ISO NEW ENGLAND PLANNING PROCEDURE 5-3

GUIDELINES FOR CONDUCTING AND EVALUATING PROPOSED PLAN APPLICATION ANALYSES

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1. Introduction

1.1 Section I.3.9 Requirement

Under Section I.3.9 of the Tariff, each Market Participant or Transmission Owner must submit plans for additions to or changes in facilities that might "have a significant effect on the stability, reliability or operating characteristics of the Transmission Owner's transmission system, the transmission facilities of another Transmission Owner or the system of a Market Participant." Section 1 of ISO New England Planning Procedure PP5-1, "Procedure for Review of Market Participant's or Transmission Owner's Proposed Plans", describes the process and contains the procedures to be followed in complying with the stated requirement. Section 1 also summarizes the information recommended or required for a formal submittal of a Proposed Plan Application. PP5-1 also contains the Proposed Plan Application forms and description of the information required.

This PP5-3 guideline is intended to be an aid to both the Market Participant or Transmission Owner filing a Proposed Plan Application and the committees who evaluate the effects of proposed additions or changes. To allow opportunity for an orderly and timely review, applicants are strongly recommended to supply supporting information in accordance with these guidelines with lead times appropriate for anticipated "Level of Analysis Required" (see PP5-3, Section 3.1.2). The Market Participant or Transmission Owner must confirm with the ISO that information is complete prior to formal submittal of its Proposed Plan Application.

1.2 Using the Guidelines

These guidelines are structured according to the facility for which an application is required and by concerns specific to that type of facility. Each section outlines the information to be provided and the measures used to evaluate the information in determining if the proposed facilities will or will not have a "significant adverse effect" on the stability, reliability or operating characteristics of the electric power system.

Generating unit operating characteristics and other power supply related concerns are addressed in **Section 2.0 Generating Units – Power Supply Concerns**. Since a generating unit can affect the performance of the integrated generation/transmission bulk power system, the guidelines of Section 3.0 also apply for generation Proposed Plan Applications.

Transmission facility additions and changes refer to transmission lines and substation equipment for which Proposed Plan Applications are required, including HVDC terminals and static VAR compensators and are addressed in **Section 3.0 Generating Units and Transmission Facilities – Bulk Power System Performance**.

Guidelines for protection and control system changes requiring approval of Proposed Plan Applications, including Special Protection Systems (SPSs) and Dynamic Control Systems, are

discussed in **Section 4.0 Protection Systems and Dynamic Control Systems**. A list of defined terms utilized in this guide is included in **Section 5.0 Definitions**.

2.0 Generating Units - Power Supply Concerns

Market Participants or Transmission Owners filing a Proposed Plan Application shall provide all information requested on the generation Proposed Plan Application, which is Attachment 1 to PP5-1. Only complete applications will be accepted for review. New units are required to meet specific criteria, listed below. Non-compliance with the criteria below will be grounds for rejecting the Proposed Plan Application. A Proposed Plan Application should be rejected if a significant adverse impact on the existing electric system is identified. The Proposed Plan Application will not be accepted until it is modified to eliminate the identified negative impact.

a. Both physical and contractual operating characteristics of all units must be reported. During emergency conditions, including the entire spectrum of load levels from peak to light load, the most restrictive operating limitations, either physical or contractual will be used to determine the unit's operation. Identify the normal and emergency operating characteristics of the unit from a physical unit characteristic perspective. Also, identify the contractual operating characteristics, if different. Particular attention should be given to operating limits (high and low), minimum shut down times, minimum run times, and start up times.

   If unable to complete the NX-12 form, provide a detailed description of the amount of dispatch control the ISO will have in determining the operation and/or output of the unit. Indicate when, and how frequently the unit can be reduced to its low limit and/or shut down during emergency conditions.

   Provide information on any constraints due to waste to energy conversion, primary/secondary steam requirements, or any other physical constraints that determine operating flexibility.

b. If a new unit is 10 MW or larger, it must be equipped with a functioning turbine governor.

c. The settings for underfrequency relays must comply with NPCC guidelines and be approved by the host utility.

3.0 Generating Units and Transmission Facilities - Bulk Power System Performance

3.1 Classification and Reporting of Analyses

This section provides guidance on the bulk power system performance analyses required to support a generation or transmission Proposed Plan Application. The type of change/addition and its potential effects on the interconnected system determines the depth of analysis expected in support of a particular Proposed Plan Application. It defines the levels of analysis expected over the range of Proposed Plan Applications and guides the applicant to that level best suited to the particular

application at hand. General guidance on performance measures and expectations is provided in Subsection 2.0. Subsections 3.0, 4.0, and 5.0 provide specific details on expected studies.

3.1.1 Areas of investigation

A Proposed Plan Application analysis is expected to demonstrate the impact of the change/addition on system performance in two transmission-related areas: area transmission requirements and transmission transfer capabilities. As applicable, the analysis should demonstrate the impact on the power supply concerns detailed in Section 2.0 above.

Impact on area transmission requirements is investigated by showing that the resultant system (after the change/addition) has sufficient transmission capacity to serve the area loads under the conditions noted below and in Planning Procedure 3 "Reliability Standards for the New England Area Pool Transmission Facilities" (the "Reliability Standards"). Impact on inter-Area and intra-Area transmission transfer capability should be demonstrated for the conditions noted below.

3.1.2 Level of analysis required

Four levels of analysis are identified for supporting a particular Proposed Plan Application. Additional analyses may be requested by the Principal Committees or the ISO. Affected Entities,[1] in consultation with the ISO, may request analysis necessary to assess the impact on their respective systems. The levels are defined as follows:

Level 0: A Proposed Plan Application is not required

Level I: A Proposed Plan Application is required for information only; reporting of study results or analysis is not required

Level II: As appropriate, analyses based on testing such as load flow, short circuit, transient network analysis (TNA), etc. should address one or both of the following:

- Area Transmission Steady State Assessment (Reference: Reliability Standards)
- Transfer Capability Assessment (Reference: Transmission Planning Technical Guide Appendix I: Transfer Capability Methodology)

Detailed descriptions will be found in Section 3.3 Steady State Analysis and Section 3.4 Other Testing.

