

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

ISO New England Transmission Equipment Rating, Characteristic and Operational Data

Transformer - FIXED/GSU/TCUL

Effective Date: October 23, 2025

Review By Date: October 23, 2027

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I. EQUIPMENT REQUIREMENTS

Data for all transformers designated as part of the Bulk Electric System¹ (BES) or with at least one winding 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

- Data for all generator step-up transformers (GSUs) attached to generators 1 MW or greater that participate in the Real-Time Energy Market, including generators connecting via a line of any voltage level that is dedicated solely to the generation interconnection (i.e., via an express feeder), will be evaluated for impact to the ISO EMS Network Model. Based on this evaluation, NX-9B data forms may be required. When required, the NX-9B data forms shall be provided by the Lead MP for the Generator Assets.
- NX-9B data forms are not required for GSUs that connect a generator to the transmission system via a line(s) that also serves customer load.
- NX-9B data forms are not required for GSUs associated solely with Settlement Only Generators.

NX-9B data forms for transformers or individual wind turbine or solar GSUs 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 separate NX-9B form shall be provided for each transformer. All data items shall be completed for each winding unless these instructions specifically indicate otherwise.

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.

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 for transformers whose low voltage connection is 69 kV or greater.

¹ Bulk Electric System (BES) is defined in the 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).

II. GENERAL DATA INSTRUCTIONS

The NX-9B 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) 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.

To assist in completing the NX-9B form, sample manufacturer's nameplate data and completed NX-9B forms utilizing that data are attached.

Example 1: Fixed Tap Transformer

Example 2: Generator Step-Up (GSU) Transformer

Example 3a and 3b: Tap Change under Load (TCUL) Three Winding Transformer (developed using the same nameplate data)

3a - TCUL Three Winding Model: Transformer with tertiary loaded.

Any 3-winding transformer whose tertiary winding connects to a generator, a transmission bus, a sub-transmission bus, a distribution bus or a capacitor/reactor bank should be modeled consistent with Example 3a. This example assumes the tertiary is connected to a capacitor bank.

3b - TCUL Two Winding Model: Transformer with tertiary not loaded.

Any 3-winding transformer whose tertiary winding is not loaded should be modeled consistent with Example 3b. If the total station service load served by one or more tertiary windings is less than 1 MW, then the transformer shall be modeled consistent with Example 3b.

If the total station service load served by one or more tertiary windings is greater than 1 MW, then the MP or TO shall confirm with ISO whether the transformer should be modeled consistent with Example 3a or 3b.

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.). See examples 3a and 3b where tap positions designated by letter on the nameplate sheet have been designated by number on the sample NX-9B forms.

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. Additional information regarding the rating of GSU Transformers and Load Serving Transformers exists in PP7 Appendix D, Power Transformers, Section 3.0 Application Guide. A facility rating shall equal the rating of the most limiting individual equipment, shall reflect relay loadability limits⁴, 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-9B 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-9B 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:

Nameplate kV – Provide the transformer voltage rating for utilized connections as listed on the nameplate document.

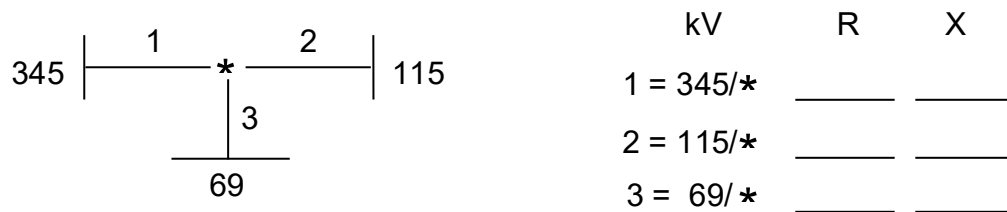
Impedance Data – Provide the positive sequence resistance (R) and reactance (X) calculated at the kV of the no load tap position in use for the fixed tap, and the Nameplate kV on the tap change side, in percent on a 100 MVA base. Do not adjust values to nominal system voltage. Impedance on new or revised NX-9B forms shall be calculated and provided out to at least the 3rd decimal place.

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

For transformers with different fixed normal tap settings at Heavy and Light Load, provide the impedance calculated at the Heavy Load fixed tap setting.

For transformers whose test report does not provide impedance at each tap, provide the impedance at the closest tap for which impedance is provided on all new or revised NX-9B forms. Provide a statement in the Equipment Notes field of the NX-9B form indicating the tap position at which the impedance is calculated.

Impedance data for three (3) winding transformers being modeled consistent with Section I Example 3a should be submitted using a wye configuration. Refer to diagram below.



Impedance data for three (3) winding transformers being modeled consistent with Section I Example 3b should be submitted in two (2) winding format.

Transformer Type – Enter the type of the transformer based upon the descriptions below:

GSU – Generator Step-Up transformer.

FIXED – Transformer without a load tap changer (LTC). Tap changes for these transformers typically require the transformer be out of service.

