TRANSMISSION & DISTRIBUTION
INTERCONNECTION REQUIREMENTS
FOR
GENERATION
December 5, 2013
## REVISION HISTORY

This document replaces CMP’s “Interconnection Requirements for Generation” dated March 19, 1998, as well as all earlier versions of CMP’s Technical Interconnection Requirements.

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<td>December 30, 1994</td>
<td>Superceded previous Documents</td>
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<td>March 19, 1998</td>
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<td>May 23, 2007</td>
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December 5, 2013
NOTE:  This document and all PE stamps and signatures are facsimiles and are not to be construed as originals. The originals are maintained at Central Maine Power Company offices in Augusta, Maine. No alterations may be made without prior written authorization from Central Maine Power Company.
i. **Purpose** - The purpose of this document is to establish the Technical Interconnection Requirements for Generation to connect to Central Maine Power Company's Transmission & Distribution (T&D) system. Central Maine Power Company will also be referred to as the Interconnecting Transmission Owner (ITO). This document reflects, in part, ITO's view of Prudent Electrical Practices with respect to the installation of generation interconnection equipment. These requirements are written to establish a basis for maintaining power quality, system reliability and a safe environment for the general public, power consumers, maintenance personnel, and equipment. This document describes the general protection requirements for parallel operation and includes typical one-line diagrams. This document also includes equipment maintenance requirements and details the information that must be provided to ITO during all stages of a project. **This document is a guide and as such, is not intended to be used as the sole basis for the specific design of the Generator's protection systems and interconnection with the T&D system.** Additional technical requirements for interconnection are contained in the ISO New England (ISO NE) Open Access Transmission Tariff (OATT), ISO NE Planning Procedures, ISO NE Operating Procedures, the Northeast Power Coordinating Council (NPCC) Criteria documents, and the North American Electric Reliability Corporation (NERC) reliability standards. **Final design will be subject to Central Maine Power Company (ITO) review and approval on a case-by-case basis.**

These Interconnection Requirements are intended to be consistent with Schedules 22 and 23 of the ISO New England (ISO-NE) Open Access Transmission Tariff (OATT), State of Maine Chapters 313, 315, and 324. To the extent there are any conflicts between this document and a site-specific Interconnection Agreement, or Schedules 22 and 23 of the ISO-NE OATT, as may be amended from time to time, the Interconnection Agreement or the OATT will be the controlling document.

Please be advised that intertie interconnection for all distribution projects that are not subject to FERC Jurisdiction are covered under the MPUC Chapter 324 rules and requirements. Please see website www.MPUC.gov.

ii. **Generator** - In the interest of simplicity, the term "Generator" is used throughout this document to refer to the owner/operator of generation connected to the T&D system.

iii. **Use** - This document is intended for general use by present Generators, prospective Generators and ITO personnel.

iv. **T&D System** - This term refers to ITO's electrical system which includes 345, 115, and 34.5 kV transmission sections, and 34.5, 12.47, and 4.16 kV distribution circuits.

v. **Qualified ITO Personnel** - This term is used to refer to those persons employed by ITO having the required knowledge, training, experience, and accountability in specialized areas of Transmission Services, Transmission & Distribution Engineering and System Planning.

vi. **Interconnecting Generator Responsibility** - The interconnection requirements set forth herein are intended to describe CMP’s process and requirements for electrically connecting to CMP’s T&D system generation that will operate in parallel with this system. Other non-electric utilities (such as cable and telephone utilities) may be involved in the interconnection process. The costs of these other utility services shall be borne by the generator interconnecting to the CMP T & D system. It is the responsibility of the interconnecting generator to make contact with these other utilities and to arrange for the
provision of any necessary services from such utilities and the payment of charges imposed by such utilities.

vii. **Interconnecting Generator Safety** – Central Maine Power (CMP) is committed to operating in a manner that protects the safety and health of our employees and the public. The safe delivery of our services to the public is paramount to our success. Safety is a primary concern in all interconnection projects. We urge you, your employees, contractors and subcontractors to utilize the utmost care in working near or around any of our equipment, energized lines and substation(s). All independent contractors working at or near our T & D system shall comply with all Federal and State safety regulations.
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<td>Please be advised that intertie interconnection for all distribution projects that are not subject to FERC Jurisdiction are covered under the MPUC Chapter 324 rules and requirements. Please see website <a href="http://www.MPUC.gov">www.MPUC.gov</a>.</td>
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| 13     | **A. Transformer Connections**  
Generally, the step-up transformer high voltage winding must be connected in a grounded/wye configuration. The Generator will coordinate with ITO to select a transformer connection and grounding arrangement. The transformer connection and grounding arrangement should be such that zero-sequence current can not pass through the transformer. A configuration that is not in-line with this requirement will require further studies to determine if it will be acceptable. For Distribution connected generation, the T&D system must remain "effectively grounded" such that $X_0/X_1 \leq 3$ and $R_0/X_1 \leq 1$ and that the voltage rise in the unfaulted phases does not exceed 125% of the nominal system line-to-ground voltage on the affected circuit(s). |
| 22     | Figure III-2: Type I Typical Installation has been replaced as the drawing has been updated to be in compliance with the new Iberdrola USA Standards. |
| 24     | Figure III-3: Type II Typical Installation has been replaced as the drawing has been updated to be in compliance with the new Iberdrola USA Standards. |
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| 30     | Figure III-6: Type V Typical Installation has been replaced as the drawing has been updated to be in compliance with the new Iberdrola USA Standards. |
Figure III-7: Legend Schematic Symbols Used On types I Thru V Typical Installations has been replaced as the drawing has been updated to be in compliance with the new Iberdrola USA Standards.

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<td>Metering shall be located at the point of delivery whenever practicable. Advance Company approval of metering location is required.</td>
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<td>Loss compensation is required if the metering equipment is not installed at the point of delivery. Loss compensation is determined based upon CMP Terms and Conditions 12.8 METER LOCATION ADJUSTMENT and ISO NE’s OP-18 Metering and Telemetering Criteria.</td>
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<td>When service is metered at a lower or higher voltage than the delivery voltage, the measured kWh will be increased or decreased by a fixed percentage or, at the option of the Company, a continuous on-site adjustment will be made through compensating metering equipment or a factor applied based on the transformer manufacturer’s data.</td>
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<td>If a fixed factor is used to compensate metering equipment, the fixed factor shall be calculated using the peak output rating of the generator. The fixed factor will take into account all transformer losses and line losses between the metering point and the point of delivery.</td>
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<tr>
<td></td>
<td>Loss compensation programmed into the meter is based on transformer and line characteristics.</td>
</tr>
<tr>
<td></td>
<td>When necessary to compensate for transformer losses, the following information is required; transformer primary voltage, transformer secondary voltage, full load kVA, no load percent exciting current, no load Watt loss, full load percent impedance, and full load Watt loss.</td>
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<td>When necessary to compensate for line losses, the following information is required; Volts line to line, charging kVARhs, line resistance in Ohms, and line inductance in Ohms.</td>
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<th>Figure VIII-1: Relay Operation Target Report has been revised to reflect new contact information:</th>
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<tr>
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<td>Central Maine Power</td>
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<tr>
<td></td>
<td>System Protection Transmission Services Department</td>
</tr>
<tr>
<td></td>
<td>83 Edison Drive</td>
</tr>
<tr>
<td></td>
<td>Augusta, Maine 04336</td>
</tr>
<tr>
<td></td>
<td>FAX (207) 623-7380</td>
</tr>
<tr>
<td></td>
<td>(207) 623-7305</td>
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Figure VIII-2: Instructions for Relay Operation Target Report has been revised to reflect new contact information:

The following instructions are a guide to using this relay operation target form and should answer the majority of Generator questions. Any additional questions can be addressed to ITO by contacting the ITO System Protection group at (207) 623-3521, ext. 3505 or Purchased Power Administration group at (207) 623-3521, ext. 3655.

This form will be completed and forwarded, faxed, or Emailed to don.gurney@cmpco.com brian.langlais@cmpco.com within 48 hours of a relay target operation, to: Central Maine Power Company, System Protection Department, 83 Edison Drive, Augusta, ME 04336, Fax No. (207) 623-7380.
I. **General Information**

The information in this interconnection requirements document is supplied to Generators (Interconnection Customer), for the purpose of establishing and maintaining an acceptable interconnection with the Transmission & Distribution (T&D) system (Interconnecting Transmission Owner (ITO)). Safety, reliability, and power quality are of utmost importance and, as such, careful study of each proposed installation and the identification of appropriate interconnection requirements is necessary before a Generator’s facility is allowed to begin interconnected operation. This standard is based on ITO’s own requirements as well as the requirements of the MPUC, the Regional Transmission Organization (RTO or ISO NE), NPCC, NERC, FERC, or other authorities having jurisdiction.

**A. ISO-NE & ITO Review & Approval**

ISO NE Inc is the Regional Transmission Organization (RTO) for New England. FERC jurisdictional generators in NE (and therefore in Maine on the ITO system) must comply with the ISO NE FERC Electric Tariff No. 3, referred to as the Open Access Transmission Tariff (OATT). This Tariff contains the requirements for applying for a new generator interconnection or changing an existing generation facility.

ISO-NE and ITO, will review T&D system parameters in relation to the proposed point of interconnection to determine any necessary changes to the T&D system in order to accept the generation. ISO-NE and ITO will verify that the Generator's design meets the required interconnection standards, perform necessary interconnection studies, and will conduct a functional field test of the Generator’s system before the Generator will be allowed to commence interconnected operation. ISO-NE and ITO will provide the Generator written approval for interconnected operation within the T&D system. Subsections 1 through 6, below, summarize the review and approval process (reference the ISO-NE OATT, Schedule 22 for Large Generators > 20 MW and Schedule 23 for Small Generators ≤ 20 MW).

1. Interconnection Request

The Interconnection Customer, to the extent required in Schedules 22 and 23 of the ISO NE OATT, shall submit a completed Interconnection Request to the System Operator, ISO New England Inc., together with the processing fee or deposit specified in the Interconnection Request. These requests can be found on the ISO NE website located at [www.iso-ne.com](http://www.iso-ne.com). From the main web page, go to Generation & Resources, New or Modified Interconnections, and then choose either the Small Generator Request Form (< = 20 MW) or the Large Generator Request Form (> 20 MW). After the Request is submitted, ISO-NE, in consultation with ITO, will determine whether the Interconnection Request is complete and the Interconnection Customer will be notified to arrange a scoping meeting.

2. Interconnection Studies

In general, all requests for a new generation interconnection or a material modification to an existing generating facility, will require one or more interconnection studies. The Open Access Transmission Tariff (OATT), the ISO NE Transmission, Markets and Services Tariff (ISO NE Tariff) (“ISO NE Tariff”) Section I.3.9, Proposed Plan Application, together with the Schedule 22 (LGIP) and Schedule 23 (SGIP), provide detailed descriptions of the Interconnection study options and requirements (Feasibility Study, System Impact Study, or Facilities Study). Either ISO NE or ITO will process the interconnection request, arrange for a scoping meeting, and prepare an interconnection study agreement. The
Interconnection Customer will provide any necessary upfront deposit to cover the estimated study costs. The interconnection study will result in a final report that will determine the feasibility and/or system impact to the T&D system and identify any required system enhancements. If the Interconnection Customer requests a Facilities Study to be performed, either ISO NE or ITO will submit a Facilities Study Agreement per the OATT.

3. Interconnection Costs

Unless otherwise specified in a site-specific interconnection agreement, or the ISO New England Open Access Transmission Tariff (OATT), the Generator will pay the interconnection costs for any system enhancements required by ITO to allow connection to the T&D system. This will include the costs of new transmission or distribution facilities and/or upgrades to existing facilities, metering equipment, and changes to the ITO Protection System. ITO will require prepayment for any necessary work.

With regard to any interconnection costs or ongoing charges, if there are any conflicts between these interconnection requirements and a site-specific interconnection agreement, or the ISO-NE OATT, as may be amended from time to time, the interconnection agreement or the applicable transmission tariff will be the controlling document.

4. Design Approval

The final decision on the design of new facilities or modifications to existing facilities required to meet the Customer's Interconnection Request (IR), will be based upon ISO-NE and ITO design standards. The interconnection requirements or upgrades will be identified in the study documents (including Feasibility Study, System Impact Study and Facility Study) and incorporated into the Interconnection Agreement (IA). ITO will review and provide written approval for the facility’s design which is required to meet these interconnection requirements.

5. Initial Inspection and Testing

Prior to the initial synchronization to the T&D system, the interconnection facilities must be inspected, calibrated, and functionally tested. ITO will inspect the interconnection facilities and will either perform or observe the functional testing. Refer to Sections III.L, “Generator Facility Acceptance,” and III.M, “Synchronizing to the T&D System,” for more specific information on this process.

6. Ongoing Testing and Maintenance

After the initial synchronization, the Generator is required to perform periodic testing and maintenance of the interconnection facilities to ensure this equipment will operate properly. Section VIII.E, “Testing & Maintenance,” provides additional details for these ongoing requirements.

B. Operation and Maintenance Charges

Equipment, including the Generating Facility, Interconnection Facilities, and metering equipment shall be itemized and identified as being owned by the Interconnection Customer or the Interconnecting Transmission Owner. The Interconnecting Transmission Owner will provide a best estimate itemized cost, including overheads, of its Interconnection Facilities and metering equipment, and a best estimate itemized cost of the annual operation and maintenance expenses associated with its Interconnection Facilities and metering equipment.
C. Grandfathering
Generators already connected to the T&D system are not exempt from the requirements of this document. ITO's Interconnection Requirements are periodically revised to reflect changes in standard electrical practice and the T&D system. Each Generator's facility will be subject to review as a result of analyzing local T&D system problems as well as during the initial inspection and ongoing biennial test and inspections. ITO may require reasonable modifications to the Intertie Protection System as a result of these reviews and inspections.

