Transmission System Planning Load Interruption Guideline

Reliability Committee Meeting
November 17, 2010

ISO new england

Today's Discussion on Load Interruption

- Present the ISO proposed Load Interruption Guideline
- Process will be to document final load interruption guideline in a planning procedure

Guiding Concepts of Load Interruption Guideline

- NERC reliability standards for transmission planning describe when and how load interruption is acceptable but not the amount of load interruption that is tolerable. Guidelines will provide the amount of load interruption that may be acceptable under certain clearly defined conditions
- Planning of the regional transmission system should not consider load interruption as the primary means to mitigate transmission system reliability violations and thus recognizes the importance of providing reliable service to all customers
- Guideline will provide a basis for consistent evaluation of allocation of costs
- Guideline will support review and understanding by siting authorities
- Guideline should not be considered an Operating Guideline

Factors Considered in Developing Load Interruption Guideline

- Customer requirements for reliable service continue to rise, thus load interruption should not be the first solution considered to address a transmission system reliability problem
- Stakeholders and regulators continue to focus on transmission infrastructure additions, thus under certain limited circumstances, load interruption continues to be considered as an alternative to transmission solutions
- Stakeholders and regulators expect that a consistent, open and transparent criteria will be used to identify regional needs and allocate costs
- The application of interrupting load will consider the amount of load at risk, the duration of the interruptions, the frequency of interruptions, the customers affected and the impacts of geography

Factors Considered in Developing Load Interruption Guideline, *cont.*

- Guideline should address all contingencies in planning criteria
- Guideline should apply at 100 kV and above for PTF (and for Non-PTF?)
- Guideline should include an implementation timeframe
- Load interruption definitions should be consistent with NERC definitions
- Incremental load interruption is not an acceptable alternative to transmission upgrades needed to allow generator interconnections or merchant transmission projects

Load Interruption Definitions

Load Interruption Categories:

- Consequential Load Interruption: All Load that is no longer served by the Transmission system as a result of Transmission Facilities being removed from service by a protection system operation designed to isolate the fault
- Non-Consequential Load Interruption: Non-Interruptible Load loss that does not include: (1) Consequential Load Loss, (2) the response of voltage sensitive Load, or (3) Load that is disconnected from the System by end-user equipment. It includes the manual or automatically controlled interruption of loads that is necessary to maintain the overall reliability of the system
- Cascading Load Loss: The uncontrolled interruption of load as a result of cascading equipment failures or voltage collapse

Note: For purposes of this guideline, load that is subject to momentary load interruptions due to automatic switching (e.g., moving load from one distribution substation to another) is excluded from this definition.

Note: For purposes of this guideline, the load interrupted will be based upon the 90/10 load forecast for the appropriate year

Load Interruption Definitions, *cont.*

Load Interruption Levels:

- Allowable: A level of consequential and/or non-consequential load interruption at which transmission solutions would generally not be undertaken and the cost of transmission solution would not generally be approved as a regional cost

- Potentially Allowable: A level of consequential and/or non-consequential load interruption at which transmission solutions should be evaluated and the cost of transmission solutions may be approved as a regional cost depending on the level of the load interruption, the characteristics of the load being interrupted, restoration time, hours of exposure and the cost of the mitigation

- Not Allowable: A level of consequential and/or non-consequential load interruption at which transmission solutions would generally be required and approved as a regional cost

Non-consequential Load Interruption Restrictions

The following questions serve as a guide for applicability of the use of non-consequential load interruption as a solution to reliability problems:

- Does the reliability problem exist at the shoulder load level? Non-consequential load interruption is not allowed for shoulder load analysis. Load interruption is limited to load levels that exist for a limited number of hours in a year (e.g., only allowed at or near peak load)
- Does the reliability problem result in overloads exceeding STE ratings? When operator action is required, non-consequential load interruption can only be utilized to resolve overloads that are below the short-time-emergency (STE) rating of equipment. Overloads above the short-time-emergency rating must be corrected by means other than by interrupting load
- Can a feasible operating plan for load shedding be demonstrated? Non-consequential load interruption can only be utilized to resolve problems if it is possible to document feasible steps to achieve the load shedding within the required timeframe (e.g., the time allowed to reduce flows to below LTE ratings following an outage)
- Does restoration take longer that 24 hours? Non-consequential load interruption can only be utilized to resolve problems if it is possible to document a feasible plan to restore interrupted load within a reasonable timeframe
- Does the reliability problem result in a voltage criteria violation? Non-consequential load interruption is not recommended as a mitigation of voltage violations
- Does the use of non-consequential load interruption require the use of a special protection system? Application of load interruption that require use of special protection systems should not be considered when the planning and operation of the transmission system becomes overly complex