TCUL-Non Auto – Transformer has an LTC but it is disabled.

TCUL-Auto⁵ – Transformer has an enabled LTC.

Normal Operating Mode – For a TCUL-Auto type transformer, enter the normal operating mode based upon the descriptions below. The normal operating mode selected should reflect the operational state that the transformer is expected to be in the majority of the time.

If the operational mode is dependent upon local generation, load level or other system condition, provide this information in the Equipment Notes field of the NX-9B form (example: transformer is operated in automatic mode when generator XYZ is offline or when load level is above xx mw). The Normal Operating Mode field shall still reflect the operational state that the transformer is expected to be in the majority of the time.

⁵ The term TCUL-Auto as used in this appendix, represents a transformer with an enabled LTC that may or may not be an autotransformer. An autotransformer has only a single voltage winding which is common to both primary and secondary.

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

Manual-Remote – Tap changes are made using the SCADA system and are manually initiated by an LCC System Operator⁶ or a TO control room operator remotely.

Auto – Transformer has enabled controls for automatic operation that allow the equipment to respond to a contingency, typically within 2 minutes, without manual intervention. Tap changes for normal operation occur without LCC System Operator or TO control room operator intervention.

Tap Switching Time Delay – For a TCUL-Auto type transformer with the Normal Operating Mode field set to Auto, enter the tap switching time delay in seconds.

Voltage Schedules – Voltage schedule data is required for all TCUL-Auto transformers with Auto and Manual-Remote control types and is optional for transformers with the Normal Operating Mode field set to Manual-Local. Voltage schedule data is not accepted for GSU, Fixed and TCUL Non-Auto transformers.

- The Controlled Winding and Controlling/LTC Side Winding flags shall be set when entering voltage schedule data.
- Typically a transformer operates to the same schedule in both on peak⁷ and off peak⁸ hours so the prevalent schedule shall be entered as both on and off peak in the voltage schedule table. If a transformer operates to a different schedule during on-peak and off-peak hours, the different schedules shall be entered in the voltage schedule table and a brief explanation shall be provided in the Equipment Notes field describing how the voltage schedule is modified in the field.
- A transformer with the technology to use SCADA to modify the programmed target voltage shall enter the single most prevalent scheduled voltage and minimum/maximum voltage range for both on and off peak and shall provide all other minimum, scheduled and maximum settings available in either the Equipment Notes field or as a file attachment (referenced in the Equipment Notes field).

TCUL-Auto transformer with the Normal Operating Mode field set to Auto (voltage schedule data is required):

- Schedule data entered in the voltage schedule table shall equal the field programmed target voltage and the minimum and maximum voltages shall equal the control bandwidth settings from the field.

⁶ System Operator is defined in the Glossary of Terms Used in NERC Reliability Standards.

⁷ On-Peak is from 0700-2300 on weekdays that are not NERC holidays.

⁸ Off-Peak is from 2300-0700 on weekdays, all weekends and NERC holidays.

TCUL-Auto transformer with the Normal Operating Mode field set to Manual-Remote (voltage schedule data is required):

- The voltage schedule data entered shall equal the most prevalent target voltage and range used by the operators.
- If there is no typical voltage schedule or range used by the operators:
 - Enter a scheduled voltage that matches the overall area voltage profile and/or any nearby regulating devices such as generators, STATCOMs or synchronous condensers.
 - Enter a generic 100% and 105% of nominal system voltage for the minimum and maximum voltages.

TCUL-Auto transformer with the Normal Operating Mode field set to Manual-Local (voltage schedule data is optional):

- If the optional voltage schedule data is provided, it shall equal the most prevalent target voltage and range used by the operators.
- If there is no typical voltage schedule or range used by the operators:
 - Enter a scheduled voltage that matches the overall area voltage profile and/or any nearby regulating devices such as generators, static synchronous compensators (STATCOMs) or synchronous condensers.
 - Enter a generic 100% and 105% of nominal system voltage for the minimum and maximum voltages.

Heavy/Light Load Normal Tap - This is required for all windings with taps. Enter zero (0) for windings without taps.

For the purposes of this document, heavy load shall mean the summer months of June through August and light load shall mean the remaining calendar months of January through May and September through December.

For no load windings with fixed tap positions - Enter the seasonal no load tap position (position number) as the normal tap number for each load period.

For other windings with fixed tap positions - Enter the fixed tap position (position number) as the normal tap number for each load period.

For LTC windings on TCUL-Auto transformers (the Normal Operating Mode field is set to Manual-Local, Manual-Remote or Auto):

- Enter the typical heavy load tap position as the normal tap number for both load periods.
- If no typical heavy load tap position exists, enter the tap number corresponding with the nameplate voltage of that winding as the normal tap number for both load periods.

