

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

ISO New England Transmission Equipment Rating, Characteristic, and Operational Data

Other Equipment

Effective Date: January 25, 2021

Review By Date: January 25, 2023

Table of Contents

I.	Equipment Requirements	2
II.	General Data Instructions	2
III.	Rating Data Instructions.....	3
IV.	Explanation Of Data Changes	3
V.	Equipment Notes.....	3
VI.	Shunt Connected Dynamic Reactive Power Device - Characteristic and Operational Data Instructions	4
VII.	Voltage Sensing Phase Shifter - Characteristic and Operational Data Instructions.....	5
	Example 1, Shunt Connected Dynamic Reactive Power Device	6
	Example 2, Voltage Sensing Phase Shifter	9
VIII.	OP-16 Appendix I Revision History	12

*This document is controlled when viewed on the ISO New England Internet web site. When downloaded and printed, this document becomes **UNCONTROLLED**, and users should check the Internet web site to ensure that they have the latest version. In addition, a Controlled Copy is available in the Master Control Room procedure binders at the ISO.*

I. EQUIPMENT REQUIREMENTS

Data for all transmission equipment designated as part of the Bulk Electric System¹ (BES) or connecting to the New England Transmission System² at a voltage of 69 kV or greater shall be provided by the Transmission Owners and Market Participants who own the equipment.³ This includes shunt connected dynamic reactive power devices, voltage sensing phase shifters and other equipment not previously defined in this procedure and installed on the New England Transmission System.

Data for equipment connected at voltages that are less than 69 kV may be required when ISO determines 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.

While specific NX-9 forms for each of these equipment types do not exist, data required for reliable operation of the New England Transmission System can be input on the existing NX-9 forms, NX-9A, NX-9B, NX-9C, NX-9D, NX-9G and NX-9H. This Appendix shall serve as a guide for using these NX-9 forms to provide data for equipment other than the equipment specified in those Appendices.

ISO recognizes that these instructions may not readily fit all equipment added to the system. If this is the case, please contact the ISO NX-9 Administrator (nx9admin@iso-ne.com) to discuss and come to agreement on how to represent the equipment on the available forms.

MPs or TOs adding equipment connecting at voltages that are 69 kV and greater and not defined within OP-16 Appendices A, B, C, D, G, H or I shall contact the ISO NX-9 Administrator (nx9admin@iso-ne.com) for instructions for providing NX-9 data.

II. GENERAL DATA INSTRUCTIONS

All NX-9 forms provide 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 be initially 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) if terminal additions or changes are needed.

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

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

³ 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 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.

III. RATING DATA INSTRUCTIONS

When required, as defined in sections VI-VII of this Appendix, facility rating data shall be provided in MVA (rounded down to the nearest whole number) and 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.

The NX-9 form provides for entry of both summer (April 1 through October 31) and winter (November 1 through March 31) thermal ratings. The ambient temperature (reported in Fahrenheit) and wind speed (reported in feet per second) 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-9 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. EXPLANATION OF DATA CHANGES

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

V. EQUIPMENT NOTES

The Equipment Notes field is used to provide explanations of data or other pertinent or operational information.

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-9 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.

VI. SHUNT CONNECTED DYNAMIC REACTIVE POWER DEVICE - CHARACTERISTIC AND OPERATIONAL DATA INSTRUCTIONS

Shunt connected dynamic reactive power devices (i.e., Static VAR Compensator (SVC), Static Compensator, Dynamic VAR Compensator (D-VAR), Synchronous Condenser) generally consist of a transformer connected to one or more reactive devices. The transformer portion of the equipment shall be reported using the NX-9B and the Appendix B instructions and each reactive device shall be reported using the NX-9D form and the Appendix D instructions with the following exceptions:

Complete the following fields as instructed below:

NX-9D Device Type – Indicate by selection whether the device is a capacitor or reactor. If the device has both capacitive and reactive capability, select the one that the device is expected to operate for the majority of the time.