Level III: As appropriate, the analyses should include Level II testing and should address one or more of the following:

- Area Transmission Stability Assessment (Reference: Reliability Standards)

[1] See ISO New England Planning Procedures No. 5-0, "Procedure for Reporting Notice of Intent to Construct or Change Facilities in Accordance with Section I.3.9 of the ISO New England Tariff (Proposed Plan Application Procedure)

- Dynamic Transfer Capability Assessment (Reference: Transmission Planning Technical Guide Appendix I: Transfer Capability methodology)

Detailed descriptions will be found in Section 3.3 Steady State Analysis Section 3.4 Other Testing, and Section 3.5 Stability Analysis.

Section 2.0, Additions or Changes Requiring Proposed Plan Applications, of PP5-1 defines items that may require Proposed Plan Applications. This list has been expanded and augmented with a table to guide the Proposed Plan applicant to the appropriate minimum level of analysis consistent with the proposed addition or change.[2] The table titled Level of Analysis Guideline is in Attachment 1.

The Proposed Plan applicant first determines the facility and the action applied to the facility e.g. add, replace, or remove to name a few. Next through a list of questions and thresholds, the appropriate level of analysis is determined.

It should be noted that the Level of Analysis Guideline table is a guide and ISO-NE may require a higher level of analysis than the level of analysis determined from the guideline table.

For the more complex Level II analyses and those of Level III, a single scope of work should be submitted for review by the ISO. This scope should include the items listed in Sections 3.1.3.1 and 3.1.3.2 below: a brief description of the facility changes and a description of the system representation to be used in the study, including all major assumptions regarding test conditions for load flow, dynamics and/or other studies. Periodic status reports to the ISO, summarizing testing and results to date, will assist in completing these complex analyses in a timely manner.

Based on past analyses, the expected amount of time generally needed from initial submission of study work to completion of review (and formal submittal of application) is as follows:

Level I: No study work submitted
Level II: 1 to 4 months, depending on complexity
Level III: 3 to 12 months, depending on complexity

3.1.3 Reporting

This section contains guidelines for the content of reports submitted in support of Proposed Plan Applications. Materials submitted with a Proposed Plan Application must be adequate to support the proposal. It is recognized that it may be necessary to conduct a Proposed Plan study using preliminary data describing transmission line and machine parameters. Using such data implies an obligation to provide more specific information at a later time.

3.1.3.1 Description of Proposed Facility(ies)

[2] NERC Standard FAC-002-4, Facility Interconnection Studies, introduces a new term, Qualified Change, which is defined by ISO-NE as an interconnection of new generation, transmission, or electricity end-user facilities or change of an existing interconnection of generation, transmission, or electricity end-user facilities that requires Level II or Level III analysis.

Describe the proposed facilities including how the modified system will be operated and a brief reason for the proposal.

Provide a map showing geographical location, a one-line diagram of the affected portion of the power system, and a switching diagram including the proposed facility and nearby facilities.

3.1.3.2 Description of System Representation Used in Studies
For Level II and III analyses, as appropriate, provide:

3.1.3.2.1 Load flow Studies - Year, season, load level, base interchanges, list of future facilities represented, source of representation and pertinent test assumptions as described in Section 3.1.1, Conditions to be Tested (below).

3.1.3.2.2 Dynamics Studies - Source of machine data and other dynamics modeling and data, load model, special protection systems and other pertinent assumptions as described in Section 3.5.1, Conditions to be Tested (below).

3.1.3.2.3 Other Testing (transient network analysis, short circuit analysis, etc.) - Source of representation, including machine data and network equivalents. Other pertinent test assumptions should be noted where they differ from those described above for load flow studies.

3.1.3.2.4 Analysis and Reporting of Results
For Level II and III analyses, as appropriate, provide a description of the baseline performance without the modification, a summary of the tests conducted with the modification and the resulting system performance in terms of its conformance to the Reliability Standards. Information of interest is discussed below in Section 3.3.1.2, 3.3.1.3 and 3.3.1.4 and Section 3.3.2 for Steady State Analyses, Section 3.5.1.2, 3.5.1.3 and 3.5.1.4 and Section 3.5.2 for Stability Analyses and Section 3.4.0 for Other Testing. This information should be sufficient to clearly demonstrate system performance without including exhaustive details of all results.

3.1.3.2.5 Conclusions
Present arguments for approval of application consistent with Section 3.3.3 for steady state analyses, Section 3.5.3 for stability analyses and Section 3.4 for other testing.

3.2 Evaluation

The Reliability Committee and the ISO will evaluate a number of aspects of the studies submitted in support of a Proposed Plan Application. As deemed appropriate by the ISO in accordance with applicable codes of conduct and confidentiality requirements, including the "ISO New England Information Policy" in Attachment D of the Tariff, the ISO will consult with Affected Entities regarding testing and aspects of the proposed plan that are specific to their respective systems. The evaluation of the acceptability of the proposed changes or additions begins with review of the

adequacy and acceptability of testing and test results. The results of tests performed and submitted in support of proposed additions or changes in facilities should clearly demonstrate compliance with the desired level of reliability as outlined in the Reliability Standards. The level of performance expected is intended to: 1) assure the reliability of the overall interconnected system and minimize the risk of widespread cascading outages due to overloads, instability or voltage collapse; and 2) demonstrate that the Nuclear Plant Interface Requirements (NPIRs) as documented in Master/Local Control Center Procedure No. 1 - Nuclear Plant Transmission Operations, Attachments C and D, are met. The Reliability Standards establish a minimum design criteria by outlining representative contingency tests and assessment.

Demonstration of acceptable system performance under the enumerated conditions and assumptions should be considered the minimum level of compliance. Additional testing, evaluations or adjustments to assumptions may be deemed necessary to either assure the adequacy of system performance or to distinguish a sensitivity to one particular condition from a more general system weakness. The final conclusions and recommendations should be based on the informed engineering judgment of the Reliability Committee with the objective of assuring that proposed changes or additions in facilities will not have a significant adverse impact on the stability, reliability or operating characteristics of the interconnected bulk power system.

