

## Appendix G - Explanation of Terms and Instructions for Data Preparation of NX-9G

### ISO New England Transmission Equipment Rating, Characteristic, and Operational Data Variable Reactor

**Effective Date: October 23, 2025**

**Review By Date: October 23, 2027**

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## I. EQUIPMENT REQUIREMENTS

Data for all variable reactors designated as part of the Bulk Electric System<sup>1</sup> (BES) or connecting to the New England Transmission System<sup>2</sup> at a voltage of 69 kV or greater shall be provided by the Transmission Owners and Market Participants who own the equipment.<sup>3</sup>

Data for variable reactors connected at voltages that are less than 69 kV may be required when ISO determines that the data is necessary for reliable operation of the New England Transmission System. When required by ISO, the TO or MP shall submit the data within thirty (30) calendar days of ISO's notification.

A copy of the manufacturer's nameplate, either by document (.pdf format) or digital photograph (.tif or .jpg formats), shall be included as a file attachment to NX-9G forms for new or replaced equipment and to new NX-9G forms for variable reactor equipment previously reported using the NX-9B form.

A copy of the manufacturer's test report document (in .pdf format) shall be included as a file attachment to NX-9G forms for new or replaced equipment and to new NX-9G forms for variable reactor equipment previously reported using the NX-9B form.

## II. GENERAL DATA INSTRUCTIONS

The NX-9G form provides for entry of both ISO and MP/TO data. ISO fields cannot be modified by the MP or TO. The MP or TO is responsible for providing data for all non-ISO fields via the NX Application.

The circuit number shall initially be entered by the MP or TO for new equipment and thereafter maintained by ISO.

Select the terminals that reflect the connection points of the equipment. Terminals are created and maintained by ISO. The user should contact the ISO NX-9 Administrator ([nx9admin@iso-ne.com](mailto:nx9admin@iso-ne.com)) if terminal additions or changes are needed.

To remove equipment from service, select the Remove Equipment From Service checkbox. Equipment is removed from service either when the equipment is retiring from service or if new forms are being submitted as a replacement due to a change in configuration.

All voltage data item responses are to be in kV unless otherwise indicated in these instructions.

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<sup>1</sup> Bulk Electric System (BES) is defined in the Glossary of Terms Used in NERC Reliability Standards.

<sup>2</sup> New England Transmission System is defined in the ISO Transmission, Markets, and Services Tariff, Section I.2.2.

<sup>3</sup> Generally, under Section I of Operating Procedure No. 16, data shall be provided by Transmission Owners (TOs) and Market Participants, *i.e.* Market Participants who own the equipment or Lead Market Participants for Generator Assets (collectively MPs).

To assist in completing the NX-9G form, sample manufacturer's nameplate data and a completed NX-9G form utilizing that data are attached (Example 1).

All tap position item responses shall indicate tap positions using numbers (1, 2, 3, 4, etc.) as opposed to letters (a, b, c, d, etc.).

### III. RATING DATA INSTRUCTIONS

Facility rating data shall be provided in MVA (rounded down to the nearest whole number) and determined in accordance with Planning Procedure 7, "Procedures for Determining and Implementing Transmission Facility Ratings in New England" (PP7). The definition of Thermal Ratings is described in PP7 Section 2.0 Collaborative Development of Rating Procedures. A facility rating shall equal the rating of the most limiting individual equipment, shall reflect relay loadability limits<sup>4</sup>, and shall account for auxiliary support equipment such as wave traps and any other equipment that Good Utility Practice suggests is necessary. This requirement does not remove the TO's obligation to adhere to PRC-023-4, and its successor standards, nor does it suggest a TO be allowed to change a relay setting to create a more limiting thermal rating for a facility.

