Smart Grid System Report Stakeholder Webinar Series

SGSR Delivery (T&D) Infrastructure Webinar

Five topics:

1. T&D Automation
2. T&D Reliability
3. Capacity Factors
4. Dynamic Line Ratings
5. Customer Complaints

Transmission and Distribution Automation

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Transmission and Distribution Automation Description

- System to remotely monitor, coordinate and operate transmission and distribution components
- Includes SCADA, Remote Sensors, Monitors, Switches and Controllers with embedded intelligence, digital relays, etc.
- Gather real-time information to provide fault location, fault isolation, feeder reconfiguration, service restoration, feeder load balancing, Volt-VAR controls and remote equipment monitoring

Transmission and Distribution Automation Proposed Metrics

- Current metric
  - Percent of substations having automation
- How many metrics do we need?
  - Other potential metrics
    - Capital expenditures in automation technology
    - Percent of substations with outage detection
    - Percent of circuits with fault detection and localization capabilities
    - Number of automated substations
    - Percent of distribution circuits with automated sectionalization and reconfiguration capabilities
    - Amount of load severed by automated distribution circuits
    - Number of customers served by automated distribution circuits

Transmission and Distribution Automation Proposed Metrics

- What metrics are most valuable in providing a sense of progress on the smart grid?
- Do we need more than one? How many?
- Do we need to separate transmission from distribution?

Transmission and Distribution Automation Data Sources

- Previous report
  - Survey results e.g. Newton-Evans report on CAPEX*
- Next report
  - Potential other data sources?
  - EIA will include substations automated in 2012 survey with data due in 2013 – what should be done for this report?

* Newton-Evans Research Company (2008), *Market Trends Digest*, Endicott City, MD

Transmission and Distribution Automation Stakeholders

- Transmission providers
- Distribution-service providers
- Vendors
- Local, state and federal energy policymakers
- Financial community
- Reliability coordinators
- Balancing authorities
- End-users

Transmission and Distribution Automation Delivery (T&D) Infrastructure

- Transmission is homogenous nationwide
- Distribution varies widely
  - Different designs and sizes
  - Some maximize feeder loading, others maintain them at lower levels
  - Differences drive the business case for automation
- Other perspectives?

Transmission and Distribution Automation Challenges

- Technical
  - Distribution differs from transmission
    - Transmission automation technologies well known but financially challenged
    - Distribution technologies not well understood
    - Also financially challenged
- Business and financial
  - Needs business case support
  - Do tools exist to support analysis?
- Other perspectives?

Transmission and Distribution Reliability

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Transmission and Distribution Reliability Description

- T&D automation is intended to enhance T&D reliability
- Approximately 80 to 90 percent of end-user outages can be traced to problems in the distribution system
- Transmission-line problems account for only 10 to 20 percent of outages, but these include the largest and most costly events
- Potential cost of 80-120 billion dollars per year
- Smart-grid technologies to address transmission congestion issues through demand response and controllable load
- Smart-grid controls and tools targeted at responding to imbalances and reducing outage events

Transmission and Distribution Reliability Proposed Metrics

- Current metrics
  - *(Metric 10.a) SAIDI represents the average number of minutes customers are interrupted each year*
  - *(Metric 10.b) SAIFI represents the total number of customer interruptions per customer for a particular electric supply system*
  - *(Metric 10.c) CAIDI represents the average outage duration that a customer experiences*
  - *(Metric 10.d) MAIFI represents the total number of customer interruptions per customer lasting less than five minutes for a particular electric supply system*

Transmission and Distribution Reliability Proposed Metrics

- What metrics are most valuable in providing a sense of progress?
- How to harmonize data and gather it?

Transmission and Distribution Reliability Data Sources

- Previous report
  - 2005 IEEE Reliability Benchmark study
- Next report
  - A single data source should be identified for national statistics covering SAIDI, SAIFI, CAIDI and MAIFI
  - IEEE 1366 Work Group (Distribution outages)
  - NERC TADS (Transmission outages)
  - Suggest NERC adopt a detailed data report like Canadian Electric Association (CEA) produces
  - SAIDI, SAIFI, and CAIDI may be addressed by EIA in 2013

Transmission and Distribution Reliability Stakeholders

- End users
- Local, state and federal energy policymakers
- Regulators
- Utilities