Step Size (per unit) – Enter the step size for each winding (per unit). This data can usually be taken from the manufacturer’s nameplate information and should be calculated as follows. Enter zero (0) for windings without taps.

$$\text{Step Size} = \frac{(\text{maximum voltage} - \text{minimum voltage})}{(\text{nameplate voltage})(\# \text{ of taps} - 1)}$$

Nameplate Tap Number – Enter the tap number for each winding at which nameplate voltage is achieved. Enter zero (0) for windings without taps.

Minimum Tap No. – Enter the tap number for each winding at which minimum kV is achieved. Enter zero (0) for windings without taps.

Minimum kV – Indicates the voltage of the windings when at minimum tap position. Value is calculated based on nameplate voltage and associated tap number, minimum tap number and step size.

Maximum Tap No. – Enter the tap number for each winding at which maximum voltage is achieved. Enter zero (0) for windings without taps.

Maximum kV – Indicates the voltage of the windings when at maximum tap position. Value is calculated based on nameplate voltage and associated tap number, maximum tap number and step size.

Controlled and Controlling/LTC Side Winding (TCUL-Auto transformers only):

These fields are required for all TCUL-Auto transformers with the Normal Operating Mode field set to Auto or Manual-Remote.

These fields are required for transformers with the Normal Operating Mode field set to Manual-Local when the optional voltage schedule has been entered.

These fields are not enterable for GSU, Fixed and TCUL Non-Auto transformers.

Select with a (√) the Controlling/LTC Side Winding (the winding on which the tap changer is located).

Select with a (√) the Controlled Winding (the winding for which desired voltages/voltage schedules are established).

V. EXPLANATION OF DATA CHANGES

Any time an NX-9B 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-9B form. For example: Tap information corrected to match nameplate.

This data is utilized by ISO in the NX-9B 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: This transformer is operated in automatic mode when generator XYZ is offline or when load level is above xx MW.

For transformers that are part of a dynamic reactive device control scheme, a brief description of the control scheme is required to provide clarity regarding the manner in which the transformer is operated.

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-9B 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-9B FIXED TAP TRANSFORMER

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

Reference 1234 Participant ID Station1 1X
 Participant Test Company ISO ID STATION1 1X
 Form State Approved Ckt 1
 Primary Station1 115 kV Bus # 111222 EMS STATION1
 Secondary Station1 34.5 kV Bus # 222333 EMS STATION1

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

Default Summer 77 F

	MVA	Limiting Device / Description	Location
Normal	49	Transformer - 1X	Station1
LTE	49	Transformer - 1X	Station1
STE	49	Transformer - 1X	Station1
DAL	49	Transformer - 1X	Station1

Default Winter 41 F

	MVA	Limiting Device / Description	Location
Normal	49	Transformer - 1X	Station1
LTE	49	Transformer - 1X	Station1
STE	49	Transformer - 1X	Station1
DAL	49	Transformer - 1X	Station1

Nameplate kV of Windings		Impedance Data (%) (100 MVA Base)	
High kV	Low kV	R	X
115	34.5	1.4001	35.812

kV of Winding	115	Step Size	0.025	Controlling Side Winding(TCUL Only)	N
Heavy Load Norm Tap#	2	Heavy Load Normal Tap (p.u.)	1	Controlled Side Winding(TCUL Only)	N
Light Load Norm Tap#	2				
		Minimum	Nameplate	Maximum	
Tap Number		5	2	1	
Voltage (kV)		106.375	115	117.875	

kV of Winding	34.5	Step Size	0	Controlling Side Winding(TCUL Only)	N
Heavy Load Norm Tap#	17	Heavy Load Normal Tap (p.u.)	1	Controlled Side Winding(TCUL Only)	N
Light Load Norm Tap#	17				
		Minimum	Nameplate	Maximum	
Tap Number		1	17	33	
Voltage (kV)		31.05	34.5	37.95	

Critical Energy Infrastructure Information (CEII)

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EXAMPLE 1 (CONTINUED), NX-9B FIXED TAP TRANSFORMER

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

Reference 1234	Participant ID Station1 1X
Participant Test Company	ISO ID STATION1 1X
Form State Approved	Ckt 1

Revision Comments Required text field for Participant to provide the reason for revising or creating this NX-9 form. Example: Ratings updated due to changes in relay settings which were previously limiting equipment.

Equipment Notes Optional text field available for Participant to supply explanations regarding the data provided or to provide any pertinent information about the equipment or the manner in which it is operated.