NX-9D Nominal Capability (MVAR) - Indicate capability of the device at nominal system voltage. If the device has both capacitive and reactive capability, indicate in this field the capability that corresponds to the device type and provide the other capability in the Equipment Notes field. The provided capability should reflect MVARs at the nominal system voltage and not per the device nameplate.

NX-9B and NX-9D Mode of Operation - Indicate the mode of operation of the device based upon the rules defined in OP-16 Appendices B and D.

NX-9B and NX-9D Equipment Notes: In addition to any other comments entered by the MP or TO, the following are required to provide clarity regarding the data on the form or the manner in which the device is operated:

NX-9B:

- A brief description of the operation control scheme for the device.

NX-9D:

- If the device has both capacitive and reactive capability, provide both. The provided capability should reflect MVARs at the nominal system voltage and not per the device nameplate.
- A brief description of the operation control scheme for the device.

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 the NX-9B form for new or replaced equipment and upon revision of existing NX-9B forms.

A copy of the manufacturer's test report document (in .pdf format) shall be included as a file attachment to the NX-9B form for all new or replaced equipment and upon revision of existing NX-9B forms.

A copy of the control scheme document (.pdf format) for the device (or devices when controlled via a coordinated control scheme) shall be included as a file

attachment to the NX-9B or NX-9D form, whichever represents the primary controlling device. This requirement applies to new or replaced equipment and upon revision of existing NX-9B or NX-9D forms.

Example 1 shows sample NX-9B and NX-9D forms for a Synchronous Condenser.

VII. VOLTAGE SENSING PHASE SHIFTER - CHARACTERISTIC AND OPERATIONAL DATA INSTRUCTIONS

Voltage sensing phase shifting devices shall be reported using the NX-9B and NX-9C forms.

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 the NX-9C form for new or replaced equipment.

A copy of the manufacturer's test report document (in .pdf format) shall be included as a file attachment to the NX-9C form for all new or replaced equipment and upon revision of existing NX-9C forms.

The transformer characteristics shall be reported as described in Appendix B on the NX-9B form.

The phase shifter characteristics shall be reported as described in Appendix C on the NX-9C form.

Example 2 shows sample NX-9B and NX-9C forms for a voltage sensing phase shifter.

EXAMPLE 1, SHUNT CONNECTED DYNAMIC REACTIVE POWER DEVICE

**ISO New England Equipment Rating, Characteristic,
and Operational Data Implementation Form
Transformers (NX-9B)**

Reference 9999 **Participant ID** Abc Synchronous Condenser
Participant Test Company **ISO ID** abc
Form State Preliminary **Ckt** 1

Primary Station1 115kV **Bus #** 123456 **EMS** STATION1
Secondary Station1 13.8kV **Bus #** 234567 **EMS** STATION1

Transformer Type TCUL-Auto **Normal Operating Mode (TCUL)** SCADA
Number of Windings 2 **Tap Switching Time Delay if Normal Mode is Auto (TCUL only) (Seconds)**

Default Summer 100 F

	<u>MVA</u>	<u>Limiting Device / Description</u>	<u>Location</u>
Normal	374	PST -	Substation
LTE	374	PST -	Substation
STE	573	Transformer - LTC	Substation
DAL	573	Transformer - LTC	Substation

Default Winter 50 F

	<u>MVA</u>	<u>Limiting Device / Description</u>	<u>Location</u>
Normal	416	PST -	Substation
LTE	---	PST -	Substation
STE	573	Transformer - LTC	Substation
DAL	573	Transformer - LTC	Substation

<u>Name Plate KV of Windings</u>		<u>Impedance Data (%) (100 MVA Base)</u>	
<u>High kV</u>	<u>Low kV</u>	<u>R</u>	<u>X</u>
115	13.8	0.1534	6.5064

kV of Winding 115 **Step Size** 0.00625 **Controlling Side Winding (TCUL Only)** Y
Heavy Load Norm Tap# 0 **Heavy Load Normal Tap (p.u.)** 1 **Controlled Side Winding (TCUL Only)** Y
Light Load Norm Tap# 0

