Valley Electric Association, Inc.

A Touchstone Energy® Cooperative

Distribution Generation Interconnection Handbook

Applicable to Customer Generating Facilities Interconnecting with VEA's Distribution Facilities

Notice: Document Subject to Change

The information and requirements in this manual are subject to change over time. The most current version of this Load Interconnection Handbook is available by emailing your request to VEAengineering@vea.coop.

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Version 1.0

Version History

Version	Date	Action	Change Tracking
1.0	6-30-18	New Distribution Generation Interconnection Handbook	New

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1 GENERATION INTERCONNECTION OVERVIEW

The purpose of this Distribution Generation Interconnection Handbook (Handbook) is to provide Customers general requirements to interconnect their non-VEA owned facilities to VEA's electric distribution system. The Handbook describes general requirements. Not all requirements can be specified in a Handbook because some requirements are case specific. Therefore, this Handbook provides Customers an overview of the requirements to address their facility interconnection requests. VEA will determine all interconnection requirements with specificity, thru VEA's interconnection studies requested and paid for by the Customer.

2 INTRODUCTION

This Interconnection Handbook has been prepared by Valley Electric Association, Inc. to identify the typical minimum technical requirements (the "Requirements") for connecting Customer Generation facilities to the distribution system operated by Valley Electric Association, Inc. (the "System or Utility").

The interconnections include facility additions and modifications to accommodate Customer facilities being connected or planned to be connected to VEA. These Requirements are necessary to ensure the safe and reliable operation of the electric Utility.

2.1 Exclusions

These Requirements do not address procedural information related to facility interconnections nor cover all possible technical details. The Requirements are not intended to function as a design specification. The final design of facility interconnections to the System will be subject to VEA review and approval on a case-by-case basis.

2.2 Other Requirements

In addition to compliance with these Requirements, any entity seeking to connect facilities to VEA is responsible for complying with all other interconnection obligations established by contract and applicable rules, tariffs, regulations, standards, and criteria. Such requirements may include the following:

- NERC reliability standards, alerts or recommendations
- Western Electric Coordinating Council (WECC) reliability standards or recommendations
- California Independent System Operator (CAISO) criteria or recommendations
- Federal Energy Regulatory Commission (FERC) regulations or recommendations
- State and Local jurisdictional requirements or recommendations

2.3 Requirements Are Subject to Change

These Requirements are subject to change. VEA maintains and updates these Requirements as necessary. During the interconnection process, the Customer shall ensure that they comply with the most recent version of these Requirements. The current version is available upon email request at VEAengineering@vea.coop.

2.4 Costs

All arrangements for system studies, engineering design, construction, ownership, operations, maintenance, replacement equipment, metering, facility controls, and telecommunications must be set forth in a written contract between VEA, the Customer, and if necessary, the CAISO. If additional equipment or replacement equipment is required on the System to accommodate the facility interconnection, VEA will install or modify the equipment at the cost of the Customer. VEA may

maintain capacity rights and operational control of such equipment. Further, as permitted by applicable laws and regulations, VEA reserves the right to participate in the costs of proposed facility expansion plans that may be accommodated through mutually advantageous alternatives which may also provide substantial benefits to regional reliability or transmission transfer capability. Advance funds or deposits are required by VEA and/or the CAISO prior to any studies, system modifications, upgrades, or additions be performed.

2.5 Transmission Capacity is Not Guaranteed

A direct interconnection into VEA's distribution system does not guarantee transmission capacity on portions of the VEA transmission system or neighboring systems. Customer's transmission capacity rights are determined through the CAISO "Generator Interconnection Deliverability Allocation Procedures Process" (GIDAP) process as described on the CAISO website (www.caiso.com).

3 INTRODUCTION

3.1 General Information

3.1.1 These guidelines serve to provide the minimum acceptable requirements for safe and effective operation of Customer-owned generation interconnected with Valley Electric Association (VEA) power system. Customer and VEA personnel will be guided by this document when planning for the installation of Customer-owned generation. It is emphasized that these requirements are general and may not cover all details in specific cases nor all requirements.

3.1.2 These guidelines apply to applicants/Customers regardless if they self-generate, generate for sale back to VEA, or whether they buy and sell concurrently.

3.1.3 The potential Customer should discuss all project plans with VEA before purchasing or installing equipment.

3.2 Definitions – Hierarchal Order

3.2.1 "VEA" will be used in this guideline to refer to Valley Electric Association, Inc.

3.2.2 "Customer" will refer to an entity applying for interconnection of their generation facilities.

3.2.3 "Members" will be used in this guideline to refer to power consuming Co-operative members who are connected to VEA's system.

3.2.4 "Interconnection" will mean the point of electrical connection between the Customer's facility and the VEA power system.

3.2.5 "Momentary Paralleling" will be used in this guideline to refer to a Customer who will only operate in parallel with VEA for durations of 100 milliseconds or less.

3.2.6 "Parallel Operation" will be used in this guideline to refer to a Customers facility that is interconnected with VEA while operating electrically connected to the VEA power system. Electrical power may flow either into or out of this Interconnection.

3.2.7 "Islanding" or "Islanded" refers to the situation where a portion of VEA's load becomes isolated from VEA sources but remains electrically connected to the Customer's generation source.

3.2.8 "Reclosing" refers to the operation of a device that has the functionality to sense and interrupt over-currents by de-energizing the circuit and to then automatically re-energize the circuit.

3.2.9 "Distributed Resource" refers to electrical power generation fed to the electric utility grid through a distribution circuit not a transmission circuit.

3.2.10 "Grid Interactive" will be used in this guideline to refer to an electric power production device, intended to be interconnected as a distributed resource, which meets IEEE 1547 and UL 1741 requirements and incorporates all VEA minimum protective requirement for a given interconnection type.

3.2.11 "CT" is the acronym for Current Transformer

3.2.12 "PT" is the acronym for Potential Transformer

3.2.13 "SCADA" is the acronym for Supervisory Control and Data Acquisition

3.3 Policy Pertaining to Non-Utility Power Production

3.3.1 It is the policy of VEA to permit eligible Customers to operate their generating equipment in parallel with VEA's electric system upon VEA review and provided this can be done without adverse effects to the general public, or to VEA's Members, Customers, equipment, personnel, or system operations. Customer's generation interconnected to VEA's power system shall be through a transformer.

3.3.2 Protective devices (including relays, circuit breakers, and the like), as specified by VEA must be installed at any location where a Customer desires to operate generation in parallel with the VEA power system. The purpose of these devices is to promptly disconnect the Customer's generating equipment from the VEA system whenever faults or abnormal operation occur which could affect the interconnected system. Other site specific modifications to the electrical system configuration or protective relays shall be required as necessary to safely accommodate parallel operation.

3.3.3 Power electronic equipment such as DC to AC inverters shall meet the most recent IEEE and UL applicable standards as outlined in subsequent sections. Such equipment employing internally protective electronic methods will be subject to VEA review for acceptance. Any recommendations from VEA for specific protective settings will be made prior to energizing the Customer's equipment.

3.3.4 VEA will determine on a case-by-case the adequacy of the distribution system, but generally a Customer facility with the ability to export greater than 20 MW of electrical power into the VEA distribution system may be required to connect to the VEA power system at the transmission level. The Customer shall bear any and all costs associated with equipment upgrades required to accommodate Customer Interconnections.

3.3.4.1 Differing transmission system conditions due to location, physical parameters, or any number of factors dictate that Customer applications will be evaluated on a case-by-case basis to determine the specific Customer Interconnect requirements at the transmission level.

3.3.4.1.1 If the Customer seeks to interconnect their project to Transmission level facilities, then the Customer must apply for interconnection thru the CAISO GIDAP process mentioned above.

3.3.4.1.2 VEA publishes a Generation Interconnection Handbook applicable to transmission level interconnections. The current version is available upon email request at VEAengineering@vea.coop.

3.3.5 With the advent of Distributed Resources becoming more popular and the differing conditions of distribution feeders, each Customer application will be evaluated on a case-by-case basis to determine the specific Customer Interconnect requirements.

3.3.6 VEA does not assume any responsibility for protection of the Customer's generator(s) or any other portion of the Customer's electrical equipment. The Customer is fully responsible for protecting their equipment in such a manner that faults or other disturbances on the interconnected system do not cause damage to the Customer's equipment.

3.4 Generation Sources

3.4.1 The Customer may elect to use any of a variety of energy sources including hydro, solar, wind, conventional fossil fuels, or other types of energy sources. The end conversion for connection to VEA's system must be 60 Hz alternating current at a voltage compatible with VEA's system at the interconnecting point. Customer generation sources shall be operated so that variations from the acceptable voltage levels and other service impairing disturbances do not occur. This includes: compliance with the harmonic limits stated in IEEE Standards as specified throughout this handbook for current and voltage distortion; and any other disturbance from the Customer's facility which could impair service to VEA Customers or Members.

3.4.2 Protective devices must provide protection to VEA's system and to its customers or Members from a Customer's facility experiencing disturbances that produce abnormal voltage and frequencies or other electrical disturbances.

3.4.3 Customers are required to generate their own reactive power requirements to assure generation at a machine specified power factor and to enhance the Customer's generator stability. Generally, VEA desires Customers have unity reactive power requirements so they are not absorbing or delivering VARs to VEA's system. A power factor of +/- 0.95 is also acceptable. Reactive power requirements will be reviewed on a case-by-case basis, and VEA will inform the Customer if specific reactive power requirements are needed. VEA review of reactive power requirements may also occur on an annual basis or as needed during system evaluations.

3.4.4 Induction machines, such as wind generation without converters, may impose additional reactive burden on a utility compared to other generating machines. Therefore, reactive power requirements for induction machines also need to be reviewed on a case-by-case basis to determine their reactive power burden and interconnection requirements.

3.5 Parallel Operation

3.5.1 A transfer of power between the two systems is a direct and often desired result of parallel operation. A consequence of such parallel operation is that parallel generation becomes an electrically connected part of the VEA power system, which must be considered in the electrical protection of VEA facilities.