Transmission and Distribution Reliability Regional Aspects

- Reporting regulations and practices vary from state to state, making it difficult to compare data
- Regional differences arise for several reasons such as climate, geography, and design and maintenance of the distribution system
- Electricity trading patterns and transmission congestion are different in the West than in the East

Transmission and Distribution Reliability Challenges

- Business and Financial Challenges
  - FERC, in a policy statement said that public utilities may be reluctant to spend significant amounts of money without reassurance that they will be able to recover it
  - There are irregularities in the ways utilities and regions report T&D reliability incidents
  - Reporting data opens utility to regulatory action by customers groups
- Technical Challenges
  - Aging infrastructure and limited new construction is the number one challenge to reliability
  - More standardized codes, requirements and reporting of T&D reliability are needed (CEA model report is very good example)

Capacity Factors

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Capacity Factors Description

- Capacity factor is the fraction of energy that is generated by or delivered through a piece of power system equipment during an interval, compared to the amount of energy that could have been generated or delivered had the equipment operated at its design or nameplate capacity
- A capacity factor of 100% means that the equipment was, on average, used at its rated capacity throughout an interval
- A capacity factor over 100% means that the equipment was overloaded, often an unsustainable or even dangerous condition
- A smart grid should better use the available capacity of its infrastructure by flatten load profiles

Capacity Factors
Proposed Metrics

- Current metrics
  - *(Metric 14.a) Yearly average and peak generation capacity factor (%)*—the yearly average capacity factor of the nation's entire generator population should be estimated
  - *(Metric 14.b) Yearly average and average peak capacity factor for a typical mile of transmission line (%-mile per mile)*: capacity factor of the nation's transmission lines should be estimated, the result being weighted to account for transmission line distances
  - *(Metric 14.c) Yearly average and average peak distribution transformer capacity factor (%)*: estimate of the average capacity factor of the nation's distribution transformers over the year
  - Data were not readily found for measurements using Equations 14.b and 14.c

Capacity Factors
Proposed Metrics

- What metrics are most valuable in providing a sense of progress on the smart grid?
- Do we need more than one? How many?
- Do we need to present transmission line and distribution transformer capacity factors when there is a lack of data available?

Capacity Factors
Data Sources

- Previous report
  - Previous report (NERC 2009 report)

- Next report
  - Better data sources? (EIA capacity reports generation only)
  - Recommend that samplings be performed to estimate these metric measurements?
  - Measure via APQC survey?

Capacity Factors Stakeholders

- Policy advocates
- Reliability
- Generation and demand wholesale electricity traders/brokers
- Balancing authorities
- Transmission providers
- Distribution service providers
- Electric service retailers
- End users

Capacity Factors
Regional Aspects

- Due to economic slowdown capacity factors are dropping

- Regions appear to alter their strategies and investments to meet their own challenges and bring their performance more in line with that of their neighbors over time

Capacity Factors Challenges

- Business and Financial Challenges
  - Because the grid spans multiple regions, industries, and functions, it is challenging to obtain the necessary information on the state of the grid
  - Leads to challenges in creating incentives to invest in smart-grid technology that can better manage capacity factors
- Technical Challenges
  - Capacity factors are not typically shared among utilities and regions
  - Because changes in power-grid infrastructure occur relatively slowly accuracy trends over time are hard to track using capacity-factor measurements

Dynamic Line Ratings

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Dynamic Line Ratings Description

- Tool for enhancing the capability and reliability of electrical transmission system
- Lower installation cost than other traditional transmission-line enhancement approaches
- Dynamic line ratings utilize actual weather and loading conditions
- Allows normal, emergency, and transient ratings of a line to be continuously updated, resulting in a higher-capacity rating of the line about 95-99% of the time

Dynamic Line Ratings Proposed Metrics

- Current metric
  - Inadequate data were available to quantitatively assess the suggested measurements in this metric
- How many metrics do we need?
  - Potential other metrics
    - Number of transmission lines in the U.S. to which dynamic line ratings are applied
    - Percentage miles of transmission circuits operated under dynamic line ratings (miles)
    - Yearly average U.S. transmission transfer capacity expansion due to the use of dynamic, rather than fixed, transmission line rating (MW-mile)
    - Number of station transformers utilizing a dynamic capability rating
- What metrics are most valuable in providing a sense of progress on the smart grid?