D. Generators 5,000 kVA and Larger
All facilities that have a generating capacity of 5,000 kVA or greater must be equipped with SCADA equipment (as described in Chapter V, “Supervisory Control and Data Acquisition”) and, for manned facilities, a telephone line dedicated to voice communications for System Operations purposes. For unmanned facilities, the Generator must provide an alternative means of communications for Systems Operations purposes.

The Interconnection Customer is required to provide detailed dynamic models for each generator with a gross output of 5,000 KVA or greater. These models will be provided in both GE PSLF and Siemens PSS/E format. Other detailed modeling requirements, such as PSCAD model, may be required as determined on a case-by-case basis.

E. Facilities Connected to the Bulk Power System
Generation facilities that are either directly connected to the Bulk Power System (BPS) or which may have a potential impact on the BPS must also comply with ISO-NE Inc., Federal Energy Regulatory Commission (FERC), North American Electric Reliability Council (NERC), Northeast Power Coordinating Council (NPCC), and Iberdrola USA Electric System Planning Manual – Criteria & Processes, guides, requirements, and standards. The classification of BPS facilities is determined by test according to NPCC A-10 Criteria. NPCC maintains a complete listing of BPS facilities within their jurisdiction.

F. Facilities Connected to the Non-BPS System
Generation facilities connected to the Non-BPS transmission system, including ISO-NE Pool Transmission Facilities (PTF), the Local CMP transmission system (Non-PTF) and the CMP distribution system, must comply with the ISO-NE Planning Procedures, Iberdrola’s Transmission and Distribution planning documents, and this document, as applicable.

G. DC & Variable Speed Generators
Direct current generators and variable speed alternating current generators may be connected to the T&D system through a synchronous inverter. The inverter installation will be designed such that a T&D system interruption will result in the removal of the generator/inverter from the T&D system. Synchronous inverters must comply with ITO's power quality requirements as outlined in Chapter VI, "Power Quality."

H. Generators 25 kW and Less
Generation equipment up to 25 kW may be installed, where appropriate power lines exist, without an extensive engineering review. However, the Generator must install the appropriate protection and obtain written approval from Qualified ITO Personnel, as specified in this document, before commencing interconnected operation.
I. Emergency Generators

Emergency generators cannot be connected to, or operated in parallel with, the T&D system, except for momentary paralleling (paralleling for 0.5 seconds or less). Facilities may utilize momentary paralleling of emergency generators providing they use automatic controls to monitor and control the switching process. The automatic control and switching system WILL require ITO review and approval. These facilities do not require an Intertie Protection System to monitor for faults on the T&D system. For additional information on emergency generators see ITO's Contractor's Handbook for Electrical Service and Meter Installations.

J. Generators 50 MW and Greater

Generators 50 MW and greater are required to have a Dedicated ARD (Auto Ring Down) phone to ITO System Operations.
II. General Requirements

The Generator's installation shall meet all requirements of prudent electrical practices, methods, and standards that are commonly used in engineering and plant operations and maintenance to provide for a safe, reliable and dependable installation.

In addition to meeting those practices, methods, and standards and the requirements set forth in this document, as may be changed from time to time, the Generator's equipment and installation shall conform to the latest revision of the National Electrical Safety Code (NESC), the National Electrical Code (NEC), and all other applicable Federal, State, and Local Government codes. These include American National Standards Institute (ANSI), Institute of Electrical and Electronics Engineers (IEEE), National Electrical Manufacturers Association (NEMA), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), Maine Department of Environmental Protection (MDEP), North American Electric Reliability Council (NERC), Federal Energy Regulatory Commission (FERC), Northeast Power Coordinating Council (NPCC), and ISO New England codes and standards, and comply with all mandated compliance standards.

A. Interconnection Process and Required Information

To facilitate the interconnection process, the Generator should contact ISO-NE early on in the design stages of the proposed installation. For facilities 1,000 kVA or smaller, ITO's approval must still be obtained, though the level of detail for information is less than that required for facilities greater than 1,000 kVA. The Generator must provide ITO the following information on each proposed facility:

- Complete, accurate, and applicable data to enable the proper modeling of the Generator's unit in load flow, transient stability, and fault studies. This will include line, transformer, and machine data as well as parameters for exciter systems, governor systems, and power system stabilizers. All dynamic data must be provided in both GE PSLF and Siemens PSS/E format compatible with the most current software versions.

- Design data and specifications which reflect the facility’s reactive capability.

- All information regarding design and implementation of any Special Protection System(s) associated with its facilities.

- Unit availability data including both unit design data and known performance data from other facilities utilizing similar equipment.

Figure II at the end of this chapter provides Electrical Equipment Data Sheets that the Generator must complete and forward to ITO for ITO to perform an engineering study. Upon receipt of the required information, as part of the engineering study, ITO will review the Intertie Protection System requirements. Any additional requirements not explicitly specified in this document will be provided by ITO to the Generator. The Generator must submit design documents reflecting these additional requirements to ITO for review and approval.
B. Protection System Requirements
Each Generator must design, install, maintain, and operate appropriate protection systems. The Generator must obtain ITO approval of specific relays and intertie equipment before parallel operation can begin. Chapter III, “System Protection,” covers ITO’s requirements for the protection systems in greater detail.

C. Transformer Interface
In general, the Generator’s facility shall interface with the T&D system through a step-up transformer or bank of transformers of adequate kVA rating and proper voltage rating for conversion from the facility's generator voltage to utility distribution or transmission voltage. The ratio of this step-up transformer must not restrict the reactive capability requirement specified in Section F, “Reactive Capability,” below. This step-up transformer must meet the technical requirements specified in Section III, B - “Transformer Connections”, page 12.

D. Switching Equipment and Station Ground
Each installation must be provided with the following switching equipment and station ground:

1. Tie Disconnect Switch
The Generator will provide a manual, three-phase, gang-operated, visible, lockable, interrupter Dispatch Point of Demarcation - DP Switch at the point of connection to the T&D system. CMP reserves the right as to ownership of this switch. See Chapter VII, “Safety,” for switch operation requirements. The DP Switch name will be assigned by CMP and that name will be used in all facility documentation, communication, and switching between the facility and CMP. Facilities with generation capacity of 100 kW or less may have this requirement waived as long as the requirement D.2, below, is met.

2. High-Side Interrupting Device
The high side of the facility's step-up transformer must be connected to the T&D system through a high-side breaker, recloser, or fuse. This device must be capable of interrupting both the facility's full generation capacity and the maximum fault current at this location.

3. Device Naming Convention
It is strongly recommended for consistency and clear communication that the High Side Interrupting Device and all devices between it and the DP switch be named following the convention assigned to the DP. Therefore the identification, location, and naming of all devices between the High Side Interrupting Device and the DP switch should be done early in a project to avoid the need for changes to drawings and documentation.

4. Station Ground
The facility's station ground must be designed and installed in accordance with ITO substation standards and the NESC.

E. Generator Circuit Breakers
A circuit breaker is normally required between each generator and the facility step-up transformer. This breaker provides a means to disconnect the generator from the T&D system under fault conditions as well as providing a means to synchronize to the T&D system. Under certain conditions, it may be more economical to design this device into
the high-voltage side of the step-up transformer. If this is the case, a low-side disconnect device will still be required.

F. Reactive Capability

All synchronous generators shall be rated to operate continuously at maximum rated power and at any power factor (pf) between 90 percent lagging and 95 percent leading within ±5 percent of rated voltage at the Point of Interconnection (POI). The Generator’s step-up transformer ratio will be set such that the Generator’s system will support this reactive capability. Generators may be required to operate in either pf or voltage control mode as directed by the System Operator to assist in maintaining normal and emergency system voltage schedules. Generators must maintain operating limits or interconnection service may be discontinued.

The nominal rating of the step-up transformer’s high voltage winding will be specified by ITO to ensure the T&D system reactive power requirements are met. As a minimum, the step-up transformer will be provided with No Load Tap Changer (NLTC) settings that span ±5 percent of the nominal voltage at 2½ percent intervals.

Taps on any station service transformers within the Generator’s facility will also be set such that the Generator’s system will support this reactive capability requirement. If tap settings restrict the Generator’s reactive capability, the transformers must be replaced. The cost for such replacement will be the responsibility of the Generator.

G. Routine Maintenance

As a minimum requirement, each Generator is expected to adopt an Operations and Maintenance program consistent with the Operations and Maintenance section of this document. Maintenance records will be kept on file at the Generator’s facility and will be provided to ITO upon request.

H. Capacitors

Excitation or power factor correction capacitors may be installed on generators only with the written consent of ITO.

I. Phase Unbalance

There may be single-phase fuses or automatic line switching devices, installed between the utility power source and the generator, which may operate and cause phase unbalance. It is the sole responsibility of the Generator to protect their own equipment from any such unbalance. ITO will not assume any responsibility or liability for this protection.

J. Insulation and Insulation Coordination

Essential to the stable operation of the transmission system is proper coordination of the system’s insulation strength. Internal insulation of equipment and external insulation of transmission lines and substation buses is required. Basic Lightning Impulse Level (BIL) for the ITO conforms to IEEE Standard 1313-1996 for Transmission voltages at 34kV, 115kV, and 345kV as noted.
### K. Electrical System Parameters

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>60 Hertz</td>
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<tr>
<td><strong>System Parameters – 345kV System</strong></td>
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<tr>
<td>Nominal Voltage</td>
<td>345kV Line to Line</td>
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<tr>
<td>Maximum Design Level Voltage</td>
<td>362kV</td>
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<tr>
<td>Basic Impulse Level</td>
<td>1300kV</td>
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<td>Design Continuous Amperage (S NOR)</td>
<td><em>See Section 3.6</em></td>
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<tr>
<td>Interrupting Device Rating</td>
<td>50kAIC</td>
</tr>
<tr>
<td>Bus Bracing/ equipment withstand rating</td>
<td>42kA</td>
</tr>
<tr>
<td>Grounding</td>
<td>Solidly grounded</td>
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<tr>
<td><strong>System Parameters – 115kV System</strong></td>
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</tr>
<tr>
<td>Nominal Voltage</td>
<td>115kV Line to Line</td>
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<tr>
<td>Maximum Design Level Voltage</td>
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<tr>
<td>Basic Impulse Level</td>
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<td>Design Continuous Amperage (S NOR)</td>
<td><em>See Section 3.6</em></td>
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<tr>
<td>Interrupting Device Rating</td>
<td>42AIC</td>
</tr>
<tr>
<td>Bus Bracing/ equipment withstand rating</td>
<td>32kA</td>
</tr>
<tr>
<td>Grounding</td>
<td>Solidly grounded</td>
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<tr>
<td>Capacitors, rated kV for normal power out</td>
<td>115kV</td>
</tr>
<tr>
<td><strong>System Parameters – 34.5kV System</strong></td>
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</tr>
<tr>
<td>Nominal Voltage</td>
<td>34.5kV Line to Line</td>
</tr>
<tr>
<td>Maximum Design Level Voltage</td>
<td>38.0kV</td>
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<tr>
<td>Bus Bracing/ equipment withstand rating</td>
<td>32kA</td>
</tr>
<tr>
<td>Grounding</td>
<td>Solidly grounded</td>
</tr>
<tr>
<td>Capacitors, rated kV for normal power out</td>
<td>34.5kV</td>
</tr>
<tr>
<td><strong>System Parameters – Station Service</strong></td>
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</tr>
<tr>
<td>Nominal DC Voltage</td>
<td>125</td>
</tr>
</tbody>
</table>
L. Changes

1. **Modification of Small Generating Facilities**  
   (Generators No Larger Than 20 MW)

   The Interconnection Customer must receive written authorization from: ITO or ISO-NE before making any changes to the Small Generating Facility that may have a material impact on the safety or reliability of ITO’s Interconnection Facilities or ISO-NE’s reliability of the New England Transmission System. Modifications shall be done in accordance with Good Utility Practice. If the Interconnection Customer makes such modification without ISO-NE’s or ITO’s, as appropriate, prior written authorization, the latter shall have the right to temporarily disconnect the Small Generating Facility.

2. **Modification of the Large Generating Facilities**  
   (Generators that Exceed 20 MW)

   Either Interconnection Customer or ITO may undertake modifications to its facilities. If a Party plans to undertake a modification that reasonably may be expected to affect the other Party’s facilities, or the New England Transmission System, that Party shall provide to the other Parties and any Affected Party: (i) sufficient information regarding such modification so that the other Party(ies) may evaluate the potential impact of such modification prior to commencement of the work; Such information shall be deemed to be confidential hereunder and shall include information concerning the timing of such modifications and whether such modifications are expected to interrupt the flow of electricity from the Large Generating Facility. The Party desiring to perform such work shall provide the relevant drawings, plans, and specifications to the other Party (ies) at least ninety (90) Calendar Days in advance of the commencement of the work. Notwithstanding the foregoing, no party shall be obligated to proceed with a modification that would constitute a Material Modification or an Interconnection Request under the LGIP, except as provided under and pursuant to the LGIP.

   In the case of Large Generating Facility modifications that do not require Interconnection Customer to submit an Interconnection Request, ITO shall provide, within thirty (30) Calendar Days, an estimate of any additional modifications to the New England Transmission System, ITO’s Interconnection Facilities or Network Upgrades necessitated by such Interconnection Customer modification and a good faith estimate of the costs thereof.