Data Revision Number 1	Date Created mm/dd/yyyy	Prepared By Participant Username
Requested Effective Date mm/dd/yyyy	Date Received mm/dd/yyyy	Approved By ISO NX9 Administrator Username
Actual Effective Date mm/dd/yyyy	ISO EMS Implementation Date mm/dd/yyyy	

EXAMPLE 1 (CONTINUED), MANUFACTURER'S NAMEPLATE



TRANSFORMER
CLASS 0A/FA/FOA THREE-PHASE

60 CYCLES
Polarity Mark

LOW VOLTAGE CONNECTIONS
LINES ON 4, 5, 6
NEUTRAL ON 7

VOLTS LINE TO LINE	MAX AMP	DIAL POS.	Mechanism Connects
37950	682	33	L L
37730	691	32	L K
37520	691	31	K K
37300	695	30	K H
37090	698	29	H H
36870	702	28	H G
36660	706	27	G G
36440	712	26	G F
36220	716	25	F F
36000	720	24	F E
35790	724	23	E E
35570	728	22	E D
35360	733	21	D D
35140	738	20	D C
34930	743	19	C C
34710	747	18	C M
34500		17	M M
34280		16	M L
34070		15	L L
33850		14	L K
33640		13	K K
33420		12	K H
33210		11	H H
32990		10	H G
32770		9	G G
32550		8	G F
32340		7	F F
32120		6	F E
31910		5	E E
31690		4	E D
31480		3	D D
31260		2	D C
31050		1	C C

HIGH VOLTAGE CONNECTIONS
LINES ON 1, 2, 3

VOLTS	KVA	AMP	DIAL POS.	TAP CHANGERS
117875	219	1	A	TO B
115000	225	2	B	TO C
112125	231	3	C	TO D
109250	237	4	D	TO E
106375	243	5	E	TO F

BASIC INSULATION LEVELS

ITEM	IMPULSE LEVEL	FULL WAVE KV
H1	H2	H3
X1	X2	X3
X0		110

SUITABLE FOR OPERATION WITH THE NEUTRAL EITHER SOLIDLY GROUNDED OR GROUNDED THROUGH AN IMPEDANCE WHICH WILL LIMIT THE LOW FREQUENCY AND IMPULSE VOLTAGES FROM NEUTRAL TO GROUND TO VALUES CONSISTENT WITH THE INSULATION LEVELS SHOWN ON THIS NAMEPLATE.

TRANSFORMER OPERATING PRESSURE RANGE IS 10 PSI POSITIVE TO 8 PSI NEGATIVE.

TRANSFORMER TANK SUITABLE TO WITHSTAND 12.5 PSI PRESSURE AND FULL VACUUM.

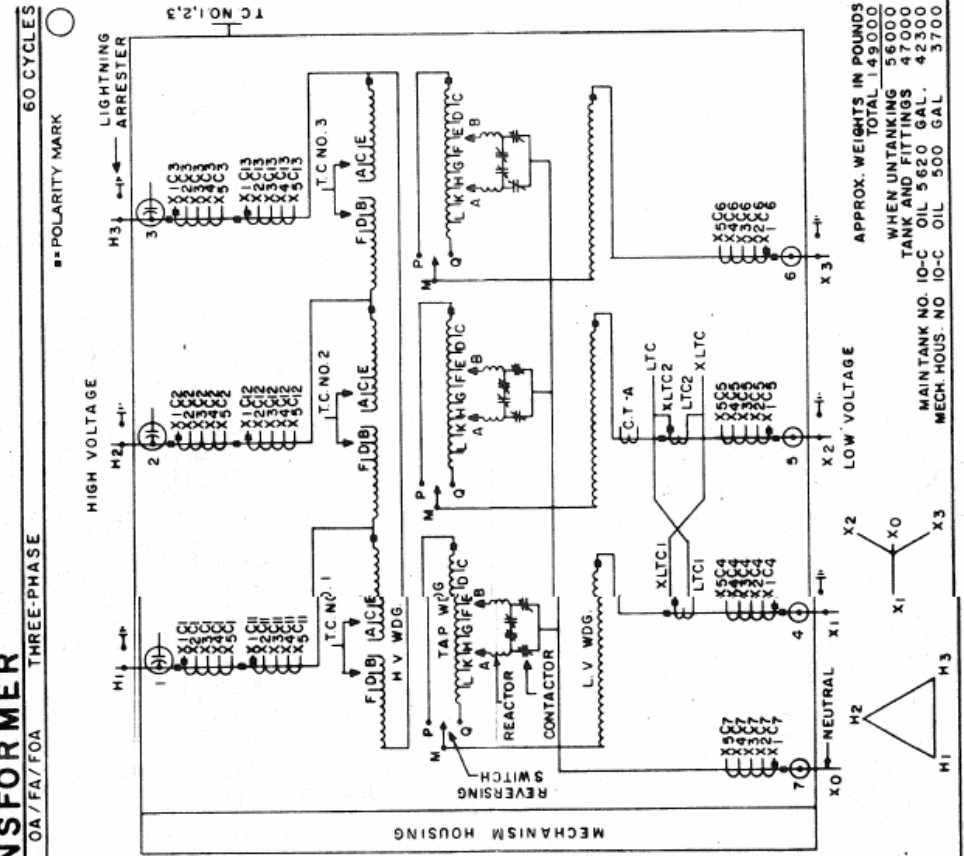
LIQUID LEVEL AT 25 C IS 12 INCHES BELOW TOP OF MANHOLE FLANGE.