Generally, if results of testing indicate that the system is not sufficient to accommodate the proposed changes or additions in facilities, system reinforcements or other mitigating measures will be required. These reinforcements or mitigating measures should fully alleviate all adverse impacts which were introduced by the proposed change or addition.

Occasionally, testing may identify weaknesses in the system prior to introduction of the proposed change or addition in facilities. The degree to which the proposed change or addition further degrades the stability, reliability or operating characteristics of the system will be of primary concern. Where no significant impact is identified, it may be possible to conclude that the proposed change or addition does not degrade system reliability. This judgment should take into account the frequency, duration, magnitude and consequences of any conditions where reliability violations occur both prior to and subsequent to the proposed changes or additions.

3.3 Steady State Analysis

It is the responsibility of the Market Participant or Transmission Owner submitting the Proposed Plan Application to identify the most severe conditions that can reasonably be expected to exist. It must be demonstrated that under such conditions, the proposed additions or changes will not have any significant adverse impact upon the reliability or operating characteristics of the bulk power system; otherwise, the Market Participant or Transmission Owner must propose system modifications, protection systems and/or operating restrictions on the proposed addition which will eliminate such adverse impact. Studies demonstrating steady state performance must then simulate normal conditions as well as conditions that stress the system beyond "typical" combinations of load level, generation dispatch and power transfers. Since it is necessary for supporting studies to reflect conditions expected to exist at the time of a future system modification, such conditions might include other future facilities with or without Proposed Plan approval that may be installed by about the same point in the future. Upon request, the ISO will

assist the Market Participant or Transmission Owner in identifying reasonably stressed conditions for testing.

3.3.1 Conditions to be Tested

3.3.1.1 Assumptions

a. Selection of Year or Year(s) to Model - The initial year chosen for study is normally that of the anticipated system modification. However, the following matters may need to be considered:
   - other facilities coming on-line in the same time period; and
   - other influences in the area, such as changes in contracts.

The Reliability Committee and the ISO will provide guidance in selecting the year(s) and related conditions to be studied.

b. Source of Base Case - The base case should have its origin from the ISO's library of cases, with changes or modifications as necessary.

c. Other Proposed Facilities - Inclusion of planned or proposed facilities in a study is subject to the status of other Proposed Plan Applications, and the System Impact Study queue. Consequently each proposed or planned facility must be individually identified in the scope of the study with the aid of the ISO prior to the start of the study. Having identified the planned or proposed facilities to include in the study, the study can be done with either or both of the following approaches: 1) the facility assumed installed in the base condition with tests determining the sensitivity of system response without the facility, or 2) as not installed in the base condition, but with sensitivity tests conducted with the facility included. The Market Participant or Transmission Owner conducting the analysis should judge which approach is appropriate for the evaluation.

d. Modeling Devices - Models for devices of particular concern, such as HVdc terminals, are available from the ISO. It is the responsibility of the Proposed Plan applicant to properly represent these devices where appropriate.

e. Load Level - Disturbances should be studied at peak load levels since they usually promote more pronounced thermal and voltage response within the New England Control Area than at other load levels. However, other load levels may be of interest in a particular analysis. This should be determined and, as appropriate, additional studies should be conducted.

f. Generation Dispatch - Testing should not be restricted to only typical dispatch; rather the dispatch(es) should be developed to reasonably test the proposed additions or changes. For example, for an export condition within the study area, the dispatch should model the maximum number of fully loaded generators expected to be in-service unless constrained by the transfer limits of an interface. For an import condition, unit outages simulated within the study area should reflect must-run, spinning reserve and minimum reactive support requirements of

system operation. All dispatches are subject to review by the ISO. The ISO will consult with Affected Entities regarding dispatches that are relevant to potential proposed plan impact on their respective systems.

g. Modeling of Transfer Conditions - Generally, intra-Area transfers will be simulated at or near their established limits (in the direction to produce "worst cases" results) and sensitivities to inter-Area transfers will be determined as appropriate. The rationale for maintaining these transfer levels before and after the addition of the proposed facility should be discussed. The ISO has developed and maintains a list of intra-Area interfaces used in operations.

3.3.1.2 Baseline Performance

Using the supplied and/or modified library case, testing should be conducted to determine pre-addition system performance. This testing will:

- validate the representation of the case used; and
- establish a baseline of performance from which the direct impact of the proposed modification can be demonstrated.

3.3.1.3 Contingency Selection

The applicant should develop a specific list of contingencies that comply with each section of the Reliability Standards which applies, including extreme contingencies. Additional contingency tests, consistent with those standards may be requested by ISO.

3.3.1.4 Tests With A Line Out Of Service

Applications for major changes in transmission or generation facilities should include tests of system performance with selected lines out of service assuming that the area resources and power flows are adjusted between outages. These tests should identify and evaluate potential constraints to future system operation.

3.3.2 Results Reporting

The applicant should provide sufficient details and information to clearly demonstrate system performance under both normal and stressed conditions. This would include:

3.3.2.1 Summary of load flow tests conducted and their results, with and without the proposed modifications, showing at a minimum the following information:

- Load level, generation dispatch and pertinent major interface loadings (both inter-Area and intra-Area);
- Contingencies tested;
- A single summary of lines loaded to 95% or more of their applicable rating;
- Bus voltages outside a range of .95 to 1.05 p.u.;
- Interactions with existing special protection systems; and
- Observed results and related comments, including impact on NPIRs, as appropriate.

3.3.2.2 Summary of results from any other pertinent testing performed such as the analyses described in Section 3.4, Other Testing.

3.3.2.3 One line diagrams showing flows and voltages with and without the proposed changes or additions for the following conditions:
- Normal generation dispatch conditions with all lines in service;
- Stressed generation dispatch conditions with all lines in service; and
- All significant contingency conditions for both normal and stressed generation dispatch cases.