3.5.2 A Customer's protection system design shall be performed by a power engineer qualified to perform such work and who is licensed as a professional engineer in the state of Nevada. The protection system design shall be reviewed by VEA. Prior to energizing a Customer facility, any changes to the protection system design requested by VEA shall

be made by the Customer. Smaller inverter type equipment meeting the most recent UL and IEEE standards for interconnecting to utility power systems may have integral protection equipment built into one complete package. Even so, all adjustable or factory set protection parameters incorporated into Grid Interactive equipment shall be reviewed by VEA. Also, prior to energizing Customer's inverter type generation facilities, all settable protection parameters recommended by VEA will be made to the Customer's equipment by the Customer. VEA and a Customer representative will confirm all protection and protection settings during a facility inspection.

3.5.3 Some general and specific requirements for parallel generation installations of various sizes are discussed in the following sections, but final requirements will be determined by VEA.

4 GENERAL REQUIREMENTS

4.1 Design Requirements

4.1.1 As part of determining protective devices for the protection of VEA's system, the Customer shall submit a single-line drawing of this equipment to VEA for approval. Any changes required by VEA shall be made prior to VEA final acceptance. VEA will approve only those portions of drawings which apply to protection of the VEA system. VEA may comment on other areas which appear to be incorrect or deficient, but will not assume responsibility for the correctness of protection pertaining to the Customer's system. The Customer shall provide VEA with dated copies of their final protection drawings.

4.1.2 A manual disconnecting device must be installed as required by VEA. The device must have the capability to be opened and locked open for line clearances. The size and specifications of this device may vary depending upon the service voltage and capacity. This device shall permit VEA to disconnect the Customer's generation from the VEA system for safety purposes during system maintenance or other system needs. This device must provide a "visible open" for VEA personnel.

4.1.3 The protective methods and devices referred to in these guidelines (including but not limited to relays and circuit breakers) which aid in the protection of VEA's system, metering equipment, Customer equipment and synchronizing equipment must be installed as required by VEA. The protective devices may differ with the size and characteristics of the installation.

4.1.4 Instrument Transformer Specifications:

4.1.4.1 VEA requires that PTs used for either revenue metering or protective relaying meet an ANSI accuracy rating of 0.3% at IEEE C57.13 standard burden designations. VEA requires a minimum IEEE PT burden designation rating of "Y".

4.1.4.2 VEA requires that CTs used solely for revenue metering meet an ANSI accuracy rating of 0.3% at a burden of 0.5 Ohms at 100% rated current.

4.1.4.3 VEA requires that CTs used for protective relaying meet ANSI Standard C57.13 minimum CT accuracy of C200. However higher CT accuracy may be required due to system conditions.

4.1.4.4 One set of PTs may be used for both relaying and metering provided that the total burden placed on the PTs does not exceed the PTs' specified limit.

4.1.5 Customer Interconnections with VEA shall be accomplished through the use of a "dedicated transformer" which serves no other Customers or Members. Small Interconnections may be exempt from this requirement.

4.1.5.1 The Customer's installation must meet all applicable national, state and local construction and safety codes in addition to all applicable UL, ANSI, IEEE, and VEA Standards and Guidelines.

4.1.6 Inspections

4.1.6.1 To ensure that the system has been installed in accordance with all VEA requirements and the originally submitted specifications, VEA must perform various inspections and a final inspection of the system before operation begins.

4.2 General Operating Requirements

4.2.1 Any Operation of the Customer's generating equipment with the VEA system shall not under any circumstance be permitted to cause any reduction in the quality of service being provided to other VEA Customers or Members. No abnormal voltages, harmonic distortions, frequency deviations, or interruptions shall be permitted. If credible high or low voltage complaints or flicker complaints result from operation of the Customer's generation, such generating equipment shall be immediately isolated from VEA's system.

4.2.2 The Customer may not commence operation of generator(s) until final written approval has been given by VEA. At any reasonable time, VEA reserves the right to inspect the Customer's facility and test or witness testing of any equipment or devices associated with the Interconnection.

4.2.3 If a VEA distribution circuit needs to be de-energized, VEA will notify the Customer on that circuit and they shall disconnect from the VEA system and will not be permitted to reconnect to VEA's system until further notified by VEA.

4.2.4 Reclosing of a VEA distribution feeder will not be adversely effected by the Customer. The Customer shall coordinate reclosing strategies with VEA. VEA will review all operational functions of the Customers equipment prior to acceptance.

4.2.5 Customer interconnections will be reviewed on a case-by-case basis to determine post disturbance reconnection strategies.

4.2.6 Operation of the Customer's generator shall not adversely affect the voltage regulation of VEA's system to which it is connected. Adequate voltage control shall be provided by the Customer to minimize voltage fluctuation on VEA's system caused by changing generator loading conditions.

4.2.6.1 For synchronous generators, sufficient generator reactive power capability shall be provided to withstand normal voltage changes on VEA's system. The generator reactive power requirements, voltage regulation, and transformer ratio settings will be jointly determined by VEA and the Customer to ensure inter-system coordination and operating capability. Customers are required to generate their own reactive power requirements to assure generation at the specified power factor and to enhance generator stability.

4.2.6.2 In cases where induction generators will have an adverse impact on VEA's system voltage, step-switched capacitors or other techniques may be required to bring the voltage changes to acceptable levels. All equipment costs associated with such reactive power production shall be borne by the Customer.

4.2.6.3 The Customer shall maintain his equipment in good working order. VEA reserves the right to inspect the Customer's facilities whenever it appears that the Customer is operating in a manner hazardous or degrading to VEA's system integrity.

4.2.7 The Customer shall discontinue operation when requested by VEA

4.2.7.1 To facilitate maintenance, test or repair of VEA or other Customer facilities.

4.2.7.2 During system emergencies.

4.2.7.3 When the Customer's generating equipment is interfering with other Customers or Members on VEA's system.

4.2.7.4 When an inspection of the Customer's generating equipment reveals a condition hazardous or degrading to VEA's system.

4.2.7.5 When maintenance of Customer equipment is inadequate to protect VEA's system.

4.2.8 VEA will require the Customer to report energy and peak demand information through a remote telecommunication medium.

4.3 Design Information – VEA System

4.3.1 VEA's primary distribution voltages are 14.4/24.9 kV. Transmission voltages are 230 kV and 138 kV. VEA's distribution circuits are effectively grounded with a substantial number of grounding points on each four-wire distribution circuit. Contact VEA for information on the specific circuit that will serve a Customer's facility.

4.3.2 Because most short circuits on overhead lines are temporary in nature, it is VEA's practice to automatically reclose on such lines one or more times within a few cycles' delay after they have automatically tripped. This practice improves continuity of service to all VEA Customers and Members. The protective relays specified by VEA or IEEE articles for parallel generation interfaces are intended to disconnect the generation from faulted or isolated lines before reclosing occurs. Should the Customer desire additional protection against the possibility that reclosing might occur with a generator still connected to the line (a potentially damaging occurrence for synchronous generators), VEA will consider revising radial line protection schemes on distribution feeders. VEA's preference is to avoid such measures due to the possibility of adverse effects on service continuity and the problems of moving or rearranging the equipment to accommodate system changes. Costs for installing, maintaining, and/or rearranging such equipment (if permitted) will be borne by the Customer(s) requesting the equipment.

4.3.3 System reconfiguration costs needed to accommodate Customer's connecting generation will be borne by the Customer(s) requesting the equipment reconfiguration.

4.3.4 Customers with three-phase generators should be aware that certain conditions in the utility system may cause negative sequence currents to flow in the generator. It is the sole

responsibility of the Customer to protect his equipment for excessive negative sequence currents.

4.3.5 The effect that a Customer will have upon a distribution circuit will depend on the stiffness of the circuit and on the total distributed generation on that circuit and feeder prior to the Customer's connection. The greater the available short-circuit MVA, the stiffer the circuit. The addition of a Customer on a distribution feeder will have less impact if the feeder is stiff with no existing or planned generation.

4.4 Induction Generators

4.4.1 Reactive power supply for induction generators may pose difficult design problems depending upon the generator size. Specific installations may require the installation of capacitors limiting the adverse effects of reactive power flow on VEA's system for proper voltage regulation. Such capacitor installations will be at the expense of the Customer.

4.4.2 The installation of capacitors for reactive power supply at or near an induction generator greatly increases the risk that the induction machine may become self-excited if accidentally isolated from the VEA system. A self-excited induction generator can produce abnormally high voltages which can cause damage to the equipment of other VEA Customers or Members. Over-voltage relays can limit the duration of such over-voltages but cannot control their magnitude because of the rapid voltage rise which occurs with self-excitation. Because of these problems, reactive power supply for large induction generators must be studied on an individual basis.

4.4.3 In order to reduce the possibility of self-excited operation, reactive power requirements for induction generators shall be determined by VEA on a case-by-case basis.

4.4.4 Self-excitation problems are more likely in rural areas where the system capacity and load density are low. Since these areas are more likely to be chosen for certain forms of small power production such as wind, it is particularly important to contact VEA when considering connecting induction machines to existing distribution lines. Where self-excitation problems appear likely, special service arrangements will be required in order to avoid the induction generator from becoming isolated with small amounts of load. For example, a two-line loop service back to the existing transmission system or a transmission level service. In many cases, the additional expense for such special service methods may outweigh the cost savings associated with induction generators.

4.5 Inverter Systems

4.5.1 Reactive power supply requirements for inverter systems shall be determined by VEA on a case-by-case basis. Inverter systems are also capable of islanded operation, which must be evaluated.

4.5.1.1 Grid Interactive inverters meeting UL 1741 may satisfy some of VEA's protective Requirements and Reactive power requirements. VEA will review the Customer's inverter specifications for protection and reactive power abilities and for compliance with VEA's Requirements.

4.5.2 Ramp rate for inverters shall be determined by VEA on a case-by-case basis.

4.5.3 Restart timing for multiple inverters shall be determined by VEA on a case-by-case basis.

4.5.4 Total harmonic output of power inverters shall be limited to the most restrictive of that specified in IEEE std. 1547 or as specified in IEEE 519.

4.5.5 If a Customer's generation is determined to be interfering with other Customers or Members or exceeds UL or IEEE recommended specifications, the Customer may be required to install filtering to bring the harmonic output of the inverter to a level that will eliminate such interference and comply with UL and IEEE specifications.

4.5.6 Low/High Voltage Ride-Through (LHVRT) and Low/High Frequency Ride-Through (LHFRT) Capability – normally required for all inverters.