3. **Standards**

   Any additions, modifications, or replacements made to a Party’s facilities shall be designed, constructed and operated in accordance with this LGIA, SGIA, and Good Utility Practice.
M. ITO Disclaimer

ITO's review of the Generator's facility, equipment, interconnection equipment, protective devices, and metering does not confirm or endorse the design. ITO's review is not a warranty of safety, durability or reliability of the facility or any of the equipment. ITO shall not, by reason of such review or failure to review, be responsible for strength, safety, details of design, adequacy or capacity of the Generator's facility, equipment, interconnection equipment, or protection systems. ITO will not assume any responsibility or liability for protection of the Generator's electrical system resulting from interconnected operation of a Generator's facility with the T&D system.
### GENERATOR STEP-UP TRANSFORMER

Required for all sites

<table>
<thead>
<tr>
<th>Transformer MVA Rating</th>
<th>Transformer Voltage Rating</th>
<th>Available Taps</th>
</tr>
</thead>
</table>

**Connection of Windings**

(ie., Wye-Wye, Wye-Delta, etc.)

**Transformer Leakage Impedance's** for Positive

<table>
<thead>
<tr>
<th>p.u. on tap</th>
<th>p.u. on tap</th>
<th>p.u. on tap</th>
<th>p.u. on tap</th>
</tr>
</thead>
</table>

and Zero Sequence on the transformer base

**between each pair of windings and for each available tap.**

(etc., as needed)

<table>
<thead>
<tr>
<th>p.u. on tap</th>
</tr>
</thead>
</table>

**Type of Grounding**

*Neutral Impedance (Reactance/Resistance)*

| *Neutral Impedance (Reactance/Resistance)* |

### INTERTIE PROTECTION SYSTEM DATA

Required for all sites

Provide one line, three line, and DC elementary diagrams of the electrical design showing the following information:

2. Voltage Transformers (VTs) - Ratios, Ratings & Winding Configurations.
3. Current transformers (CTs) - Ratios & Ratings.
4. Protective Relays - Model and Style Numbers.
5. Switching Devices - Manufacturer's Electrical Specifications.
7. Synchronizing Devices - Generator Specifications

### EXCITATION SYSTEM DATA

Required for sites > 1000 kVA

<table>
<thead>
<tr>
<th>Manufacturer</th>
</tr>
</thead>
</table>

**Type of Excitation System**

IEEE Type 1 _____ 2 _____ 3 _____ 4 _____ DC _____

<table>
<thead>
<tr>
<th>AC</th>
<th>ST</th>
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</thead>
</table>

**Voltage Response**

<table>
<thead>
<tr>
<th>Manufacturer Exciter Type</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Manufacturer Regulator Type</th>
</tr>
</thead>
</table>

**Saturation Curve No. on Open Circuit**

| Saturation Curve No. for Rated Armature Current |

**Saturation Curve No. for Rated Armature Current**

* Develop in conjunction with ITO.

** Please supply gains, time constants and limits applicable to the model. IEEE Paper F 80 258-4, "IEEE Committee Report on Excitation System Models for Power System Stability Studies" provides model descriptions and block diagrams.

---

**Figure II: Electrical Equipment Data Sheets, Page 1 of 2.**

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### GENERATOR DATA

**Required for sites > 1000 kVA**

<table>
<thead>
<tr>
<th>Field</th>
<th>Required Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
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<td>Generator Nameplate Number</td>
<td></td>
</tr>
<tr>
<td>Rated MVA at Rated H2 psig</td>
<td></td>
</tr>
<tr>
<td>Rated kV</td>
<td></td>
</tr>
<tr>
<td>Rated P.F. (±)</td>
<td></td>
</tr>
<tr>
<td>Max. Turbine kW Capability</td>
<td></td>
</tr>
<tr>
<td>(Utilizing over pressure, etc.)</td>
<td></td>
</tr>
<tr>
<td>Field Amperes for Rated Conditions</td>
<td></td>
</tr>
<tr>
<td>Field Amperes at Rated Generator</td>
<td></td>
</tr>
<tr>
<td>Volts &amp; Amps. @ 0 p.f. Overexcited</td>
<td></td>
</tr>
<tr>
<td>Field Resistance</td>
<td></td>
</tr>
<tr>
<td>Generator Grounding Type/Specification</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>In Per Unit on Rated Machine MVA and kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Axis Unsaturated Synchronous Reactance</td>
</tr>
<tr>
<td>Quadrature Axis Unsaturated Synchronous Reactance</td>
</tr>
<tr>
<td>Direct Axis Transient Reactance at Rated Current</td>
</tr>
<tr>
<td>Direct Axis Transient Reactance at Rated Voltage</td>
</tr>
<tr>
<td>Quadrature Axis Transient Reactance at Rated Current</td>
</tr>
<tr>
<td>Direct Axis Subtransient Reactance at Rated Current</td>
</tr>
<tr>
<td>Quadrature Axis Subtransient Reactance at Rated Current</td>
</tr>
<tr>
<td>Direct Axis Subtransient Reactance at Rated Voltage</td>
</tr>
<tr>
<td>Quadrature Axis Subtransient Reactance at Rated Voltage</td>
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<tr>
<td>Negative Sequence Reactance</td>
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<tr>
<td>Zero Sequence Reactance</td>
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<tr>
<td>Stator Leakage Reactance at Rated Voltage</td>
</tr>
<tr>
<td>Stator Leakage Reactance at Rated Current</td>
</tr>
<tr>
<td>Potier Reactance</td>
</tr>
<tr>
<td>Positive Sequence Resistance</td>
</tr>
<tr>
<td>Zero Sequence Resistance</td>
</tr>
<tr>
<td>Negative Sequence Resistance</td>
</tr>
<tr>
<td>Direct Axis Transient Open-Circuit Time Constant</td>
</tr>
<tr>
<td>Direct Axis Subtransient Open-Circuit Time Constant</td>
</tr>
<tr>
<td>Quadrature Axis Transient Open-Circuit Time Constant</td>
</tr>
<tr>
<td>Short-Circuit Time Constant of Armature Winding</td>
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<tr>
<td>Generator, Turbine and Exciter Inertia</td>
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<tr>
<td>Rated Speed</td>
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<td>Inertia Constant on Machine Base</td>
</tr>
<tr>
<td>Saturation Curve No. on Open-Circuit</td>
</tr>
<tr>
<td>Saturation Curve No. for Rated Stator Current at 0 p.f lagging</td>
</tr>
<tr>
<td>&quot;V&quot; Curve No. (Capacity Curve)</td>
</tr>
</tbody>
</table>

The above resistances, reactances and time constants are defined in ASA Standards-Definitions of Electrical Terms (Group 10-Rotating Machinery, Section 31).

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**Figure II: Electrical Equipment Data Sheets, Page 2 of 2.**

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III. Protection Systems

Requirements for protection due to interconnected operation of generation facilities will vary depending on the size and type of installation and the characteristics of the T&D system at the point of interconnection. The following requirements are necessary for planning and designing generation facilities for interconnected operation with the T&D system.

A. ITO Engineering Review of Proposed Generation Facilities

Only those portions of the drawings and other design documents which apply to the Interconnection Facilities and the Intertie Protection System, see Footnote 1, will be reviewed to determine if any changes are required due to the interconnected operation of the Generator's facility.

B. Transformer Connections

Generally, the step-up transformer high voltage winding must be connected in a grounded/wye configuration. The Generator will coordinate with ITO to select a transformer connection and grounding arrangement. The transformer connection and grounding arrangement should be such that zero-sequence current can not pass through the transformer. A configuration that is not in-line with this requirement will require further studies to determine if it will be acceptable. For Distribution connected generation, the T&D system must remain “effectively grounded” such that $X_0/X_1 < 3$ and $R_0/X_1 < 1$ and that the voltage rise in the unfaulted phases does not exceed 125% of the nominal system line-to-ground voltage on the affected circuit(s).

C. General Protection System Descriptions

The ITO Protection System and the Intertie Protection System must provide the necessary level of protection for the T&D system. ITO will determine the Intertie Protection System relay settings and changes to the existing ITO Protection System or other power system equipment due to the interconnected operation of the Generator's facility.

1. Intertie Protection System

The Intertie Protection System must detect power system faults or abnormal conditions and will not take into consideration protection for the Generator's electrical system or equipment; rather it will provide protection for the T&D system and other customers. The Intertie Protection System will:

- comply with the minimum operating and safety standards set forth in these requirements and in Maine Public Utilities Commission Chapter 32 rules;
- operate to limit the severity and extent of system disturbances and damage to T&D system equipment;
- detect abnormal operating conditions and disconnect the Generator's facility when such conditions do not return to normal within certain time limits;
- communicate with utility equipment as required;

Footnote 1. The relay can protect the utility from having generators island on the system after the utility disconnects power from the feeder. This is accomplished by monitoring the intertie (point of common coupling to the utility) for abnormal voltage, abnormal frequency, and excessive power import/export, which can indicate loss of utility supply. The relay also provides detection of phase and ground faults, as well as current and voltage unbalance on the utility system.
monitor for loss of the utility supply (feed) and prevent energizing a de-energized utility circuit, except when doing so as provided under Section VI.D, “Islanded Generation Limits;” and
be located in a secure, environmentally controlled, easily maintained, and readily accessible location, such as a switchgear room.

2. Bulk Power System (BPS)

Any Generator whose facility is interconnected to the BPS will be required to meet Northeast Power Coordinating Council (NPCC) guidelines for protection requirements. These guidelines require redundant protection equipment including station batteries, breaker trip coils, station service AC supply, and breaker failure systems. ITO will verify these requirements are incorporated into BPS interconnected facilities.

3. Generator Protection System

Generators must provide the necessary Generator Protection System, see Footnote 2, to protect their own equipment. ITO will provide system data to the Generator to allow the Generator to coordinate their protective system settings with the ITO Protection System and the Intertie Protection System.

In addition to these standard protection systems, ITO may require other Special Protection Systems at certain sites. Special Protection System requirements will be determined by ITO on a case-by-case basis.

D. Quality of Protection System Equipment

Protection system components must perform under extreme environmental and electrical transient conditions. Therefore, equipment ratings must meet or exceed ANSI and IEEE Standards, i.e., all protective relays must meet or exceed ANSI/IEEE Standard C37.90-2005. In addition, protection systems must include design, maintenance, and testing features as follows:

1. Equipment Quality

The Intertie Protection System equipment, including auxiliary equipment and instrument transformers, must be utility grade (of suitable quality, proven design and commonly used in similar applications).

2. Primary Wiring

All primary or high-voltage wiring of CTs, VTs, breakers, etc., shall be in accordance with all applicable sections of the National Electrical Safety Code, State Codes, Local Codes, ITO standards and all standards of prudent electrical practice.

3. Secondary Wiring

All secondary wiring and connections on the Intertie Protection System and its associated equipment shall meet all requirements of applicable National, State, and Local Electrical Codes and all standards of prudent electrical practice.

Footnote 2. The relay can protect a generator from abnormal voltage, abnormal frequency, motoring (loss of prime mover), phase faults, ground faults, and unbalanced currents. In addition, syn check may be applied for proper connection of the generator to the bus.
All intertie relay trip outputs must be hard-wired directly to the tie breaker or interposing lock-out device. No intertie relay trip may be wired through, or derived from, any interposing device, such as a programmable logic controller (PLC) or a plant process computer.

Screws, studs, nuts, and terminals used for Intertie Protection System electrical connections shall be nickel plated brass/copper alloy. The wire used will be no smaller than #14 AWG stranded copper, except wire used for grounding of CT and VT circuits will be no smaller than #12 AWG. All wire insulation will be cross-linked polyethylene or equivalent high quality insulation (type "SIS" or equivalent). Polyvinyl chloride insulation is not permitted. The minimum rating for insulation is 600 volts. Wire terminations must utilize solderless, "Crimp-Style" ring lug terminals. "Spade" or "Fork" type lug terminals are not permitted.

E. Primary Interrupting Device

The Generator’s facility must be connected to the T&D system through a primary interrupting device. This device must be capable of interrupting the maximum fault current available at the facility. If this device is a breaker, it must be capable of opening after loss of either the facility’s generation, the T&D system, or both. In addition, this breaker must have the ability to be electrically tripped (opened) by the Intertie Protection System. If this device is a fuse it must be sized in consideration of the facility’s kVA rating and the maximum available fault current at the facility.

In certain installations, high-side fault protection may be provided by ITO’s remote-end line protection. In these specific installations, a high side fault interrupting device may not be initially required providing no other ITO customers are affected by remote-end tripping. However, future changes to the T&D system may require the Generator to install a high-side fault protection device at a later date. Under these circumstances, if ITO determines that high-side fault protection is necessary, the Generator will be responsible for the cost of installing the necessary equipment.

F. Trip Source (Battery)

The source of tripping and/or control power must be a storage battery, equipped with a battery charger, and designed and suitable for the intended use. (Small induction generators may be exempt from this requirement based upon the design of the protection systems involved.) This trip source will be ungrounded and equipped with a ground detection system.

The battery must have sufficient capacity, in accordance with appropriate IEEE Standards, to permit operation of the station in the event of a loss of the battery charger or AC supply. The battery charger must be capable of supplying the station load and be able to charge the battery. The charger shall be equipped with over/undervoltage alarms, loss of AC to charger alarm, and a battery ground alarm.

All DC peripheral devices must be fused separately from the protection systems, including the breaker trip coil(s). This will prevent the failure of any other device from jeopardizing the security of the protection systems. Use of AC voltage, or use of the generator exciter as a source of DC power, is not an acceptable alternative to the battery and charger system. The battery and breaker trip coil must be a nominal 48 volts DC, minimum. The breaker trip coils and relay circuits must be monitored for loss of DC.
G. Islanding

Islanding is the operation of the Generator's facility supplying an isolated portion of the T&D system. This operation can create hazards to personnel, other customers, and the general public, and may cause equipment damage. Because of the hazards involved, islanding must be avoided, except as provided for in Section VI.D, “Islanded Generation Limits.” Where it is allowed, the Generator's facility shall be designed with appropriate control and protection systems to safely supply connected loads while islanding.