The NX-9G form provides for entry of both summer (April 1 through October 31) and winter (November 1 through March 31) thermal ratings as well as ratings for special conditions or configurations. The ambient temperature (reported in Fahrenheit) used to establish the normal ratings shall be entered for each rating set. If ratings for special conditions or configurations are added to the NX-9G form, comments that describe the associated circumstances for use of the special ratings are required. The MP or TO is also responsible for providing a statement as to the authority of ISO and the Local Control Center (LCC) for use and distribution of these special ratings.

### IV. CHARACTERISTIC AND OPERATIONAL DATA INSTRUCTIONS

Complete the following fields as instructed below:

Control Type – Indicate the normal control mode based upon the descriptions below. The Control Type selected should reflect the operational state that the device is expected to be in the majority of the time.

Manual-Local – Reactor is operated locally at the substation.

Manual-Remote – Tap changes are typically made using the SCADA system and initiated by an LCC System Operator<sup>5</sup> or a TO control room operator.

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<sup>4</sup> The term "relay loadability limits", as used in this Appendix, represents the minimum flow at which the relay acts

<sup>5</sup> System Operator is defined in the Glossary of Terms Used in NERC Reliability Standards.

Auto – Reactor has controls which are set up for complete automatic operation. Tap changes typically occur without LCC System Operator or TO control room operator intervention.

#### Nominal Capability

Fixed – Provide the fixed capability (MVAR) calculated at nominal system voltage and 60 Hertz.

Variable – This value is calculated by the NX Application as Maximum – Fixed

Maximum – Provide the maximum capability (MVAR) calculated at nominal system voltage and 60 Hertz.

Impedance Data Table - For each position listed, Minimum, Midpoint, Nameplate and Maximum, provide the following values:

Tap # @ MVAR Consumption – Indicate the tap number at the listed position.

MVAR Consumption – Indicate the MVAR consumption at the listed position.

Impedance X – Provide the positive sequence reactance (X) calculated in percent on a 100 MVA base at the listed position. Do not adjust values to nominal system voltage. Impedance on NX-9G forms shall be calculated and provided out to at least the 3rd decimal place.

## V. EXPLANATION OF DATA CHANGES

Any time an NX-9G form is modified or created, a brief description of the reason(s) for the entry shall be provided in the Revision Comments field. It will provide a written record of the change and clearly identify the equipment changes made in the field and/or other reasons that necessitated the update of the NX-9G form. For example: Ratings modified due to replacement of previously limiting terminal equipment.

This data is utilized by ISO in the NX-9G form review and approval process.

## VI. EQUIPMENT NOTES

The Equipment Notes field is used to provide explanations of data or other pertinent or operational information. For example: Unit is connected to the bus between breakers CB1 and CB2.

Fields are provided for both ISO and MP/TO notes. An additional private field is available to the MP or TO for internal notes that can be edited and viewed only by the MP or TO owning the record.

Equipment notes are carried forward when an NX-9G form is updated. MPs and TOs should review and modify or delete any MP or TO note that is no longer pertinent. ISO is responsible for maintaining ISO notes.

**EXAMPLE 1, NX-9G VARIABLE REACTOR**

**ISO New England Equipment Rating, Characteristic,  
and Operational Data Implementation Form  
Variable Reactor (NX-9G)**

Reference 141010002 ParticipantID abc variable reactor  
Participant Test Company ISO ID abc  
Form State Approved Ckt 1

Terminal Station1 345kV Bus # 123456 EMS STATION1  
Equipment Variable Reactor Control Type Auto

Nominal System Voltage (kV) 345

Nominal Capability (MVAR) Fixed 50 Variable 50 Maximum 100

Default Summer 100 F

	MVA	Limiting Device / Description	Location
Normal	100	Reactor- Reactor	Substation
LTE	100	Reactor- Reactor	Substation
STE	100	Reactor- Reactor	Substation
DAL	100	Reactor- Reactor	Substation

Default Winter 50 F

	MVA	Limiting Device / Description	Location
Normal	100	Reactor- Reactor	Substation
LTE	100	Reactor- Reactor	Substation
STE	100	Reactor- Reactor	Substation
DAL	100	Reactor- Reactor	Substation


Impedance Data	Tap number @ MVAR Consumption	MVAR Consumption	Impedance X (%) (100 MVA Base)
	Min 33	50	200.76
	Midpoint 17	69	145.39
	Nameplate 17	69	145.39
	Max 1	100	100.93

Revision Comments Variable Reactor Example - Ratings modified due to replacement of previously limiting terminal equipment.