Load Interruption Mitigation-General

Measures to Mitigate Load Interruptions (not necessarily listed in order of importance):

- Reduce the risk of occurrence
- Reduce the hours of exposure
- Reduce the amount of load that would be interrupted
- Reduce or eliminate the potential for interruption

Factors to consider when determining if mitigation is required (not necessarily listed in order of importance):

- Level of load interruption
- Duration of need for load interruption, load cycle
- Ability to restore load within a reasonable time frame (e.g., within 24 hours)
- Time to repair faulted element
- Hours of exposure to load level requiring load interruption
- Characteristics of affected customers
- Cost
- Time required to implement corrective action including permitting (e.g., earlier approval of long lead time transmission solutions)

Consequential Load Interruption Mitigation

The following list provides examples of methods to mitigate potentially allowable consequential load interruptions. Specific mitigation methods can be listed in three categories. In general the likelihood that a mitigation method will be cost effective for mitigating potentially allowable load interruptions will be highest for methods in category A, relatively lower for methods in category B and still lower for methods in category C.

Group A

- Automatic transfer of load using distribution ties
- Sectionalizing a line with motor-operated switches or circuit switchers at a location where minimal additional facilities are required
- Implementing differential insulation levels on DCT where minimal tower work is required
- Reconfiguring the transmission system (e.g., moving load to an another line on same right-of-way)
- Permanent transfer of load to another supply point
- Targeted DSM

Group B

- Sectionalizing a line with motor-operated switches or circuit switchers at a location where significant additional facilities are required
- Sectionalizing a line with circuit breakers where new protection zones are created
- Separating lines on double circuit towers where length of exposure is short and sufficient right-of-way exists
- Adding a series circuit breaker to eliminate exposure to a breaker failure

Group C

- Separating lines on double circuit towers where length of exposure is not short or sufficient right-of-way does not exists
- Addition of a new autotransformer or phase-shifter
- Construction of a new overhead or underground line

Non-Consequential Load Interruption Mitigation

The following list provides examples of methods to mitigate transmission reliability criteria violations where non-consequential load interruptions have been determined to be feasible but at potentially allowable levels. Specific mitigation methods can be listed in three categories. In general the likelihood that a mitigation method will be cost effective for mitigating potentially allowable load interruptions will be highest for methods in category A, relatively lower for methods in category B and still lower for methods in category C.

Group A

- Sectionalizing a line with motor-operated switches or circuit switchers at a location where minimal additional facilities are required.
- Permanent transfer of load to another supply point
- Targeted DG or DSM
- Reconfiguring the transmission system (e.g., moving load to an another line on same right-of-way)
- Line/cable terminal equipment upgrade
- Addition of a series reactor in a transmission line (assuming no substation footprint expansion).
- Adding a series circuit breaker to eliminate exposure to a breaker failure (assuming no substation footprint expansion).

Group B

- Sectionalizing a line with motor-operated switches or circuit at a location where significant additional facilities are required.
- Sectionalizing a line with circuit breakers where new protection zones are created.
- Separating lines on double circuit towers where length of exposure is short and sufficient right-of-way exists
- Reconductoring a short section of overhead line where minimal tower modification is required

Group C

- Separating lines on double circuit towers where length of exposure is not short or sufficient right-of-way does not exists
- Addition of a new autotransformer or phase-shifter
- Construction of a new overhead or underground line
- Reconductoring a longer section of overhead line or where significant tower modification is required

