

Reliability Standards

ACERCA Committee Meeting



Primary Reliability Topics to Cover

- Importance of Standards
- Role of NERC Standards
- History of Idaho Standards
- Existing Guarantees & Performance Standards
- Measurement Indicators
- Interruption Types
- Reliability Indices
- Performance Types
- Disruption Categories
- Reliability Management
- Summary and Questions

Definition of Reliability

- The degree to which the performance of the elements in a bulk system results in electricity being delivered to customers within accepted standards and in the amount desired.
- The degree of reliability may be measured by the frequency, duration, and magnitude of adverse effects on the electric supply.

Importance of Standards

(Regarding Idaho Code)

- ⦿ The utility must adhere to Idaho Code:

- ⦿ Section 61-302 requires every public utility to “furnish, provide and maintain such service, instrumentalities, equipment and facilities as shall promote the safety, health, comfort and convenience of its patrons,...and as shall be in all respects adequate, efficient, just and reasonable.”

- ⦿ If not.....

- ⦿ Section 61-520 gives the commission power to ascertain and fix “adequate and serviceable standards for the measurement of quantity, quality, pressure, initial voltage or other condition pertaining to the supply of the product, commodity or service furnished or rendered by any such public utility.”

Importance of Standards

(Regarding Electricity Rates and Rate of Return)

• In a general rate case, the Commission must:

- Decide whether the company has an adequate process for determining how it invests in capital, and ultimately decide if its investments are necessary and prudent (e.g.- gross plant and equipment, materials and supplies, inventories of fuel).
- Make sure the company is cost effectively and non-discriminatorily serving the needs of its customers.
- Set a fair Rate of Return (ROR) that is high enough to encourage capital investment but low enough to discourage over investment. If the difference between the cost of debt and cost of equity (ROE) are too far apart, the utility may have an incentive to overbuild, and therefore provide more reliability and capacity than is necessary (i.e.- raising electricity rates).

Role of NERC Standards

(North America Transmission)

● North American Electric Reliability Corporation (NERC):

- Commits to ensuring the reliability of the bulk power system in North America.
- Is subject to oversight by the U.S. Federal Energy Regulatory Commission (FERC) and governmental authorities in Canada.
- Enforces mandatory reliability standards with all users, owners, and operators of the system.

● Transmission vs. Distribution:

- Transmission is enforced by NERC. Currently transmission is divided by function not by line size.
- Currently FERC is proposing a rule qualifying the distribution threshold as being under 100 kV for applicability of reliability standards.
- For many utilities in the west with sub-transmission at voltage levels between 100 and 200 kV, this could significantly change reliability and system operation.
- One concern is that there has not been a cost/benefit analysis illustrating the tradeoff between the reliability investment in lower voltage lines and the incremental reliability gained.

History of Idaho Standards

(Initiating Control- Merger of Scottish Power & PacifiCorp)

- Reliability Issues Surface-

- During the 1999 merger of Scottish Power with PacifiCorp customers testified that following a prior merger (UP&L), PacifiCorp service quality in south eastern Idaho diminished (PAC-E-99-1).

- Customer Concerns-

- Most concerns were expressed by farmers who typically take delivery of electric service at numerous points, in rural areas, and whose needs and concerns can be unique. They were concerned that if the merger occurred, there would be further neglect to the system.

- Poor System Reliability-

- Scottish Power and PacifiCorp proposed a Service Standards Program, where system improvements were committed to in order to meet seven performance standards and eight customer guarantees within the 5 year period following approval of the merger transaction, or else be subject to penalties (Rule 25 and Schedule 300).

History of Idaho Standards

(Maintaining Control- Merger Commitments and Solutions)

• Conditional Commitments-

- Beyond the normal purchase price, Scottish Power would spend \$30 million for capital investment in new infrastructure, and \$25 million for additional maintenance, payments for customer guarantee failures, employees and training.
- If the reliability performance standards were not met at the end of the five year implementation period following the merger, the financial penalties included \$1 dollar for every customer in the jurisdiction where standards were not achieved. If this were to happen in all jurisdictions , the total penalty was \$7 million dollars.