Equipment Notes Rated Maximum Voltage=362kV, Rated Operating Voltage=345kV

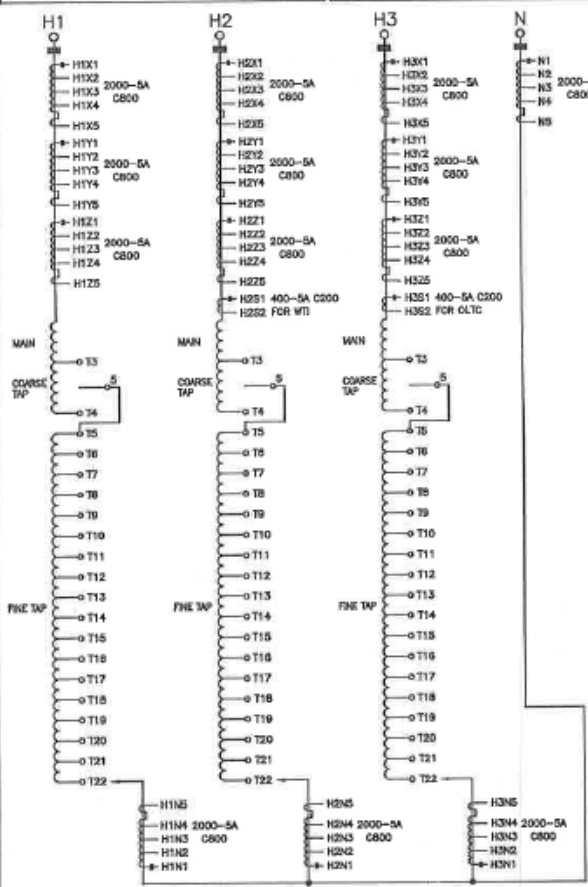
Data Revision Number 2 Date Created 10/10/2014 Prepared By Participant Username  
Requested Effective Date 10/11/2014 Date Received 10/21/2014 Approved By ISO Username  
Actual Effective Date ISO EMS Implementation Date 10/20/2014

EXAMPLE 1 (CONTINUED), NX-9G VARIABLE REACTOR

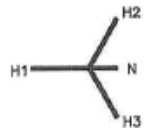


# HICO

VOLTAGE RATING		THREE PHASE SHUNT REACTOR		RATED FREQUENCY		60Hz	
RATED OPERATING	345,000 V			COOLING METHOD		ONAN	
RATED MAXIMUM	362,000 V						
KVA RATING (65°C RISE)		SOUND LEVEL _____ dB 160 MVAR		WEIGHT			
MAXIMUM	160 MVAR			CORE & COIL			
MINIMUM	70 MVAR			TANK & FITTINGS		lbs	
		MATERIAL		INSULATION OIL		lbs	
		INSULATING OIL		ASTM D-3487 TYPE I		TOTAL	
		CONDUCTOR		COPPER		UNTANKING	
				OIL QUANTITY			
SERIAL NO.   TP80050701		BIL OF WINDING		TEMPERATURE RISE ONAN		MAIN	
		LINE   1050 KV		OIL   65°C		LTC	
		NEUTRAL   150 KV		WINDING   65°C		CONSERVATOR	
						gallons	
						gallons	
						gallons	