Load Interruption for N-1 Testing

Event	Consequential Load Interruption (e.g., radially supplied customer load or directly connected customer load)	Non-Consequential Load Interruption
Loss of a single generator (10)	None Allowed (Other than station service loads)	None Allowed
Loss of a single element	0-25 MW: Allowed (1) 25-100 MW: Potentially Allowable – develop plans for mitigation measures >100 MW: Not allowed – design and implement mitigating measures (2)	None Allowed
Double Circuit Tower fault (5)	0-100 MW: Allowed (4) 100-300 MW: Potentially Allowable – develop plans for mitigation measures >300 MW: Not allowed – design and implement mitigating measures (3) (4)	None Allowed (7)
Fault on a single element w/ breaker failure	0-100 MW: Allowed (6) 100-300 MW: Potentially Allowable – develop plans for mitigation measures >300 MW: Not allowed – design and implement mitigating measures (6)	None Allowed (7)
Circuit breaker fault	0-100 MW: Allowed 100-300 MW: Potentially Allowable – develop plans for mitigation measures >300 MW: Not allowed – design and implement mitigating measures (6)	None Allowed (7)

Load Interruption for N-1-1 Testing

Event	Consequential Load Interruption (e.g., radially supplied customer load or directly connected customer load)	Total Consequential and Non-Consequential Load Interruption (9)
Loss of two generators (10)	None Allowed (Other than station service loads)	0-100 MW: Allowed 100-300 MW: Potentially Allowable – develop plans for mitigation measures >300 MW: Not allowed – design and implement mitigating measures
Loss of a generator (10) and a single transmission element	0-25 MW: Allowed 25-100 MW: Potentially Allowable – develop plans for mitigation measures >100 MW: Not allowed – design and implement mitigating measures	0-100 MW: Allowed 100-300 MW: Potentially Allowable – develop plans for mitigation measures >300 MW: Not allowed – design and implement mitigating measures
Loss of a single transmission element followed by loss of a second single transmission element	0-100 MW: Allowed 100-300 MW: Potentially Allowable – develop plans for mitigation measures >300 MW: Not allowed – design and implement mitigating measures	0-100 MW: Allowed 100-300 MW: Potentially Allowable – develop plans for mitigation measures >300 MW: Not allowed– design and implement mitigating measures
Loss of a single transmission element followed by a fault on a single transmission element w/ breaker failure or a double circuit tower fault (5) or Loss of a generator followed by a fault on a single transmission element w/ breaker failure or a double circuit tower fault (5)	0-100 MW: Allowed 100-300 MW: Potentially Allowable – develop plans for mitigation measures >300 MW: Not allowed – design and implement mitigating measures	0-100 MW: Allowed 100-500 MW: Potentially Allowable – develop plans for mitigation measures >500 MW: Not allowed – design and implement mitigating measures (8)

Table Reference Notes

- (1) 25 MW value was selected based on the design criteria for distribution substations and the threshold value for implementation of redundant supply within distribution substations, which is typically in the order of 25 MW
- (2) 100 MW value meets the definition of load shedding under EIA and DOE reporting requirements
- (3) 300 MW value is based on reporting requirements for EIA and DOE for any “loss of service”
- (4) A higher level of load interruption is considered acceptable for double circuit tower faults because they have a lower likelihood of occurring than single element faults. Additionally, it is likely that one of the two lines can be restored quickly by automatic reclosing or switching
- (5) Line with portions that contain double circuit tower lines and that have exclusions from consideration by NPCC are excluded from consideration in this guideline
- (6) A higher level of load interruption is acceptable for circuit breaker faults or failures because they have a lower likelihood of occurring. Additionally, it is likely that some of the disconnected equipment can be restored quickly by automatic reclosing or switching