In situations where islanding is not allowed and the Generator's facility is not immediately disconnected from the T&D system after the utility breaker opens, additional relaying and/or communications equipment will be required, at the Generator's expense. See Section I, "Transfer Trip," below.

H. Automatic Reclosing

ITO utilizes automatic reclosing to reduce outage durations of the T&D system. Should a utility recloser open due to a detected fault condition, that recloser will automatically reclose. The Generator's equipment, the T&D system, and other ITO customers' equipment is susceptible to damage if the recloser closes back in while the Generator is still connected to the T&D system. Additional fault interrupting devices may exist between the utility substation breaker and the Generator's facility. Generators are responsible for protecting their equipment from automatic or manual reclosing of all such utility devices.

I. Transfer Trip

ITO may require, or the Generator may request that ITO install, transfer trip equipment as additional protection against the Generator's facility backfeeding a portion of the T&D system. This equipment shall provide separation of the Generator's facility from the T&D system in the event of system disturbances detected by utility equipment remote from the Generator's facility. The Generator will be responsible for all costs associated with the installation, operation, and maintenance of such equipment, including the installation and ongoing costs associated with any required communications channels.

The Generator may be required to provide local breaker failure protection, which may include direct transfer tripping to the utility line terminal(s), in order to detect and clear faults within the Generator's facility that cannot be detected by ITO's back-up protection.

J. ITO's Underfrequency Load Shedding Program

The Underfrequency Load Shedding (UFLS) program is designed to match load to generation for the loss of a major tie line or the significant loss of generation, and to return the system frequency to acceptable limits following such a loss. ITO must review and report annually to the ISO New England and Northeast Power Coordinating Council (NPCC) on this program. Frequency relaying installed as part of the Intertie Protection System and the Generator Protection System will be set according to criteria which will allow ITO to meet UFLS program goals.

Each Generator is responsible to review the setting criteria to ensure that the ITO specified settings will not unduly stress their generating equipment. In instances where these settings cannot be implemented in accordance with this criteria, or where generator controls or auxiliary equipment prevent generator operation at these frequencies, ITO will install alternate load relief to compensate for the lost generation. The Generator will be responsible for the cost of providing and maintaining this alternate load relief.

Generators who have other frequency and/or speed control devices not required by ITO must coordinate the setpoints of these devices with the intertie frequency relay settings.
specified by ITO. If there is no intertie frequency relay, these other devices must be set to meet the UFLS program. The Generator will be responsible to test any of these additional devices and maintain this test information on file. Such information will be provided to ITO upon request.

K. Black Start Capability

In order to meet the requirements of ISO-NE Operating Procedures, certain generators interconnected to the T&D system may have black start capability. These generators must be able to start without an external power source, to allow for restoration of the T&D system in the event of a system-wide outage. This capability must be tested annually in accordance with ISO-NE Operating Procedure #11, unless conducting such a test would interrupt firm customer load. In this instance, the testing interval will be as agreed to by the Generator and ITO, on a case-by-case basis.

L. Generator Facility Acceptance

Before interconnected operation with the T&D system can begin, the Generator’s facility must be inspected by ITO to verify that protection system requirements are met, that operability of Intertie Protection System is verified, and that all appropriate testing has been completed. To facilitate this process, the Generator will assign a professional engineer currently licensed in the state of Maine. This person will certify in writing (PE Stamped Letter) that all testing and commissioning has been completed and the facility is ready to be energized. This individual will also act as the liaison between the Generator and ITO until the interconnection requirements have been met.

Ninety (90) Calendar days prior to the initial functional test, the Generator shall supply construction grade P & C drawings to the ITO. These drawings must provide sufficient information for ITO to analyze all functional test requirements specified below.

- CTs: rating, circuit polarity, ratio, insulation, excitation, continuity and burden tests.
- VTs: rating, circuit polarity, ratio, insulation and continuity tests.
- Relay pick-up and time delay tests.
- Functional breaker trip tests from protective relays.
- Relay in-service tests to check for proper phase rotation and magnitudes of applied currents and voltages.
- Breaker closing interlock tests.
- Paralleling and de-paralleling operation.
- Other relay commissioning tests typically performed for the relays involved.

The Generator will provide ITO a copy of all test data for evaluation fourteen (14) calendar days prior to energization. ITO will perform or observe a functional test and commissioning of the entire Intertie Protection System. This will include a calibration check of the intertie protective relays and as many trips of the intertie breaker and/or the generator breaker(s) as ITO considers necessary to verify the correct operation of the Intertie Protection System and the breaker trip circuits. Phase rotation and synchronizing will also be verified.

To facilitate this testing, test points must be accessible to permit injection of test voltages or currents to verify the calibration and operation of the components making up the Intertie Protection System. One means of providing these test points is incorporating ABB FT or GE PK test blocks into the facility design. These test points shall also
interrupt the protection system trip outputs. ITO will review and approve the testability of the Intertie Protection System as part of the initial design review.

After the final commissioning, the Generator must provide ITO with one set of accurate drawings and maintain one set on-site. Any subsequent changes to the facility impacting the Intertie Protection System must be approved by ITO before being incorporated. After incorporation, such changes must be verified by ITO and documented and incorporated into the facility prints within ninety (90) days. A set of updated prints will be provided to ITO within this time-frame.

M. Synchronizing to the T&D System

All components of the Intertie Protection System, the Generator Protection System, and the synchronizing circuits must be energized and functioning correctly before the Generator will be allowed to begin parallel operation with the T&D system.

The Generator is solely responsible for properly synchronizing to the T&D system. No more than a 3% instantaneous variation in voltage (flicker) is allowed when connecting or disconnecting any generator or station load to the T&D system. The circuit breakers associated with the generating units must be equipped with facilities to automatically or manually synchronize the generating unit with the T&D system. All synchronizing must be performed with the aid of either a synchronizing relay or a synchroscope. A sync check relay is recommended to prevent catastrophic errors during the synchronizing process. New units larger than 1 MVA directly connected to distribution load must be equipped with automatic synchronizing.

NOTE: For facilities 5 MVA or greater, the Generator must notify the Maine Satellite prior to connecting or disconnecting any generation or station load on the T&D system when such action is a planned operation.

ITO requires a detailed procedure from the Generator for the initial synchronization. The Generator’s actual synchronizing procedure will require approval from ITO. See Figure III-1 for a sample procedure. Upon complete implementation of the Generator’s procedure, assuming that all technical requirements have been met, the Generator will be allowed to connect to the T&D system and begin parallel operation.

NOTE: The Maine Local Control Center (ITO’s System Operations), must be notified at least 24 hours prior to the initial synchronizing to the T&D system by calling 1-800-750-2976 or 1-800-750-6934.

THE INITIAL SYNCHRONIZATION SHALL BE WITNESSED BY ITO.

N. Typical Installations

The installations listed in this section provide the important characteristics of connecting to a distribution line or transmission line. In general, a distribution line has only one connection with the rest of the T&D system. Transmission line and substation busses generally have two (or more) connections with the rest of the T&D system, and are typically of higher voltage. 115 kV and 345 kV are the nominal phase-to-phase transmission voltages within the T&D system. ITO also has a 34.5 kV subtransmission system.

The following subsections give a general overview of acceptable interconnection designs. Figures III-2 through III-6 are one-line diagrams for the installations listed below. Figure III-7 provides a legend of symbols used in the one-line diagrams. ALL INSTALLATIONS MUST BE REVIEWED AND APPROVED BY ITO PRIOR TO FINAL ACCEPTANCE AND COMMISSIONING.
<table>
<thead>
<tr>
<th>Type</th>
<th>Rating</th>
<th>Transformer Configuration (HV-LV)</th>
<th>Utility Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1-phase ≤ 25 kW</td>
<td>Single-phase</td>
<td>Distribution</td>
</tr>
<tr>
<td>II</td>
<td>3-phase ≤ 100 kW</td>
<td>Wye-Delta</td>
<td>Distribution</td>
</tr>
<tr>
<td>III</td>
<td>3-phase &gt; 100 kW</td>
<td>Wye-Delta</td>
<td>Distribution</td>
</tr>
<tr>
<td>IV</td>
<td>Any size 3-phase</td>
<td>Wye-Delta</td>
<td>Transmission</td>
</tr>
<tr>
<td>V</td>
<td>Any size 3-phase</td>
<td>Wye-Delta</td>
<td>Transmission-Bus</td>
</tr>
<tr>
<td>VI</td>
<td>Any size 3-phase</td>
<td>Wye-Delta</td>
<td>Subtransmission</td>
</tr>
</tbody>
</table>
Purpose: To verify proper rotation and phase relationships of primary and secondary circuits of Generator's generator and the T&D system prior to connection.

Discussion: Both the incoming and running VTs will be energized from a common source.

Rotation and phase angle checks will be taken on both VTs and the synchronizing circuits will be verified for correct operation.

Precautions: To prevent personnel injury and motoring the generator, the links between the generator and the main bus shall be removed prior to performing any switching.

The safety of the plant will be the Generator's responsibility.

Prerequisites:
• Verify that all relay and control testing has been completed and the unit step-up transformer and all other pertinent equipment is ready for energization.
• Verify that 86 devices have been reset.
• Verify generator and transformer relays are operable.
• Verify transformer auxiliaries are ready to be energized and operable.

Procedure:

a. Energize main step-up transformer from the T&D system.

b. Read and record rotation on running VTs.

c. Read and record bus voltage on running VTs for all 3-phases.
   Phase A ___________
   Phase B ___________
   Phase C ___________
   By: ___________________

d. Close generator breaker to energize incoming VTs.

e. Observe synchroscope is at 12 o'clock position. If not at 12 o'clock position, STOP and inform ITO.
   By: ___________________

f. Read and record rotation on incoming VTs. Should be the same as running VTs. If not, STOP and inform ITO.
   By: ___________________

g. Read and record bus voltage on incoming VTs for all 3-phases.
   Phase A ___________
   Phase B ___________
   Phase C ___________
   By: ___________________

h. Should be the same as running VTs. If not, STOP and inform ITO.
   By: ___________________

i. Return system to normal.

j. Reinstall generator links.

k. Rack generator breaker into test position.

l. Bring unit up to rated speed and voltage.

m. Using a strip chart recorder, record voltage and speed matching capability.

n. Allow auto synchronizing equipment to close generator breaker in test position. Record phase angle difference between generator bus and the T&D system at time of closing. Mismatch must be less than 1% between the incoming and running volt-meter. The phase difference must be zero. (This information required to be on file with ITO.)

o. Open the generator breaker.

NOTE: If provisions have been made for manual synchronizing, the operator must demonstrate his ability as follows:

p. Select sync selector to "Manual".

q. Adjust unit speed allowing at least 6 seconds per revolution on the synchroscope (generator faster than the T&D system).

r. Adjust voltage to less than 1% voltage mismatch.

s. At 6 seconds per revolution, the operator would initiate the close pulse approximately 5 degrees prior to the 12 o'clock position.

t. Record phase angle difference between generator bus and the T&D system at time of closing.

u. Rack generator breaker into normal operating position and repeat synchronizing procedures n. through t.
   By: __________________ (This information required to be on file with ITO.)

Final Conditions:

• Synchronizing procedure has been completed.

Date/Time: __________________

Operator: __________________

Figure III-1: Sample Synchronizing Procedure for Commissioning.
1. TYPE I INSTALLATIONS (Figure III-2)

These are small, single-phase, induction generators or static power converters connected to a
distribution circuit, usually 12KV (7200V phase to neutral). These units are usually protected by
a molded case circuit breaker and utilize a separate contactor for controlling the generator
connection. They require one over-frequency relay, one under-frequency relay, one over-
voltage relay, and one under-voltage relay to control the contactor. Utility voltage must be re-
established and stable before the Generator is allowed to reconnect. While some power may
flow onto the T & D system from this type installation, the primary purpose of this type
installation is to supply power to the home or small business to which it is connected. The
following are typical characteristics of the Type I installation:

- Designed by a manufacturer as a complete system and meeting UL1741 and/or IEEE
  1547 standards planned for a connection to a 240V, 2-pole molded case breaker.

- Contactor is sized in accordance with the manufacturer’s specifications. In the absence
  of a manufacturer’s specification, this contactor will be sized no less than 2.0 times the
  available current at the rated output (KVA) of the generator/static power converter.

- Details shown on Figure III-2 for this Type I installation provide the important
  characteristics of the design philosophy for connecting to the ITO system and are not
  intended to be inclusive of all project specific requirements. Location of a proposed
  Generator within the ITO system may extend the requirements shown to ensure reliable
  dispatch, control, and protection for both the ITO and Generator.
Figure III-2: Type I Typical Installation.

NOTES:
1. Synchronizing is required on all synchronous generators.

DEVICE | FUNCTION | TRIPS
--- | --- | ---
27 | Undervoltage | C
29 | Test facility | C
52 | Fault interrupting device | C
59 | Overvoltage | C
81-O | Overfrequency | C
81-U | Underfrequency | C

*SPCS - Static Power Converters

This drawing is a guide only, and not intended to be used as a sole basis for design.
2. TYPE II INSTALLATIONS (Figure III-3)

These are three-phase generators (induction or synchronous) or static power converters with a maximum generation of 100KW connected to a distribution circuit, usually 12KV (7200V phase to neutral). This installation provides for power flow from the Generator’s facility to the T & D system. However, the primary reason for the generation may be to supply the Generator’s own load.

- This installation requires a primary circuit breaker, circuit switcher, recloser, or contactor designated as component “52G” in Figure III-3.

- If fused on the high-side, the fuse size will be specified by ITO based on the generator output, the Generator facility’s load, and the available fault current at the generator’s location.

