ISO Transmission Planning Standards
Discussion Paper on Revisions

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April 11, 2014

Agenda

Time	Item	Presenter
10:00-10:10	Introduction	Tom Cuccia
10:10-10:30	Overview	Neil Millar
10:30-11:45	Non-consequential load dropping: Category C Contingencies	Robert Sparks
11:45-12:45	Lunch	
12:45-1:30	San Francisco-Peninsula Extreme Event Reliability Standard	Jeff Billinton
1:30-2:15	Changes to NERC Transmission Planning (TPL) Standards	Jeff Billinton
2:15-2:30	Wrap-up	Neil Millar

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ISO Transmission Planning Standards
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Overview

Neil Millar
Executive Director, Infrastructure Development
April 11, 2014

Scope of Changes to ISO Transmission Planning Standards

- The ISO is proposing to modify the ISO Planning Standards to clarify and codify existing policy applications in the standards as well as updates due to changes within the NERC Transmission Planning (TPL) standards.
- The three areas that the ISO is planning on making the specific changes to Planning Standards are as follows:
  - Non-consequential load shedding for Category C contingencies
  - Extreme Event mitigation for San Francisco Peninsula area
  - Changes to NERC Transmission Planning Standards (TPL)

ISO Planning Standards

- Planning standards are critical to providing reliable service to customers.
- Form the foundation or basis for all planning activities.
- ISO required to adhere to:
  - NERC Reliability Standards
  - WECC regional standards, criteria and business practices
- ISO's FERC-approved tariff provides for the approval of Planning Standards by the ISO's Board of Governors, which provides the necessary vehicle for needs specific to the ISO controlled grid to be properly addressed in ensuring acceptable system reliability.

Schedule for Revision of ISO Planning Standards

Date	Action
March 26	Post issue paper/straw proposal
April 11	Stakeholder meeting (in person)
April 25	Stakeholder comments due by 5:00 p.m.
May 14	Post revised straw proposal
May 21	Stakeholder web conference
June 4	Stakeholder comments due by 5:00 p.m.
July 2	Post Draft Final Proposal
July 16	Stakeholder web conference
July 30	Stakeholder comments due by 5:00 p.m.
September 18-19	ISO Board meeting

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Non-consequential load dropping: Category C Contingencies

Robert Sparks
Manager, Regional Transmission - South
April 11, 2014

Scope of Category C Load Shedding

- The ISO is intending to provide further clarity in the ISO Planning Standards regarding when load shedding through Special Protection Systems is considered an acceptable means to address planning needs for Category C contingencies.
- The ISO Planning Standards currently provide guidelines regarding system implications of SPS operation and SPS design considerations that need to be taken into account,
  - but do not currently address the current and historical practices regarding considerations of non-consequential load shedding for Category C contingencies.

Current and Historical Practices

- The ISO's current practice in local area planning, which is consistent with historical practices prior to and since the creation of the ISO, is to not rely upon high density urban load shedding as a long term planning solution for Category C contingencies.
  - this practice has not previously been codified in the ISO Planning Standards
  - further clarification of the considerations in the viability of load shedding as a short term measure, or in lower density areas is also being considered.

NERC TPL-003 – System Performance Following Loss of Two or More BES Elements

- Requirement R1 states:
  - The Planning Authority and Transmission Planner shall each demonstrate through a valid assessment that its portion of the interconnected transmission systems is planned such that the network can be operated to supply projected customer demands and projected Firm (non-recallable reserved) Transmission Services, at all demand Levels over the range of forecast system demands, under the contingency conditions as defined in Category C of Table I.

NERC TPL-003 – System Performance Following Loss of Two or More BES Elements

- Footnote ‘c’ of TPL-003 Table I that is applicable to performance for all Category C contingencies states:

  – Depending on system design and expected system impacts, the controlled interruption of electric supply to customers (load shedding), the planned removal from service of certain generators, and/or the curtailment of contracted Firm (non-recallable reserved) electric power transfers may be necessary to maintain the overall reliability of the interconnected transmission systems.

Local Area Long-Term Planning

- Local area is characterized by relatively small geographical size with:
  - limited transmission import capability; and
  - most often with scarce resources

- One of the fundamental ISO Tariff requirements is to maintain service reliability at pre-ISO levels, and this further drives the need to codify the circumstances in which load shedding is not an acceptable long term solution.