Actual fault events have demonstrated that certain asynchronous generators (i.e., inverters) from specific manufacturers may be susceptible to false tripping or temporary shutdown during fault conditions. Based on investigations performed into this issue, several causes and contributing factors have been identified which include:

a) Apparent miscalculated frequency at many inverters when fault-induced phase shifts occurred in the reference voltage;
b) Inverter protection settings set to meet prior IEEE 1547 standards;
c) Momentary overvoltage;
d) Momentary under-voltage.

5 SPECIFIC REQUIREMENTS

5.1 Interconnection Types Described

5.1.1 Customer-owned generation facilities are classified by generation size, ratings, voltage, and current. The Table below shows typical requirements. VEA will evaluate each interconnection on a case-by-case basis to determine actual requirements.

5.1.2 An Interconnection will require a system protection study to determine any additional protection equipment needed above that outlined for each of the standard Interconnection types. Such protection may include but is not limited to loss of excitation, loss of synchronism, or over excitation protection. Any cost associated with the study and/or additional equipment will be borne by the Customer.

5.1.3 Each facility shall have individual protection, metering, and operating requirements.

5.1.4 Where multiple generators are connected to VEA's system through a single service point, the Interconnection Type will be determined by the sum of the generators. The final decision as to the requirements for each installation will depend on the Customer's load magnitude, the magnitude of other loads connected to that circuit/system, ampacity of serving circuit, maximum power to be delivered to VEA's system, available short circuit contribution, short circuit current ratio, etc.

5.1.5 Interconnection Type definitions, Table, and notes

5.1.5.1 Interconnection Types:

5.1.5.1.1 Type 1: Total generation of 400 amps or less at secondary voltages Note: Secondary voltages of 240/120 limited to 100kVA or less.

5.1.5.1.2 Type 2: Total generation greater than 400 amps and less than or equal to 2,500 kVA at three-phase secondary voltages.

5.1.5.1.3 Type 3: Total generation less than or equal to 10 MVA at distribution primary voltage.

5.1.5.1.4 Type 4: Total generation greater than 10 MVA and less than or equal to 20 MVA at distribution primary voltage.

NOTE: Specific physical distribution feeder conditions may change interconnection sizes discussed in this Handbook.

5.1.5.2 The following Table identifies the minimum requirements that must be met to Interconnect with VEA's system for each interconnection type.

Table - Minimum requirements for Interconnection Types

	Type 1	Type 2	Type 3	Type 4
Single Phase Connection (Limited kVA, See Notes)	Y	N	N	N
Lockable Disconnect with Visible Open	Y	Y	Y	Y
Interconnect Breaker (B) or Fuse (F)	B or F	B or F	B††	B††
In/Out Metering	Y	Y	Y	Y
Energy Recorder	N	N	N	Y
Dedicated Transformer	N	N	Y	Y
Transformer - Customer Pays / Utility Owns	Y	Y	N	N
Transformer - Customer Pays / Customer Owns	N	N	Y	Y
Under-Voltage (27) †	Y	Y	Y	Y
Over-Voltage (59) †	Y	Y	Y	Y
Under-Frequency (81U) †	Y	Y	Y	Y
Over-Frequency (81O) †	Y	Y	Y	Y
Phase Over-Current (50/51)*, †	Y	Y	Y	Y
Neutral Over-Current (51N) †	N	N	Y	Y
Transfer Trip	N	N	TBD	TBD
Close Permissive Required	N	N	Y	Y
Automatic Synchronizer (synchronous machine) 25†, 25a†	Y	Y	Y	Y
Automatic Synchronizer (induction machine) 25†, 25a†	N	N	N	N
Automatic Synchronizer (UL 1741 inverter) 25†, 25a†	N	N	N	N
Isolation Detection / Anti-Islanding†	Y	Y	Y	Y
Communication – Voice	N	Y**	Y	Y
Telemetry	N	Y**	Y	Y
Power Quality Monitoring	N	Y**	Y	Y
Export Power Control Equipment	N	N	Y	Y
Operational Data Logging	N	N	Y	Y
Sequence of Event Reporting	N	N	Y	Y
Fault Recording	N	N	Y	Y
Modeling and Analysis	N	Y**	Y	Y
Machine Testing	N	N	N	N
Metering CTs Supplied By VEA (Customer Installs)	N/A	Y	N	N
Metering CTs Supplied By Customer (Customer Installs)	N/A	N	Y	Y
Momentary Paralleling	Y	Y	N	N

Notes:

TBD means To Be Determined during design phase

* Three Phase Only, may not be required for inverters or induction machines

** May be required

† These requirements are met if Grid Interactive equipment is used.

†† An additional utility owned SCADA protection device may be required near Point of Connection

225 kVA Maximum Three-Phase Pole Mount Transformer Limit

75 kVA Maximum Single-Phase Pole Mount Transformer Limit

167 kVA Maximum Single-Phase Pad Mount Transformer Limit

2500 kVA and greater:

Special Requirements Apply Regardless of Interconnection Type: Dedicated Telemetry

5.2 Total generation of 2,500 kVA or less at secondary voltages (Type 1 and 2)

5.2.1 Type 1 and Type 2 Interconnections are described in this section as outlined in Section 3.1. See Figures for examples of typical one-line diagrams.

5.2.1.1 The difference between a Type 1 and Type 2 Interconnection is in the ampacity. Interconnections of 320 Amps and less (Type 1) do not require a current transformer meter installation.

5.2.1.2 Type 1 and Type 2 Interconnection requirements are based on an assumed low density of parallel generation Customers on the serving circuit. Other conditions may be imposed should the density exceed a tolerable limit.

5.2.1.3 Type 1 and Type 2 Interconnections with a VEA distribution level circuit may be done on a single-phase or three-phase basis.

5.2.2 Where VEA has only single-phase distribution lines

5.2.2.1 The Customer shall fund a single-phase to three-phase line conversion, if required for a three-phase generator installation.

5.2.3 A manual disconnecting device with provisions for locking in the open position shall be required at or near the point of Type 1 and Type 2 Interconnections as per this Handbook.

5.2.3.1 The Customer's Interconnection shall be equipped with fuses or a breaker rated for the installation ampacity and must have an interrupt rating adequate for the available fault current at the Interconnection.

5.2.4 Metering of Type 1 and Type 2 Interconnections

5.2.4.1 Type 1 and Type 2 Interconnections shall be equipped with metering equipment capable of recording the kWh (in) and kWh (out) separately. Additional metering for kW and kVARh will be determined by the requirements of the individual installations. See Metering area in this Handbook for more detailed metering information.

5.2.4.2 CTs for revenue metering shall be provided and installed by VEA at Customer's expense.

5.2.5 Customer Interconnections of Type 1 and Type 2 shall be served from a VEA four-wire multi-grounded neutral distribution circuit to provide adequate grounding. This is necessary to avoid dangerous over-voltages to other customers served from phase-to-neutral connected distribution transformers. A three-phase Interconnection transformer shall have a grounded-wye, grounded-wye winding configuration connection to VEA's system.

5.2.5.1 Type 1 and Type 2 Interconnection transformers shall be supplied, installed, and maintained by VEA.

5.2.5.2 Single-phase pad mounted transformer Interconnections are limited to a maximum of 100 kVA. Single-phase pole mounted transformer Interconnections maybe limited to 75 kVA.

5.2.5.3 Pad mount transformers shall be installed by VEA on a Customer's transformer pad as detailed in VEA's Electrical Service Requirements. Single-phase limitations may apply depending on the electrical Interconnection location, total generation size, and total Member load on a distribution feeder. Each Interconnection shall be reviewed on a case-by-case basis.

5.2.5.4 Pole mounted transformers shall be installed by VEA. If the Customer's facility is to be Interconnected via an underground feeder, the Customer shall be responsible for all costs and materials required as outlined in VEA's Electrical Service Requirements.

5.2.6 Customer protection systems and Compliance with IEEE 1547 and UL 1741 shall be as follows:

5.2.6.1 Generation equipment used for Type 1 and Type 2 Interconnections shall meet the requirements of IEEE 1547 and UL 1741 along with any supporting documents created for testing, clarification, or information follow up of each article.

5.2.6.2 Customer Interconnections using generation equipment such as standalone synchronous or induction machines that do not comply with IEEE 1547 or UL 1741 must be equipped with protective devices that will make the Interconnection installation meet the requirements of these articles and standards. A line voltage relay and a shunt trip breaker that will prevent the generator from being connected to a de-energized or single-phased (if normally three-phase) source may be required. This relay is to disconnect the generator from a de-energized utility line and prevent its reconnection (islanding) until the line is re-energized by VEA. Re-energizing times and feeder reclosing will be coordinated with VEA. A Customer's facility shall not adversely affect VEA feeder reclosing.

5.2.6.3 Depending upon specific system conditions or the type of Customer generation, protective devices other than those outlined above may be required.

5.2.6.4 Instrument transformer accuracy for protective relaying shall meet the accuracy requirements of this Handbook. Circuit design and specified equipment shall be reviewed by VEA prior to installation. System design costs shall be borne by the Customer.

5.2.6.5 Phase fault relay protection shall be required for three-phase installations. Inverter and Induction machine installations may not require phase fault relay protection. A fuse or main breaker may suffice for over-current protection of single-phase installation and inverter or induction machines. VEA will determine requirements on a case-by-case basis.

5.2.6.6 The Customer shall provide information on the type of anti-islanding protection used and coordinate those protection schemes such that any VEA circuit reclosing will not be adversely affected.

5.2.7 Remote Control, Telemetry, and SCADA

5.2.7.1 Remote control of Customer equipment or devices by VEA system operators will not be required for Type 1 and Type 2 Interconnections.

5.2.8 Harmonic output of power inverters will comply with IEEE 1547, IEEE 519, and/or UL 1741. If a Customer is found to be interfering with other Customers or Members, or exceeds IEEE recommended specifications, the Customer may be required to install filtering to bring the harmonic output of their inverter(s) to an acceptable level.

5.3 Total generation less than or equal to 10 MVA (Type 3)

5.3.1 Type 3 Interconnections are described in this section. See Figures for examples of typical one-line diagrams.

5.3.1.1 A Type 3 Interconnection employs a point of service at the primary or distribution circuit voltage.

5.3.1.2 All Type 3 Interconnections require a VEA review of the Customer's protective functions.

5.3.1.3 All Type 3 Interconnections with a VEA distribution level circuit shall be done on a three-phase, four wire basis only.