- The Generator’s control scheme for breaker “52M” must be designed to allow for its closing only if the feed from ITO is energized, and breaker “52G” is open. If breaker “52M” is open and breaker “52G” is closed, the Generator may synchronize across breaker “52M”. If the feed from ITO is not energized, then the Generator’s control scheme must prevent closing of breaker “52M”. If “52M” is a fuse, the Generator’s control scheme must prevent closing of “52G” if the feed from ITO is not energized.

- Voltage Transformers providing sensing input to Inter-tie Protective Relays must be continuously rated for line-to-line voltage.

- Details shown on Figure III-3 for this Type II installation provide the important characteristics of the design philosophy for connecting to the ITO system and are not intended to be inclusive of all project specific requirements. Location of a proposed Generator within the ITO system may extend the requirements shown to ensure reliable dispatch, control, and protection for both the ITO and Generator.
Figure III-3: Type II Typical Installation.
3. TYPE III INSTALLATIONS  (Figure III-4)

These are three-phase generators (induction or synchronous) or static power converters with generation greater than 100KW connected to a distribution circuit, usually 12KV (7200V phase to neutral). This installation provides for power flow from the Generator’s facility to the T & D system as a normal operating mode. However, the primary reason for the generation may be to serve the Generator’s own load.

Typically, a distribution circuit can accept up to 1MVA of generation with the Inter-tie configuration shown in Figure III-4. The ITO will study any facility greater than 1MVA and may study smaller facilities in this category to determine if additional or different Inter-tie protection equipment is required.

- This installation requires a primary circuit breaker, circuit switcher, recloser, or fuse designated as component “52L” in Figure III-4, that is capable of interrupting the maximum available fault current at this location.

- The Generator’s control scheme for breaker “52L” must be designed to allow for the closing of “52L” only if the feed from ITO is energized. If the feed from ITO is not energized, then the Generator’s control scheme must prevent closing of breaker “52L”.

- It may be desirable to have synchronizing equipment on breaker “52L” as well as breaker “52G”.

- The ITO may require a transfer trip system, at the Generator’s expense, to allow automatic separation of the generator from the T & D system in the event of system disturbances detected by utility equipment remote from the generating site.

- Voltage Transformers providing sensing input to Inter-tie Protective Relays must be continuously rated for line-to-line voltage.

- Details shown on Figure III-4 for this Type III installation provide the important characteristics of the design philosophy for connecting to the ITO system and are not intended to be inclusive of all project specific requirements. Location of a proposed Generator within the ITO system may extend the requirements shown to ensure reliable dispatch, control, and protection for both the ITO and Generator.
NOTES:
1. Synchronizing is required on all synchronous generators.
2. All VTS rated for line to line voltage.
3. Generator ground fault protection is only required for synchronous generators. Either ground overvoltage or neutral overcurrent relaying will be required according to CMP requirements.
4. If 52L is a breaker or recloser, then overcurrent relaying is required to provide transformer protection.

Figure III-4: Type III Typical Installation.
4. TYPE IV INSTALLATIONS (Figure III-5)  
CONNECTED TO ITO TRANSMISSION LINE - NO EXISTING SUBSTATION

These are three phase generators interconnected to the 115 or 345kV transmission system. This installation provides for power flow from the Generator’s facility to the ITO as a normal operating mode. A new interconnecting ITO substation is required.

- This installation requires a primary circuit breaker or circuit switcher designated as component “52L” in Figure III-5 capable of interrupting the maximum available fault current at this location.

- System Operations directly controls the operation of all switching devices on the utility transmission system. On this type installation, the Generator's switches affected are the tie disconnect switch, the station grounding switch, and “52L”.

- The Generator’s control scheme must be designed to allow for the closing of breaker “52G” only if the feed from ITO is energized or breaker “52L” is open. If breaker “52L” is open and breaker “52G” is closed, the Generator may synchronize across breaker “52L”. If the feed from ITO is not energized, then the Generator’s control scheme must prevent closing of both breakers “52G” and “52L”. Black start facilities will require an override to this control that will be utilized only under the direct authorization of System Operations.

- This installation requires pilot channel relaying and/or transfer trip for high speed fault clearing capability.

- The ITO may require a transfer trip system, at the Generator’s expense, to allow automatic separation of the generator from the T & D system in the event of system disturbances detected by utility equipment remote from the generating site.

- Voltage Transformers providing sensing input to Inter-tie Protective Relays must be continuously rated for line-to-line voltage.

- When interconnecting to the Bulk Power System (BPS), the ITO will require the Generator to provide two independent, redundant protection systems in accordance with ISO New England and NPCC criteria. This will also be required for facilities interconnected to the transmission system if ITO determines that delayed clearing of faults within the Generator’s facility could adversely affect the BPS system.

- Details shown on Figure III-5 for this Type IV installation provide the important characteristics of the design philosophy for connecting to the ITO system and are not intended to be inclusive of all project specific requirements. Location of a proposed Generator within the ITO system may extend the requirements shown to ensure reliable dispatch, control, and protection for both the ITO and Generator.
Figure III-5: Type IV Typical Installation.
5. TYPE V INSTALLATIONS (Figure III-6)

**CONNECTED TO ITO TRANSMISSION SUBSTATION**

This installation is interconnected to the utility transmission system through an existing 34.5, 115kV, or 345kV substation. The substation will be connected to at least two (2) utility transmission line sections. This design provides for power flow from the Generator's facility to the utility as a normal operating mode.

Because the facility is connected to a transmission substation, some of the standard inter-tie protection for the other installation types may not be required. Specifically, over/under frequency and undervoltage protection may not be required where a Generator will not island to serve local distribution load. As shown in Figure III-6, other protection, such as bus differential relaying may be required to meet site-specific conditions.

- As with the Type IV installation, a primary breaker is required, rated to interrupt maximum available fault current designated as “52B” in Figure III-6. This breaker, along with the associated breaker disconnects, bypass switch, and grounding switch will be under the direct control of System Operations.

- The Generator's control scheme must be designed to allow for the closing of breaker “52G” only if the feed from ITO is energized or breaker “52L” is open. If breaker “52L” is open and breaker “52G” is closed, the Generator may synchronize across breaker “52L”. If the feed from ITO is not energized, then the Generator's control scheme must prevent closing of both breakers “52G” and “52L”. Black start facilities will require an override to this control that will be utilized only under the direct authorization of System Operations.

- The ITO may require a transfer trip system, at the Generator's expense, to allow automatic separation of the generator from the T & D system in the event of system disturbances detected by utility equipment remote from the generating site.

- When interconnecting to the Bulk Power System (BPS), the ITO will require the Generator to provide two independent, redundant protection systems in accordance with ISO New England and NPCC criteria. This will also be required for facilities interconnected to the transmission system if ITO determines that delayed clearing of faults within the Generator's facility could adversely affect the BPS system.

- Details shown on Figure III-6 for this Type V installation provide the important characteristics of the design philosophy for connecting to the ITO system and are not intended to be inclusive of all project specific requirements. Location of a proposed Generator within the ITO system may extend the requirements shown to ensure reliable dispatch, control, and protection for both the ITO and Generator.
Figure III-6: Type V Typical Installation.
Figure III-7: Legend of Schematic Symbols.
6. TYPE VI INSTALLATIONS

These are three-phase generators (synchronous or induction) interconnected to the utility subtransmission system (34.5 kV). The interconnection requirements for this type installation could be the same as a Type III or Type IV facility or could lie somewhere in between the requirements for these installation types. Actual requirements will be determined by ITO on a case-by-case basis.

O. Protection System Device Numbers and Functions

<table>
<thead>
<tr>
<th>Device</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>21P</td>
<td>Primary Line Relaying</td>
</tr>
<tr>
<td></td>
<td>This relay is required to interface with remote terminal relaying and requires some type of transfer tripping or pilot communications scheme.</td>
</tr>
<tr>
<td>27</td>
<td>Undervoltage Relay</td>
</tr>
<tr>
<td></td>
<td>This relay is used to detect a low voltage condition and is usually set at 90% of nominal system voltage.</td>
</tr>
<tr>
<td>29</td>
<td>Test Facility</td>
</tr>
<tr>
<td></td>
<td>This device is used to isolate components and relays from their respective source(s) and load(s) to facilitate maintenance and testing.</td>
</tr>
<tr>
<td>50/51</td>
<td>Overcurrent Relays</td>
</tr>
<tr>
<td></td>
<td>These relays are used to detect transformer faults and initiate tripping of the intertie breaker without causing loss of service to other ITO customers. The time overcurrent element will be set to coordinate with ITO’s line relaying. The instantaneous element will typically be set to provide high-speed clearing of transformer internal faults.</td>
</tr>
<tr>
<td>50/51G</td>
<td>Ground Overcurrent Relay</td>
</tr>
<tr>
<td></td>
<td>This relay is used to detect feeder unbalance and coordinate with other protective devices on the circuit.</td>
</tr>
<tr>
<td>50/51N</td>
<td>Neutral Ground Overcurrent Relay</td>
</tr>
<tr>
<td></td>
<td>The time overcurrent and instantaneous elements of this relay are used to detect bus ground faults by sensing a transformer neutral current.</td>
</tr>
<tr>
<td>51V</td>
<td>Voltage Controlled Overcurrent Relay</td>
</tr>
<tr>
<td></td>
<td>This relay is used to detect feeder faults and to trip the Generator’s facility when coordination with other protective devices on the circuit is required. The overcurrent element is typically set considering the generator’s damage curve. The voltage element will typically operate at 80% of normal system voltage to obtain the clearing required yet maintain the generation during a sag in system voltage.</td>
</tr>
<tr>
<td>52</td>
<td>AC Circuit Breaker</td>
</tr>
<tr>
<td></td>
<td>A device used to close and interrupt an AC power circuit under normal conditions and to interrupt the AC circuit under fault or emergency conditions.</td>
</tr>
<tr>
<td>59</td>
<td>Overvoltage Relay</td>
</tr>
<tr>
<td></td>
<td>The time overvoltage element on this relay is required to detect an high voltage condition. It will be set 10% above the normal system voltage on distribution circuits and 15% above the nominal system voltage on transmission circuits. The instantaneous element may be required to detect ferroresonance or extreme overvoltages possible during fault conditions. It will be set 20-30% above the normal system voltage.</td>
</tr>
<tr>
<td>Device</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>59G/I</td>
<td><strong>Instantaneous Ground Overvoltage Relay</strong></td>
</tr>
<tr>
<td></td>
<td>This relay is used to detect ground faults when the high-voltage side of the</td>
</tr>
<tr>
<td></td>
<td>generator step-up transformer is ungrounded. This relay requires three voltage</td>
</tr>
<tr>
<td></td>
<td>transformers connected grounded-wye on the high-side and broken-delta on the</td>
</tr>
<tr>
<td></td>
<td>low side. The 59G/I relay is connected across the broken delta to measure the</td>
</tr>
<tr>
<td></td>
<td>zero sequence voltage (Vo) on the feeder. It is normally set at approximately</td>
</tr>
<tr>
<td></td>
<td>110% of the rated single phase VT secondary voltage and provides protection</td>
</tr>
<tr>
<td></td>
<td>for extreme ground overvoltage conditions. This relay must also be able to</td>
</tr>
<tr>
<td></td>
<td>withstand 3 times the rated single phase VT secondary voltage.</td>
</tr>
<tr>
<td>59G/T</td>
<td><strong>Time Ground Overvoltage Relay</strong></td>
</tr>
<tr>
<td></td>
<td>This relay is used for the same purpose and connected in the same manner as</td>
</tr>
<tr>
<td></td>
<td>the 59G/I relay. The overvoltage relay must be able to withstand 3 times the</td>
</tr>
<tr>
<td></td>
<td>rated single phase VT secondary voltage, and is usually set for approximately</td>
</tr>
<tr>
<td></td>
<td>20% of the single VT secondary voltage with a time delay of approximately 1</td>
</tr>
<tr>
<td></td>
<td>second.</td>
</tr>
<tr>
<td>81O/U</td>
<td><strong>Over and Underfrequency Relays</strong></td>
</tr>
<tr>
<td></td>
<td>Used to prevent islanding of the generator facility with other ITO customers.</td>
</tr>
<tr>
<td></td>
<td>These relays shall be set in accordance with NPCC Regional Reliability</td>
</tr>
<tr>
<td></td>
<td>Reference Directory 12.</td>
</tr>
<tr>
<td>87T</td>
<td><strong>Transformer Differential Relay</strong></td>
</tr>
<tr>
<td></td>
<td>This relay is used to detect internal transformer faults and is required on</td>
</tr>
<tr>
<td></td>
<td>larger installations to coordinate with transmission line relaying.</td>
</tr>
</tbody>
</table>

**P. Exceptions**

While the majority of installations have been discussed, this document cannot cover every possible contingency or variation in equipment to be encountered at the various Generator installations. Questions on the protective relaying to be used at any installation not covered by this document shall be addressed to ITO.
IV. Metering

Any location where a Generator’s facility is connected in parallel with the T&D system will be metered to measure energy flow in two directions. The metering requirements contained herein assume bi-directional metering at the point of interconnection. Any other metering arrangement will require approval of, and design by, ITO.

A. In and Out Metering

Metering of energy flowing from the T&D system into a customer is known as "IN" Metering and metering of energy flowing out from a Generator’s facility to the T&D system is known as "OUT" Metering.

B. Metering Location

Metering shall be located at the point of delivery whenever practicable. Advance Company approval of metering location is required.

Loss compensation is required if the metering equipment is not installed at the point of delivery. Loss compensation is determined based upon CMP Terms and Conditions 12.8 METER LOCATION ADJUSTMENT and ISO NE’s OP-18 Metering and Telemetering Criteria.