Existing Special Protection Scheme (SPS) Application on ISO System

- The ISO system has approximately 14 SPS that drop load for Category C contingencies on the 100 kV system and above.
  - two of these SPS will be removed once transmission upgrades that are under development are in-place.
  - the remaining SPS are not relied upon in order to serve load in high population density areas from the high voltage transmission system.

Other North American ISO and RTO Typical Practices

- ISO has explored the practices of other ISOs and RTOs regarding load shedding for category C contingencies
  - four of the nine ISO-RTO have identified various degrees of differences in planning criteria between their overall footprints and some of the large urban centers within those footprints
    - The purpose of these criteria for large urban centers is in part to not rely on interruption of firm customer demand in lieu of planned transmission or generation to meet TPL 003 and for other credible contingency events.
  - out of the remaining five ISO-RTO that we talked to four of them do not rely on, or limit the amount of, interruption of firm customer Demand in lieu of planned transmission or generation to meet TPL 003 throughout their footprint.

Population Density

Thematic Map of Density per square mile of land area - Population
Geography by: County

NOTE: For information on confidentiality protection, nonsampling error, and definitions, see http://www.census.gov/prod/cen2010/doc/sf1.pdf.

Legend:

Data Classes

- 0.0 - 656.5
- 661.8 - 2438.6
- 2585.7 - 7671.5
- 7993.5 - 20553.6
- 32903.3 - 69468.4