3.3.2.4 Clear, concise narrative interpreting the above results and leading to the conclusion that installation of the subject facility(ies) will have no significant adverse effect on the reliability of the bulk power system as specified in Section I.3.9 of the Tariff. Also, any actions required to mitigate adverse system behavior associated with the proposed facility should be fully documented and explained.

3.3.3 Steady State Evaluations

Evaluations of steady state analyses submitted in support of Proposed Plan Applications will be based on the considerations and expectations described in Section 3.2, Evaluation. Additionally, the two aspects noted below will be of primary concern to the Reliability Committee and the ISO during their review.

3.3.3.1 Was the analysis conducted according to generally accepted practice?
- Were assumptions and test conditions as outlined in Section 3.3.1?
- Were tools and procedures applied properly and were they sufficient to provide a complete analysis?

3.3.3.2 Do results of the analysis support the conclusion that the change(s) will: 1) result in no significant adverse effect on the reliability of the bulk power system; and 2) meet the NPIRs? If the analyses indicated any problem areas, how were they resolved?

In particular, the ISO will review each analysis, and consult with Affected Entities as necessary, to ensure that all of the applicable conditions specified in the Reliability Standards are satisfied. The recommendation of the ISO to the Reliability Committee will be based on the applicant having satisfied the applicable conditions required in the Reliability Standards.

3.4 Other Testing

Studies demonstrating system performance may occasionally require other testing, in addition to the load flow testing described in Section 3.3 above, to adequately assess the effects of proposed facility changes or additions on the reliability and operating characteristics of the bulk power system. The need for this other testing, such as transient network analysis, short-circuit analysis, and/or reactive power and voltage (Q/V) analysis, depends on the specific project involved. These three analyses, while dealing with dynamic phenomena, do not involve the detailed time simulation of a stability analysis; rather, each is a single snapshot of the ability of the power system

to withstand events such as loss of components, short-circuits or unanticipated demand. It is the responsibility of the Market Participant or Transmission Owner submitting the Proposed Plan Application to consider the need for these tests when preparing the Proposed Plan supporting analysis and include them as appropriate. The Reliability Committee or the ISO may request any one or more of these other tests, or in the course of their review of the supporting analysis, may request other testing not described in this guideline. The ISO will consult, as necessary, with Affected Entities regarding the need for additional testing relevant to the potential impact of the proposed plan on their respective systems. Each Market Participant or Transmission Owner that is a Nuclear Plant Generator Operator is expected to have its Reliability Committee representative review the reporting of analysis of a proposed plan and request any additional analysis to address meeting any applicable NPIRs.

3.4.1 Transient Network Analysis (TNA)

Transient Network Analysis studies are typically performed as part of the detailed design engineering of a project where there may be concern for transient or temporary overvoltages, voltage flicker, arrester capabilities or insulation coordination. Sudden changes in circuit conditions, such as switching operations, lightning strikes, sudden loss of load or inrush currents (e.g., from a cable, capacitor bank or transformer energization or de-energization) can lead to this type of overvoltage, whose effects are usually confined to an area localized to the switching station. As such, those projects where this would be a concern typically include a TNA study as part of the design process but do not usually include the TNA results as part of the Proposed Plan study.

In those situations where a neighboring Affected Entity is close enough to be potentially affected (typically no more than two busses away from the switching location), the applicant and the Affected Entity should engage in a joint review of the base case models to be used in the TNA study. Then, in the Proposed Plan study, the applicant should provide sufficient details and information to clearly demonstrate system performance under both normal and stressed conditions. This would normally include a summary of all TNA tests conducted and their results, generally in the form of peak overvoltages or percent voltage change at selected busses and a clear, concise narrative interpreting these results and leading to the conclusion that installation of the subject facility(ies) will have no significant effect on the reliability of the bulk power system as specified in Section I.3.9 of the Tariff. Any actions required to mitigate adverse system behavior associated with the proposed change or addition should be fully documented and explained.

3.4.2 Short-Circuit Analysis

Projects such as the addition of a generator or a transmission element can have a significant impact on the short-circuit duty at substations in the vicinity of the proposed facilities. For those projects where this would be a concern, the applicant should include an analysis of the incremental effects of the project on short-circuit interrupting duty in the vicinity of the proposed change or addition. In those situations where a neighboring Affected Entity is close enough to be significantly affected, the applicant and the other Affected Entity(ies)

should engage in a joint review of the capabilities of the equipment in the area prior to submission of the Proposed Plan analysis.

In the Proposed Plan study, the applicant should provide sufficient details and information to clearly demonstrate system performance with respect to short-circuits. This would normally include a summary of the short-circuit tests conducted and their results, generally in the form of duty at selected busses, and a clear, concise narrative interpreting these results and leading to the conclusion that installation of the subject facility(ies) will have no significant effect on the reliability of the bulk power system as specified in Section I.3.9 of the Tariff. Any actions required to mitigate adverse system behavior associated with the proposed change or addition should be fully documented and explained.

3.4.3 Q/V Analysis

Voltage and reactive power performance of the bulk power system varies according to the load, transmission and generation in each area. It cannot be predicted system-wide by a single type of facility change or addition. Rather, the impact on the bulk system of a particular change or addition is evidenced by a high sensitivity of voltage at key busses in the system to changes in load, circuit conditions, or reactive compensation. For those projects where this would be a concern, the applicant should include an analysis of the effects of the proposed change or addition on the reactive power and voltage performance of the bulk power system.

In the Proposed Plan study, the applicant should provide sufficient details and information to clearly demonstrate reactive power support and voltage performance under both normal and stressed conditions. This would normally include a summary of all tests conducted and their results, generally in the form of Q/V (or P/V) curves or another measure of reactive power and voltage margin in the affected area and a clear, concise narrative interpreting these results and leading to the conclusion that installation of the subject facility(ies) will have no significant effect on the reliability of the bulk power system as specified in Section I.3.9 of the Tariff. Any actions required to mitigate adverse system behavior associated with the proposed change or addition should be fully documented and explained.