When service is metered at a lower or higher voltage than the delivery voltage, the measured kWh will be increased or decreased by a fixed percentage or, at the option of the Company, a continuous on-site adjustment will be made through compensating metering equipment or a factor applied based on the transformer manufacturer’s data.

If a fixed factor is used to compensate metering equipment, the fixed factor shall be calculated using the peak output rating of the generator. The fixed factor will take into account all transformer losses and line losses between the metering point and the point of delivery.

Loss compensation programmed into the meter is based on transformer and line characteristics.

When necessary to compensate for transformer losses, the following information is required; transformer primary voltage, transformer secondary voltage, full load kVA, no load percent exciting current, no load Watt loss, full load percent impedance, and full load Watt loss.

When necessary to compensate for line losses, the following information is required; Volts line to line, charging kVARhs, line resistance in Ohms, and line inductance in Ohms.

C. Net Energy Billing

When the generation is 100 kW or less and the Generator elects Net Energy Billing, ITO will provide, install, own, maintain, and test at its expense the metering equipment required to measure energy flowing both "IN" and "OUT".

The Generator will provide the meter mounting device or the necessary metering enclosures and metering conduit for the "IN" meter per ITO’s Handbook of Requirements for Electric Service and Meter Installations. For Net Energy Billing generation facilities equipped with single-phase, 100 or 200 Amp, self-contained metering, ITO will provide the meter mounting device for the "OUT" meter. This may consist of a separate
enclosure or a special adapter (adapts a standard socket base to a two socket arrangement). As an alternative, when the “net” energy flow is IN every month, ITO may elect to install a solid state “net energy” meter (currently available for single-phase 200A and 320A only).

The following guidelines are to be used to determine the Net Energy Billing metering requirements:

1. Meters

   All installations will require two standard kWh (or Time-of-Use) meters with detents or one solid state bi-directional or “net energy” meter.

2. Demand Register

   All General Service (non-residential) installations above the Small General Service (SGS) retail rate will require the addition of a demand register to measure "IN" kW demand.

3. “IN” kVAR

   Three phase installations may require the addition of "IN" kVAR metering.

Central Maine Power Company’s (“ITO’s”) Power Contracts Administration administers the Customer Net Energy Billing Agreements (“CNEBAs”). The following items must be completed before operating a facility in parallel with ITO’s system:

- **A signed contract**

  Two original CNEBAs will be sent to the customer for signatures, which must be witnessed. Both originals should be returned to the Contract Administrator. ITO will execute the CNEBA and will return one executed original to the customer.

- **Meter upgrades**

  ITO will arrange for the necessary metering equipment to be installed. For residential existing and new services equipped with a single-phase, self-contained, 100 or 200 amp meter socket, in most instances, ITO will connect the meters using a ITO furnished meter adapter in the customer’s single meter socket. For all other services, both existing and new, a separate enclosure for the out meter is required as a meter adapter cannot be used. For all new services, the customer is responsible for installing the meter enclosure(s) in accordance with ITO’s Handbook of Standard Requirements. ITO will pay for the “out” metering enclosure. As an alternative, where the “net” energy flow is IN every month, ITO may elect to use a solid-state “net energy meter” (currently available for single-phase (non-demand) 200 amp and 320 amp only).

- **Satisfactory inspection**

  The customer must procure all necessary licenses and permits (DEP, EAP, FERC, etc.) as required. All local, state, and federal applicable requirements apply.

  ITO requires the installation of specific hardware, such as protective relaying, to ensure that ITO’s power quality is maintained. Many pre-manufactured, self-contained systems may already contain such equipment. The customer will be responsible for the cost of any material requirements.

  ITO will inspect and test the interconnection equipment, as necessary. The customer may be responsible for the cost of the initial inspection and testing.

  Upon receipt of acceptable interconnection inspection results, the customer will be authorized to operate the facility in parallel with ITO’s system.
D. "OUT" Metering (Other than Net Energy Billing)

ITO will own, maintain, and test all metering equipment required to measure and record energy flowing "OUT" from the Generator's facility to the T&D system. "OUT" Metering equipment will be installed at the Generator's expense (see Section H, "Metering Costs," below).

The Generator must provide the necessary metering conduits and enclosures in accordance with ITO’s Contractor's Handbook. The Generator must also provide telephone service to any required electronic meter with recorder at their own expense. All metering equipment and installations will be approved, inspected, tested, and maintained in keeping with standard ITO policy, as well as State, Federal, and ISO New England requirements, as applicable.

The following guidelines should be used to determine the "OUT" Metering requirements for specific installations:

1. All Installations
   All installations, regardless of size, must include kWh and kVARh measurement.

2. Installations with Special Contract Requirements
   All installations with special contract requirements (On-peak/Off peak, demand limits) and installations larger than 1 MW generation must also include an electronic meter with recorder (remotely interrogated via the telephone line).

3. Installations Larger Than 5 MW Generation
   All installations with generation above 5 MW must include the necessary equipment for telemetering MW, MVAR, kV, and MWh to System Operations. (Refer to Chapter V, “Supervisory Control and Data Acquisition, “for additional information.)

   Metering equipment must meet ISO-NE Operating procedure OP 18 requirements.

E. "IN" Metering (Other than Net Energy Billing)

ITO will provide, install, own, maintain, and test at its expense, all "IN" Metering equipment required to measure energy flowing "IN" to the Generator's facility.

The ITO-owned metering devices will normally be located in or on the Generator's structures with access provided for ITO personnel. Other arrangements are possible by mutual agreement.

The Generator must provide the necessary metering conduits and enclosures in accordance with ITO’s Contractor’s Handbook. The Generator must also provide telephone service to any required electronic meter with recorder at their own expense.

All metering equipment will be inspected, tested, and maintained in keeping with standard ITO policy as well as State and Federal requirements, as applicable.

Unless ITO agrees otherwise, the following guidelines must be used to determine the "IN" Metering requirements for specific installations:

1. All Installations
   All installations, regardless of size, must include kWh/kWD and kVARh/kVARD measurement.
2. Installations with Load Greater Than 400 kW

All installations with load above 400 kW must also include time-of-use measurement (for kWh/kWD and kVARh/kVARD) and an electronic meter with recorder.

NOTE: Both “IN” and “OUT” measurement requirements above may be provided by one (1) solid-state, bi-directional meter.

F. Metering One-Line Diagrams

Diagrams of five typical metering schemes are included as Figures IV-1 through IV-5 at the end of this section.

G. Metering Enclosure Mounting Diagrams

Diagrams of two typical meter enclosure mounting schemes are included as Figures IV-6 and IV-7 as typical reference material. Installation-specific diagrams will be provided by ITO upon request.

H. ITO Approval

ITO approval must be obtained for the design and specifications of any metering equipment, such as in the case of switchgear installations furnished by the Generator. Factory certification of tests is required for all instrument transformers.

I. Metering Costs

With the exception of Net Energy Billing, the Generator must pay in advance ITO's estimated equipment and installation cost, including any engineering and computer programming costs, for any "OUT" Metering equipment. This charge will include the cost of bi-directional meters and instrument transformers (VTs and CTs) if their primary purpose is the measurement of energy flowing "OUT" from the Generator's facility to ITO. In the case of existing installations, this charge may also include the cost of any modifications of "IN" Metering required to accommodate the Generator. Final billing will be adjusted to actual costs upon completion of the work. ITO may charge replacement cost if the equipment installed is not new.

In addition to the one-time charge for metering equipment, a monthly operation and maintenance (O&M) charge shall be assessed on the installed value of the metering equipment required to provide the "OUT" Metering. This charge will vary if either the equipment or the O&M rate is modified. The carrying charge rate will be updated and become effective June 1st of each year pursuant to the ISO New England OATT, Schedule 21-CMP, Schedule 13. There is also a monthly charge for recording and processing pulse data.

All metering equipment installed shall be owned and maintained by ITO.

J. Test and Calibration

ITO may test the metering equipment periodically. Tests are made in accordance with ITO's meter testing program (which complies with MPUC Chapter 32, ISO-NE Operating Procedure No.18 and applicable ANSI standards) and are typically scheduled annually. The Generator's representatives may be present to witness such tests.

K. Grandfathering Existing Metering

Certain existing metering arrangements which do not fully comply with the requirements above may be “grandfathered” as acceptable. Such arrangements must be approved by ITO and include the following:
• Metering of gross generator output and station service, in lieu of, interconnection-point metering.

• No measurement of kVARh “OUT.”

• Ownership and maintenance of CT’s and VT’s by the Generator, ie., metering other than interconnection-point where CT’s and VT’s are shared by ITO and the Generator.
Figure IV-1: Metering: 25 kW or Less Single-Phase Generation

NOTES:
1. THE ABOVE DIAGRAM IS TYPICAL FOR METERING A RESIDENTIAL (RATE 'A') CUSTOMER WITH GENERATION (25kW OR LESS). IF THE CUSTOMER IS ON RATE 'A-TOU', THEN BOTH METERS WILL BE TOU METERS. A GENERAL SERVICE CUSTOMER WILL BE REQUIRED TO HAVE A DEMAND REGISTER ON THE "IN" METER.
2. OUT METER IS ACTUALLY WIRED BACKWARDS.
3. REFER TO CMP'S CUSTOMER NET ENERGY BILLING AGREEMENT PROCEDURES.
Figure IV-2: Metering: 25 kW - 100 kW Generation & 0 - 400 kW Load.

NOTES:
1. The above diagram is typical for metering a general service (Rate 'SOS' or 'MG5') customer with generation (25kW - 100kW). 'TOU' registration may be required on both meters and/or 'KVAR' registration may be required on the 'IN' meter depending on the customer's applicable rate.

2. Out meter is actually wired backwards.
Figure IV-3: Metering: 25 kW – 100 kW Generation & > 400 kW Load.
Figure IV-4: Metering: 100 kW - 5 MW Generation Any Load.

NOTES:
1. The above diagram is typical for metering a general service (Rate 'MGS', 'IGS', OR 'LGS') customer with generation (100KW - 5MW).
2. Out meter is actually wired backwards.
Figure IV-5: Metering: > 5 MW Generation Any Load.

NOTE:
The above diagram is typical for metering a general service (Rate 'MGS', 'IGS', or 'LGS') customer with generation (Above 5MW).

WH/M = ELECTRONIC MULTIFUNCTION 4 QUADRANT METER WITH INTEGRAL RECORDER/DNP OUTPUT AND MODEM
("*"): (2) CT & (2) VT FOR 3 PH 3W METERING
(3) CT & (3) VT FOR 3 PH 4W WYE METERING
CT = CURRENT TRANSFORMERS
VT = VOLTAGE TRANSFORMER
P/T = PROTECTOR/TELEPHONE SURGE

ABOVE 5MW GENERATION
ANY LOAD
TRANSFORMER-RATED METERS

CENTRAL MAINE POWER CO. METERING CONSTRUCTION STANDARDS
Figure IV-6: Pole Mounted Meter Enclosure Mounting.
Figure IV-7: Underground Meter Enclosure Mounting.
V. Supervisory Control and Data Acquisition

The Generator is obligated to meet not only the requirements specified in this document but also the requirements documented by ISO-NE’s OP18 Metering and Telemetering Criteria Operating Procedure. ITO employs a Supervisory Control and Data Acquisition/Energy Management System (SCADA/EMS) to control and monitor the status of the T&D system. This SCADA/EMS system provides real time status of the T&D system and its components by collecting information from each installation via a Remote Terminal Unit (RTU). These RTUs are interconnected by data communications facilities to the ITO’s Primary and Back-up SCADA/EMS computers. The SCADA/EMS computers are used by System Operations personnel who are responsible for power system operation and for interfacing with the ISO NE.

A. RTU Requirements

The Generator’s RTU must be compatible with ITO’s SCADA/EMS computer. The preferred communications protocol to be used with such SCADA RTU equipment is DNP3 although the Leeds and Northrop CONITEL protocol may be permitted in special circumstances. Communication equipment design and procurement must be reviewed by ITO to ensure this compatibility.

The RTU and Communication power supply requirements shall meet, as a minimum, the requirements specified under ISO-NE’s OP18 Metering and Telemetering Criteria Operating Procedure Section VIII. Any required maintenance or repair on the RTU and/or Communication equipment must be completed expeditiously to return the RTU to continuous operation.

B. Normal SCADA Point Requirements

Generators that are required to install an RTU shall provide for the following telemetry.

1. Analog Data (for each generating unit)
   - Unit Net Real Power Output (Megawatts)
   - Unit Net Reactive Power Output (Megavars)
   - Unit Output Voltage (Kilovolts)

2. Digital Data (for each generating unit)
   - Unit Net Hourly Energy Output (Megawatthours)
   - Net Hourly Energy Input (Megawatthours) (where required)

3. OPEN/CLOSED Status of Each Generator Circuit Breaker

4. Scanning Frequency

The following are required scan rates for scanning the data quantities indicated:

- Analog data: scan every ten seconds.
- Status data: scan every two seconds.
- AGC data: scan every five seconds
  (Automatic Generation Control)
C. Automatic Generation Control
For each unit participating in Automatic Generation Control (AGC), the following functionality shall be required in addition to the SCADA requirements listed in Section V. B.

1. Unit Control Status (Auto/Manual)
2. Raise/Lower AGC Adjustment by direct transmission of the AGC load target setpoint values to the unit’s control computer or other regulating apparatus.