Boundaries

- State
- '10 County
- '10 Census Tract

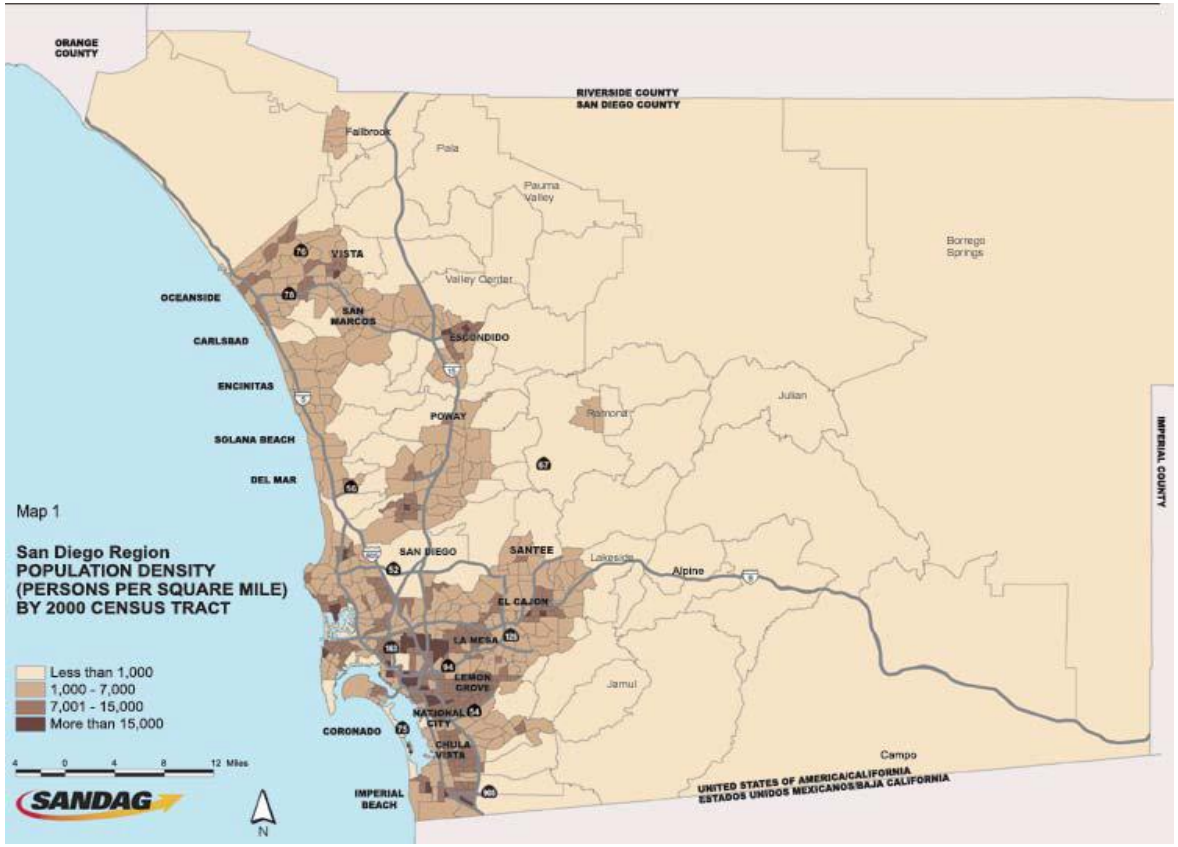
Features

- Major Road
- Street
- Stream/Waterbody

Items in grey text are not visible at this zoom level

Example: San Diego Area Population Density

- San Diego County is one of nine counties in the ISO footprint which show significant population densities
- Practically all of the population is concentrated in the coastal area of San Diego County
- Approximately 5,000 MW of the areas 5,100 MW load is in high population density areas



Risk of Outage

- In considering if load shedding is a viable mitigation in **Non-high density urban load** areas, case-by-case assessments need to be considered.
- Assessments should take in consideration risk assessment of the outage(s) that would activate the SPS including:
  - common right of way,
  - common structures,
  - history of fires,
  - history of lightning,
  - common substations,
  - restoration time,
  - coordination among parties required to operate pertinent part of the transmission system,
  - number of resources in the area,
  - outage history for resources in the area,
  - retirement impacts, and
  - outage data for the local area due to unrelated events.

Risk of Outage
Use of Benefit to Cost Ratio (BCR) calculation

- BCR can provide meaningful input into transmission reinforcement decisions, particularly in the case of radial systems and the need to loop or otherwise provide back-up service to radially-served loads.

- BCR calculations do not necessarily give correct values or magnitude of impacts for large and complex networked transmission systems due to several factors generally beyond existing modeling capabilities to properly quantify within looped transmission systems:
  - duration of interruption,
  - number of interruptions per year,
  - time of occurrence of interruption,
  - multiple possible contingency conditions, and
  - availability of multiple local resources.

System Wide Long-Term Planning

- System planning is characterized by much broader geographical size with:
  - greater transmission import capability, and
  - plentiful resources.
- Reliance on non-consequential load drop for double contingencies is mostly used to:
  - increase the transfer capability of major transmission paths across California and the West
  - the benefit of all and with rather rare occurrences of real outages
- operators have a greater availability of resources at their disposal and take active steps to reduce reliance on these load dropping schemes

Short-Term Planning

- In the near team any SPS, may be used to bridge the gap between real-time operations and the time when system reinforcements could potentially be built and/or otherwise made available.

- The ISO intends to add this clarification to the ISO Planning Standards.

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San Francisco-Peninsula Extreme Event Reliability Standard

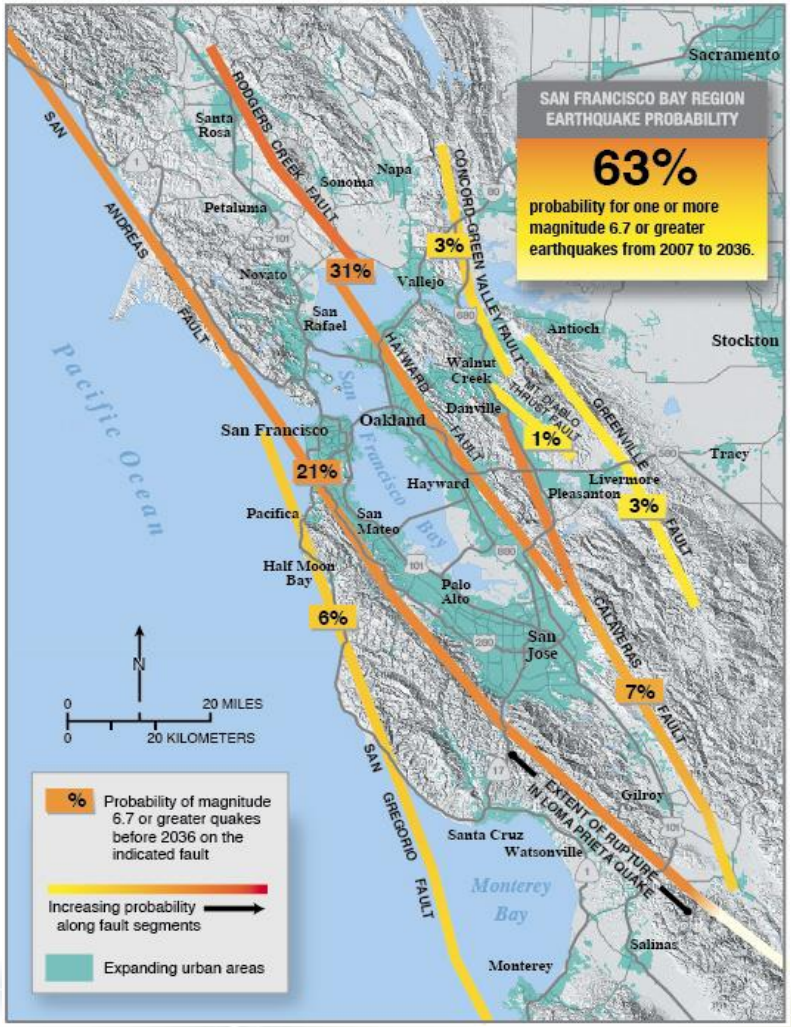
Jeff Billinton
Manager, Regional Transmission - North
April 11, 2014

