

# ISO New England Operating Procedure No. 17

## Load Power Factor and System Assessment

**Effective Date: June 5, 2024**

**Review By Date: June 5, 2026**

### References:

ISO New England Operating Procedure No. 5 - Resource Maintenance and Outage Scheduling (OP-5)

ISO New England Operating Procedure No. 12 - Voltage and Reactive Control (OP-12)

ISO New England Operating Procedure No. 14 - Technical Requirements for Generators, Demand Response Resources, Asset Related Demands and Alternative Technology Regulation Resources Appendix B – Generator and Asset Related Demand Reactive Data Explanation of Terms and Instructions for Data Preparation for ISO Form NX-12D (OP-14B)

ISO New England Operating Procedure No. 19 - Transmission Operations (OP-19)

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### **Appendices:**

Appendix A - Area Definitions

Appendix B - Methodology for Developing Load Power Factor Standards

Appendix C - Instructions for the ISO New England Load Power Factor Survey

## I. INTRODUCTION

This Operating Procedure (OP) establishes the ranges of acceptable load power factor (LPF) for various areas within the New England Control Area, and the responsibilities of the ISO, Transmission Owners (TOs) and Transmission Customers in New England with respect to LPFs. It also describes the analysis that ISO undertakes to monitor, assess and report on LPF compliance

### A. Overview

ISO is responsible for operating all transmission facilities rated 115 kV and above. Local Control Centers (LCCs) are responsible for operating all transmission facilities rated 69 kV and below. To maintain a reliable system, ISO and the LCCs manage the pre-contingent voltage profile of the New England Transmission System<sup>1</sup> and the system's reactive power Resources to meet reactive power demands. Managing the reactive power output of energy Resources as well any dynamic and shunt reactive power elements connected to the transmission system helps supply the system's reactive losses and the reactive demand of load served by the system.

One key contributing factor to system voltage is the reactive demand of system load. The reactive demand component of load is often described in terms of LPF. The LPF is, in simple terms, the ratio of real power demand (MW) to apparent power (MVA). LPF is a key study assumption used in long range planning of the transmission system, and it is a key factor in the operation of the power system. Significant changes in LPF from that assumed in planning studies can lead to out-of-merit Resource commitments to prevent unacceptable high or low system voltages, and potential reliability concerns, when operating the system.

### B. Responsibilities

ISO monitors the LPF throughout the New England Transmission System by surveying portions of the system defined as LPF Areas in Appendix A – Area Definitions. Those Areas where LPF is not within defined acceptable LPF ranges (which are defined by the LPF used in planning or that defined by operating analyses), and/or where an Operating Issue exists, shall implement the actions listed in Part I(C)(1-2).

For purposes of this OP, the term “Operating Issue” is defined as an actual or near voltage limit exceedance condition that requires any of the following mitigating actions:

- Deviating from economic dispatch,
- Switching out a cable,
- Purchase of available emergency capacity or energy,
- Shedding load

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<sup>1</sup> The New England Transmission System is defined in the ISO New England Inc. Transmission, Markets, and Services Tariff (ISO Tariff) and includes the Reliability Coordinator Area/Balancing Authority Area (RCA/BAA), Bulk Electric System (BES) and NPCC bulk power system (BPS) elements found within New England on the transmission network.

- Actions that go beyond what is established by current Transmission Operating Guides (TOGs)

For example, additional commitment of generators to control a post-contingent high voltage limit exceedance due to a change in LPF is deemed an Operating Issue due to the exceedance's impact on the system's ability to accommodate the limiting system condition / topology as well as the availability of generation to mitigate the voltage limit exceedance.

### C. Compliance Actions

#### 1. Non-compliance with LPF Standard

For each LPF area that violates its standard(s), a letter will be sent to **all** TLC Contacts (s) within the LPF area by the end of the year following the survey year. For example, in 2022, the year 2021 is being surveyed, and by the end of 2022, a letter regarding the 2021 survey results will be sent.

In the letter, TLC(s) within the violating LPF area are encouraged to evaluate their LPF performance, and if they in fact violated the LPF standard, to take mitigating actions to improve LPF performance. However, the TLC is not responsible for providing the analysis or mitigating plan to ISO. Since the LPF survey aggregates the performance of all load serving transformers within an LPF area, it is possible that an individual TLC operated within the LPF standards, yet exists within an LPF area that, as a whole, violated the standard(s).

