New England States
Committee on Electricity

To: **ISO-NE, PAC**
From: **NESCOE**
Date: **April 19, 2013**
Subject: **Enhancing Consistency in Regional System Planning**

One of the most important topics that arose in the review of the Transmission Planning Technical Guide was base case development in the transmission needs assessment process. NESCOE observes that the degree of latitude in the current transmission planning procedure can create inconsistency within the region and between the development plans of various transmission owners. We offer this memorandum to help advance a discussion among states, ISO-NE and market participants on this important topic and do so as we all review and discuss the draft Transmission Planning Technical Guide for efficiency. We believe a discussion of the issues raised in this memorandum at a Planning Advisory Committee (PAC) meeting would be a constructive start to a valuable regional dialogue.

In this memo, we describe the problem in defining "reasonable stress," provide a numeric example to illustrate the statistical degree of latitude in current practice[1], and offer for discussion a possible improvement for ISO-NE and stakeholders to consider. In particular, NESCOE encourages ISO-NE and stakeholders to consider the introduction of statistical parameters to narrow the range of interpretation afforded by the current language. This approach has the potential to increase the objectivity and uniformity of transmission planning analyses among utilities, and to help expedite state siting proceedings.

Problem statement: The use of subjective terms in our current planning procedure allows a wide range of subjectivity in base case development that can effectively defeat the purpose of standards. In New England, development of transmission planning base cases with widely varying degrees of likelihood calls into question what context can be given to terms such as "reasonable stress."

Application of Standards: There is a common thread emphasizing the relationship between planning conditions and the likelihood of those conditions in ISO-NE planning standard discussions. ISO New England Planning Procedure 3 "Reliability Standards for

[1] The example provided here is illustrative only and not intended as a critique of particular projects or practices.

the New England Area Bulk Power Supply System" (PP3) defines reasonably stressed conditions as "those severe load and generation system conditions which have a **reasonable probability** of actually occurring...." PP3 goes on to say:

> *Transmission transfer capabilities will be based on the load and **resource** conditions **expected** (emphasis added)to exist for the period under study and shall be determined in accordance with Section 4.1 for normal transfers, and Section 4.2 for **emergency** transfers.*

In the ISO New England Draft Transmission Planning Technical Guide, Section 13.1 states:

> *"Reliability studies begin with development of system models which must include definition of the initial or base conditions that are assumed to exist in the study area over the study horizon. These assumed initial conditions must be based on requirements as described within the applicable reliability standards and criteria as well as supplemental information that describe **system operating conditions likely to exist**." (emphasis added)*

The language provided above indicates that transmission systems should be planned to withstand unexpected events under challenging but *expected* conditions that are *likely to exist*. But exactly how expected, or likely, should those conditions be? Put another way, since the objective of the planning process is to test the system "with due allowance for generator maintenance and forced outages, design studies will assume power flow conditions with applicable transfers, load, and resource **conditions that reasonably stress the system**," how can "reasonableness" be linked to experience and probability? A wide degree of latitude is currently allowed in our planning process regarding what could be considered reasonable for the base case. And different assumptions about these conditions can make the difference of whether or not a transmission system performs satisfactorily when contingencies are applied.

The degree of variability can be demonstrated through a simple statistical analysis of partial base case probabilities. The probability of a situation in which numerous independent events take place simultaneously is determined by the multiplication rule of statistics. Given independent events A and B, the probability of both occurring together is the product of probability of A times the probability of B. Using this approach to New England planning exercises demonstrates that within the same control area - and even in the same planning exercise - vastly different levels of "credible" or "reasonable" stress are being applied. To illustrate, at the January16, 2013 PAC meeting ISO-NE presented the Greater Hartford And Central Connecticut (GHCC) Needs Assessment II. Slide 7 of the presentation contained the following table showing the various "2 generator out" base case dispatch assumptions.

UNIT	Qualifi ed Capacity	AREA	Middletown Dispatch	NWCT Disp.	Hartf or Disp. #1	Hartf or Disp. #2	Barbour Hill Disp.	CCRP Disp. #1	CCRP Disp. #2	CCRP Disp. #3	CCRP Disp. #4	Interstate Dispatch #1
Middletown 2	117	Middletown	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON
Middletown 3	236	Middletown	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON
Falls Village Hydro	3	NWCT	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON
Forestville	13	NWCT	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON
South Meadow 5	23	Hartf ord	ON	ON	OFF	OFF	ON	ON	ON	ON	ON	ON
South Meadow 6	25	Hartf ord	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON
CDEC	55	Hartf ord	ON	ON	ON	OFF	ON	ON	ON	ON	ON	ON
Dexter	37	Barbour Hill	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON
Rainbow Hydro	8	Barbour Hill	ON	ON	ON	ON	OFF	ON	ON	ON	ON	ON
Bridgeport Energy	448	SWCT	ON	ON	ON	ON	ON	OFF	ON	ON	OFF	ON
Bridgeport Harbour 3	383	SWCT	ON	ON	ON	ON	ON	OFF	ON	OFF	ON	ON
New Haven Harbor 1	448	Western CT	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	ON
Kleen Energy	620	Eastern CT	ON	ON	ON	ON	ON	ON	OFF	ON	ON	ON
Millstone 2	877	Eastern CT	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF
Millstone 3	1225	Eastern CT	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF

It is possible to calculate a partial probability[2] of the base case under these different dispatches. For example, the probability of the base case with the Middletown dispatch in the left column is calculated by multiplying the EFORd[3] of the two Middletown units (.0846 and .2898 respectively), times the EFORd of a Gas Turbine fast start unit (.0724), times the probability of hitting the peak hour (1/8760) times the 10 percent confidence level (.1) = $2.03 * 10^{-8}$. On the other hand, the probability of the base case with the "Interstate Dispatch" in the rightmost column is calculated similarly by substituting the EFORd of two nuclear units (.0311 and .0297 respectively) for the EFORds of the fossil units and yields $7.64 * 10^{-10}$. All else equal, the base case with the Interstate Dispatch is relatively 27 times less likely than the Middletown Dispatch. Do both dispatches fall within what is considered to be *expected or likely* in the standards language cited above? Does either? These important questions merit ISO-NE, stakeholder and state discussion.

Potential Conflicts with Standards: In the slides it uses for transmission planning training, ISO-NE makes two statements about setting up the Study Conditions[4]:

- The conditions evaluated in the assessments serve as a proxy for the multitude of potential system conditions that can occur.
- The exact system conditions evaluated may never occur, but they need to yield a system robust enough that it can be operated reliably under most circumstances.

The use of hypothetical situations to represent potential real situations that could arise on the power system is a reasonable approach to transmission planning. On the other hand, the description of the fact that planning should use proxies provides little guidance for *how* to determine if the particular proxy chosen is consistent with the overarching point to

[2] This example applies the multiplicative law only to the coincidence of peak, level of confidence in the forecast, and generator outage rates. The level of interface transfers has been excluded because the data set is not as well developed and it is not clear whether or not transfer levels are dependent or independent of the system peak.

[3] Expected Forced Outage Rate demand statistics are kept for New England and reported to NERC. Data for these examples used generic oil and gas plant ratings by size were drawn from "NERC 2011 GADS EFORd Class average data November 2010 – October 2011.

[4] Slide 38 of "Transmission Planning Process; Module 3" http://www.iso-ne.com/support/training/courses/trans_plan/index.html

stress the system "reasonably." As demonstrated by the GHCC example above, the current approach allows a wide range of "likelihood" in what could be considered "reasonable."

One Possible Improvement for Discussion:

One way to reduce subjectivity in determining base case conditions is to better define what is meant by *expected* or *likely*, and thus within the ambit of "reasonable." This could be accomplished by establishing a probability value or range for elements of the base case.[5] The calculation can be made with information that is already available:

- NERC GADS data specific to each region and divided by plant type provides Expected Forced Outage Rates for generating plants and can be used to develop a probability for choosing specific plants out of service.
- Peak load forecasts are already expressed in terms of their statistical probability.

If establishing a single probabilistic point value for the base or reference case is too restrictive, a range of values within which the base case could fall might be an appropriate metric, or one which would dictate the type of solution or corrective action plan. A process similar to this has already been implemented in the Western Electric Coordinating Council through its "Probabilistic Based Reliability Criteria" (PBRC).[6]

Conclusion

Power system reliability is measured in two ways: Resource Adequacy and Transmission Security. New England has already adopted the statistical convention of "one in ten" as an appropriate level of reliability for resource adequacy purposes, but no statistical convention for reliability has been established for transmission security. In a number of fora, including the New England Planning Advisory Committee stakeholder meetings and state siting authority proceedings, there is a debate about the generator dispatches chosen for nearly every transmission needs assessment conducted. Those debates almost always center around the probability of occurrence for a particular dispatch and ultimately lead back to whether the stress is "reasonable." The persistence of the debate may be due largely to the fact that we are conducting a deterministic analysis on events that are stochastic in nature. An agreement in New England that selects a probability value (or range) to represent what we mean by a "reasonable" stress level (with respect to some elements of the base case at least) – in effect some advance agreement on just how "likely" or "expected" base case conditions need to be – would allow transmission planners the latitude to modify generator dispatches (for example) to test certain flows on the system so long as the probability of the base case fell within a certain range. If the probability of the dispatch of interest fell below the predefined "reasonable" value, other

[5] We are not recommending a specific number here, only suggesting that adopting such a metric for appropriate base case elements would be useful.

[6] The WECC PBRC is applied by the WECC (Reliability Performance Evaluation Work Group) RPEWG. If a facility owner can establish that contingencies on their facilities lie within certain outage per year or "mean time between failure" ranges may apply for a "Performance Category Upgrade Request (PURC), that permit a relaxation of certain WECC standards.

parameters could be varied to bring the base case probability up and allow modeling of the dispatch of interest.[7]

By selecting a probability value or range to define "reasonable" stress in Planning Procedure 3, New England might be able to ensure a greater level of comparability among the transmission needs assessments conducted in region, reduce the level of stakeholder debate on "base case scenarios," and streamline siting proceedings.

We would appreciate ISO-NE and stakeholders considering the questions and issues raised in this memo and having a discussion at PAC about the potential merits of adopting a metric to standardize and better define what is meant by the word "reasonable" in our current planning practices. We would welcome an opportunity to lead an initial discussion of this matter at a PAC meeting and look forward to any informal questions and inputs in the interim.

[7] For example in the GHCC Needs Assessment, the probability of the Interstate dispatch could be made more comparable to the Middletown dispatch simply by assuming a 50/50 peak and assuming fast start unit availability.