Peninsula Area

- There are unique circumstances affecting the San Francisco area that form a credible basis for considering mitigations of risk of outages and of restoration times that are beyond the reliability standards applied to the rest of the ISO footprint.
- The Peninsula area does have unique characteristics in the western interconnection due to:
  - the urban load center,
  - geographic and system configuration, and
  - potential risks with challenging restoration times for these types of events.

Likelihood of seismic event

- The figure illustrates the probability of earthquakes of magnitudes 6.7 or greater occurring in the Bay area in the next 30 years.
- Issue is not so much related to if a seismic event is to occur in the area, but where exactly and to what extent the impact of such event will be.



New York State Reliability Council

- Within the United States, a similar area for comparison would be the New York City area which has established specific requirements for operation of the system in the area as a part of the New York State Reliability Council Reliability Rules

http://www.nysrc.org/pdf/Reliability%20Rules%20Manuals/RR%20Manual%20V32%20Final%201-11-13%20.pdf

NYSRC Reliability Rules
Extreme Contingencies

Table B
Extreme Contingencies

a. Loss of the entire capability of a generating station.

b. Loss of all transmission circuits emanating from a generation station, switching station, d-c terminal, or substation.

c. Loss of all transmission circuits on a common right-of-way.

d. Permanent three-phase *fault* on any generator, transmission circuit, transformer, or bus section, with *delayed fault clearing* and *with due regard to reclosing.*

e. The sudden loss of a large *load* or major *load* center.

f. The effect of severe power swings arising from *disturbances* outside the *NYS Bulk Power System.*

g. Failure of a *SPS* to operate when required following the normal contingencies listed in Table A.

h. The operation or partial operation of a *SPS* for an event or condition for which it was not intended to operate.

i. Sudden loss of multiple generating plants due to loss of fuel delivery system (i.e. gas pipeline events).

NYSCR Reliability Rules Extreme Contingencies are more stringent than NERC Reliability Standards

In particular NYSCR Table B – b.

b. Loss of all transmission circuits emanating from a generation station, switching station, d-c terminal, or substation

NERC TPL-004 Table 1 – Category D

8. Loss of a substation (one voltage level plus transformers)
9. Loss of a switching station (one voltage level plus transformers)

Con Edison – Transmission Planning Criteria
Extreme Contingency Assessment

Extreme contingency assessment recognizes that the bulk power system can be subjected to events that exceed, in severity, the normal planning criteria. This assessment is conducted to determine the nature and potential extent of widespread system disturbances from such events and to identify measures that will be utilized, *where appropriate, to reduce the frequency of occurrence of such events, or to mitigate the consequences that are indicated as a result of testing for such contingencies.* Analytical studies shall be performed to determine the effect of the Extreme Contingencies as listed in Table B of the NYSRC Reliability Rules. *{Emphasis Added}*

Past ISO Planning Standards treatment of San Francisco area as unique

- ISO Planning Standards did provide the San Francisco-Bay Area a special standard that had to do with resource unavailability at peak conditions and treatment of system normal conditions with certain resources out of service.
- This unique treatment in the ISO Planning Standard was retired after all old and less reliable resources in the San Francisco-Peninsula retired and transmission facilities were brought into service.
    - Jefferson-Martin 230 kV cable and the TransBay Cable HVDC
    - Primarily dealt with addressing Category C type contingencies.

Planning Standards Performance Requirements

- The ISO is required as a part of the NERC Reliability Standard TPL-004 to study the effects of Extreme Events (Category D) on the system, however the standard does not require that the Extreme Events to be mitigated for.