• Results-

- The Company achieved its five year performance standard targets according to the Scottish Power merger commitments.
- The standards from the Scottish Power merger were set to expire March 2008, however these were extended during MidAmerican Energy Holding Company's acquisition of PacifiCorp (PAC-E-05-08). With some changes, the customer guarantees, performance standards, and reporting continue until March 2011.

Existing Guarantees

(Idaho)

<u>Customer Guarantee 1:</u> Restoring Supply After an Outage	The Company will restore supply after an outage within 24 hours of notification with certain exceptions as described in Rule 25.
<u>Customer Guarantee 2:</u> Appointments	The Company will keep mutually agreed upon appointments, which will be scheduled within a two-hour time window.
<u>Customer Guarantee 3:</u> Switching on Power	The Company will switch on power within 24 hours of the customer or applicant's request, provided no construction is required, all government inspections are met and communicated to the Company and required payments are made. Disconnections for nonpayment, subterfuge or theft/diversion of service are excluded.
<u>Customer Guarantee 4:</u> Estimates For New Supply	The Company will provide an estimate for new supply to the applicant or customer within 15 working days after the initial meeting and all necessary information is provided to the Company.
<u>Customer Guarantee 5:</u> Respond To Billing Inquiries	The Company will respond to most billing inquiries at the time of the initial contact. For those that require further investigation, the Company will investigate and respond to the Customer within 10 working days.
<u>Customer Guarantee 6:</u> Resolving Meter Problems	The Company will investigate and respond to reported problems with a meter or conduct a meter test and report results to the customer within 10 working days.
<u>Customer Guarantee 7:</u> Notification of Planned Interruptions	The Company will provide the customer with at least two days notice prior to turning off power for planned interruptions.

Existing Guarantees (Utah)

<u>Customer Guarantee 1:</u> Restoring Supply After an Outage	The Company will restore supply after an outage within 24 hours of notification with certain exceptions as described in Rule 25.
<u>Customer Guarantee 2:</u> Appointments	The Company will keep mutually agreed upon appointments, which will be scheduled within a two-hour time window.
<u>Customer Guarantee 3:</u> Switching on Power	The Company will switch on power within 24 hours of the customer or applicant's request, provided no construction is required, all government inspections are met and communicated to the Company and required payments are made. Disconnection for nonpayment, subterfuge or theft/diversion of service is excluded.
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<u>Customer Guarantee 6:</u> Resolving Meter Problems	The Company will investigate and respond to reported problems with a meter or conduct a meter test and report results to the customer within 10 working days.
<u>Customer Guarantee 7:</u> Notification of Planned Interruptions	The Company will provide the customer with at least two days notice prior to turning off power for planned interruptions.

Existing Performance Standards (Idaho)

Network Performance Standard 1: Improve Controllable Distribution System Average Interruption Duration Index (SAIDI)	The Company will achieve SAIDI of 30.5 minutes or less by December 31, 2011.
Network Performance Standard 2: Improve Controllable Distribution System Average Interruption Frequency Index (SAIFI)	The Company will achieve SAIFI of 0.297 or less by December 31, 2011.
Network Performance Standard 3: Improve Under Performing Circuits	The Company will reduce by 20% the average circuit performance indicator (CPI) for a maximum of two under-performing circuits on an annual basis within five years after selection.
Network Performance Standard 4: Supply Restoration	The Company will restore power outages due to loss of supply or damage to the distribution system within three hours to 80% of customers on average.
Customer Service Performance Standard 5: Telephone Service Level	The Company will answer 80% of telephone calls within 30 seconds. The Company will monitor customer satisfaction with the Company's Customer Service Associates and quality of response received by customers through the Company's eQuality monitoring system.
Customer Service Performance Standard 6: Commission Complaint Response/Resolution	*The Company will a) respond to at least 95% of non-disconnect Commission complaints within three working days and will b) respond to at least 95% of disconnect Commission complaints within four working hours, and will c) resolve 95% of informal Commission complaints within 30 days.