5.3.1.4 Where VEA has only single-phase distribution, the Customer shall NOT be allowed to connect a Type 3 Interconnection. VEA may upgrade the distribution feeder to accommodate the Customer's generation needs at the Customer's expense.

5.3.2 A manual disconnecting device with provisions for locking in the open position shall be required at or near the point of Type 3 Interconnections as per this Handbook.

5.3.3 The Customer's Interconnection shall be equipped with breakers, reclosers, or switch gear rated for the installation ampacity and have an interrupt rating adequate for the available fault current at the Interconnection.

5.3.4 Metering of Type 3 Interconnections.

5.3.4.1 Type 3 Interconnections shall be equipped with metering equipment capable of recording the kWh (in) and kWh (out) separately. Additional metering for kW and kVARh will be determined by the requirements of the individual installations. Typical required metering points are shown in Figures.

5.3.4.2 CTs and PTs for Type 3 Interconnections shall be provided and installed by the Customer. Type 3 Interconnections are primary metered (see Figures).

5.3.4.3 Instrument transformer accuracy shall be as specified in this Handbook.

5.3.4.4 In installations where surplus power sales are anticipated and for all simultaneous buy and sell arrangements, VEA will install metering and be

given access as required. This metering will be located at the VEA interconnection facility or at the Customer's switchgear, as appropriate.

5.3.4.5 The Customer shall provide adequate space in the generator switchgear for VEA to install, at its option, metering and/or telemetering of the generator output.

5.3.4.6 See "Metering" section for more detailed information.

5.3.5 Customer Interconnections of Type 3 shall be served from a VEA four-wire multi-grounded neutral distribution circuit to provide adequate grounding. This is necessary to avoid dangerous over-voltages to other customers served from phase-to-neutral connected distribution transformers.

5.3.5.1 Type 3 Interconnection dedicated transformers shall be purchased, owned, installed, and maintained by the Customer.

5.3.5.2 The Customer's main power transformer shall have a grounded-wye, grounded-wye winding configuration connection to VEA's system if the Interconnection is to supply any Customer load.

5.3.5.3 If the Customer's machine configuration is a delta connection and the Customer plans to supply load, the Interconnection transformer will be grounded-wye, grounded-wye and it will be the Customer's responsibility to supply the appropriate equipment to connect a delta machine configuration.

5.3.5.4 If the Customer Interconnection is solely used for generation, a grounded-wye (high side), delta (low side) connection may be used depending upon the Customer's machine configuration.

5.3.6 Customer protection systems for Type 3 Interconnections

5.3.6.1 Customer protection systems and Compliance with IEEE 1547 and UL 1741.

5.3.6.1.1 Customer generation equipment used for Type 3 Interconnections shall meet the requirements of IEEE 1547 and UL 1741 along with any supporting documents created for testing, clarification, or information follow up of each article.

5.3.6.1.2 Customer Interconnections using generation equipment such as standalone synchronous or induction machines that do not comply with IEEE 1547 or UL 1741 must be equipped with protective devices that will make the Interconnection installation meet the requirements of these articles. A line voltage relay or contactor which will prevent the generator from being connected to a de-energized or single-phased (if normally three-phase) source may be required. This relay is to disconnect the generator from a de-energized utility line and prevent its reconnection (islanding) until the line is re-energized by VEA. Re-energizing times and feeder reclosing will be

coordinated with VEA. A Customer's facility shall not adversely affect VEA feeder reclosing.

5.3.6.2 Customer provided protection and typical protection devices which may be required to satisfy Type 3 Interconnection requirements are:

5.3.6.2.1 The Customer shall provide adequate protective devices to detect and clear the generator(s) from short circuits or grounds on the VEA facilities serving the Customer.

5.3.6.2.2 The Customer shall provide adequate protective devices to detect the voltage and frequency changes that can occur if the VEA facilities serving the Customer are disconnected from the main system; and if abnormal voltages or frequencies exist, these relays would then clear the Customer generation from the isolated system. Isolation from the VEA system should be such that it will not affect the VEA reclosing cycle normally employed on the serving facilities.

5.3.6.2.3 Phase over-current trip devices (Device 51).

5.3.6.2.4 Residual over-voltage relay to trip for ground faults on the VEA system (Device 59N).

5.3.6.2.5 Under/over-voltage relays (Device 27/59). Under-voltage relays shall be adjusted to a percentage of nominal voltage as specified by VEA during design coordination and have sufficient time delay to prevent unnecessary tripping of external faults. Over-voltage relays should be adjustable from 110-120% of nominal voltage and should be instantaneous. Setting change with temperature variation should not exceed $\pm$ 2 volts over the expected temperature range.

5.3.6.2.6 Phase sequence/under-voltage relay (Device 47/27). To permit paralleling when VEA voltage and phase sequence are normal.

5.3.6.2.7 A synchronizing check relay shall be required for a synchronous generator (Device 25).

5.3.6.3 In specific installations, particularly with large generators (over 3,000 kVA), VEA may require specific additional protective functions such as loss of excitation, loss of synchronism, and over excitation protection, if these conditions would have an impact on VEA's system.

5.3.6.4 Depending on the size of the generation and the size of the distribution system to which it is connected, VEA may require the Customer to utilize "utility grade" protective relays. Such relays have more stringent tolerances, are more flexible, and the characteristics are more widely published than "industrial grade" relays. This requirement shall be invoked only if generation is of such size that close coordination with VEA's relays is required or if the generation is

applying for interconnection under VEA's Wholesale Distribution Access Tariff (WDAT).

5.3.6.5 Where induction generators or static inverters are employed rather than synchronous machines, the phase over-current protective devices required by VEA may be waived since these sources will not deliver sustained over-currents. The other protective devices would still be required.

5.3.6.6 In some cases, protective devices supplied with the Customer's generating equipment will meet some or all of the VEA protective device requirements. However, the minimum requirement must provide the ability to trip the generator whenever VEA source is lost. If the Customer desires to automatically separate from the VEA source and commence isolated operation upon loss of the VEA source, additional devices may be necessary to effect the separation. Also, VEA complies with NERC Standards, Guidelines and Alerts. NERC released a Solar Alert in May 1, 2018 (Loss of Solar Resources during Transmission Disturbances due to Inverter Settings - II) which primarily recommends revising inverter ride through capabilities and inverter restoration post-fault clearing. VEA and the Customer shall comply with NERC's ride through recommendation made in the alert.

5.3.6.7 All protective devices supplied to satisfy the requirements for this Type 3 interconnection shall be equipped with operation indicators (targets) or shall be connected to an annunciator or event recorder so that it will be possible to determine, after the event, which devices caused a particular trip.

5.3.6.8 All protective devices supplied to satisfy the requirements in this this Type 3 interconnection shall be tested, certified and sealed by qualified personnel at intervals recommended by the manufacturer. Special tests may also be required by VEA to investigate apparent misoperations or to compile a record of performance.

5.3.6.9 Instrument transformer accuracy for protective relaying shall meet the accuracy requirements of this Handbook.

5.3.6.10 The Customer shall provide information on the type of anti-islanding protection used and coordinate those protection schemes such that any VEA circuit reclosing shall not be adversely affected. Additionally, system design information showing the method of preventing reparalleling Customer generation shall be provided to VEA. Reparalleling Customer generation shall not occur after a circuit is disconnected unless the VEA service voltage is of normal magnitude, normal phase sequence, and approval is received from the VEA control center.

5.3.7 The Customer shall provide and maintain on-site communications between the Customer's generating facility and VEA's control center. As part of the interconnection process, VEA will inform the Customer of the type of communications required on a case-by-case basis.

5.3.8 Remote control of Customer equipment or devices by VEA system operators may be required for Type 3 Interconnections. Remote control may be waived depending upon total generation, physical system parameters, or other governing factors. The installation

of Utility owned protective equipment ahead of interconnection would waive control requirements of customer equipment. Types of control by the VEA control center includes:

5.3.8.1 Close Permissive Control,

5.3.8.2 Transfer Trip Capabilities,

5.3.8.3 Interconnect breaker tripping.

5.3.9 VEA may require telemetry capability to allow VEA to verify at a minimum, on-line/off-line (tie point breaker) status and measure amps, watts, vars and voltage output.

5.3.10 Harmonic output of power inverters will comply with IEEE 1547, IEEE 519, and/or UL 1741. If a Customer is found to be interfering with other Customers or Members, or exceeds IEEE recommended specifications, the Customer may be required to install filtering to bring the harmonic output of their inverter(s) to an acceptable level.

5.4 Distribution Level or Direct Substation Interconnections - Type 4 (10-20 MVA)

5.4.1 Type 4 Interconnections are described in this section. Total generation greater than 10 MVA shall be interconnected at primary/main distribution feed or direct substation connection. The Customer shall bear the costs of all upgrades to existing infrastructure required to accommodate the Interconnection.

5.4.1.1 Type 4 Interconnections will require an independent design review for each Customer facility. Type 4 Interconnections utilize a point of service at the primary distribution voltage level and will be done on a three-phase, three wire basis only.

5.4.1.2 All Type 4 Interconnections require a VEA review of protective functions. Design information shall be provided by the Customer. VEA shall be contacted during the design process for information and coordination of the Customer's facility and protective requirements.

5.4.2 A manual disconnecting device with provisions for locking in the open position shall be required at or near the point of Type 4 Interconnections as per this Handbook.

5.4.3 The Customer's Interconnection shall be equipped with breakers rated for the installation ampacity and have an interrupt rating adequate for the available fault current at the Interconnection.

5.4.4 Metering of Type 4 Interconnections

5.4.4.1 Type 4 Interconnections shall be equipped with metering equipment capable of recording the kWh (in), kWh (out), kVARh (in), and kVARh (out) separately. Additional demand metering will be determined by the requirements of the individual installations. A backup energy recording device shall be required.

5.4.4.2 Metering for Type 4 Interconnections shall be capable of load profiling.

5.4.4.3 CTs and PTs for Type 4 Interconnections shall be provided and installed by the Customer after approval by VEA.

5.4.4.4 Instrument transformer accuracy shall be as specified in this Handbook.

5.4.4.5 VEA will install metering and be given access as required. This metering will be located at the Interconnection point.

5.4.4.6 The Customer shall provide adequate space in the facility switchgear for VEA to install, at its option, metering and/or telemetering of the generator output.

