.
EOP-001-0	R1.	FAC-009-1	R1.	PER-002-0	R3.	PRC-005-1	R2.	TOP-004-2	R1.
EOP-003-1	R7.	IRO-005-2	R17.	PER-002-0	R4.	TOP-001-1	R3.	TOP-004-2	R2.
EOP-005-1	R6.	PER-001-0	R1.	PRC-004-1	R1.	TOP-001-1	R6.	TOP-006-1	R6.
EOP-008-0	R1.	PER-002-0	R1.	PRC-004-1	R2.	TOP-001-1	R7.	TOP-008-1	R2.
FAC-003-1	R1.	PER-002-0	R2.	PRC-005-1	R1.	TOP-002-2	R17.	VAR-001-1	R1.
FAC-003-1	R2.								

* All 26 requirements have high Violation Risk Factor (VRF).

Component Trend (2008-2010 by Quarter)



Issues to Be Considered...

- What about the intersection versus union in the conceptual model?
- If CDI and SDI become obvious leading indicators what happens to EDI?
- Is it necessary to actual integrate the components together into a single metric?
- What would mechanism for weighting if they were to be integrated?
- And how about changing that mechanism with time?
- How will the index be used?

NERC Workshop
Measuring ERO Reliability Performance

Panel 3: *IRI Components*

July 28, 2011

Greg Pierce
Director, Transmission Compliance
Entergy Services, Inc.

Panel 3 – IRI Components(I)

- **Should CIP standard violations be included in SDI? If yes, what are the criteria to be used to determine its impact to bulk power system reliability? Should they be weighted the same as the other types of violations?**
  - ***Premise: CIP elements should be categorized separately. There are too many external contributors to the equation than can drive CIP issues, including elements such as terrorism. A separate measure is may be most useful for this set of standards.***

Panel 3 – IRI Components(II)

- **Should EDI include weather-caused events? If yes, why? If not, why not? What about earthquakes, tsunamis, fires started by humans, or any other type natural disaster? What about typically unrelated infrastructure failures, as in public water systems, levees, bridges, sewers, etc.?**
  - ***Premise: All events should be included unless separately captured to be considered for inclusion on an annual or biannual basis.***

Panel 3 – IRI Components(III)

- **Should equipment or load loss that operated as designed be treated differently than the equipment or load loss that did not operated as designed? If yes, how?**
  - ***Premise: Events exacerbated as the result of equipment failures should reasonably identified, for example as organizational and programmatic issues or as human errors. These should become a subset of the EDI and/or most certainly a part of the CDI data.***

Panel 3 – IRI Components(IV)

- Are there any consistent methods to determine the weighting factors used in EDI, CDI and SDI? If yes, what are they?

  - *Premise: This is the most challenging aspect of having an integrated index that has nested or feeder indices. For such an indicator there should be a formal, programmatic review of the embedded indices, e.g. EDI, CDI and SDI, by a group that can evaluate the accuracy of conclusions/results and subsequent impact and suggest adjustments that would then be approved by an oversight steering group*