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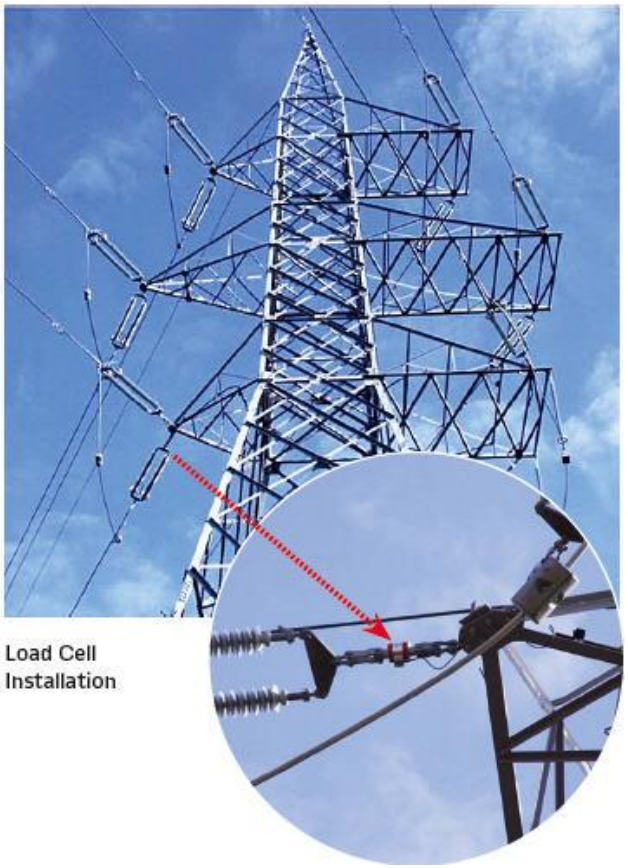
Dynamic Line Ratings
Data Sources

- Previous report
  - *"Real Time Rating Systems,"* Seppa T.O., 1997
- Next report
  - EIA 816 Survey form will collect data in 2012 and report in 2013
  - Interim data source?

Dynamic Line Ratings Stakeholders

- End users
- Products and services suppliers
- Transmission providers



Dynamic Line Ratings
Regional Aspects

- IOUs and Transmission-only companies are making investments in expanding capacity
- Actions of state and local regulators to influence investment in transmission infrastructure
- Other perspectives?

Dynamic Line Ratings Challenges

- Technical
  - Voltage instability
  - Transient stability
  - Control software must be updated to accept dynamic line rating measurements (SCADA and Remedial Action Schemes (RAS))
- Business and financial
  - Many players and regions involved; unclear who is responsible for making enhancements
  - Decreasing utility load (economy) has reduced urgency for line capacity upgrades
- Other perspectives?

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Customer Complaints Regarding Power Quality Issues

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Customer Complaints Regarding PQ Issues Description

- Definition of PQ incident varies widely depending on the customer being served
- Smart-grid system has the ability to offer several pricing levels for varying grades of PQ
- Smart grid utilizes advanced controls
  - Allows for rapid diagnosis and solutions to PQ events
  - Decreases the number of PQ disturbances from weather events, switching surges, line faults, and harmonic sources

Customer Complaints Regarding PQ Issues Metrics

- Current Metric
  - The percentage of customer complaints related to power quality issues (excluding outages)
- How many metrics do we need?
- Alternative metrics
  - Total number of customer complaints regarding power quality issues
  - Number of power quality incidents that could be identified over time
  - Number of states that have defined electric rate structures based on power quality service level
- Other metrics?

Customer Complaints Regarding PQ Issues Data Sources

- Previous report
  - APQC survey conducted for SGSR
- Next report
  - Review SG Consumer Collaborative and SG Maturity Models
  - Potential other data sources?

Customer Complaints Regarding PQ Issues Stakeholders

- Electric service retailers working toward providing better PQ to customers
- End users (residential, commercial and industrial users) needing consistent power quality
- Regulators interest in enhancing PQ and better serving the customer base
- Other stakeholders?

Customer Complaints Regarding PQ Issues Regional Aspects

- Climate
- Design of the distribution system
- Maintenance levels
- Number and type of customers (residential, commercial, or industrial)
- Interruption costs will vary depending on industries, demographics, and economic health of the region
- Other regional aspects?

Customer Complaints Regarding PQ Issues Challenges

- Technical
  - Standards organizations have not created standards for categories of PQ that customers can choose from according to their needs
  - More distinct definitions and better reporting and handling of evolving PQ issues would help clarify the issue
- Business and financial
  - There are significant costs associated with implementing advanced PQ devices that some may not be willing to assume
- Other perspectives?