POSITION NUMBER	CONNECTION		VOLTS	IMPEDANCE [OHM]	EXCITING CURRENT [A]	CAPACITY [MVAR]
	COARSE TAP	FINE TAP				
35		T8	345,000			
34		T7	345,000			
33		T8	345,000			
32		T9	345,000			
31		T10	345,000			
30		T11	345,000			
29		T12	345,000			
28		T13	345,000			
27		T14	345,000			
26		T15	345,000			
25		T16	345,000			
24		T17	345,000			
23		T18	345,000			
22		T19	345,000			
21		T20	345,000			
20		T21	345,000			
19		T22	345,000			
18		T4	345,000			
17		T8	345,000			
16		T7	345,000			
15		T8	345,000			
14		T9	345,000			
13		T10	345,000			
12		T11	345,000			
11		T12	345,000			
10		T13	345,000			
9		T14	345,000			
8		T15	345,000			
7		T16	345,000			
6		T17	345,000			
5		T18	345,000			
4		T19	345,000			
3		T20	345,000			
2		T21	345,000			
1		T22	345,000			




VECTOR GROUP  
Yn

THE TRANSFORMER TANK IS DESIGNED TO WITHSTAND COMPLETE VACUUM AND AN INTERNAL PRESSURE OF 10 POUNDS PER SQUARE INCH.  
"DO NOT STAND ON TANK WHILE SHUNT REACTOR IS UNDER VACUUM"

APPLIED STANDARD : ANSI

DATE OF MFG. :

INSTRUCTION BOOK NO. : HSM - 6515



## VII. OP-16 APPENDIX G 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 0	05/04/12	New appendix defines data required for transmission equipment installed in New England and not covered by Appendices A-D
Rev 1	12/09/13	Biennial review by procedure owner. General language changes to accommodate new web-based NX Application for NX-9/NX-12D data. Globally change the term "Participant" to "Market Participant or Transmission Owner" Define Market Participant as MP and use throughout document. Define Transmission Owner as TO as use throughout document Sections I+II: renamed and reorganized. Some instructions moved from Section I to Section II Section III: Specify that temperature provided in the rating set should be the temp used to obtain the Normal rating. Section V: renamed to match new application and clarified the desired information and purpose of the field. Changed all references to use "Equipment Notes" Replaced example with report from new application.
Rev 2	11/06/15	Biennial review by procedure owner; With this set of revisions to OP16 and its appendices, separate NX-9 form types of NX-9G and NX-9H have been created to represent Variable Reactors and Series Devices which were originally included in Appendix G for Other Equipment; As a result, Appendix G has been re-written and re-purposed to reflect the new NX-9G form and Variable Reactor equipment data requirements; A new Appendix H has been created for the new NX-9H form and Series Device equipment data requirements; A new Appendix I has been created for Other Equipment which covers the equipment requirements for the remaining equipment types not represented on a specific NX-9 form;
Rev 3	08/05/16	Globally all footers, added the required corporate document identity; Update equipment requirements to include BES equipment;
Rev 4	11/03/17	Biennial review by procedure owner; Globally, made editorial changes to be consistent with current practices and management expectations (e.g., grammar changes from "must" to "shall" and "which" to "that" as appropriate; and remove capitalization from non-defined terms; Clarify circumstance for ISO to require reporting of equipment connected at voltages less than 69 kV is because it is needed for reliable operation of the New England Transmission System;
Rev 4.1	06/06/19	Annual review by procedure owner requiring no changes; Made administrative changes required to publish the Minor Revision
Rev 4.2	01/25/21	Annual review by procedure owner requiring no changes; Made administrative changes required to publish the Minor Revision;
Rev 5	08/22/22	Biennial review by procedure owner; Clarify ratings requirements to include relay loadability limits and other equipment deemed necessary by Good Utility Practice.
Rev 6	10/26/23	Periodic review by performed procedure owner; Add footnote to define "relay loadability limits" as used in this Appendix; Update Control Type field labels from Manual + SCADA to Manual-Local + Manual-Remote as previously requested by the Reliability Committee.
Rev 6.1	10/23/25	Biennial review by procedure owner requiring no changes; Made administrative changes required to publish the Minor Revision.