LIQUID LEVEL CHANGES 1.2 INCHES PER 10 C CHANGE IN LIQUID TEMPERATURE.

C.T. -A IS FOR USE WITH AN INDICATING THERMAL RELAY.

C.T.'S NO. 1, 2, 3, 4, 5, 6, 7, 11, 12, 13 ARE 1200/5 AMP. REFER TO C.T. NAMEPLATE FOR RATIOS AND CONNECTIONS.

IMPEDANCE VOLTS PER CENT 115000-345000GR. Y VOLTS AT 24000 KVA



APPROX. WEIGHTS IN POUNDS
TOTAL 149000
WHEN UNTANKING 56000
TANK AND FITTINGS 47000
MAINTANK NO. 10-C OIL 5620 GAL. 42300
MECH. HOUS. NO. 10-C OIL 500 GAL. 3700

MADE IN U.S.A.

PITTSFIELD MASS.

CAUTION: BEFORE INSTALLING OR OPERATING, READ INSTRUCTIONS, G.E.K.-16368

EXAMPLE 2, NX-9B GENERATOR STEP-UP (GSU) TRANSFORMER

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

Reference 1234 Participant ID Station1 G1X
 Participant Test Company ISO ID STATION1 G1X
 Form State Approved Ckt 1

Primary Station1 345 kV Bus # 111222 EMS STATION1
 Secondary Station1 21.3 kV Bus # 222333 EMS STATION1

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

Default Summer 77 F

	MVA	Limiting Device / Description	Location
Normal	709	Transformer - G1X	Station1
LTE	709	Transformer - G1X	Station1
STE	709	Transformer - G1X	Station1
DAL	709	Transformer - G1X	Station1

Default Winter 41 F

	MVA	Limiting Device / Description	Location
Normal	709	Transformer - G1X	Station1
LTE	709	Transformer - G1X	Station1
STE	709	Transformer - G1X	Station1
DAL	709	Transformer - G1X	Station1

Nameplate kV of Windings		Impedance Data (%) (100 MVA Base)	
High kV	Low kV	R	X
345	21.3	0.031	1.28

kV of Winding 345 Step Size 0.025 Controlling Side Winding(TCUL Only) N
 Heavy Load Norm Tap# 2 Heavy Load Normal Tap (p.u.) 1.025 Controlled Side Winding(TCUL Only) N
 Light Load Norm Tap# 2

	Minimum	Nameplate	Maximum
Tap Number	5	3	1
Voltage (kV)	327.75	345	362.25

kV of Winding 21.3 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

	Minimum	Nameplate	Maximum
Tap Number	0	0	0
Voltage (kV)	21.3	21.3	21.3

EXAMPLE 2 (CONTINUED), NX-9B GENERATOR STEP-UP (GSU) TRANSFORMER

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

Reference 1234

Participant ID Station1 1X

Participant Test Company

ISO ID STATION1 1X

Form State Approved

Ckt 1

Revision Comments Required text field for Participant to provide the reason for revising or creating this NX-9 form. Example: Transformer to be replaced in June, 2013.

Equipment Notes Optional text field available for Participant to supply explanations regarding the data provided or to provide any pertinent information about the equipment or the manner in which it is operated.

Data Revision Number 1

Date Created mm/dd/yyyy

Prepared By Participant Username

Requested Effective Date mm/dd/yyyy

Date Received mm/dd/yyyy

Approved By ISO NX9 Administrator Username

Actual Effective Date mm/dd/yyyy

ISO EMS Implementation Date mm/dd/yyyy

EXAMPLE 2 (CONTINUED), MANUFACTURER'S NAMEPLATE

**THREE PHASE
60 HERTZ
TRANSFORMER
CLASS FOA
INSULOR INSULATION**

WINDING
345000 GRD.Y VOLTS
21300 VOLTS

55°C. AVG. T.E
633000 KVA
633000 KVA

GEN. AVR. I.C.E
709360 KVA
709360 KVA

IMPEDANCE % AT 633000 KVA

L. SPEC. MGM711-08 SERIAL

WINDING DIAGRAM MGM711-04 INSTRUCTION BOOK MGM711-12

GALLONS OIL :

FULL WAVE PULSE TEST LEVEL: HIGH VOLTAGE 900 KV., LOW VOLTAGE 150 KV.,
HIGH VOLTAGE NEUTRAL AND BUSHING 150 KV.