Existing Performance Standards (Utah)

<u>Network Performance Standard 1:</u> Improve System Average Interruption Duration Index (SAIDI)	The Company will improve Controllable Distribution SAIDI by 29% by December 31, 2011.
<u>Network Performance Standard 2:</u> Improve System Average Interruption Frequency Index (SAIFI)	The Company will improve Controllable Distribution SAIFI by 27% by December 31, 2011.
<u>Network Performance Standard 3:</u> Improve Under Performing Circuits	The Company will reduce by 20% the circuit performance indicator (CPI) for a maximum of five underperforming circuits on an annual basis within five years after selection.
<u>Network Performance Standard 4:</u> Supply Restoration	The Company will restore power outages due to loss of supply or damage to the distribution system within three hours to 80% of customers on average.
<u>Customer Service Performance Standard 5:</u> Telephone Service Level	The Company will answer 80% of telephone calls within 30 seconds. The Company will monitor customer satisfaction with the Company's Customer Service Associates and quality of response received by customers through the Company's eQuality monitoring system.
<u>Customer Service Performance Standard 6:</u> Commission Complaint Response/Resolution	The Company will a) respond to at least 95% of non-disconnect Commission complaints within three working days; b) respond to at least 95% of disconnect Commission complaints within four working hours; and c) resolve 95% of informal Commission complaints within 30 days, except in Utah where the Company will resolve 100% of informal Commission complaints within 30 days.

Measurement Indicators

(IEEE Standard 1366-2003)

● IEEE Guide for Electric Power Distribution Reliability

- Published by the Institute of Electrical and Electronics Engineers.
- Developed by the Standards Coordinating Committees of the IEEE Standards Association Board.
- Approved by the American National Standards Institute (ANSI).

● Indicators

- **Interruption Types-** Classification of Momentary Outage vs. Sustained Outage.
- **Reliability Indices-** Measurements for evaluating system performance.
- **Performance Type Categories-** Classification of Major Events vs. Underlying Events.

Interruption Types

- There are two Interruption Types-

- Momentary Interruption- an outage of less than 5 minutes in duration that results in zero voltage, captured using substation breaker fault counts.
- Sustained Interruption- an outage of equal to or greater than 5 minutes in duration.

- Utilities may vary-

- Even though the criteria for differentiating interruption types are outlined in IEEE 1366-2003. Utilities may use something other than 5 minutes depending on system design, system operation, and external conditions (e.g.-weather) in which a system is expected to operate.

Reliability Indices

- SAIDI (System Average Interruption Duration Index)- The average outage duration for each customer served. When not explicitly stated otherwise, this value can be assumed to be for a one year period.
- SAIFI (System Average Interruption Frequency Index)- The average number of interruptions that a customer would experience. It is measured in units of interruptions per customer and attempts to identify the frequency of all sustained outages that the average customer experiences during a given time frame.
- CAIDI (Customer Average Interruption Duration Index)- The average outage duration that any given customer would experience. This can also be viewed as the average restoration time. Outages with high customer interruptions and high customer minutes interrupted will cause significant impact to CAIDI.
- CAIFI (Customer Average Interruption Frequency Index)- Designed to show trends in customers interrupted and helps to show the number of customers affected out of the whole customer base.
- MAIFI (Momentary Average Interruption Frequency Index)- The average number of momentary interruptions that a customer would experience during a given period (typically a year). This can be defined differently between utilities, some defining it as less than 1 minute in duration and some defining it as less than 5 minutes in duration.
- CEMI (Customers Experiencing Multiple Interruptions)- This is a measurement of customers experiencing multiple interruptions. The index depicts repetition of outages across the period being reported and can be an indicator of recent portions of the system that have experienced reliability challenges.