D. Additional SCADA Point Requirements
ITO, at its discretion, may require the following data quantities, measured at the point of interconnection with the T&D system, in addition to or in lieu of the quantities listed in Section V.B:

1. Analog Data
   • Net Real Power flow (Megawatts)
   • Net Reactive Power flow (Megavars)
   • System voltage (Kilovolts)
   • Automatic High and Low Operation Limit for each unit
2. Digital Data
   • Net Hourly Energy Output (Megawatthours)
   • Net Hourly Energy Input (Megawatthours)
3. Other Data
   • OPEN/CLOSED status of each Circuit Breaker (if any) between the Generator Breakers referenced in Subsection B.3, above, and the point of interconnection with the T&D system.
   • Miscellaneous trouble alarms (if any) associated with protective relay equipment considered vital to the protection of the transmission system. (Examples: "Loss of Transfer Trip Guard Tone", "Power Line Carrier Checkback Failure", and "Loss of Protective Relay DC.")

E. SCADA Communication Requirements
The Generator is responsible for the cost to install and maintain two a continuous SCADA communications paths. The first shall be between the ITO’s Primary SCADA/EMS computer in Augusta, Maine and the generation facility. The second shall be between the ITO’s Back-Up SCADA/EMS computer in Fairfield, Maine and the generation facility. Information can be transmitted via a telephone company provided circuit or via a private communications carrier. In some circumstances, the utility Data Communications Network may be utilized for a fee to provide the connection to the ITO Control Centers, as noted above. The ITO reserves the right to approve or disapprove of this later option on a case by case basis.
1. Channel Requirements

The primary demarcation for circuit termination will be at the Master Control Center in Augusta, Maine and will meet current Bell System digital circuit standards applicable to serial DNP3 communication facilities.

A second demarcation for SCADA communication circuit termination must also be provided at the ITO Backup Control Center located in Fairfield, Maine.

2. Maintenance

All Generation facilities with AGC are required to have 7 days-per-week, 24 hours-per-day repair capability for all SCADA circuits. All non-AGC generation facilities will undertake to effect SCADA circuit repairs as soon as reasonably possible in a time period negotiated with the System Operator.

F. SCADA Point Listing & RTU Configuration Data Schedule Requirements

The ITO requires that any and all SCADA Point Listing(s) and RTU Configuration data be submitted to the ITO for review and approval no later than forty five (45) Calendar Days prior to the projected energization date of any new facility interconnection and no later than fifteen (15) Calendar Days for any subsequent SCADA or Communication changes associated with an existing interconnected facility. The Generator Owner shall be responsible for coordinating with the ITO EMS representative(s) all SCADA data collections and Communication additions or modifications thereto.
VI. Power Quality

The Maine Public Utilities Commission has established certain criteria for ITO to meet in order for all power consumers to be served in a manner consistent with expected power quality standards. The following criteria are established to ensure that generation facilities within the utility service area provide the power quality expected by power consumers and other generators.

A. Voltage

The voltage from synchronous generators must be controlled so that ITO can maintain the distribution voltage within ±5% of nominal. Voltage limits for generation facilities connected to the T&D system will be determined by ITO. Any facility with synchronous generators may be required to provide voltage support to the T&D system by operating their generator at any point within the generator’s capability curve as directed by System Operations.

B. Step Voltage Change and Flicker

A sudden (step) voltage change at the Point of Common Coupling, see Footnote 3., caused by the Generator’s facility must not exceed 3% of the nominal voltage.

Flicker, or the impression of fluctuating brightness, if caused by repetitive voltage fluctuation of Generator’s facility, will be assessed according to IEEE Std. 1453-2004.

C. Harmonic Content

The harmonic content of the voltage and current waveforms on the T&D system must be restricted to levels which will not cause any interference or equipment operating problems for customers. Minimum requirements for limitations of harmonic content on the T&D system shall comply with IEEE Standard 519.

Harmonic problems will also be addressed on a complaint basis. If ITO determines that the Generator’s facility is the cause of a harmonic problem, then that generation must be removed from the T&D system until the condition is resolved. In addition, all costs associated with research and corrective action, including settlements paid to other customers, will be at the Generator’s expense.

D. Islanded Generation Limits

Under certain circumstances, ITO may request that the Generator serve local distribution load while isolated from ITO. To accommodate these situations, the voltage and frequency limits will be specified by ITO. These will be reviewed and approved by ITO on a case-by-case basis.

Footnote 3. Point of Common Coupling means the point in the interconnection of a customer generator facility with an electric delivery system and shall have the same meaning as in IEEE Standard 1547.
VII. **Safety**

The interconnection of multiple generation facilities (controlled by many independent companies) on the T&D system introduces additional safety concerns and the need for good communications between ITO and all Generators. This also requires that additional steps be added to ITO’s work procedures for all feeders known to supply interconnected generation facilities.

**A. Switching and Tagging**

Strict adherence to established Switching, Tagging and Grounding procedures must be maintained for the safety and protection of all personnel. All switching operations of the Dispatch Point of Demarcation / DP Switch at the Generator’s site will be performed in accordance with ITO's "Switching and Tagging Procedures" manual. ITO will lock this switch in the appropriate position (open or closed) based upon T&D system requirements.

The Generator will provide to the CMP Manager-Dispatch & ECC of System Operations, with a switch and tag list of all Generator personnel trained and qualified to operate this switch annually or any time the list changes. This list will be certified and maintained by the Generator. Qualified Generator personnel who are on the switch and tag list may operate the switch, under the jurisdiction of System Operations, to the appropriate position based on Generator requirements. This provision is made to allow the Generator to comply with Occupational Safety and Health (OSHA) requirements for deenergizing lines and equipment for employee protection. Should the Generator not have anyone qualified to operate the DP, the Generator will provide a list of Authorized personnel that are knowledgeable about the status of the Generator’s equipment from the T&D system. This must be someone who will take responsibility for the status of the equipment, and give CMP authority to energize. These Generator Qualified personnel names must be provided to the CMP Manager-Dispatch & ECC as above and are the only people that are authorized to contact System Operations to discuss operations of the DP. Generator personnel not on the switch and tag list will not be allowed to operate the tie disconnect switch.

During the construction phase (prior to commercial operation), the developer shall provide a list of contacts who meets the CMP requirements as outlined in this section to take responsibility for switching and tagging at the demarcation point at the time of energization.

**B. ITO Responsibility**

When ITO is required to work on a Generator’s premises, an inspection of the work area will be made by ITO representatives. If ITO believes that hazardous working conditions exist, the Generator will be required to correct the unsafe condition before ITO will commence work.

**C. Generator Responsibility**

The Generator is responsible for establishing a program to comply with all required safety regulations for protection of personnel.

1. **Switch Operation**

   Should opening of the Dispatch Point of Demarcation / DP Switch be required, the Generator with 5 MVA and above of generation, must contact System Operations at 1-800-750-2976 or 1-800-750-6934. This call must be placed two (2) workdays before the switching needs to be done. Generators with less than 5
MVA of generation should also call System Operations at the numbers above prior to switching.

- **Switching for ITO personnel:** Switching orders will be issued to ITO personnel. ITO personnel will either operate or observe the proper operation of the tie disconnect switch. ITO personnel will then lock and tag the switch. ITO personnel will take all Holds and Clearances.

- **Switching for Generator personnel:** System Operations will issue switching orders for qualified Generator personnel to operate the switch. Authorized Generator personnel will lock and tag the switch with ITO tags. Generator personnel will take all Holds and Clearances for Generator-required work on the Generator's side of the tie disconnect.

- **The Generator may request that ITO personnel perform the switching.** After ITO has operated, locked, and tagged the switch, Generator personnel will add their own locks, and, if applicable, tags. Qualified/Authorized Generator personnel listed per A. above, will take all Holds and Clearances. All locks and tags added by Generator personnel must be properly cleared before ITO will clear the lock, operate the switch, and lock it in the appropriate position.

2. **Working on De-energized Equipment**

   It is the Generator's responsibility to ensure that the equipment served by an open switch is actually deenergized. This equipment must be tested for voltage, using appropriate techniques, to ensure deenergization.

3. **Switch Access**

   **The Generator must provide ITO unrestricted, continuous access to the Dispatch Point of Demarcation / DP Switch.** If this switch is located inside a Generator's facility, such as a substation, then that facility must be dual locked by the Generator and ITO in a manner such that opening either lock will enable access to that facility.

D. **Deenergized Circuits**

   The Generator shall **not** energize a deenergized T&D circuit unless the generation facility is black start capable. This black start capability must be verified by ITO and the generation facility must be acting under the direct authorization of a System Operator for a generator to energize a deenergized circuit. See Section VI.D, "Islanded Generation Limits."
VIII. Operations and Maintenance

Power consumers are affected by the Generator’s operation and maintenance practices. Practices that promote high reliability will enhance the quality of service to all customers on the T&D system.

ISO-NE coordinates and approves facility outages in accordance with the ISO New England Operating Documents, see Footnote 4., Applicable Reliability Standards, or successor documents. Each Party may in accordance with the ISO New England Operating Documents, Applicable Reliability Standards, or successor documents, in coordination with the other Party(ies), remove from service any of its respective Interconnection Facilities or Network Upgrades that may impact the other Party(ies’) facilities as necessary to perform maintenance or testing or to install or replace equipment, subject to the oversight of System Operator in accordance with the ISO New England Operating Documents, in accordance with the site-specific agreement, ISO NE Operating Documents, Applicable Reliability Standards, or successor documents.

A. Generator Interfacing

There are many events that will necessitate communications between ITO and the Generator. ITO and the Generator will provide each other a contact name, phone number, address, and Email addresses, for the purpose of conducting ongoing business.

1. Trouble Calls

Generators may call the ITO trouble number for inquiries about utility power outages and other day-to-day problems, 1-800-696-1000. Requests for ITO to open/close the Generator’s DP Switch should be made to ITO as indicated in Chapter VII, “Safety,” of this document.

2. Metering

The metering package at the Generator’s facility will be on a regular calibration schedule which is coordinated by ITO Metering Services. This department will attempt to contact the Generator prior to actually calibrating these meters. The Generator can observe this procedure if desired.

B. Site Inspections

The following site inspections will be coordinated between the Generator and ITO.

1. Initial Inspection

The initial inspection includes the Generator’s facility acceptance testing which must be conducted before the Generator will be allowed to generate in parallel with the T&D system, as described in Section III.L, “Generator Facility Acceptance,” of this document. This inspection will also involve a discussion and observation of standard operation and safety procedures.

2. Annual Inspection

ITO will determine the necessity for an annual inspection. If conducted, it will include a visual inspection of the generator and switchgear rooms (where intertie equipment is located) and a review of operation and maintenance procedures, pertinent documentation, and adherence to all applicable codes and standards.

See Footnote 4. ISO-NE provides operating procedures to Market Participants for the Regional Transmission Organization and the region’s bulk electric power system. The procedures inform generators of operating and reliability requirements.
3. Biennial Test and Inspection

This test and inspection will occur every two years after the initial inspection. Items of concern for the annual inspection will be reviewed and a test of the intertie system will be performed per Section VIII.E.1, “Intertie Protection System.” This test will include input verification testing, overall protection system operability, and calibration of protective relays. Input verification testing will include verification of VT and CT circuits, transformer ratios, and DC trip source availability. The overall protection system operability will entail verification of trip circuits including a trip test of each breaker tripped by the intertie relaying. Calibration of relays will verify the setpoints and confirm the ability of the protective devices to respond within specified parameters.

Protective Intertie Relay calibration testing must be performed by a qualified contractor and observed by the ITO, or an ITO representative, as required. Verification of setpoints will be in accordance with ITO specifications.

C. Site Access;

ITO will require site access for the following reasons:

1. Routine Access

ITO will require access to the Generator's facilities to perform the inspections and tests detailed in this document as well as for other business needs. Normally, this access will be coordinated and scheduled by phone so as to enable each party to conduct the necessary business with minimum impact to the other party.

2. Emergency Access

ITO will require unrestricted access to the Dispatch Point of Demarcation / DP Switch per Section VII.C.3, “Switch Access,” of this document. In an emergency situation, it may be necessary for the Generator's facility to be disconnected from the T&D system.

- If the Generator's site is manned and time permits, ITO will request the plant operator to reduce generation then trip the generator(s) off-line in accordance with standard operating procedures. Qualified ITO or Generator personnel will then open the Generator's DP Switch using ITO's switching procedures.
- If the Generator's site is not manned or time does not permit, ITO will open the DP Switch using ITO's switching procedures. Should the Generator discover that the site has been disconnected from the T&D system, the Generator may call ITO's System Operations for information.

D. Operational Requirements

Utility T&D systems are designed to provide safe, reliable service to all customers. Generators operating in parallel with the T&D system must not operate in a manner which results in unacceptable service to customers. Generators whose operation of equipment results in unacceptable service to customers or adversely affects the T&D system must immediately correct any problems by performing modifications to equipment as necessary to prevent the recurrence of those problems. If necessary, ITO will discontinue the facility interconnection service until the problems have been corrected.

During maintenance, testing, or repair of T&D facilities, ITO may request the Generator to discontinue parallel operations. Such maintenance may require opening of the tie disconnect switch.
Interconnection Customer shall maintain satisfactory operating communications with the System Operator and Interconnecting Transmission Owner in accordance with applicable provisions of ISO New England Operating Documents, Applicable Reliability Standards, or successor documents.

The following operating requirements are necessary to ensure reliable service and that the operation of generation equipment does not cause any adverse affects on the T&D system.

1. Voltage Control

The Generator must automatically adjust generation to maintain adequate voltage regulation to maintain its voltage schedule, (Schedule J of the IA if applicable), and be in accordance with ISO-NE Operating Procedure #12 and Master / Local Control Center #8. The distribution voltage to all customers must be maintained within ±5% of nominal voltage as specified by the Maine Public Utility Commission Chapter 32 Rules, Service Standards for Electric Utilities. The Generator must employ an automatic method of disconnecting generation equipment from the T&D system if the system voltage cannot be maintained within tolerance.

2. Reactive Power

To prevent the degradation of system voltage to ITO's customers as a result of interconnection with a Generator's facility, Generators with synchronous generators shall generate such reactive power as may be reasonably necessary to maintain voltage levels and reactive area support.