- However due to the nature of this highly urban load center, geographic and system configuration, potential risks of outages including seismic and collocating facilities and challenging restoration times it has become apparent that the San Francisco-Peninsula is uniquely situated and requiring consideration of mitigation.

Recommendation for ISO Planning Standards

- The ISO is therefore proposing to add to the Planning Standards specific recognition of the unique characteristics of supply to the San Francisco Peninsula and acknowledgment that planning for extreme events – including the approval of transmission solutions to improve the reliability of supply - is an appropriate action for the ISO Board to consider and approve.

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Changes to NERC Transmission Planning (TPL) Standards

Jeff Billinton
Manager, Regional Transmission - North
April 11, 2014

TPL-001-4: Major Changes

- Base models
  - More detailed description of system conditions to model
  - Modeling of known maintenance outages
- Sensitivity analysis
  - Study of sensitivity cases for varying assumptions
  - Spare equipment strategy for long lead equipment
- Annual short-circuit assessment
- New method and restrictions on limited use of load shedding
- Documentation of criteria for monitoring limits, system deviations, identification of system instability

TPL-001-4: Major Changes (Cont.)

- Stability analysis
  - Dynamic load models
  - Transient voltage criteria
  - Use of relay models in analysis to simulate tripping and OOS blocking
  - Simulation of generator ride-through capability
- Contingencies
  - Loss of a shunt device (capacitors, reactors, SVCs, etc.)
  - Loss of generator plus loss of another facility (G-1, N-1)
  - Separated and clarified stuck breaker versus relay failure contingencies
- Planning Coordinator/Transmission Planner division of responsibilities

TPL-001-4: Major Changes (Cont.)

- Responsible Entities shall have criteria for acceptable system steady state voltage limits, post-contingency voltage deviations and transient voltage response for its system
- Responsible Entities shall define and document the criteria or methodology used to identify system instability
- Responsible Entities shall distribute its assessment to adjacent Planning Coordinators and Transmission Planners

Contingency Event Table

New Category	Old Category	Description
P0	Cat A	System intact
P1	Cat B	Single contingency (Fault of a shunt device- fixed, switched or SVC/STATCOM is new)
P2	Cat C1, C2	Single event which may result in multiple element outage. Open line w/o fault, bus section fault, internal breaker fault
P3	Cat C3	Loss of generator unit followed by system adjustments + P1. No load shed is allowed
P4	Cat C	Fault + stuck breaker events
P5	n/a	Fault + relay failure to operate (new)
P6	Cat C3	Two overlapping singles (not generator)
P7	Cat C5, C4	Common tower outages; loss of bipolar DC

Loss of Non-consequential Load for Category B Contingencies

- Controversial “Footnote b” of existing standards.
- TPL-001-4 only allows for in limited circumstances:
  - Cannot exceed 75 MW
  - Allowed as Near-Term horizon solution only
  - Must provide for an open process before using
  - Must obtain review from regulatory authority under certain conditions.
- Effective 1/1/2021: No longer allowed to have non-consequential load loss for N-1 in Corrective Action Plans

TPL-001-4 Effective Dates

- Effective 1/1/2015: models created and responsibilities for studies decided
- Effective 1/1/2016: TPL assessments must follow new requirements
- Effective 1/1/2021: No longer allowed to have non-consequential load loss for N-1 in Corrective Action Plans

Effective Date for changes to ISO Planning Standards due to TPL-001-4

- Since NERC effective date for TPL assessment is 1/1/2016 the ISO will run the 2015-16 TPP assessment with the new changes.
- Changes are discussed in this process and will be approved by the ISO Board in order to stream line the process.
- These changes will only take effect late April, early May 2015 such that the 2015-2016 TPP assessment will be subject to them and not the current 2014-2015 TPP assessment.

Changes required to ISO Grid Planning Standards due to TPL-001-4

1. Line and Generator Outage Standard
   - remove due to new P3 requirement
2. Voltage Standard
   - clean-up references to the old NERC standards
   - include reference to TPL-001-WECC-RBP-2
3. Loss of Combined Cycle Power Plant Module as a Single Generator Outage Standard
   - replace reference to TPL-002 with P1 and P3 respectively
4. Planning for New Transmission versus Involuntary Load Interruption Standard
   - rewrite bullet 1 to be consistent with new NERC standard

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Wrap-up

Neil Millar
Executive Director, Infrastructure Development
April 11, 2014

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