APPROX. WEIGHT IN LBS. CORE AND COILS CASE TOTAL

MADE IN U.S.A. WESTINGHOUSE ELECTRIC CORPORATION MGM711-10A

CONNECTIONS				
WINDING	VOLTAGE	AMPERES AT 633000 KVA	NO LOAD TAP CHANGER POS. CONNECTS IN EACH PHASE	
HIGH VOLTAGE WYE	362250	1009	1	4 TO 5
	353625	1033	2	3 TO 5
	345000	1059	3	3 TO 6
	336375	1086	4	2 TO 6
LOW VOLTAGE DELTA	21300	17158		

THE TRANSFORMER MUST NOT BE ENERGIZED FROM ANY VOLTAGE SOURCE WHEN NO LOAD TAP CHANGERS ARE OPERATED.
 THE TRANSFORMER TANK IS DESIGNED TO WITHSTAND COMPLETE VACUUM AND AN INTERNAL PRESSURE OF 10 POUNDS PER SQUARE INCH.
 THE TRANSFORMER IS DESIGNED TO OPERATE AT ESSENTIALLY ATMOSPHERIC PRESSURE OVER THE NORMAL RANGE OF OIL TEMPERATURES.

POLARITY :

EXAMPLE 3A, NX-9B TCUL 3-WINDING TRANSFORMER WITH TERTIARY LOADED

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

Reference	1234	Participant ID	Station1 1X
Participant	Test Company	ISO ID	STATION1 1X
Form State	Approved	Ckt	1
Primary	Station1 345kV	Bus #	123456 EMS STATION1
Secondary	Station1 115kV	Bus #	111222 EMS STATION1
Tertiary	Station1 13.8kV	Bus #	334455 EMS STATION1
Midpoint	Station1 1X Midpoint 99kV	Bus #	333444 EMS STATION1

Transformer Type TCUL-Auto Normal Operating Mode (TCUL) Auto
 Number of Windings 3 Tap Switching Time Delay if Normal Mode is Auto (TCUL only) (Seconds) 45

Default Summer 77 F

	<u>MVA</u>	<u>Limiting Device / Description</u>	<u>Location</u>
Normal	524	Transformer - 1X	Station1
LTE	543	Transformer - 1X	Station1
STE	543	Transformer - 1X	Station1
DAL	543	Transformer - 1X	Station1

Default Winter 41 F

	<u>MVA</u>	<u>Limiting Device / Description</u>	<u>Location</u>
Normal	598	Transformer - 1X	Station1
LTE	672	Transformer - 1X	Station1
STE	672	Transformer - 1X	Station1
DAL	672	Transformer - 1X	Station1

Winding	Name Plate kV of Windings	Impedance Data (%) (100 MVA Base)	
	kV	R	X
Primary	345	0.002	0.174
Secondary	115	0.04	2.555
Tertiary	13.8	0.2	5.628

kV of Winding	345	Step Size	0.00625	Controlling Side Winding(TCUL Only)	Y
Heavy Load Norm Tap#	17	Heavy Load Normal Tap (p.u.)	1	Controlled Side Winding(TCUL Only)	N
Light Load Norm Tap#	17				

	Minimum	Nameplate	Maximum
Tap Number	33	17	1
Voltage (kV)	310.5	345	379.5

kV of Winding	115	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)	Y
Light Load Norm Tap#	0				

	Minimum	Nameplate	Maximum
Tap Number	0	0	0
Voltage (kV)	115	115	115

EXAMPLE 3A (CONTINUED), NX-9B TCUL 3-WINDING TRANSFORMER WITH TERTIARY LOADED

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

Reference 1234
Participant Test Company
Form State Approved

Participant ID Station1 1X
ISO ID STATION1 1X
Ckt 1

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		

	Minimum	Nameplate	Maximum
Tap Number	0	0	0
Voltage (kV)	13.8	13.8	13.8

Voltage Schedule Data for Automatically Operated (AVR) TCUL Transformers

		Scheduled	Minimum	Maximum
Controlled Side Voltage Schedules (kV)	On Peak	119.51	117.95	121.07
	Off Peak	119.51	117.95	121.07

Revision Comments Required text field for participant to provide the reason for revising or creating this NX-9 form. Example: Ratings updated due to changes in relay settings which were previously limiting equipment.

Equipment Notes Optional text field available for Participant to supply explanations regarding the data provided or to provide any pertinent information about the equipment or the manner in which it is operated.

Data Revision Number 1	Date Created mm/dd/yyyy	Prepared By Participant Username
Requested Effective Date mm/dd/yyyy	Date Received mm/dd/yyyy	Approved By ISO NX9 Administrator Username
Actual Effective Date mm/dd/yyyy	ISO EMS Implementation Date mm/dd/yyyy	

EXAMPLE 3B, NX-9B TCUL 2-WINDING TRANSFORMER WITH TERTIARY NOT LOADED

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

Reference 1234

ParticipantID Station1 1X

Participant Test Company

ISO ID STATION1 1X

Form State Approved

Ckt 1

Primary Station1 345kV

Bus# 123456

EMS STATION1

Secondary Station1 115kV

Bus# 111222

EMS STATION1

Transformer Type TCUL-Auto

Normal Operating Mode (TCUL) Auto

Number of Windings 2

Tap Switching Time Delay if Normal Mode is Auto (TCUL only) (Seconds) 45

Default Summer 77 F

	MVA	Limiting Device / Description	Location
Normal	524	Transformer - 1X	Station1
LTE	543	Transformer - 1X	Station1
STE	543	Transformer - 1X	Station1
DAL	543	Transformer - 1X	Station1