3. System Performance Reporting

For ITO to adequately assess the performance of its system, ensure compliance with regulatory requirements, and provide conformance reporting to NPCC and the ISO New England, Generators will be required to submit the following operational information:

- Continuously (Units Larger than 5 MVA): Accurate and reliable metering and information regarding status and the output (MW, MVAR, kV, MWh, and alarms) of the Generator's facility as specified in Chapter V, “Supervisory Control and Data Acquisition.”
- When Available: Information about whether the facility has capability for participation in system restoration or has black start capability.
- Each Year or as Required: Maintenance schedules for the generator, step-up transformer, tie breaker, and protection system.
- Biennially: Setpoint verification on all underfrequency/overfrequency relays or underspeed/overspeed devices which are not part of the Intertie Protection Equipment.
- After Outages or Relay Operations: Information about any outage or intertie relay operation involving their facility as per ITO instructions for Relay Operation Target Report within two (2) working days. (See the sample report, Figure VIII-1, and associated instructions, Figure VIII-2, at the end of this chapter.) Blank reports are available through ITO.
E. Testing & Maintenance

The Generator will have full responsibility for the routine testing and maintenance of the interconnection equipment, including the Intertie Protection System, the Generator Protection System, the Unit Step-up Transformer, the Intertie Circuit Breaker, and the Station Battery and Charging System. ITO will monitor maintenance on the Intertie Equipment, including protection system(s), transformer(s), Intertie Circuit Breaker(s), and Station Battery(ies) and Charging System(s), etc.

ITO is primarily interested in the performance of the total facility to ensure that the facility operates with no adverse impact to the T&D system. Therefore the Generator is expected to maintain the generator and all of its support systems. The Generator is also responsible for tree trimming and vegetation control in accordance with ITO vegetation control standards for any portion of the intertie where a fault could affect the operation of ITO’s T&D system.

As a minimum, Generators must perform all periodic maintenance and testing according to: The recommended manufacturer’s maintenance and test guidelines; the requirements specified in this document; and specifications found in reference documentation of controlling authorities.

Maintenance records are required to be maintained and must be made available to ITO during the annual inspections and biennial test and inspections. Specific equipment test data must be made available to ITO upon request to provide evidence that the equipment will operate as intended. Failure of the Generator to provide proper testing and maintenance will result in the Generator being notified and requested to take prompt corrective action within ten (10) days. Should the Generator then fail to provide the proper testing and maintenance, ITO will discontinue the facility interconnection service until appropriate corrective action is taken and ITO approval is obtained.

If the interconnection equipment is not properly maintained, fails to perform its intended function, or has been modified from that approved by ITO, then ITO will give notice to correct the area of noncompliance or will open the interconnection. The time allowed for the Generator to comply, while remaining on line, will depend upon ITO’s assessment of the safety, reliability, and performance issues relating to the noncompliance.

ITO may inspect any of the intertie equipment, including the protection systems, whenever such an inspection is deemed necessary by ITO. This inspection may include tripping of the intertie and/or generator circuit breaker(s). The Generator shall bear the cost of any necessary testing that may be requested by ITO.

All outage schedules and maintenance work will be coordinated through ITO.

The Generator must implement a maintenance program consistent with acceptable industry practice so as to achieve a highly reliable interconnection. During site visits, ITO representatives will be interested in checking maintenance records and performing testing as follows:

1. Intertie Protection System

The Generator must perform a relay calibration test every two (2) years using equipment of known accuracy. This biennial test shall include calibration and operational tests of individual relays and functional tests of the subsystems and the total system. Calibration checks will include verification of setpoints and voltage and current measurements. Operational and functional tests will include as many trips of the tie and/or generator breaker(s) as necessary, a synchronizing test, and any other test as may be required by ITO. Transfer trip
equipment, where installed, will also be tested. During the biennial operational test, up-to-date design drawings must be made available to ITO personnel to allow for safe, reliable testing of the facility.

2. Intertie Circuit Breakers/Reclosers and Transformers

The Generator will perform maintenance on these devices at a maximum interval not to exceed twenty-four (24) months. The Generator must provide to ITO the identity and qualifications of the personnel who perform this maintenance and any associated testing. This maintenance must be coordinated with System Operations to obtain the proper zones of clearance.

3. Station Battery and Charging System

Batteries associated with the Intertie Protection System must have a high degree of reliability. To ensure that the Intertie Protection System performs its intended function, the Generator must implement a battery preventative maintenance (PM) program to include periodic battery inspections and testing as approved by ITO. The reports from these battery inspections and tests shall be maintained by the Generator and made available for review by ITO personnel during the periodic tests and inspections of the facility and at other times as requested by ITO.

- Battery Inspections per IEEE Std 450-2002 and IEEE Std 1188-1996
  
  The Monthly PM program will include the following:
  a) Float voltage measured at battery terminals.
  b) General appearance and cleanliness of the battery, the battery rack and/or battery cabinet, and the battery area.
  c) Charger output current and voltage.
  d) Electrolyte levels (where applicable).
  e) Cracks in cells or evidence of electrolyte leakage.
  f) Any evidence of corrosion at terminals, connectors, racks, or cabinets.
  g) Ambient temperature and ventilation.
  h) Pilot-cells voltage and electrolyte (where applicable) temperature.
  i) Battery float charging current or pilot cell specific gravity (where applicable).
  j) Unintentional battery grounds.
  k) All battery monitoring systems are operational, if installed.

  The Quarterly PM Program will include the following:
  a) Voltage of each cell.
  b) Specific gravity (where applicable) of 10% of the cells of the battery if battery float charging current is not used to monitor state of charge.
  c) Electrolyte temperature (where applicable) of 10% or more of the battery cells.
  d) Cell unit internal ohmic values (for VRLA batteries only).
The Yearly PM Program will include the following:

a) Specific gravity (where applicable) and temperature of each cell.

b) Cell condition. This involves a detailed visual inspection.

c) Cell-to-cell and terminal connection resistance.

d) Structural integrity of the battery rack and/or cabinet.

e) Cell unit internal ohmic values (for VRLA batteries only).

A sample form for recording this information is included as Figure VIII-3 at the end of this chapter.

f) With charger on, check all individual cell voltages (if bank consists of 3 cell units, check the voltage of all 3 cells.)

A sample form for recording this information is included as Figure VIII-3 at the end of this chapter.

A high-rate charge will be performed as required, or battery cells replaced, if the cells aren't within the manufacturer's recommendations or applicable IEEE Standards, or if a trend of reduced cell voltage is detected. Where inspection data is incomplete or indicates battery deterioration or improper maintenance, ITO will require the completion of a battery capacity test or replacement of the battery.

During the biennial test and inspection, the Generator may be required to perform a battery inspection in the presence of ITO's representative. The results of this inspection will be reviewed by ITO for compliance with this station battery PM requirement.

- Battery Testing: The Generator must perform a battery capacity (load-discharge) test on the station battery that provides tripping power for the Intertie Protection System. This capacity (load discharge) test must prove that the station battery retains at least 80% of its rated capacity. If the capacity falls below 80%, the battery must be replaced. An initial battery capacity test shall be done prior to battery installation and commissioning. For flooded cells, additional capacity tests will be done at least every five years during the battery's operational life, in accordance with the latest applicable IEEE Standards and manufacturer's specifications. For VRLA batteries, capacity tests will be performed on an annual basis during the battery’s operational life.

DC internal cell resistance testing, as approved by ITO on a case-by-case basis, may be temporarily used as an alternative to capacity testing. This approval would only take place if assurances were made that the battery would be capacity tested in an acceptable time period to ITO. To obtain approval for load testing, the Generator will supply ITO with a proposed battery test program certified by a professional engineer. The professional engineer must certify that the battery test program will yield test results that reliably indicate the battery has ample capacity to meet the needs of the generation facility.

Results of all station battery tests must be provided to ITO.

- Battery Charging: A normal float charge will be maintained on the battery and a high-rate (equalizing) charge will be performed periodically as
recommended by the manufacturer or applicable IEEE standards. The battery must be cleaned and each cell must be appropriately and conspicuously marked with a cell number for reference. Where applicable, cell fluid levels must be maintained with appropriate replacement fluid, in accordance with manufacturer’s recommendations.

F. Planning Standards

For facilities interconnected to the utility transmission system, the Generator is required to meet Central Maine Power Transmission Planning Criteria; ISO NE Planning Procedures; NPCC Criteria, Guides, and Procedures; North American Electric Reliability Council (NERC) Planning and Compliance Standards; and FERC standards.
### OPERATION REPORT FOR PROTECTIVE RELAYS

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<tr>
<th>TRIPPED</th>
<th>RELAY ID NUMBER</th>
<th>TARGET</th>
<th>TIME CLOSED</th>
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**COMMENTS:**

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

**WEATHER CONDITIONS ON DATE OF EVENT** - (Circle if known):

- fair
- wind
- rain
- sleet
- snow
- thunder, lightning

- other

**SPECIAL INSTRUCTIONS:**

- Fill out and FAX to ITO at the number listed above, or fold as indicated, attach first-class postage, and drop in the mail.

---

**Figure VIII-1: Relay Operation Target Report.**
The following instructions are a guide to using this relay operation target form and should answer the majority of Generator questions. Any additional questions can be addressed to ITO by contacting the ITO System Protection group at (207) 623-3521, ext. 3505.

This form will be completed and forwarded, faxed, or Emailed to don.gurney@cmpco.com within 48 hours of a relay target operation, to: Central Maine Power Company, System Protection Department, 83 Edison Drive, Augusta, ME 04336, Fax No. (207) 623-7380.

**Site:** The name of the facility where the relay is located.

**Date:** The date the form is filled out. This is also the date the target is reset.

**Inspector/Operator:** The person reporting the target drop.

**Phone:** The extension, or phone, where the Inspector/operator can be reached.

**Time and Date tripped:** The time when the device tripped. If unknown, and the station has SCADA capability, call System Operations for the date of operation. If the station is not manned or tied to SCADA, write the date of the last station check under System disturbance details. This will indicate a time frame within which the event occurred.

**Relay I.D. number:** This is the ITO identification number affixed to the relay. Report all relays indicating a trip flag.

**Target letter:** This indicates which element of the relay operated to trip the breaker.

- **T or I:** This indicates either a time delayed or instantaneous relay operation, which is usually displayed by a red flag.
- **LED:** This target letter is displayed by an LED next to a label indicating the target.
- **Phase Target:** This indicates which phases were faulted during the event. Typically displayed by a red flag.
- **Alpha-numeric:** This target display uses ANSI designations to indicate the type of fault that occurred. For example; 21Z1, 51N, ABC, AG etc.

Refer to the manufacturer's instruction book for instructions on retrieving target information from specific relays.

**Time closed:** The time the generation is brought back in parallel with ITO. If the date for re-energization is different than the trip date, add it in this column also.

**Comments:** In addition to the list on the form, indicate any information that may be relevant to the situation. For example; "wood crews were working in the area". Record information received from ITO in this section also.

**Weather conditions on date of event:** Circle or list the condition. If the weather condition was extreme, indicate this under "Other".

---

**Figure VIII-2: Instructions for Relay Operation Target Report.**
Location __________ Make ______ Date ______ Pilot Cell # ______
No. of Cells ______ Type ______ Yr Mfd ______ Voltage ______
Batt Temp ___°F Normal Charging Current ______ Temp Corr. ______
Readings: o Corrected Positive to Ground _______ Negative to Ground ________
o Not Corrected

<table>
<thead>
<tr>
<th>INDIVIDUAL CELL READINGS</th>
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REMARKS:  

* Monthly inspection is required only on the pilot cell. All cells must be inspected quarterly.

** Fluid Level: A check indicates fluid was added to a specific cell due to a low fluid level.

Taken by: _______________________

Figure VIII-3: Sample Station Battery Inspection Form.
IX. **References**

The references listed below will provide the Generator with a ready list of relevant technical standards and documents pertaining to the design, operation, and maintenance of a Generator’s facility to be operated in parallel with an electric utility.


ISO-NE Inc Transmission; Market & Services Tariff Schedule 22 Standard Large Generator Interconnection Procedures (LGIP), (Applicable to Generating Facilities That Exceed 20 MW).

Bulk Power System Criteria as specified by:

1. ISO New England Criteria, Rules & Procedures, see WWW.ISO-NE.COM.
2. New England Power Coordinating Council (NPCC) Criteria, see WWW.NPCC.ORG.
3. Maine Bulk Power System, call System Operations @ 1-800-750-6934.


Iberdrola USA Electric System Planning Manual – Criteria & Processes


Central Maine Power Company, Substations Standards.

IEEE 88 THO224-6-PWR, Intertie Protection of Consumer-Owned Sources of Generation.*


Maine Public Utilities Commission Chapter 32, Service Standards for Electric Utilities.

Maine Public Utilities Commission Chapter 304, Standards of Conduct for Transmission and Distribution Utilities and Affiliated Competitive Electricity Providers

Maine Public Utilities Commission Chapter 313, Customer Net Energy Billing

Maine Public Utilities Commission Chapter 315, Small Generator Aggregation.

Maine Public Utilities Commission Chapter 324, Small Generator Interconnection Procedures


North American Electric Reliability Council (NERC) & Western Electricity Coordinating Council, NERC/WECC Planning Standards (4/10/2003), see WWW.NERC.COM.
Northeast Power Coordinating Council (NPCC), Bulk Power Systems Protection Criteria, NPCC Document A-5, see WWW.NPCC.ORG.

*IEEE information can be obtained from:
IEEE Operations Center
445 Hoes Lane,
Piscataway, N.J.08854-4141 USA
Phone: 1(732) 981 0060
Email: stds-info@ieee.org