3.5 Stability Analysis

It is the responsibility of the Market Participant or Transmission Owner submitting a Proposed Plan Application to identify the most severe conditions that can reasonably be expected to exist. It must be demonstrated that under such conditions, the proposed additions or changes will not have any significant adverse impact upon the stability, reliability or operating characteristics of the bulk power system; otherwise, the Market Participant or Transmission Owner must propose system modifications, protection systems and/or operating restrictions which will eliminate such adverse impact. Studies demonstrating dynamic performance must then simulate conditions that stress the system beyond "typical" combinations of load level, generation dispatch and power transfers. Further, while the dynamic response of an individual proposed generating unit is of interest, the response of the bulk power system is of primary importance. Since it is necessary for

supporting studies to reflect conditions expected to exist at the time of a future system modification, such conditions might include other future facilities with or without Proposed Plan approval that may be installed by about the same point in the future. Upon request, the ISO will assist the Market Participant or Transmission Owner in identifying reasonably stressed conditions for testing.

3.5.1 Conditions to be Tested

3.5.1.1 Assumptions

a. Selection of Year(s) to Model - The initial year chosen for study is normally that of the anticipated system modification. However, the following matters may need to be considered:
   - other facilities coming on-line in the same time period; and
   - other influences in the area, such as changes in contracts.

   The Reliability Committee and the ISO will provide guidance in selecting the year and related conditions to be studied.

b. Source of Base Case(s) - The base case(s) should have its origin from the ISO's library of cases, with changes or modifications as necessary.

c. Other Proposed Facilities - Inclusion of planned or proposed facilities in a study is subject to the status of other Proposed Plan Applications, and the System Impact Study queue. Consequently each proposed or planned facility must be individually identified in the scope of the study with the aid of the ISO prior to the start of the study. Having identified the planned or proposed facilities to include in the study, the study can be done with either or both of the following approaches: 1) the facility assumed installed in the base condition with tests determining the sensitivity of system response without the facility, or 2) the facility not installed in the base condition, but with sensitivity tests conducted with the facility included. The Market Participant or Transmission Owner conducting the analysis should judge which approach is appropriate for the evaluation.

d. Modeling Devices - Models for devices of particular concern, such as HVdc terminals, are available from the ISO. It is the responsibility of the Proposed Plan applicant to properly represent these devices where appropriate.

e. Load Level - Disturbances should be studied at light load levels since they usually promote more pronounced dynamic response within the New England Control Area than at other load levels. However, other load levels may be of interest in a particular analysis. This should be determined and, as appropriate, additional studies should be conducted.

f. Generation Dispatch - Testing should not be restricted to only typical dispatch; rather the dispatch(es) should be developed to test the proposed modification under stressed conditions. For example, an export condition would be tested by

modeling the maximum number of fully loaded generators expected to be in-service in the exporting area unless constrained by the transfer limits of an interface. This will demonstrate if groups of machines in such areas could accelerate and lose synchronism with the bulk power system. At the same time, a "reasonable" number of units should be dispatched within the importing areas. These units need not be fully dispatched but they should reflect must-run, spinning reserve and minimum reactive support requirements of system operation. All dispatches are subject to review by the ISO. The ISO will consult with Affected Entities regarding dispatches that are relevant to potential proposed plan impact on their respective systems.

g. Modeling of Transfer Conditions - Transfer levels should be selected to produce accentuated dynamic response. Generally, intra-Area transfers will be simulated at or near their established limits (in the direction to produce "worst cases" results) and sensitivities to inter-Area transfers will be determined as appropriate. The rationale for choosing particular interface loadings before and after a modification due to a proposed facility should be discussed. The ISO has developed and maintains a list of interfaces used in operations.

3.5.1.2 Baseline Performance

Using the supplied and/or modified library case, testing should be conducted to validate the representation of the case and dynamics modeling used. If contingency testing indicates a problem, pre-addition testing will be needed to establish a baseline of performance from which the direct impact of the proposed modification can be demonstrated.

3.5.1.3 Contingency Selection

The applicant should develop a specific list of contingencies that comply with each section of the Reliability Standards which applies, including extreme contingencies. Additional contingency tests, consistent with those standards may be requested by the ISO. To assist in understanding the selection of contingencies, the applicant should provide a general description of the relay systems at 115 kV stations and above in the vicinity of the proposed change.

3.5.1.4 Tests With A Line Out Of Service

Applications for major changes in transmission or generation facilities should include tests of system performance with selected lines out of service assuming that the area resources and power flows are adjusted between outages. These tests should identify and evaluate potential constraints to future system operation.

3.5.2 Results Reporting

The applicant should provide sufficient details and information to clearly demonstrate system performance under both normal and stressed conditions. This would include:

3.5.2.1 Summary of dynamic tests conducted and their results, with and without the proposed modification, showing at a minimum the following information:
- Load level, generation dispatch and major interface loadings;
- Contingencies tested, with assumed sequence of events and associated times;
- Interactions with existing special protection systems; and
- Observed results and related comments as appropriate.

3.5.2.2 One line diagrams showing at a minimum flows and voltages with and without the proposed modifications for the conditions tested, including:
- Normal generation dispatch conditions with all lines in service;
- Stressed generation dispatch conditions with all lines in service; and
- Conditions tested with lines out of service.

3.5.2.3 Plots demonstrating that stability is maintained in the area of the modification, in other areas of New England and in neighboring systems. Enough information must be provided to demonstrate no other dynamics problems are encountered, such as unacceptable voltage or frequency excursions, undamped oscillations, control system problems, etc.

3.5.2.4 Clear, concise narrative interpreting the above results and leading to the conclusion that installation of the subject facility(ies) will have no significant adverse effect on the reliability of the bulk power system as specified in Section I.3.9 of the Tariff. Also, any actions required to mitigate adverse system behavior associated with the proposed facility should be fully documented and explained.

3.5.3 Stability Evaluations

Evaluations of stability analyses submitted in support of Proposed Plan Applications will be based on the considerations and expectations described in Section 3.2. Additionally, the two aspects noted below will be of primary concern to the Reliability Committee and the ISO during their review.