	<u>Minimum</u>	<u>Nameplate</u>	<u>Maximum</u>
Tap Number	-16	0	16
Voltage (kV)	103.50	115.00	126.50

kV of Winding 13.8 **Step Size** 0 **Controlling Side Winding (TCUL Only)** N
Heavy Load Norm Tap# 0 **Heavy Load Normal Tap (p.u.)** 1 **Controlled Side Winding (TCUL Only)** N
Light Load Norm Tap# 0

	<u>Minimum</u>	<u>Nameplate</u>	<u>Maximum</u>
Tap Number	0	0	0
Voltage (kV)	13.8	13.8	13.8

Revision Comments Test Form has been created to represent new equipment.

EXAMPLE 1 (CONTINUED), SHUNT CONNECTED DYNAMIC REACTIVE POWER DEVICE

ISO New England Equipment Rating, Characteristic, and Operational Data Implementation Form Transformers (NX-9B)

Reference 9999**Participant ID** Abc Synchronous Condenser**Participant** Test Company**ISO ID** abc**Form State** Preliminary**Ckt** 1

Equipment Notes Each condenser has capacitive capability of 25 MVAR and an inductive capability of -12.5 MVAR. The synchronous condensers, capacitors, and transformer LTCs are controlled from an integrated Joint Var Controller to regulate the 115 kV bus voltage. The condensers will normally be operated to maintain a voltage of 117 kV.

Data Revision Number 0**Date Created** mm/dd/yyyy**Prepared By** Participant Username**Requested Effective Date** mm/dd/yyyy**Date Received****Approved By****Actual Effective Date****ISO EMS Implementation Date***Critical Energy Infrastructure Information (CEII)*

WEDNESDAY, MAY 29, 2013 01:40 PM

*Hard Copy Is Uncontrolled**Page 2*

EXAMPLE 1 (CONTINUED), SHUNT CONNECTED DYNAMIC REACTIVE POWER DEVICE

ISO New England Equipment Rating, Characteristic, and Operational Data Implementation Form Capacitor / Reactor (NX-9D)

Reference 9999**Participant ID** Abc Synchronous Condenser**Participant** Test Company**ISO ID** abc**Form State** Preliminary**Ckt** 1**Station** Station1 13.8kV**Bus #** 123456**EMS** STATION1**Device Type** Capacitor**System Voltage** 13.8**Normal Capability (MVAR)** 25**On Voltage (kV)****Mode of Operation** Manual**Off Voltage (kV)****Switching Time Delay****Revision Comments** Test Form has been created to represent new equipment.

Equipment Notes Each condenser has capability of 25 MVAR and inductive capability of -12.5 MVAR. The synchronous condensers, capacitors, and transformer LTCs are controlled from an integrated Joint Var Controller to regulate the 115 kV bus voltage. The condensers will normally be operated to maintain a voltage of 117 kV.

Data Revision Number 0**Date Created** mm/dd/yyyy**Prepared By** Participant Username**Requested Effective Date** mm/dd/yyyy**Date Received****Approved By****Actual Effective Date****ISO EMS Implementation Date***Critical Energy Infrastructure Information (CEII)*

THURSDAY, MAY 30, 2013 11:52 AM

*Hard Copy Is Uncontrolled**Page 1*

EXAMPLE 2, VOLTAGE SENSING PHASE SHIFTER

**ISO New England Equipment Rating, Characteristic,
and Operational Data Implementation Form
Phase Shifter (NX-9C)**

Reference 9999

Participant ID Abc VSPS

Participant Test Company

ISO ID abc

Form State Preliminary

Ckt 1

Terminal A Station1 115KV

Bus # 123456

EMS STATION1

Terminal B Station1 Phase Shifter

Bus # 234567



EMS STATION1

Default Summer 77 F

	<u>MVA</u>	<u>Limiting Device / Description</u>	<u>Location</u>
Normal	235	Phase Shifting Transformer -	STATION1
LTE	250	Phase Shifting Transformer -	STATION1
STE	300	Phase Shifting Transformer -	STATION1
DAL	435	Phase Shifting Transformer -	STATION1