5.4.4.7 See this Handbook for more detailed metering information.

5.4.5 The Customer shall bear the costs of all upgrades to existing infrastructure, including design and construction, required to accommodate Type 4 Interconnections. VEA shall review and comment on the design and shall be an active participant reviewing each design phase submittal from a qualified Engineer performing the design.

5.4.6 Customer protection systems for Type 4 Interconnections

5.4.6.1 Customer protection and generation equipment shall comply with the most recent standards and utility practices.

5.4.6.2 Generation equipment used for Type 4 Interconnections shall be reviewed on a case-by-case basis.

5.4.6.3 Customer provided protection and typical protection devices which may be required to satisfy Type 4 Interconnection requirements include:

5.4.6.3.1 The Customer shall provide adequate protective devices to detect and clear the generator(s) from short circuits or grounds on the VEA facilities serving the Customer.

5.4.6.3.2 The Customer shall provide adequate protective devices to detect the voltage and frequency changes which can occur if the VEA facilities serving the Customer are disconnected from the main system; and if abnormal voltages or frequencies exist, these relays shall disconnect the Customer generation from the system.

5.4.6.3.3 Phase over-current trip devices (Device 51).

5.4.6.3.4 Residual over-current relays to trip for ground faults on the VEA system (Devices 51N).

5.4.6.3.5 Under/over-voltage relays (Device 27/59). Under-voltage relays shall be adjusted to a percentage of nominal voltage as specified by VEA during design coordination and have sufficient time delay to prevent unnecessary tripping of external faults. Over-voltage relays should be adjustable from 110-120% of nominal voltage and should be instantaneous. Setting change with temperature variation should not exceed $\pm$ 2 volts over the expected temperature range.

5.4.6.3.6 Under/over-frequency relays (Device 81). The under/over-frequency relay shall be set as specified by VEA during design coordination.

5.4.6.3.7 Phase sequence/under-voltage relay (Device 47/27). To permit paralleling when VEA voltage and phase sequence are normal.

5.4.6.3.8 A synchronizing check relay and an auto-synchronizing relay shall be required for a synchronous generator (Device 25).

5.4.6.4 Instrument transformer accuracy for protective relaying shall meet the accuracy requirements described in this Handbook.

5.4.6.5 The Customer shall provide information on the type of anti-islanding protection used and coordinate those protection schemes such that any VEA circuit reclosing shall not be adversely affected. Additionally, system design information showing the method of preventing reparalleling Customer generation shall be provided to VEA. Reparalleling Customer generation shall not occur after a circuit is disconnected unless the VEA service voltage is of normal magnitude, normal phase sequence, and approval is received from the VEA control center.

5.4.6.6 VEA complies with NERC Standards, Guidelines and Alerts. NERC released a Solar Alert in May 1, 2018 (Loss of Solar Resources during Transmission Disturbances due to Inverter Settings - II) which primarily recommends revising inverter ride through capabilities and inverter restoration post-fault clearing. VEA and the Customer shall comply with NERC's ride through recommendation made in the alert.

5.4.6.7 In specific installations, particularly with large generators, VEA may require specific additional protective functions such as loss of excitation, loss of synchronism, and under/over excitation limiting protection, if these conditions would have an impact on the VEA's system.

5.4.6.8 All Type 4 Interconnections require the Customer to utilize "utility grade" protective relays. Such relays have more stringent tolerances, are more flexible, and the characteristics are more widely published than "industrial grade" relays.

5.4.6.9 All protective devices supplied to satisfy the requirements in this Handbook shall be equipped with operation indicators (targets) or shall be connected to an annunciator or event recorder so that it will be possible to determine, after the fact, which device(s) caused a particular trip.

5.4.6.10 All protective devices supplied to satisfy the requirements in this Handbook shall be tested, certified and sealed by a qualified person. Special tests may also be required by VEA to investigate apparent misoperations or to compile a record of performance.

5.4.6.11 Phase over-current protection shall be required regardless of generation source type.

5.4.7 The Customer shall provide and maintain on-site communications between the Customer's generating facility and the VEA control center.

5.4.8 Remote Control, Telemetry, and SCADA: All costs related to operational telemetry and control as required for VEA to accommodate Customer's generation shall be borne by the Customer.

5.4.9 Remote control of Customer equipment or devices by the VEA control center shall be required for Type 4 Interconnections. VEA shall require dedicated communications for both telemetry and control. Additionally, VEA may also have other communication or control requirements which will be determined during the project design coordination phase. The installation of Utility owned protective equipment ahead of interconnection would waive control requirements of customer equipment. Types of control by VEA's control center includes:

5.4.9.1 Close Permissive Control,

5.4.9.2 Transfer Trip Capabilities,

5.4.9.3 Interconnect breaker tripping.

5.4.10 Customer shall provide telemetry capability to allow VEA continuous monitoring of the installation and verify, at a minimum, on-line/off-line (tie point breaker) status and measure amps, watts, vars and voltage output.

5.4.10.1 The Customer shall provide and install a Remote Terminal Unit (RTU) compatible with VEA's SCADA system along with any necessary transducers.

5.4.10.2 All transducers used for VEA monitoring shall be utility grade quality and subject to VEA approval.

5.4.10.3 The Customer shall provide a telephone line interface, a four wire data circuit, and telephone isolation equipment, and arrange for the telephone lines. Fiber optic communication may be substituted for dedicated phone lines where applicable.

5.4.10.4 The Customer shall provide space for all required VEA communication and control equipment in their facility.

5.4.11 Harmonic output of Customer generation shall comply with IEEE 519. If Grid Interactive power sources are used, IEEE 1547 and UL 1741 shall also apply and the most stringent specification shall govern. If a Customer is found to be interfering with other customers or Members, or exceeds IEEE recommended specifications, the Customer may be required to install filtering equipment to bring the harmonic output of their inverter(s) to an acceptable level.

5.4.12 Adequate facility and equipment grounding meeting NESC, IEEE recommended standards, and current safe utility practices for grounding must be designed and installed by the Customer.

5.4.13 Reactive power requirements: The facility shall have the capability to adjust reactive power. VEA will provide reactive power requirements on a case-by-case basis.

5.4.14 Machine testing and Computer Modeling

5.4.14.1 VEA may model Customer generation in its computer models. The Customer shall provide VEA equipment specifications and test reports upon request so

VEA can model their facilities. All costs of such modeling shall be borne by the Customer.

5.4.14.2 Machine testing results shall be provided to VEA and shall include, but not be limited to, generator, governor and automatic voltage regulator (AVR) parameters. Field testing of all machines shall be provided in accordance with the regulatory requirements and guidelines.

5.4.15 The Customer's facilities shall be secure to prevent unauthorized personnel access.

6 METERING

6.1 General Information

6.1.1 Energy flow to VEA shall be measured by bi-directional meters or meters equipped with detents so that the record of those flows will not be affected by any flows to the Customer. Flows to Customer shall be metered separately and billed monthly in accordance with the terms of the Purchase Agreement, if any, existing between the parties, and/or otherwise in accordance with VEA tariffs and/or policies.

6.1.2 At VEA's option, VEA shall procure, install, own, inspect, test, and maintain meters to record flows to and from VEA's system.

6.1.3 VEA shall determine the integrated demand for each fifteen (15) minute period for such recordings. VEA shall also procure, install, own, inspect, test, and maintain meters for measurement of reactive volt-amperes. VEA may also, in its sole discretion, install additional metering devices at a location agreed upon by both parties within Customer's facility to enable VEA to telemeter information and data. All costs relating to metering devices and any metering related telemetering equipment installed and required for VEA to accommodate Customer's generation shall be borne by Customer as part of the interconnection costs.

7 REQUIREMENTS FOR COMMERCIAL OPERATION

7.1 Purpose

The purpose of this section is to provide Customers with a general understanding of VEA and some CAISO requirements for parallel operation with the VEA grid. Generally, these requirements apply to all WDAT Customers, however some Customers with small projects may be exempt from some of these requirements. Such exemptions will be determined by VEA on a case-by-case basis.

The Customer must comply with the CAISO's "New Resource Implementation" (NRI) process and requirements. CAISO NRI information is found on their webpage at www.caiso.com. NRI information contains guidelines, deliverables and activities required during the final days of the project's interconnection. This CAISO process requires the following two letters from VEA to the Customer: (1) Interconnection Approval Letter and (2) VEA Final Approval Letter. These letters originate from VEA, then are sent by the Customer to the CAISO as part of their NRI process.

7.2 Customer Requirements for VEA Interconnection Approval Letter

CAISO requires an "Interconnection Approval Letter" from VEA in order for the CAISO to grant permission for generator(s) syncing and testing. Before that, VEA requires the Customer provide VEA a

"Turn-Over" letter stating their equipment installation and testing is complete, all relay and control systems have been tested between the Customer and VEA, their equipment is ready for service and all other requirements in this section have been completed. The Turn-Over letter will also provide that the Customer is aware, and that their personnel have been informed (and/or trained), that VEA facilities up to their Generating facilities will be energized.

7.3 Test Results and/or Information Required Prior to Syncing and Testing

All tests outlined below must be complete and two (2) copies of test reports submitted to VEA Engineering a minimum of three (3) weeks before the date the Customer wants the Interconnection Approval Letter. Customer's work plan should include that test reports are approved by VEA at least five (5) calendar days before the date the Customer wants the Interconnection Approval Letter. Failure to meet VEA requirements may result in delay of issuance of the Interconnection Approval Letter, which will delay syncing/testing of Customer's equipment. Also any inspections required by local government agencies must be completed and permits signed off prior to the syncing/testing date.

7.4 Proving Insulation

For any of the megger tests referred to below a 2,500-volt DC megger or a hipot is preferred, but a 1,000-volt DC megger is acceptable.

- All transformers connected to the primary bus and the main transformer must be meggered winding to winding and each winding to ground. For purposes of this document, "primary bus" is defined as the source-side bus or conductor from the primary interrupting device to the generating plant.
- All circuit breakers and circuit switchers connected to the primary bus and at the interconnection point must be meggered in the following manner: Breaker open - each pole to ground, pole 1-2, pole 3-4, pole 5-6; breaker closed - pole 1-ground, pole 3-ground, pole 5-ground and if the poles are in common tank or cell, pole 1-3, pole 3-5, pole 5-1.
- All buses and cables shall be meggered phase-to-phase and phase-to-ground.
- The main transformer(s) and main breaker(s) shall have a dielectric test performed on the insulating medium (gas or oil). This does not apply to factory-sealed circuit switcher interrupters.
- The Generating Unit(s) must be meggered or hi-pot tested phase-to-phase and phase-to-ground.