In the letter, several hours of poor performance will be identified. The poor performance hours do *not* represent the extent of the problem within the violating LPF area; rather, the poor performance hours provide a potential starting point or focus point for the TLCs' investigation. It is possible that the TLC was in fact compliant during the identified poor performance hour and yet not compliant during another hour that was not identified. Ultimately, the responsibility of assessing an individual TLC's LPF performance lies with that TLC. The poor performance hours identified by ISO on the LPF letters will represent 10 unique days of the highest MVAR surplus or deficiency. The hour of the highest MVAR surplus or deficiency of that day will also be identified. Therefore, the hours identified may not be the top 10 hours for highest surplus or deficiency. For example, if one day contains the three highest surplus hours for the year, only the highest surplus hour of that day will be listed on the letter.

#### 2. Operating Issue

The ISO shall conduct the initial review of any Operating Issue and depending on the results of that technical review shall:

- Share any correlation of new system voltage Operating Issues and LPF with the Voltage Task Force (VTF);
- Review trends with the VTF and any appropriate entities and recommend corrective actions;

- Review trends with Master / Local Control Center Heads and Reliability Committee when appropriate

The timeline and actions applicable when an Operating Issue is identified are as follows:

- ISO shall send a request to the LCC to confirm the Transmission Load Customers (TLC) and Transmission Load Customer Contacts (TLC Contacts) as recorded in Appendix C – Instructions for the ISO New England Load Power Factor Survey (OP-17C) in a non-compliant area, within seven (7) Business Days of the event identification.
- The LCC shall confirm / correct the list of TLCs and TLC Contacts in the non-compliant area within seven (7) Business Days of receipt of the list.
- ISO shall request additional data from the TLC Contact(s) to determine the entities involved in the actual or near miss Operating Issue within seven (7) Business Days of receipt of LCC confirmation. As described in OP-17C, the TLC Contact is expected to forward the data requests to their associated TLCs as indicated in OP-17C Table 1.
- The TLC shall send requested data regarding LPF operation to ISO System Operations for the identified dates and times by no later than fourteen (14) Business Days of the data request. If the TLC believes the requested data is voluminous and requires additional time to collect, it can request additional time from the ISO.
- ISO shall review the TLC's LPF data. If review and analysis of the TLC LPF data demonstrates that the TLC contributed to the Operating Issue, then ISO will send a notification of non-compliance to the responsible TLC. The notification of non-compliance will be send to the TLC within fourteen (14) Business Days of the TLC's data submittal to ISO Operations.
- Responsible TLCs shall submit to the ISO an action plan within forty (40) Business Days of receipt of a non-compliance notification. The mitigation plan shall include an expected date of a return-to-compliance based upon completion of the action plan.
- Responsible TLCs shall submit evidence of implementing the action plan to return-to-compliance, to ISO within forty (40) Business Days of submitting the action plan, as well as when the action plan is complete.

## II. LPF REQUIREMENT

The ranges of acceptable LPFs within the New England Control Area (described in Appendix A – Area Definitions) are portrayed as bandwidths of LPF expressed as a function of system load level. For a specific system load level (see Figure 1), the

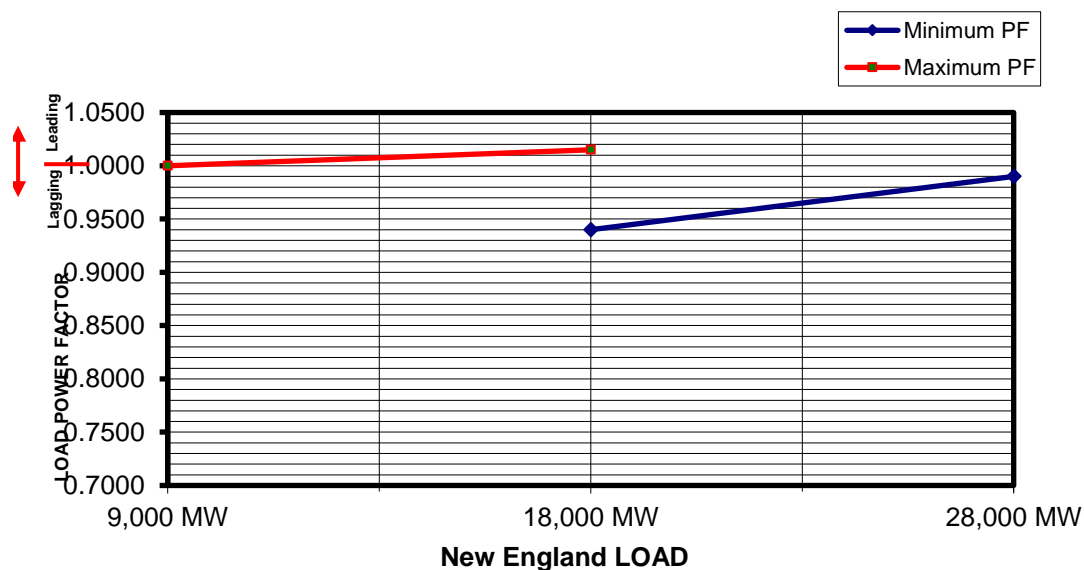
bandwidth between a pair of limiting curves represents the range of acceptable LPFs.