Default Winter 41 F

	MVA	Limiting Device / Description	Location
Normal	598	Transformer - 1X	Station1
LTE	672	Transformer - 1X	Station1
STE	672	Transformer - 1X	Station1
DAL	672	Transformer - 1X	Station1

Nameplate kV of Windings		Impedance Data (%) (100 MVA Base)	
High kV	Low kV	R	X
345	115	0.042	2.729

kV of Winding 345 Step Size 0.00625 Controlling Side Winding(TCUL Only) Y
 Heavy Load Norm Tap# 17 Heavy Load Normal Tap (p.u.) 1 Controlled Side Winding(TCUL Only) N
 Light Load Norm Tap# 17

	Minimum	Nameplate	Maximum
Tap Number	33	17	1
Voltage (kV)	310.5	345	379.5

kV of Winding 115 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) Y
 Light Load Norm Tap# 0

	Minimum	Nameplate	Maximum
Tap Number	0	0	0
Voltage (kV)	115	115	115

EXAMPLE 3B (CONTINUED), NX-9B TCUL 2-WINDING TRANSFORMER WITH TERTIARY NOT LOADED

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

Reference 1234	Participant ID Station1 1X
Participant Test Company	ISO ID STATION1 1X
Form State Approved	Ckl 1

Voltage Schedule Data for Automatically Operated (AVR) TCUL Transformers

		Scheduled	Minimum	Maximum
Controlled Side Voltage Schedules (kV)	On Peak	119.51	117.95	121.07
	Off Peak	119.51	117.95	121.07

Revision Comments Required text field for participant to provide the reason for revising or creating this NX-9 form. Example: Ratings updated due to changes in relay settings which were previously limiting equipment.

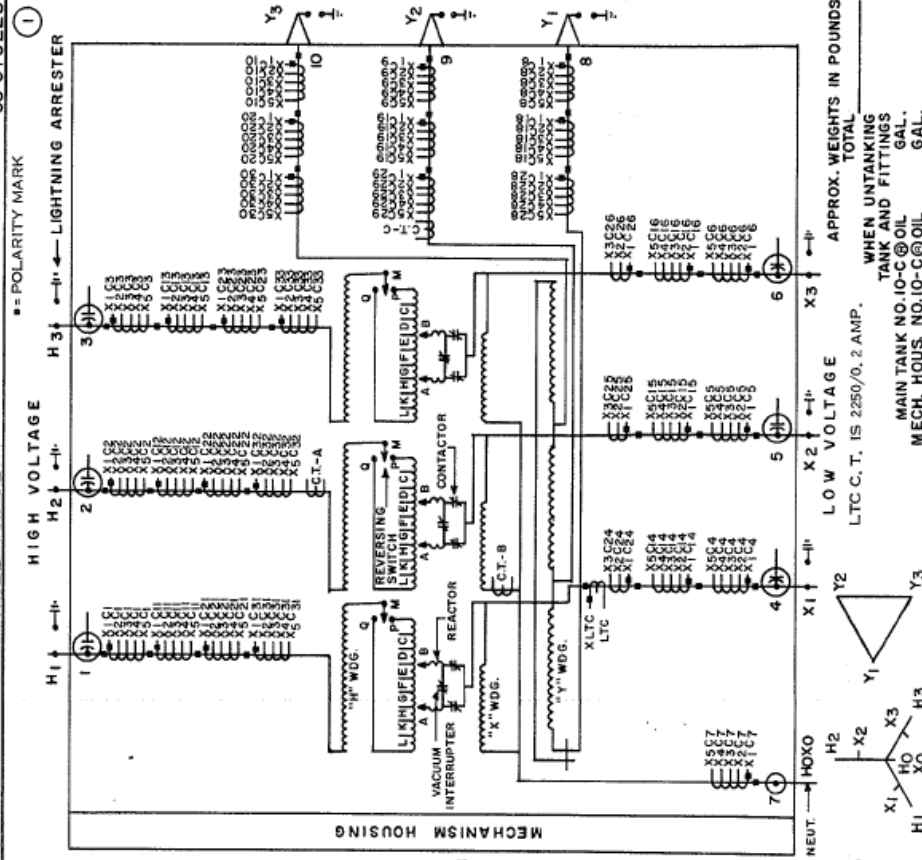
Equipment Notes Optional text field available for Participant to supply explanations regarding the data provided or to provide any pertinent information about the equipment or the manner in which it is operated.