Reliability Indices

(Calculations)

- SAIDI- Sum of all customer interruption durations divided by the total number of customers served.
- SAIFI- Total number of customer interruptions divided by the total number of customers served.
- CAIDI- Sum of all customer interruption durations divided by the total number of customer interruptions (or SAIDI/SAIFI).
- CAIFI- Total number of customer interruptions divided by the total number of customers who had at least one interruption.
- MAIFI- Total number of customer interruptions less than the defined time divided by the total number of customers served.
- CEMI- Total number of customers that experience more than n interruptions divided by the total number of customers served.

Performance Types

- There are two categories of performance:
 - Major Events- These are categorized as atypical events, (“acts of god”) with extraordinary numbers and durations for outages beyond the usual.
 - Underlying Events- These are categorized as being caused by normal events.
- Major Events should be studied separately in order to reveal trends in daily operation that would be hidden by the large statistical effect of major events.
- The “Beta Method” outlined in IEEE 1366-2003 is typically used to determine the major event day threshold value.
- The threshold will vary between utilities (e.g.-age of network, weather, system remoteness).

Disruption Categories

Cause Category	Description and Examples
Environment	Contamination or Airborne Deposit (i.e. salt, trona, ash, other chemical dust, sawdust, etc.); corrosive environment; flooding due to rivers, broken water main, etc.; fire/smoke related to forest, brush or building fires (not including fires due to faults or lightning).
Weather	Wind (excluding windborne material); snow, sleet or blizzard; ice; freezing fog; frost; lightning.
Equipment Failure	Structural deterioration due to age (incl. pole rot); electrical load above limits; failure for no apparent reason; conditions resulting in a pole/cross arm fire due to reduced insulation qualities; equipment affected by fault on nearby equipment (i.e. broken conductor hits another line).
Interference	Willful damage, interference or theft; such as gun shots, rock throwing, etc; customer, contractor or other utility dig-in; contact by outside utility, contractor or other third-party individual; vehicle accident, including car, truck, tractor, aircraft, manned balloon; other interfering object such as straw, shoes, string, balloon.
Animals and Birds	Any problem nest that requires removal, relocation, trimming, etc; any birds, squirrels or other animals, whether or not remains found.
Operational	Accidental Contact by PacifiCorp or PacifiCorp's Contractors (including live-line work); switching error; testing or commissioning error; relay setting error, including wrong fuse size, equipment by-passed; incorrect circuit records or identification; faulty installation or construction; operational or safety restriction.
Loss of Supply	Failure of supply from Generator or Transmission system; failure of distribution substation equipment.
Planned	Transmission requested, affects distribution sub and distribution circuits; Company outage taken to make repairs after storm damage, car hit pole, etc.; construction work, regardless if notice is given; rolling blackouts.
Trees	Growing or falling trees
Other	Cause Unknown; use comments field if there are some possible reasons.