- These ranges are determined by ISO, in coordination with the TOs, for planning and system design studies.
- These ranges are determined by ISO, in consultation with the VTF, for Real-Time operations, when LPF curve updates are warranted based on major system changes such as installation of major transmission projects, generation additions or retirements, or installation of new significant reactive power Resources.

Appendix B – Methodology for Developing Load Power Factor Standards - contains the study methodology used in Operations for developing the ranges of acceptable LPFs.

If the ISO determines that the LPF acceptable ranges require updating, loadflow analysis shall be conducted by the ISO and VTF at a maximum of three distinct load levels. These load levels may be modified as system demand dictates.

Figure 1



The TO and Transmission Customer have the responsibility to manage the LPF of all connected distribution loads, and may do so by switching in-or-out-of-service, transmission and distribution reactive Resources to meet the LPF Area's voltage needs and, ultimately, LPF requirements.

Generators connected to the power transmission system and sub-transmission system shall comply with the voltage schedules in OP-12B (as applicable), or as established by the local TO, and operate all units with AVRs in-service, in automatic and regulating to a voltage schedule unless the units are:

- Exempted from providing voltage control under the provisions of Master/Local

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Control Center Procedure No.8 – Coordination of Generator Voltage Regulator and Power System Stabilizer Outages (M/LCC 8); And

- According to the limit of reactive capability provided under ISO New England Operating Procedure No. 14 - Technical Requirements for Generators, Demand Response Resources, Asset Related Demands and Alternative Technology Regulation Resources, Appendix B - Generator and Asset Related Demand Reactive Data Explanation of Terms and Instructions for Data Preparation for ISO Form NX-12D (OP-14B).

### III. LPF SURVEY AND ASSESSMENT PROCEDURE AND EVALUATION

#### A. LPF Survey

The ISO shall conduct a survey of all LPF areas annually or more frequently as circumstances may dictate. If the LPF survey shows a significant amount of LPF points outside the established LPF curves during the surveyed period, the ISO may request additional data from TOs or Transmission Customers to determine the responsible entity or entities causing the area's non-compliance, within a reasonable and agreed upon timeframe. Further actions will be taken by the ISO as described in Section 1 of this OP.

The ISO is responsible for collecting the data, sharing the data with the VTF and, if necessary, requesting additional data from TOs and/or Transmission Customers to complete this analysis. The TOs and Transmission Customers are required to provide the requested data to the ISO within the timeframes noted within this procedure.

The ISO shall perform the LPF survey and calculate the LPF at the transmission level, evaluate the LPF compliance, review trends and share the results with the VTF, M/LCC Heads and Reliability Committee. The TOs and Transmission Customers are responsible for reviewing the LPF survey results on an area basis for their load and shall provide additional data if requested by the ISO, to determine the load entity or entities that were non-compliant. The Transmission Customers are responsible for developing corrective actions when required.

The information gained from performing the LPF survey, if appropriate, may then be used by the ISO to create and update system models for conducting system studies and creating new operating voltage guides, as appropriate.

#### B. LPF Assessment or Reliability Review

Changes in the system or perceived changes in system performance will necessitate a review and potential revision to one or more LPF's requirements for the LPF Areas. The ISO and LCC's VTF members (as needed) shall conduct studies based on the methodology described in Appendix B of this OP. Any resulting change in the LPF standards will then be used for any succeeding LPF assessments.