3.5.3.1 Was analysis conducted according to generally accepted practice?
- Were assumptions and test conditions as outlined in Section 3.5.1?
- Were tools and procedures applied properly and were they sufficient to provide a complete analysis?

3.5.3.2 Do results of analysis support conclusion that the change(s) will: 1) result in no significant adverse effect on the reliability of the bulk power system; and 2) meet the NPIRs? If the analyses indicated any problem areas, how were they resolved?

The ISO will review each analysis, and consult with Affected Entities, as necessary, to ensure that all of the applicable conditions in the Reliability Standards are satisfied. The recommendation of the ISO to the Reliability Committee will be based on the applicant having satisfied the applicable conditions required in the Reliability Standards.

4.0 Protection Systems and Dynamic Control Systems

Sections 2.6 and 3.3 of PP5-1 indicate the protection system additions/changes for which Proposed Plan Applications are required. These fall into two categories: fault clearing and special protection systems (SPSs).

Proposed Plan Applications for additions/changes in protection systems designed for fault clearing should include assurance that:

- the protection system is designed in accordance with the NPCC Bulk Power System Protection Criteria;
- the associated fault clearing time will not degrade system reliability performance; and
- the NPIRs will be met.

A Level III analysis, as described in Section 3.0, may be needed to demonstrate the effects of increased fault clearing times.

Applications for SPSs require analyses similar to that of a generation or transmission application and the guidelines of Section 3.0 apply. In addition to compliance with the Reliability Standards and NPCC Bulk Power System Protection Criteria, the following factors will be considered in evaluating an application for an SPS:

- Is the SPS initiated by a normal contingency or an extreme contingency?
- How many events trigger the SPS? Are the triggers local or remote?
- What are the monitoring requirements?
- How selective are the triggers (i.e., monitor system parameters vs. breaker contact)?
- Is the response local or remote?
- How many inputs, decisions and actions are involved?
- What is potential for interaction with other SPSs?
- Is the SPS required to control dynamic, voltage or thermal response?
- What actions are taken (load rejection, generation rejection, opening of a transmission line)?
- What is the probability that the SPS will be required to operate?
- What are the implications of inadvertent operation or misoperation (local vs. widespread effects)?
- Operational considerations (operator's view of requirements and constraints).
- Anticipated life of the SPS - is it meant to be temporary or permanent?
- What operating options are available if planning assumptions do not materialize?
- What are modeling requirements; when will they be provided?
- Economic tradeoffs with other alternatives.
- Will the NPIRs be met?

Dynamic control systems such as voltage regulator/exciter systems, power system stabilizers and governors on generators can have a significant effect on the stability, reliability or operating characteristics of the bulk power system. Such dynamic control systems and their attendant effects

are to be included in the analyses conducted in support of new generator additions. Effects of changes in dynamic control systems should normally be determined in the course of design studies and a Proposed Plan Application should be submitted if such a change could have a significant effect on the performance of the bulk power system. In such cases, a stability analysis may be requested as outlined in Section 3.5.

5.0 Definitions

If appropriate definitions were available from the Reliability Standards they are used in this section. The source of the definition is shown in parenthesis. Following these existing definitions, additional comments are included to assist the reader in interpreting them.

For those cases where no formal definition exists, the one used here is based on a review of existing ISO New England and NPCC documents.

5.1 Applicable Emergency Limit

Transmission circuit loading limits have been established for use under both normal and emergency conditions. In general, normal ratings are used for "All lines in" conditions. Under emergency conditions, long term emergency ratings (LTE) may be used for up to one daily load cycle assuming no contingency would cause the loading to go above LTE. Short term emergency ratings (STE) may be used following a system disturbance for up to fifteen minutes. The STE ratings may only be used in situations where the component loading can be reduced below the LTE ratings within fifteen minutes by operator corrective action.

In actual system operations, under emergency conditions, drastic action limits (DAL) may be used where preplanned immediate post contingency actions can reduce loadings below LTE within five minutes. These DAL limits are only used as a last resort during actual system operations. They should not be used in testing the system adequacy in the Proposed Plan Application studies.

Emergency voltage limits have also been established for system operation under emergency conditions. These limits recognize that voltages should not drop below those voltages required for acceptable system stability performance, acceptable operation of generating auxiliaries, acceptable operation of other electrical equipment, operation well above the knee of the voltage curve, and for meeting the NPIRs. Also, the voltage should not rise above the maximum rating of electrical equipment.

5.2 Reasonably Stressed Conditions

Reasonably stressed conditions are those severe load and generation system conditions which have a reasonable probability of actually occurring. Generally both import and export conditions should be addressed. The purpose of testing these conditions is to identify potential weaknesses in the system and not to test the worst imaginable extreme.

5.3 Operating Characteristics

The actual operation of the interconnected system requires that each component of the system must be capable of operating in such a manner as not to adversely affect the system operation. Any additions to the system must be able to operate in such a manner so as not to degrade the present operating flexibility of the system. Operating Characteristics include, but are not limited to: dispatchability, including constraints on economic dispatch, voltage control, flicker, harmonics, black start capability, environmental limitations, maintenance scheduling, TV and radio interference, audible noise, and under frequency load shedding.

5.4 Significant Adverse Effect (Section I.3.9 of the Tariff)

The existing system is designed and operated to meet specific criteria as contained in the various documents referenced through this guideline. After the addition it must be demonstrated that there has been no significant degradation in the level of system performance.

5.5 Normal Dispatch Conditions

Normal Dispatch Conditions refers to the economic dispatch of all New England Control Area generation with appropriate allowance for scheduled maintenance and forced outages. Applicable firm contractual transfers, both purchases and sales, should be included.

5.6 Remedial Action Schemes

See PP5-5 Requirements and Guidelines for Application of Remedial Action Schemes and Automatic Control Schemes.