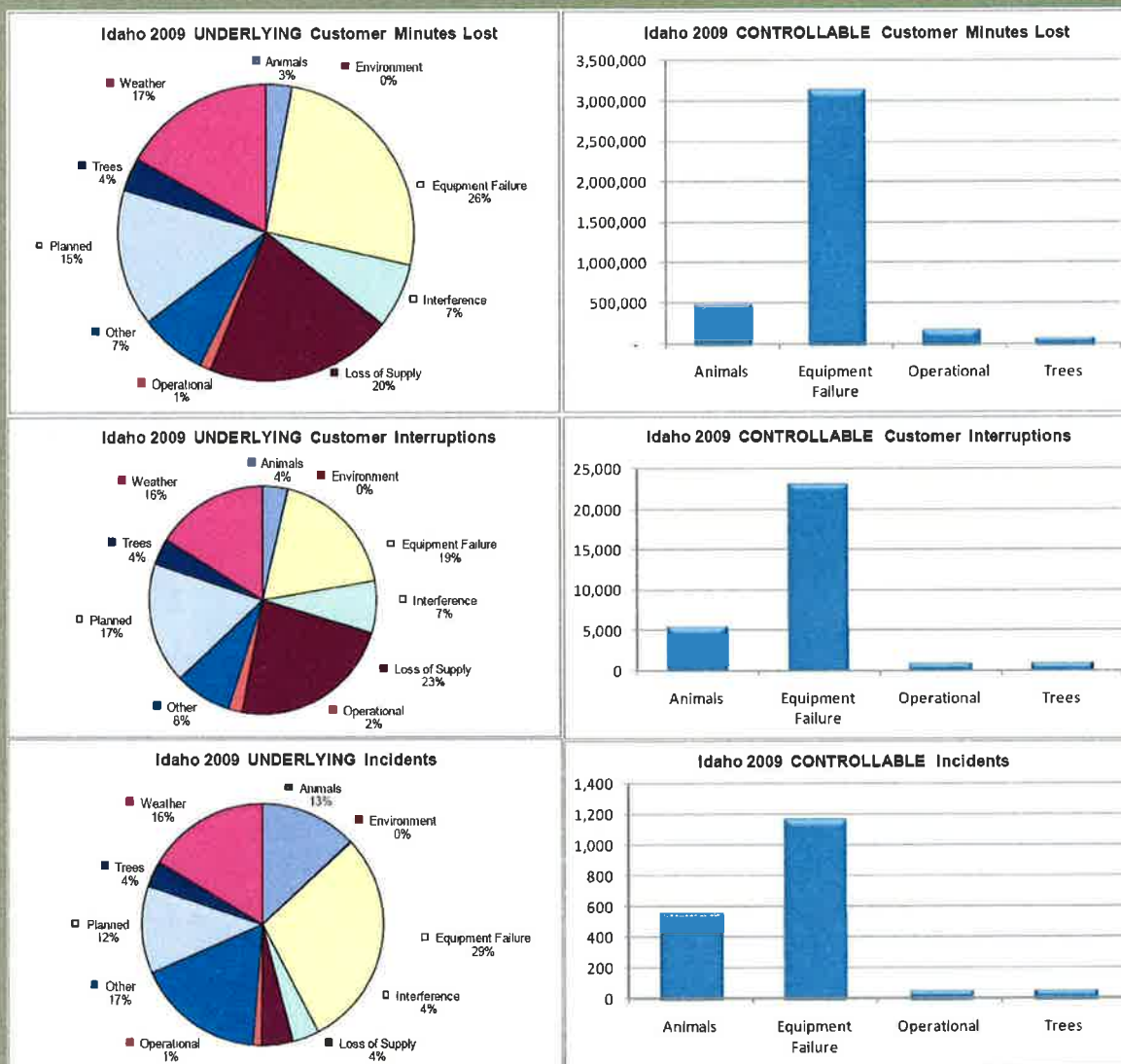
Disruption Categories

(Additional Differentiation)

- **PacifiCorp further separates its disruptions into two classes:**
 - **Controllable Distribution-** Attributed to causes where the Company is able to implement system improvements that have a high probability of avoiding future recurrence at a local level. Examples include equipment failure, and animal interference.
 - **Uncontrollable Distribution-** Attributed to outages that are generally not avoidable via engineering programs. Examples include transmission outage events and car related outage events.