The LPF standard is defined as a boundary, normally defined as a line or curve, where acceptable system performance occurs for LPF and load level combinations. The area on one side of the curve yields unacceptable performance while the other side yields acceptable performance. The LPF standard, or curves, shall be established using pre or post-contingent voltage limits to establish where the limiting curve point exists for defined test system load levels and sets of system conditions. For example, in Figure 1 above, the area below the red curve and above the blue curve would yield combinations of LPF and system load where reliable operation with respect to voltage limit should be able to occur (for all lines in-service and specific facility out conditions). The area above the red curve and below the blue curve should result in either potential high or low post-contingent system operation, respectively.

LPF assessments determine the level of shunt compensation required to return the



area in question to LPF compliance. The assessment determines the change in shunt capacitance, or reactance, to return the area's LPF to within the defining curves for a low voltage, or high voltage, exceedance, respectively. These shunt compensation levels are reasonable estimates of the net relative change in area power factor that would need to occur to return the area to LPF compliance.

When an Operating Issue is identified, the ISO shall perform a reliability review. For the reliability review, if the LPF assessment shows that actual or near voltage limit exceedances from the system are strongly correlated with the LPF Area's performance, the results will then be compared against the area's existing LPF standards to determine the amount of LPF correction needed to improve reliability. The ISO, after consultation with the VTF, shall determine the amount of shunt capacitors or reactors needed to improve reliability. If the ISO determines that a new LPF standard is needed for any of the LPF Areas due to an Operating Issue, the VTF shall develop the new standard and share the new requirements through the annual report on LPF.

The ISO shall annually provide a report to the M/LCC Heads and Reliability Committee on LPF compliance by LPF Area, highlight future reactive targets and any Operating Issue created by the LPF performance. The report shall also include a summary of the LPF survey, assessment or reliability review and list the non-compliance notifications issued by the ISO, either due to general area LPF non-compliance or for Operating Issues impacted by poor LPF as described in Part 1, above. Any new LPF standards developed for any of the LPF areas shall be updated and shared with the Transmission Customers and TOs to provide the area's LPF requirements.

This OP is intended to complement other ISO New England Operating Procedures and ensure reliable operation of the transmission system. This OP also directly supports the goals of ISO New England Operating Procedure No.19 - Transmission Operation (OP-19), which prescribes criteria for the reliable operation of the transmission system including voltage and reactive limitations and contingencies.

## OP-17 REVISION HISTORY

**Document History** (This Document History documents action taken on the equivalent NEPOOL Procedure prior to the RTO Operations Date as well revisions made to the ISO New England Procedure subsequent to the RTO Operations Date.)

Rev. No.	Date	Reason
Rev 1	03/07/03	
Rev 2	02/01/05	Updated to conform to RTO terminology
Rev 3	05/06/05	Update for initiation of VELCO Local Control Center
Rev 4	10/01/06	Updated for ASM Phase 2
Rev 5	12/8/06	Update for changes resulting from VTF meetings
Rev 6	12/17/14	Cover page under the "Local Control Center Instructions" section - Modified "REMVE II" to "REMVEC/NGRID" and added "NSTAR". Section II - Added a paragraph explaining how the VTF will address instances when projects assumed in-service in the forecasted LPF study are not placed in-service in the field as planned. Section III - modified Figure 1 to only plot 6 points. Removed the additional point.
Rev 6.1	07/06/16	Periodic review performed requiring no changes; Made administrative changes required to publish a Minor Revision;
Rev 6.2	06/14/18	Periodic review performed requiring no changes; Made the administrative changes (including globally updating OP-5 and OP-14 titles and replacing "REMVEC/NGRID" with "NGRID") required to publish a Minor Revision;
Rev 6.3	04/24/20	Periodic review performed requiring no changes; Made administrative changes required to publish a Minor Revision;
Rev 7	10/01/20	Targeted rewrite of document to describe changes in scope and process
Rev 8	09/08/22	Periodic review performed by procedure owner; Editorial edits to correct grammar and spelling; Swapped content of Section I.C.1 and Section I.C.2; Updated Section I.C.1 Non-compliance with LPF Standard; Updated Section I.C.2 Operating Issue.
Rev 8.1	06/05/24	Biennial review performed by procedure owner requiring no changes; Made administrative changes required to publish a Minor Revision.