7.5 Proving Ratios

All ratios of transformers connected to the primary bus must be proven using either a turns ratio tester or a voltage ratio test. The main transformer must be tested on the final operating tap as determined by VEA.

7.6 Circuit Breakers and Circuit Switchers

- A minimum to trip at 70 volts (assuming a nominal 125 VDC battery system) must be performed on all circuit breakers and/or circuit switchers that are operated by VEA-required relays.
- A Micro-Ohm test must be performed on all circuit breakers and circuit switchers.
- A timing test showing the time from trip initiation to main poles opening is required.
- A timing test showing the time from close initiation to main poles closing is required.

7.7 Current Transformers and Current Circuits

- A saturation check must be made on all current transformers (CTs) associated with the required VEA relays.
- The ratio of all CTs must be proven.
- CT circuits must be checked for proper connections and continuity by applying primary or secondary current and reading in the relays. Each test (primary or secondary) must be

performed in all combinations to prove proper connections to all phase and ground relays. Current must be applied or injected to achieve a secondary reading of 0.5 amps in each relay to ensure that no loose wiring or parallel current paths exist.

A check of the total circuit with the ground wire lifted must be done to prove that only one ground exists.

7.8 Relays

All relays must be field tested on site to their specified settings to verify the following:

- Minimum operating point at which relay picks up (minimum pickup).
- Time delay at three different current test points, in integral multiples of minimum pickup that closely characterize the relay time-current curve.
- Phase angle characteristic of directional relay.
- Pickup points at maximum torque angle (MTA) and 30 degrees of MTA on impedance relays using the approved settings.
- Slip frequency, voltage matching, phase angle acceptance and breaker compensation time on synchronizing relays.
- VEA tolerances are listed below:
  - Current/Voltage/Time + 3 to 5 percent
  - Impedance/Phase Angle + 0.05 degrees
  - Frequency + 0.05 Hz

If a pilot relay system is required by VEA, signal level checks must be performed.

7.9 Primary Disconnect Switch

The primary disconnect switch at the point of interconnection shall be clearly labeled and lockable in the open position.

7.10 Real-Time Device

The final remote Real-Time Device database shall be provided to VEA at least thirty (30) calendar days prior to scheduled commercial operation date.

7.11 Metering Inspection

Subsequent to VEA Engineering approval of the metering design, VEA shall be provided at least six (6) weeks' notice to perform an inspection of the facility. This inspection includes, but is not limited to, verifying wire impedances, ratio checking of CTs, and inspecting the metering cabinet and associated hardware. Upon a satisfactory inspection by VEA of the facility, the VEA meters and ancillary equipment shall be installed by VEA. The facility may not be energized before the installation of the VEA meters.

7.12 Station Battery

When a battery is installed, proof of discharge testing is required to ensure that the battery has the capacity to support the load and trip.

7.13 Pre-Parallel Test

The Customer is responsible for ensuring that all relays, data telemetry and other protective devices are adjusted and working properly prior to the pre-parallel inspection. If problems arise with equipment during testing, the VEA protection representative may elect to cancel the test and reschedule. All pre-parallel tests should only be scheduled to begin at 8:00 AM and completed by 6:00 PM Monday through Friday. Functional tests shall be performed by the Customer and all tests shall be observed by VEA as outlined below. The Customer shall provide all test equipment and qualified personnel to perform the required tests. VEA shall be included strictly as an observer.

7.14 Functional Tests

The following functional tests shall be performed after the equipment has been energized, but before the Generating Unit is paralleled with VEA's grid:

- Check that each protective relay trips the appropriate generator breaker and/or main breaker. This may require injecting a signal. Jumpering across a contact on the back of the relay is not acceptable.
- When first energized, check that proper secondary potential is applied to all voltage and frequency relays.
- Check the synchronizing meter, synchronizing equipment and phasing panel (if used) with the paralleling breaker closed and the generator off-line. This typically requires lifting the generator leads. The equipment should show an "in-phase" condition.
- Check the generator phase rotation. (VEA's phase rotation is C-B-A) phasing tool or a phasing panel provided by the Generator. The synchronizing equipment typically checks one phase only. Any other method of demonstrating correct phasing and phase rotation shall be approved by VEA in writing prior to conducting the test. Alternative methodologies to check phasing and phase rotations must be submitted to VEA three (3) weeks in advance of scheduled pre-parallel test. VEA must approve the methodology one (1) week in advance of pre-parallel test date.

7.15 Impedance and Directional Relay Tests

Direction-check all impedance and directional relays.

7.16 Customer Load Tests

For Customers, the following load tests shall be performed after the Generating Unit picks up load:

- Verify operation of the Generating Unit at 95 percent lagging power factor and at 95 percent leading power factor at rated output.
- Verify operation of the Generating Unit at 95 percent and 105 percent of per unit voltage while delivering rated output.
- Load check all VEA required differential relays. The load current must balance to zero in all differential relays.
- Load check voltage restraint over-current relays to prove correct connection of currents and potentials.
- The Generating Unit(s) may have to be paralleled temporarily with VEA’s system to run the load tests. Permission to do this shall be given by the VEA representative observing the test and coordinated with Dispatch.

7.17 Data Telemetry Tests

Dispatch must verify the following prior to Pre-Parallel Operations.

- Communications circuits meet specifications and are functioning properly.
- Real-Time Device data is mapped correctly to VEA SCADA systems.
- Scaling on all analog data points is correct.
- Point to Point check on all status points is verified at Dispatch.

Typically, pre-parallel inspections can be performed within a normal working day. If a test cannot be completed by 6:00 PM, the VEA representative may cancel the remainder of the test and reschedule it. In this case, the Customer shall incur additional costs for the pre-parallel inspection.

7.18 Model Testing and Validation Report

WECC guidelines require generation equipment to be tested in order for utilities to verify computer models of such equipment. Customer data submitted to VEA for computer steady-state and dynamics modeling used in planning and operating studies must be consistent with the actual physical

characteristics of the Customer's equipment. The Customer shall report to VEA the following data to verify computer models: generator gross and net dependable capability, gross and net reactive power capability, voltage regulator controls, speed and/or load governor controls and excitation systems.

7.19 VEA Final Approval Letter

The Customer may require a Final Approval Letter from VEA before the Customer requests a final Commercial Operation Date with the CAISO. The Final Approval Letter will clearly state VEA is giving the Customer permission to commence commercial operation at a specific MW capacity. Note, a final letter may not be required if the Interconnection Approval Letter has already granted the Customer both testing and commercial operation.

If a Final Approval Letter is required, then the Customer shall certify in writing to VEA at least two (2) weeks before their Commercial Operation Date that it has met all VEA requirements.

7.20 General Notes

- The VEA system has C-B-A clockwise rotation.
- Any changes to VEA-required protection equipment or major substation equipment (e.g., transformers and breakers) must be submitted to VEA for review and approval by the appropriate VEA engineer prior to the changes being made.
- Routine maintenance on VEA-required protective relays and the breaker(s) must meet VEA's maintenance and test practices. After completion of these tests, test reports must be submitted to VEA (protection specialist) for review and approval by the appropriate VEA engineer.
- A VEA technical representative shall then come to the Customer's Generating Facilities and verify the settings.

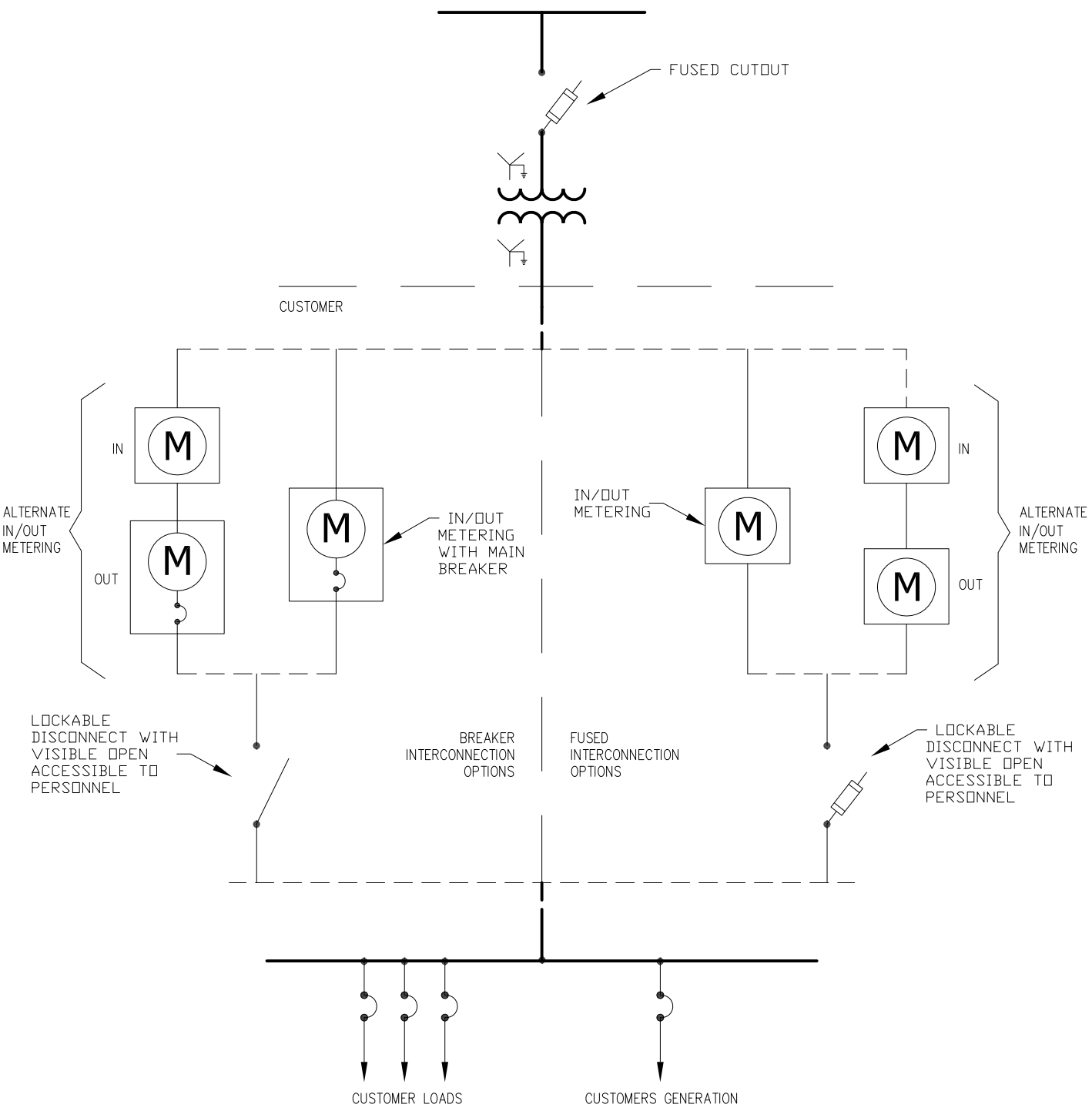
7.21 Signage for Facilities Accessed by Valley Electric Personnel

Some Producer facilities may be accessed by Valley Electric personnel. The Producer shall coordinate with Valley Electric on appropriate signage and component identification numbers if applicable. Generally, Valley Electric signage meets NESC and ANSI Z535 Safety Sign Standards for Electric Utility Power Plants and Substations.