Document History[3]

Rev. 0: Rec.: RTPC – 1/18/00; App.: PC – 2/4/00
Rev. 1: Rec.: RC – 11/14/00; App.: PC 12/1/00
Rev. 2: Eff.: 2/1/05
Rev. 3: Rec. RC – 2/26/10; Rec.: PC 3/05/10; Eff.: 3/05/10
Rev. 4: Rec. RC – 2/14/13; Rec.: PC 3/01/13; Eff.: 3/01/13
Rev. 5: App. RC – 10/17/17; PC – 11/03/17; ISO-NE – 11/08/17 (elimination of Task Force review)
Rev. 6: App. RC – 12/18/19; PC – 2/06/20; ISO-NE – 2/06/20 (replacement of the term "Governance Participant" with "Market Participant or Transmission Owner" to align with Section I.3.9 of the Tariff. Updated reference to NPIRs due to the retirement of Vermont Yankee and Pilgrim.)
Rev. 7: Rec. RC – 11/14/23; Rec.: PC 12/07/23; Eff: 12/08/23 (Update Attachment 1 by removing Figure and Table 1 and replacing them with the Level of Analysis Guideline.)

[3] This Document History documents action taken on the equivalent NEPOOL Procedure prior to the RTO Operations Date as well as revisions to the ISO New England Procedure subsequent to the RTO Operations Date.

Attachment 1

ISO New England Planning Procedure 5-3

LEVEL OF ANALYSIS GUIDELINE

Facility	Action	Study Determination
Transmission Lines including DCT separations where applicable (≥ 69 kV)	Add or Remove	• A PPA with Level I analysis may be appropriate for a radial[4] line addition if all of the following are met: o There are no Generators in the radial portion of the system that is explicitly modeled in the latest short circuit model o It can be demonstrated through a review of protection systems at the line terminals, without an analysis or study, that clearing times for faults associated with the new line are no longer than the clearing times for existing contingencies on the pre-project system, o Increase in charging associated with added line is less than or equal to 5 MVAR, if applicable, **and** o There are no increases in MW flow into the radial system with the new or removed line (MW flow changes within the radial system served by the radial line is acceptable.) • All other instances of transmission line additions or removals would require a PPA with Level II or Level III analysis. See **Determination between Level II and Level III Analysis** section below.
	Reconductor or Rebuild	• A PPA with Level I analysis may be appropriate if all of the following are met: o All post project ratings are at least 100% of the pre project ratings,[5] o The post project clearing times for design contingencies that involve the line are less than or equal to the clearing times for the line in the pre-project system, o The change in charging associated with project is less than or equal to 5 MVAR, **and** o The change in the reactance associated with the line is less than or equal to 10% on a 100 MVA base • All other instances of transmission line reconductor or rebuild would require a PPA with Level II or Level III analysis. See **Determination between Level II and Level III Analysis** section below.
HVDC Line and Terminals	Add, Remove, or Replace[6]	• See **Determination between Level II and Level III Analysis** section below.
Transformers including Phase-angle Regulators (PARs)[7] and excluding Generator Step Ups (GSUs) (High -side ≥ 69 kV)	Add or Remove	• A PPA with Level I analysis may be used for a radial or sub-transmission (<69 kV) transformer addition if all of the following are met: o There are no Generators in the radial or sub-transmission portion of the system that is explicitly modeled in the latest short circuit model o It can be demonstrated through a review of protection systems at the transformer terminals, without an analysis or study, that clearing times for faults associated with the new transformer are no longer than clearing times for existing contingencies on the pre-project system, **and** o There are no increases in MW flow into the radial or sub-transmission system with the new or removed transformer • All other instances of transformer additions or removals would require a PPA with Level II or Level III analysis. See **Determination between Level II and Level III Analysis** section below.
	Replace	• A PPA with Level 1 analysis may be appropriate if all of the following are met: o All post project ratings are at least 100% of the pre project ratings, o The post project clearing times for design contingencies that involve the replaced transformer are no longer than the clearing times for transformers in the pre-project system, **and** o **For radial or sub-transmission transformers**: there is no increase in load in the radial or sub-transmission system that would affect the PTF system o **For networked transformers**: there is no change in load in the vicinity of the transformer that would affect the flows PTF system o The Change in the reactance associated with the transformer is less than or equal to 10% on a 100 MVA base • All other instances of replacing a transformer would require a PPA with Level II or Level III analysis. See **Determination between Level II and Level III Analysis** section below.

[4] The system shall be radial, served from a single substation, in its normal operating configuration or lines and associated facilities that are classified as MTF or OTF.

[5] Project ratings include summer normal, long-time emergency (LTE), and short-time emergency (STE) ratings and winter normal, LTE, and STE ratings. There are instances where the STE rating is less than 100% is acceptable as long as the STE rating is much greater than LTE rating and STE rating is rarely relied upon to reliably operate the system.

[6] Per Section 4.0 of PP5-1, the rehabilitation with like equipment that does not affect transmission capability does not require a PPA. The term replace is used here and throughout this attachment to indicate the rehabilitation with equipment possessing different attributes that may affect transmission capability.

[7] For the purpose of this guideline, PARs are not considered static devices.