Default Winter 41 F

	<u>MVA</u>	<u>Limiting Device / Description</u>	<u>Location</u>
Normal	290	Phase Shifting Transformer -	STATION1
LTE	305	Phase Shifting Transformer -	STATION1
STE	340	Phase Shifting Transformer -	STATION1
DAL	530	Phase Shifting Transformer -	STATION1

	<u>Tap Number</u>	<u>Impedance Tap Correction Multiplier</u>
Up / 	1	1.68
	17	1
Down / 	33	1.68

Name Plate kV 115 / 115 **Step Size (Deg)** 3.2625 **Max Angle (Deg)** 52.2 **Min Angle (Deg)** -52.2
Type Non-Auto **Auto Mode Tap Switch Delay (sec)**
Normal Operating Mode SCADA **Normal Heavy Load Tap Number** 0
Impedance Data (%) (100 MVA Base) **Normal Light Load Tap Number** 0
 R 0.0663 X 4.0397 **Advancing Tap Increases MW Flow From Terminal A to Terminal B** N

Revision Comments Revision Comments Not Available

Equipment Notes This form is a partial representation of this voltage controlling phase shifting transformer. For full representation, the companion 9B datasheet must also be referenced. Total impedance information is included on this form.

Data Revision Number 0 **Date Created** mm/dd/yyyy **Prepared By** Participant Username
Requested Effective Date mm/dd/yyyy **Date Received** **Approved By**
Actual Effective Date **ISO EMS Implementation Date**

Critical Energy Infrastructure Information (CEII)
 THURSDAY, MAY 30, 2013 11:48 AM

Hard Copy Is Uncontrolled
 Page 1

EXAMPLE 2 (CONTINUED), VOLTAGE SENSING PHASE SHIFTER

**ISO New England Equipment Rating, Characteristic,
and Operational Data Implementation Form
Transformers (NX-9B)**

Reference 9999

Participant ID Abc VS PS

Participant Test Company

ISO ID abc

Form State Preliminary

Ckt 1

Primary Station1 115kV

Bus # 123456

EMS STATION1

Secondary Station1 Phase Shifter

Bus # 234567

EMS STATION1

Transformer Type TCUL-Auto

Normal Operating Mode (TCUL) SCADA

Number of Windings 2

Tap Switching Time Delay if Normal Mode is Auto (TCUL only) (Seconds)

Default Summer 77 F

	<u>MVA</u>	<u>Limiting Device / Description</u>	<u>Location</u>
Normal	235	Phase Shifting Transformer -	STATION1
LTE	250	Phase Shifting Transformer -	STATION1
STE	300	Phase Shifting Transformer -	STATION1
DAL	435	Phase Shifting Transformer -	STATION1

Default Winter 41 F

	<u>MVA</u>	<u>Limiting Device / Description</u>	<u>Location</u>
Normal	290	Phase Shifting Transformer -	STATION1
LTE	305	Phase Shifting Transformer -	STATION1
STE	340	Phase Shifting Transformer -	STATION1
DAL	530	Phase Shifting Transformer -	STATION1