8 FIGURES

The following represent typical interconnection options for illustrative purposes only. VEA will evaluate each interconnection on a case-by-case basis.

8.1 Type 1 – Metering, Disconnect & Fusing Options for 400 Amps or Less at Secondary Voltages



VALLEY ELECTRIC ASSOCIATION

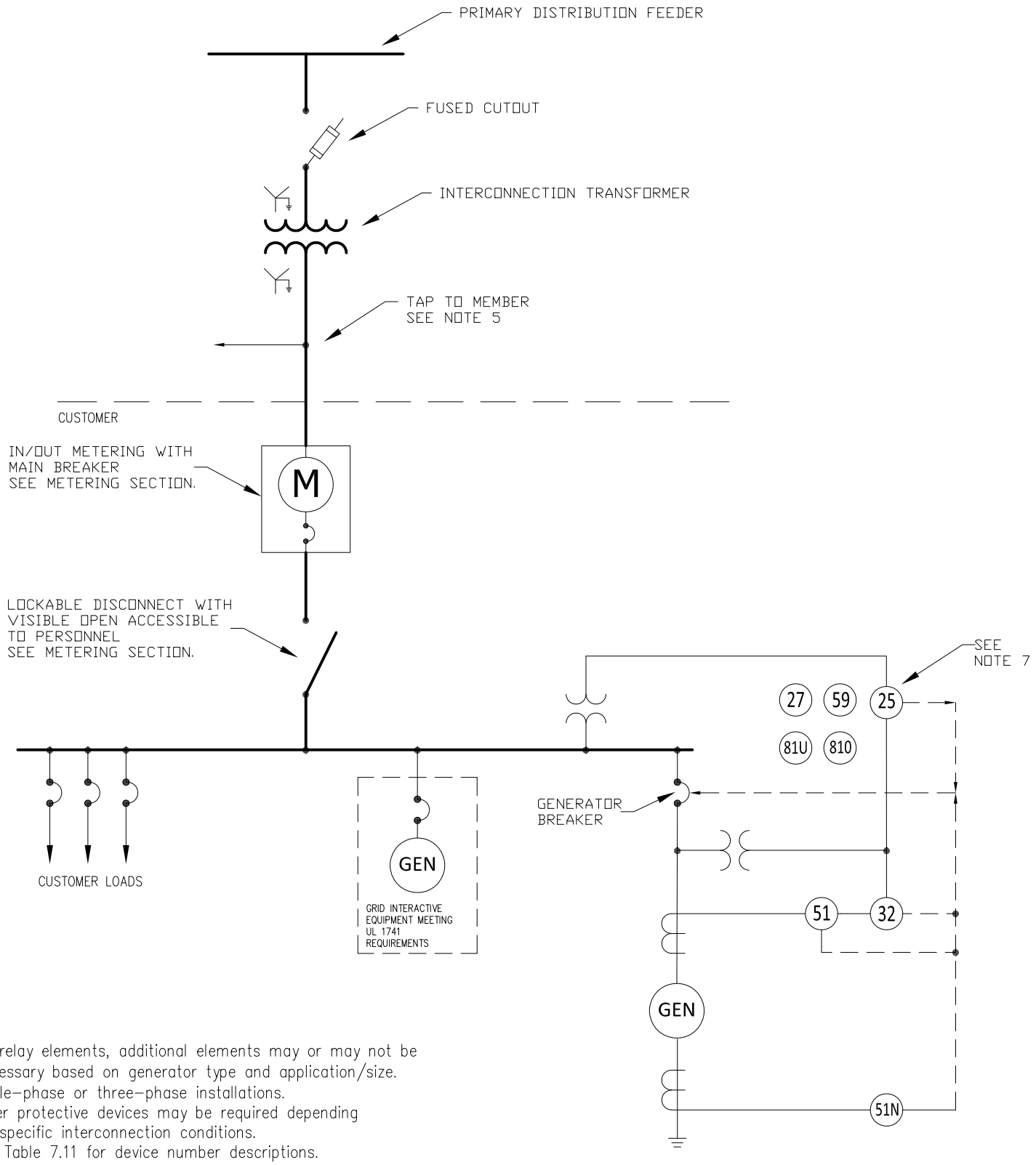
PAHRUMP, NEVADA

Type 1 - Metering, Disconnect, & Fusing Options 400 Amps or Less at Secondary Voltages

E&O Document Library\Interconnection Handbooks\Distribution\Drawings from Derek\AutoCAD\Type 1

REVISION: 0

8.2 Type 1 – Total Generation for 400 Amps or Less at Secondary Voltages



NOTES:

1. For relay elements, additional elements may or may not be necessary based on generator type and application/size.
2. Single-phase or three-phase installations.
3. Other protective devices may be required depending on specific interconnection conditions.
4. See Table 7.11 for device number descriptions.
5. Protection shown is to protect facilities. The Customer may elect to have more protection than shown.
6. Non-dedicated Interconnection transformer may not be allowed in all cases. Determination shall be made up on a case-by-case basis
7. Sync check relay (25) supervises manual synchronized closing.
8. Secondary voltages of 240/120 is limited to 100 kVA or less.

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Type 1 - Total Generation
400 Amps or Less at Secondary Voltages

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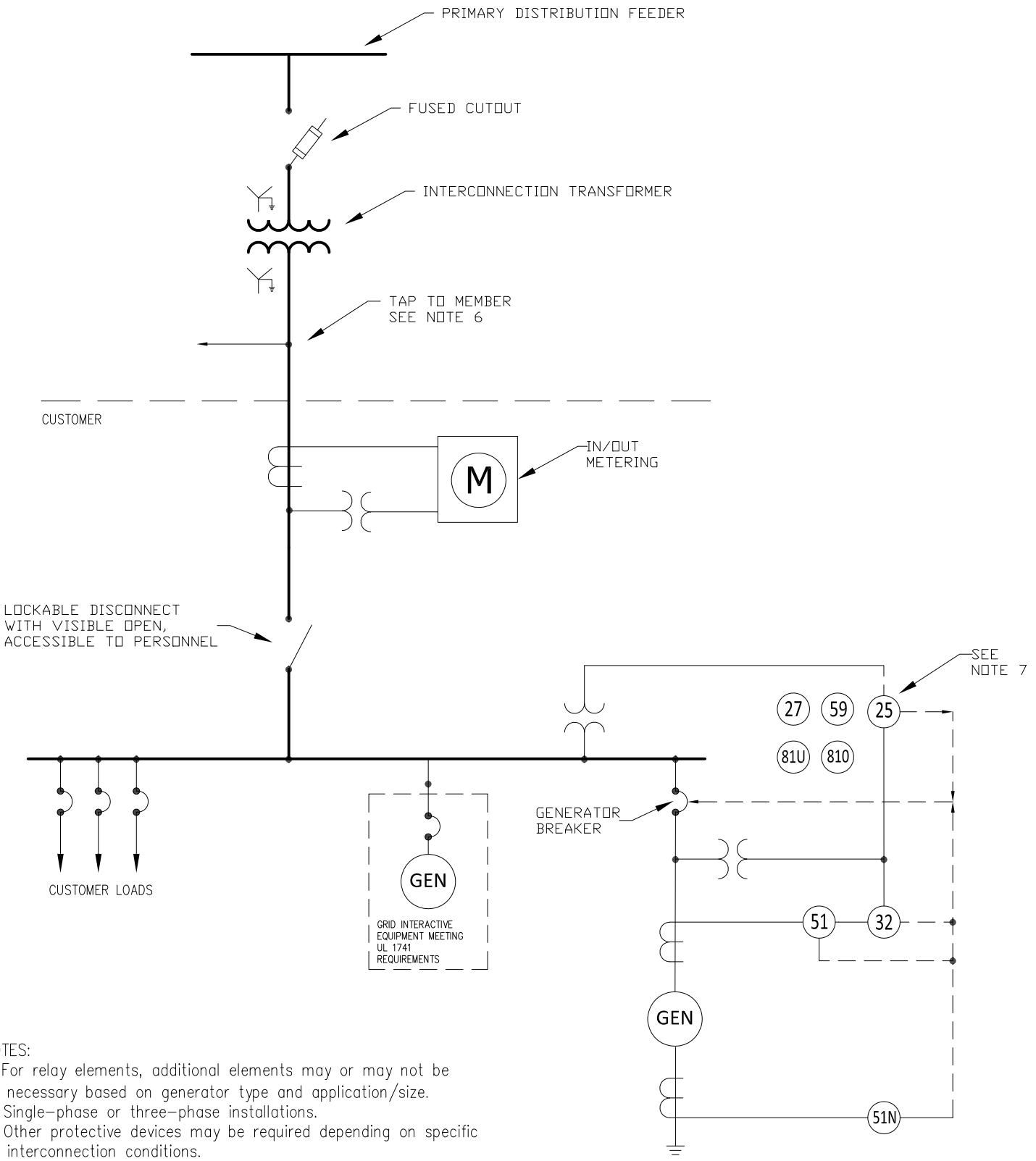
8.3 Type 2 – Total Generation Greater than 400 Amps and Less than or Equal to 2,500 kVA at Three-Phase Secondary Voltages



NOTES:

1. For relay elements, additional elements may or may not be necessary based on generator type and application/size.
2. Single-phase or three-phase installations.
3. Other protective devices may be required depending on specific interconnection conditions.
4. See Table 7.11 for device number descriptions.
5. Protection shown is to protect facilities. The Customer may elect to have more protection than shown.
6. Non-dedicated Interconnection transformer may not be allowed in all cases. Determination shall be made on a case-by-case basis.
7. Sync check relay (25) supervises manual synchronized closing.