Disruption Category

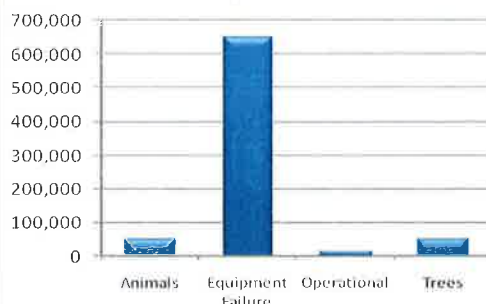
Idaho Analysis (PacifiCorp-Rocky Mtn. Power)



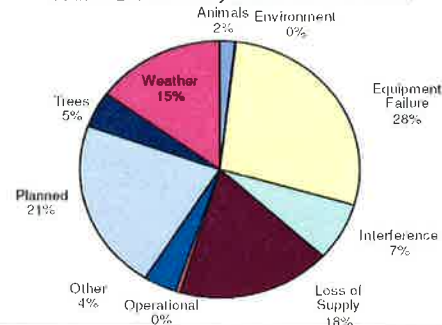
Disruption Category

Utah Analysis (PacifiCorp-Rocky Mtn. Power)

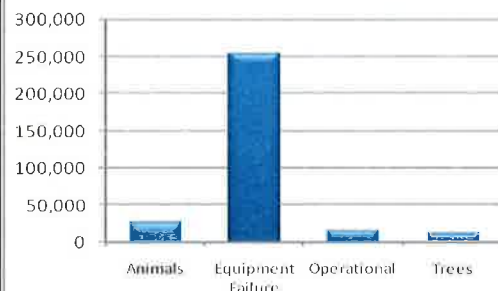
Utah CY2009 SAIDI by Cause - CONTROLLABLE



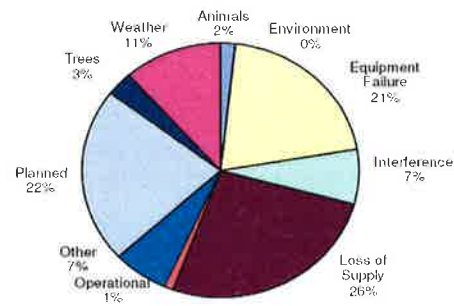
Utah CY2009 SAIDI by Cause - UNDERLYING



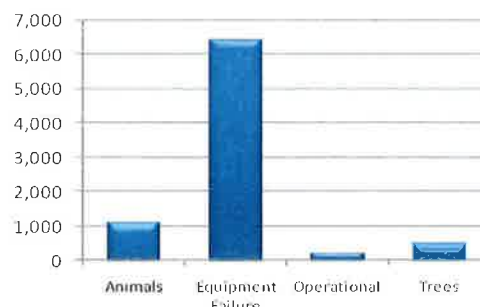
Utah CY2009 SAIFI by Cause - CONTROLLABLE



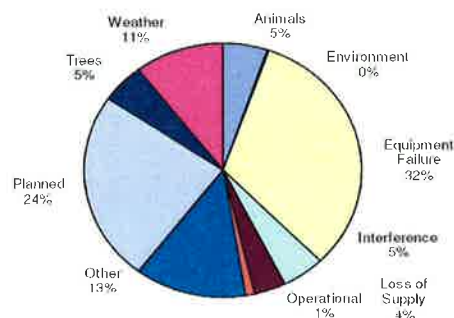
Utah CY2009 SAIFI by Cause - UNDERLYING



Utah CY2009 Incidents by Cause - CONTROLLABLE



Utah CY2009 Incidents by Cause - UNDERLYING



Reliability Management

(Outage Management System)

- According to IEEE, an Outage Management System (OMS) is a system of computer based tools and utility procedures to efficiently & effectively-
 - become aware of outages.
 - diagnose & locate outages.
 - provide feedback to affected customers on outages.
 - dispatch trouble/repair crews to outages.
 - restore electrical outages.
 - maintain historical records of outages.
 - compute statistical indices on outages.
- OMS improves reliability data, provides quantifiable statistics, establishes performance on fact, facilitates operational solutions, and facilitates the accurate setting of achievable targets.

In Summary

- Reliability management and measurement-
 - Is multidimensional.
 - Benefits rate payers.
 - Will be unique between companies.
 - Requires access to fundamental data.
 - Needs to be looked at across locations, time, equipment types, etc.
 - Can be effective throughout the organization.
- Questions?