<u>Name Plate KV of Windings</u>		<u>Impedance Data (%) (100 MVA Base)</u>	
<u>High kV</u>	<u>Low kV</u>	<u>R</u>	<u>X</u>
115	115	0.0	0.0

kV of Winding 115	Step Size 0.0	Controlling Side Winding (TCUL Only) Y
Heavy Load Norm Tap# 0	Heavy Load Normal Tap (p.u.) 1	Controlled Side Winding (TCUL Only) N
Light Load Norm Tap# 0		
	Minimum	Nameplate
Tap Number	0	0
Voltage (kV)	115.00	115.00
	Maximum	
	0	115.00

kV of Winding 115	Step Size 0.00575	Controlling Side Winding (TCUL Only) N
Heavy Load Norm Tap# 0	Heavy Load Normal Tap (p.u.) 1	Controlled Side Winding (TCUL Only) Y
Light Load Norm Tap# 0		
	Minimum	Nameplate
Tap Number	-10	0
Voltage (kV)	108.39	115.00
	Maximum	
	10	121.61

Revision Comments Test Form has been created to represent new equipment.

Critical Energy Infrastructure Information (CEII)
WEDNESDAY, MAY 29, 2013 01:40 PM

Hard Copy Is Uncontrolled
Page 1

EXAMPLE 2 (CONTINUED), VOLTAGE SENSING PHASE SHIFTER

ISO New England Equipment Rating, Characteristic, and Operational Data Implementation Form Transformers (NX-9B)

Reference 9999**Participant ID** Abc VS PS**Participant** Test Company**ISO ID** abc**Form State** Preliminary**Ckt** 1

Equipment Notes This form is a partial representation of this voltage controlling phase shifting transformer. For full representation the companion 9C form must also be referenced. This form does not contain impedance data. The impedance data for this phase shifting transformer is shown on the companion 9C form only.

Data Revision Number 0**Date Created** mm/dd/yyyy**Prepared By** Participant Username**Requested Effective Date** mm/dd/yyyy**Date Received****Approved By****Actual Effective Date****ISO EMS Implementation Date***Critical Energy Infrastructure Information (CEII)**Hard Copy Is Uncontrolled*

WEDNESDAY, MAY 29, 2013 01:40 PM

Page 2

VIII. OP-16 APPENDIX I REVISION HISTORY

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

Rev. No.	Date	Reason
Rev 0	11/06/15	<p>Initial document creation;</p> <p>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.</p> <p>This new appendix has been created for Other Equipment which covers the equipment requirements for the remaining equipment types not represented on a specific NX-9 form. This allows each appendix to have the same letter designation as its corresponding form type. Due to the addition of the new form types and related new appendices, series devices and variable reactors are not included in this appendix;</p> <p>Specific changes made to the device types that remained in this appendix:</p> <ul style="list-style-type: none"> Add instruction to contact NX-9 Administrator when the instructions do not fit the equipment being installed. Add instructions for use of the Remove Equipment From Service field; Add that ratings are to be provided in whole numbers; Add that facility rating is equal to the rating of the most limiting individual equipment that comprises the facility; Shunt connected dynamic reactive power devices: <ul style="list-style-type: none"> Instructions for when both capacitive and reactive capability exist Changes to mode of operation instructions Add equipment note requirements to clarify control scheme and capability data Add requirement for attachment of control scheme document Voltage sensing phase shifters: <ul style="list-style-type: none"> Submit attachments (nameplate and test report) with NX-9C for new or revised equipment <p>Example NX-9B forms updated to show new field Heavy Load Normal Tap (p.u.)</p>
Rev 1	08/05/16	<p>Globally all footers, added the required corporate document identity;</p> <p>Update equipment requirements to include BES equipment;</p>
Rev 2	11/03/17	<p>Biennial review by procedure owner;</p> <p>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;</p> <p>Clarify circumstance for ISO to require reporting of equipment connected at voltages that are less than 69 kV is because it is needed for reliable operation of the New England Transmission System;</p> <p>Globally changed MVAR to MVAR for consistency;</p>
Rev 2.1	06/06/19	<p>Annual review by procedure owner requiring no changes;</p> <p>Made administrative changes required to publish the Minor Revision;</p>
Rev 2.2	01/25/21	<p>Annual review by procedure owner requiring no changes;</p> <p>Made administrative changes required to publish the Minor Revision;</p>