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Type 2 - Total Generation

Greater than 400 Amps and Less than or Equal to 2,500 kVA at Three-Phase Secondary Voltages

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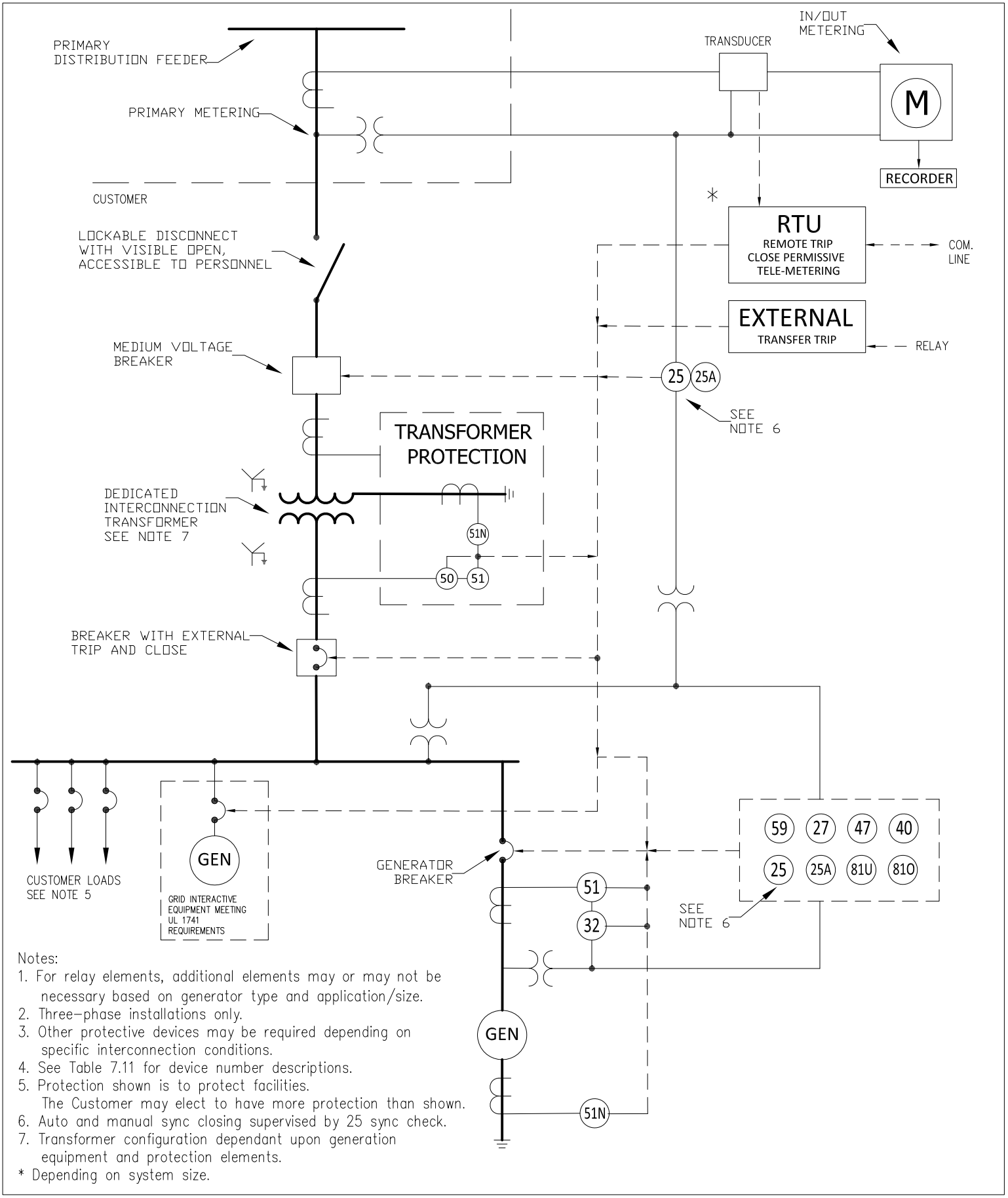
8.4 Type 3 – Total Generation Less than or Equal to 10 MVA at Distribution Primary Voltage



Notes:

1. For relay elements, additional elements may or may not be necessary based on generator type and application/size.
2. Three-phase installations only.
3. Other protective devices may be required depending on specific interconnection conditions.
4. See Table 7.11 for device number descriptions.
5. Protection shown is to protect facilities. The Customer may elect to have more protection than shown.
6. Auto and manual sync closing supervised by 25 sync check.
7. Transformer configuration dependant upon generation equipment and protection elements.

* Depending on system size.

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Type 3 - Total Generation

Less than or Equal to 10 MVA at Distribution Primary Voltage

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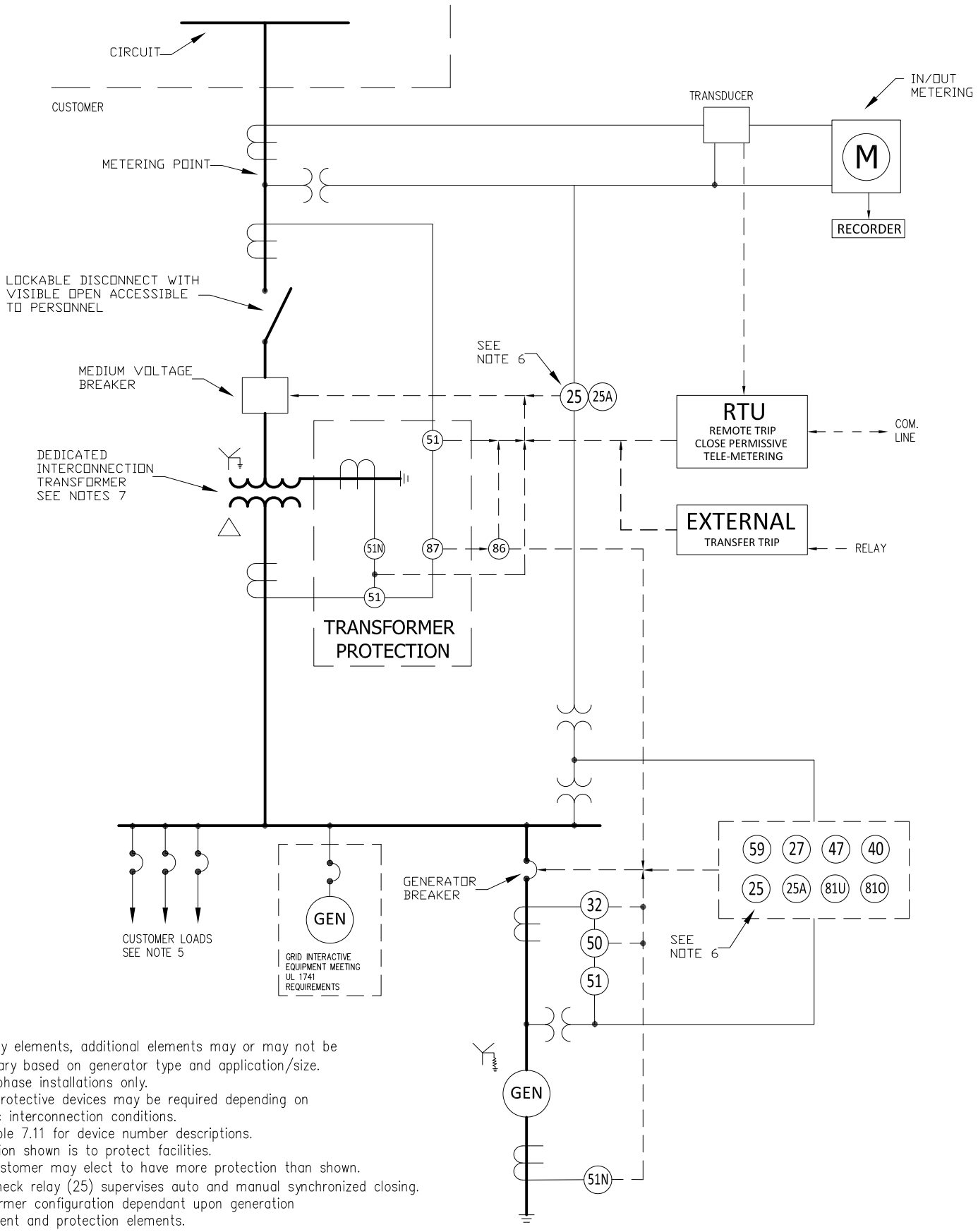
8.5 Type 4 – Total Generation Greater than 10 MVA and Less than or Equal to 20 MVA at Distribution Primary Voltage



Notes:
1. For relay elements, additional elements may or may not be necessary based on generator type and application/size.
2. Three–phase installations only.
3. Other protective devices may be required depending on specific interconnection conditions.
4. See Table 7.11 for device number descriptions.
5. Protection shown is to protect facilities. The Customer may elect to have more protection than shown.
6. Sync check relay (25) supervises auto and manual synchronized closing.
7. Transformer configuration dependant upon generation equipment and protection elements.

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Type 4 - Total Generation

Greater than 10 MVA and Less than or Equal to 20 MVA at Distribution Primary Voltage

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8.6 IEEE Protective Device Numbers

Typical Protective Device Numbers	
4	Master Contactor
25	Synchronizing of Synchronism Check
25A	Automatic Synchronizer
27	Under-voltage
32	Directional Power
40	Loss of Field Detection
46	Phase Balance Current
47	Voltage Phase Sequence
51	Phase Over-current
51G	Ground Time Over-current
51N	Neutral Time Over-current
51V	Voltage Restrained/Controlled Time Phase Over-current
52	Circuit Breaker
59	Over-voltage
59N	Residual Over-voltage (Ground Fault Detection)
79	Reclosing Relay
81O	Over-frequency
81U	Under-frequency
87	Current Differential
NOTE: For additional information on device number, refer to ANSI C37.2	