Table Reference Notes, *cont.*

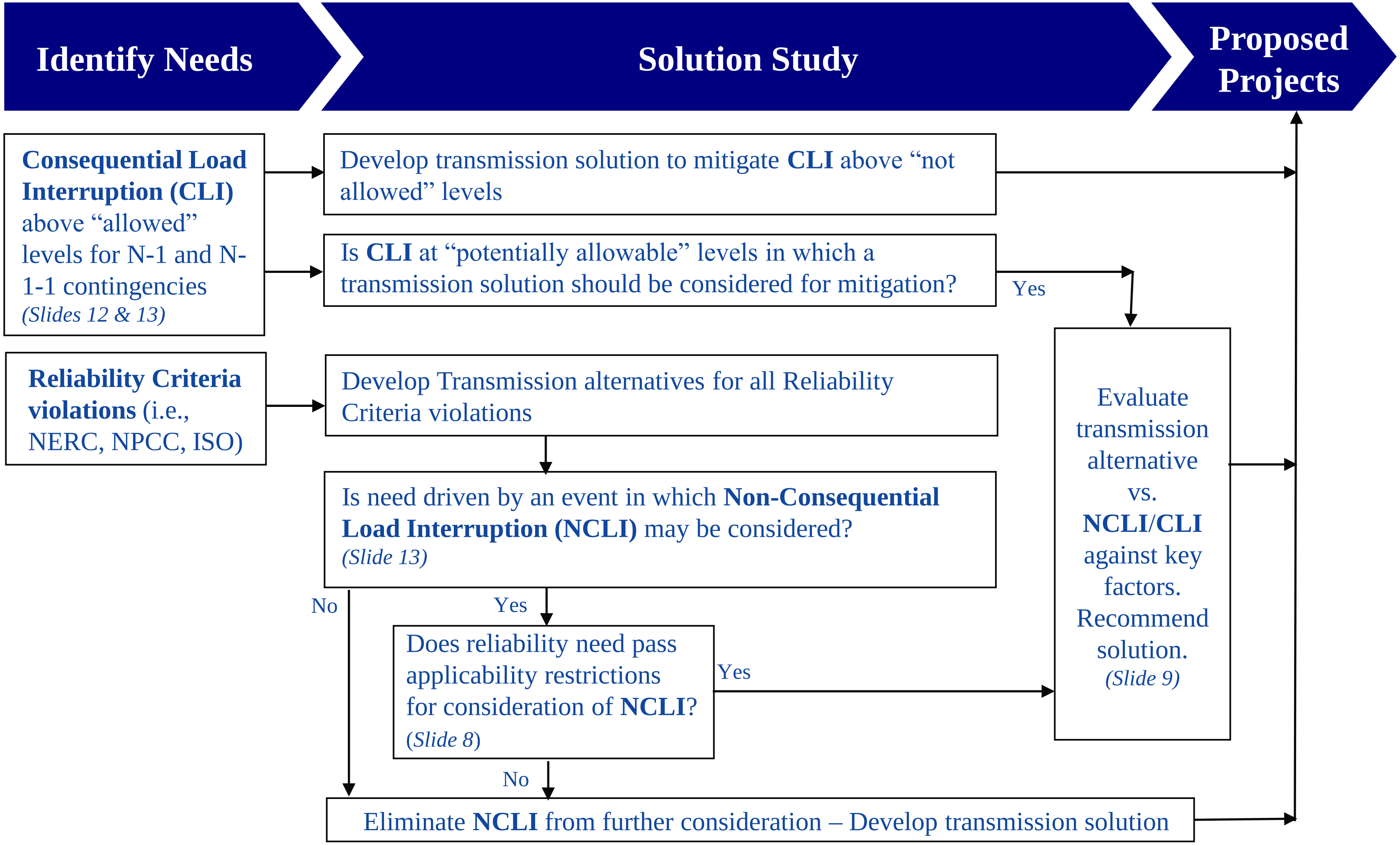
- (7) Although FERC would accept non-consequential load shedding for these contingencies, New England will not generally accept non-consequential load shedding for an event initiated by a single fault. New England Transmission Owners can design their substations such that non-consequential load shedding is unnecessary for an event initiated by a single fault

- (8) 500 MW value was chosen for two independent events that have a lower likelihood than the N-1 and N-1-1 events with a value of 300 MW

- (9) Use of non-consequential load interruption is subject to the limitations listed on page 7 of this guideline

- (10) The contingency of loss of a generator is loss of an additional generator beyond the generator(s) assumed to be unavailable in the base case

Integration of Guidelines into the NE Transmission Planning Process



Questions?