Facility	Action	Study Determination
GSU Transformers	Add	• See Generators section below.[8]
	Replace	• Consult with ISO-NE to determine the level of analysis required.
Shunt Reactive Devices: capacitors or reactors (≥ 69 kV)	Add	• A PPA with Level I analysis may be appropriate for the addition of a shunt reactive device if all of the following are met: o The new shunt reactive device is added at a station with other existing shunt reactive device(s), o The size of the new shunt reactive device or the cumulation of several shunt reactive devices at a station is less than or equal to 5 MVAR larger than the largest size of the other shunt reactive devices at the station, o The shunt reactive device will be modeled in EMS and will be adjusted remotely by the Local Control Center, **and** o It can be demonstrated through a review of protection systems at the station, without an analysis or study, that clearing times for faults associated with the new shunt reactive device are no longer than the clearing times for existing contingencies on the pre-project system • All other instances of shunt reactive device additions or removals would require a PPA with Level II or Level III analysis. See **Determination between Level II and Level III Analysis** section below.
	Remove	• The removal of a shunt device would require a PPA with Level II or Level III analysis. See **Determination between Level II and Level III Analysis** section below.
	Replace	• A PPA with Level I analysis may be appropriate if all of the following are met: o The post project clearing times for design contingencies that involve the replaced shunt reactive device are no longer than the clearing times for the shunt device in the pre-project system, **and** o The size of the new shunt device or the cumulation of several shunt reactive devices at a station is less than or equal to 5 MVAR larger than the size of the existing device • All other instances of replacing a shunt reactive device would require a PPA with Level II or Level III analysis. See **Determination between Level II and Level III Analysis** section below.
Series Reactive Devices: capacitors or reactors (≥ 69 kV)	Add or Remove	• The removal of a series reactive device would require a PPA with Level II or Level III analysis. See **Determination between Level II and Level III Analysis** section below.
	Replace	• A Level I analysis may be appropriate if all of the following are met: o The post project clearing times for design contingencies that involve the replaced series reactive device are no longer than the clearing times for the series device in the pre-project system, **and** o The change in the reactance associated with the new series reactive device is less than or equal to 10% on a 100 MVA base • All other instances of replacing a reactive device would require a Level II or Level III analysis. See **Determination between Level II and Level III Analysis** section below.
Dynamic Reactive Devices (≥ 69 kV)	Add, Remove, or Replace	• The addition, removal, or replacement of a dynamic reactive device would require a PPA with Level III analysis.
Circuit Breakers (≥ 69 kV)	Add or Remove	• A PPA with Level I analysis may be appropriate for the addition or removal of circuit breakers if all of the following are met: o There is no new steady state or stability contingency added,[9] o It can be demonstrated through a review of protection systems at the station, without an analysis or study, that clearing times for faults associated with the new circuit breaker are no longer than the clearing times for existing contingencies on the pre-project system,[10] **and** o The ratings of a new breaker are equal or higher than the highest existing breaker at the station[11] • All other instances of circuit breaker additions or removals would require a PPA with Level II or Level III analysis. See **Determination between Level II and Level III Analysis** section below.
	Replace	• No PPA is required for the replacement of a circuit breaker if all of the following are met:[12] o It can be demonstrated through a review of protection systems at the station, without an analysis or study, that clearing times for faults associated with the replaced circuit breaker are no longer than the clearing times for existing contingencies on the pre-project system, **and** o The ratings of the replaced breaker are equal or higher than the existing breaker • All other instances of circuit breaker replacements would require a PPA with Level II or Level III analysis. See **Determination between Level II and Level III Analysis** section below.

8 For GSU Transformer additions that do not have an associated generator change or addition, consult with the ISO to determine the level of analysis required.
9 A new contingency is defined as a contingency that is not covered by another contingency, or results in more severe system conditions.
10 An analysis or study in this context means the use of computer simulations e.g. PSS/E or ASPEN.
11 Ratings include interrupting duty and momentary duty.
12 A circuit breaker is considered as terminal equipment and is used as an example in Section 4.0 of PP5-1 where the replacement in kind of the equipment does not need a PPA.

Facility	Action	Study Determination
Protection System Changes in a Station (≥ 69 kV)	Add, Remove, or Replace	• A PPA with Level I analysis may be appropriate for the addition, removal, or replacement of a protection system change in a station if all of the following are met: ○ The protection system change results in the same or faster clearing times, **and** ○ The protection system change results in no change to the isolation of elements • All other instances of adding, removing, or replacing a protection system change in a station would require a PPA with Level II or Level III PPA analysis. See **Determination between Level II and Level III Analysis** section below.
RAS or ACS	Add	• The addition of a RAS or ACS would require a PPA with Level II or Level III analysis. See **Determination between Level II and Level III Analysis** section below.
	Remove	• A PPA with Level I analysis may be appropriate for the removal of a RAS or ACS if it can be demonstrated, without an analysis or study, that the system issue addressed by the RAS or ACS is no longer present • All other instances of removing a RAS or ACS would require a PPA with Level II or Level III analysis. See **Determination between Level II and Level III Analysis** section below.
	Modify[13] or Replace	• The modification or replacement of a RAS or ACS would require a PPA with Level II or Level III analysis. See **Determination between Level II and Level III Analysis** section below.
Other Transmission Equipment (≥ 69 kV)[14]	Add, Remove, or Replace	• A PPA with Level I analysis may be appropriate if it can be demonstrated that the addition, removal, or replacement of the equipment, without an analysis or study, does not have a significant adverse effect upon the reliability or operating characteristics of the transmission system or Market Participant's system • All other instances of adding, removing, or replacing other equipment would require a PPA with Level II or Level III analysis. See **Determination between Level II and Level III Analysis** section below.
Generators	Add, Replace, or Modify	• See Section 2.1 of PP5-1 for the level of analysis.

Determination between Level II and Level III Analysis

- A PPA with Level II analysis may be sufficient if:
  - New contingencies that are created or existing contingencies that are modified in the post project system results in:
    - No more elements taken out of service when compared to the pre project system contingencies **and**
    - The fault clearing times for the new or modified contingencies are the same or faster than equivalent contingencies in the pre project system,
  - The system modification is restricted to static devices (no changes to the transient stability models), **and**
  - The system modification is not in the vicinity of a known stability constraint (for example, a line that is a part of an existing/planned stability limited interface)
- All other PPAs will require Level III analysis

[13] As defined in PRC-012-2 Attachment 1, a functional modification to a RAS consists of any of the following:
- Changes to the system conditions or contingencies monitored by the RAS
- Changes to the actions the RAS is designed to initiate
- Changes to RAS hardware beyond in-kind replacement; i.e. match the original functionality of existing components
- Changes to RAS logic beyond correcting existing errors
- Changes to redundancy levels; i.e. addition or removal

A functional modification to an ACS is defined in the same way. A change in the timing of actions taken by an ACS is not considered a functional modification, unless the actions are taken in order to maintain transient stability, including voltage stability.

[14] Equipment not mentioned in this attachment or in Section 4.0 of PP5-1.