Data Revision Number 1	Date Created mm/dd/yyyy	Prepared By Participant Username
Requested Effective Date mm/dd/yyyy	Date Received mm/dd/yyyy	Approved By ISO NX9 Administrator Username
Actual Effective Date mm/dd/yyyy	ISO EMS Implementation Date mm/dd/yyyy	

EXAMPLE 3A+B (CONTINUED), MANUFACTURER'S NAMEPLATE



GENERAL ELECTRIC
AUTOTRANSFORMER
 CLASS 0A/FA/FOA THREE-PHASE 60 CYCLES



NO. VOLTAGE RATING 345000GR, Y/1991.85-115000GR, Y/66395-13800
 KVA RATING 240000 (OUTPUT) CONTINUOUS 55 C RISE SELF-COOLED
 KVA RATING 320000 (OUTPUT) CONTINUOUS 55 C RISE FORCED-AIR-COOLED
 KVA RATING 400000 (OUTPUT) CONTINUOUS 55 C RISE FORCED-OIL AND FORCED-AIR-COOLED
 KVA RATING 480000 (OUTPUT) CONTINUOUS 65 C RISE FORCED-OIL AND FORCED-AIR-COOLED

"X" WINDING CONNECTIONS	
LINE TO LINE	115000
AMP	2250
"Y" WINDING CONNECTION	
LINE ON 8, 9, 10	448000 KVA
AMP	4840
BASIC INSULATION LEVELS	
ITEM	IMPULSE LEVEL-FULL WAVE KV
H1 H2 H3	1050
X1 X2 X3	450
H0X0	150
Y1 Y2 Y3	110

"H" WINDING CONNECTIONS	
LINE TO LINE	448000
AMP	2250
MECHANISM CONNECTS	
LINE TO LINE	448000
AMP	2250
NEUTRAL ON 7	
LINE TO LINE	448000
AMP	2250

SUITABLE FOR OPERATION WITH THE NEUTRAL EITHER SOLIDLY GROUNDED OR GROUNDED THROUGH AN IMPEDANCE WHICH WILL LIMIT THE LOW FREQUENCY AND IMPULSE VOLTAGES FROM NEUTRAL TO GROUND TO VALUES CONSISTENT WITH THE INSULATION LEVELS SHOWN ON THIS NAMEPLATE.

SUITABLE FOR SIMULTANEOUS THREE-WINDING OPERATION PROVIDED THAT THE KVA RATING OF ANY WINDING IS NOT EXCEEDED, THAT THE ARITHMETICAL SUM OF THE OUTPUTS DOES NOT EXCEED 240000/320000/400000/448000 KVA AND THAT THE CURRENT IN THE COMMON WINDING DOES NOT EXCEED 934/1245/1560/1750 AMPERES.

TRANSFORMER OPERATING PRESSURE RANGE IS 0.6 PSI POSITIVE TO 0 PSI.

TRANSFORMER TANK SUITABLE TO WITHSTAND 5 PSI PRESSURE AND FULL VACUUM WITH ALL TANK BRACING IN PLACE.

C.T. NO. 1, 2, 3, 11, 12, 13, 21, 22, 23, 31, 32, 33 ARE ARE 3000/5 AMP.

C.T. NO. 4, 5, 6, 14, 15, 16 ARE 4000/5 AMP.

C.T. NO. 7, 8, 9, 10, 18, 19, 20 ARE 3600/5 AMP.

C.T. NO. 11, 12, 13, 21, 22, 23, 31, 32, 33 ARE 4000/5 AMP.

C.T. NO. 24, 25, 26 ARE 3600/5 AMP.

C.T. NO. 27, 28, 29, 30 ARE 4000/5 AMP.

REFER TO C.T. NAMEPLATE FOR CONNECTIONS AND RATIOS.

345000GR, Y-115000GR, Y VOLTS AT 240000 KVA
 PER CENT IMPEDANCE VOLTS
 345000GR, Y-13800 VOLTS AT 62000 KVA
 PER CENT IMPEDANCE VOLTS
 115000GR, Y-13800 VOLTS AT 62000 KVA
 PER CENT IMPEDANCE VOLTS

APPROX. WEIGHTS IN POUNDS TOTAL WHEN UNTANKING TANK AND FITTINGS
 LTC C.T. IS 250/0.2 AMP.
 MAIN TANK NO. 10-C@OIL GAL.
 MECH. HOUS. NO. 10-C@OIL GAL.

ATMOSSEAL OIL PRESERVATION SYSTEM
MADE IN U.S.A.

CAUTION! BEFORE INSTALLING OR OPERATING READ INSTRUCTIONS GEK-19526
 PITTSFIELD MASS

VII. OP-16 APPENDIX B 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
--	10/26/23	For previous revision history, refer to Rev 10 available through Ask ISO.
Rev 11	10/26/23	Periodic review completed by procedure owner; Add footnote to define "relay loadability limits" as used in this Appendix; Update Normal Operating Mode field labels from Manual + SCADA to Manual-Local + Manual-Remote as previously requested by the Reliability Committee; Add requirement for control scheme information to Equipment Notes for transformers connecting dynamic reactive devices.
Rev 11.1	10/23/25	Biennial review by procedure owner requiring no changes; Made administrative changes required to publish the Minor Revision.