

**ANNEX "A-1"**

**DRAFT AMENDED NET-METERING INTERCONNECTION STANDARDS**

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## I. OVERVIEW

These guidelines set forth the Net-Metering Interconnection Standards for Qualified End-users (QEs) who enter into Net-metering Agreements with on-grid Distribution Utilities (DUs).

## II. SCOPE AND PURPOSES

These guidelines cover distributed generation, which is connected to and operates in synchronism with the on-grid DUs, and apply to single-phase or three-phase generation with a maximum capacity of 100 kW. These guidelines establish the rules and standards for the interconnection of RE generating facilities to the DU's Distribution System. They provide technical guidance to address engineering, electric system reliability, and safety concerns for net-metering interconnections.

## III. DEFINITIONS

The following terms shall be understood to have the following meanings when used in these guidelines:

- 3.1 Commissioning Test** refers to a test conducted when the equipment is installed to verify correct operation.
- 3.2 Connection Point** refers to the point of connection of the QE System or Equipment to the Distribution System.
- 3.3 Distributed Generation** refers to a system of small generation entities supplying directly to the distribution grid, any one of which shall not exceed one hundred kilowatts (100 kW) in capacity, as defined in Section 4(j) of Republic Act No. 9513.
- 3.4 Distribution Asset Study (DAS)** refers to a study to determine all distribution assets and costs necessary to accommodate a proposed net-metering interconnection.
- 3.5 Distribution Impact Study (DIS)** refers to a set of technical studies which are used to assess the possible effects of a proposed expansion, reinforcement, or modification of the Distribution System or a User Development and to evaluate Significant Incidents.
- 3.6 Distribution Services and Open Access Rules (DSOAR)** refers to the Rules promulgated by the Energy Regulatory Commission

- under ERC Resolution No. 2, Series of 2010 including any subsequent amendments thereto, covering, among others, the terms and conditions for the connection of generating facilities to the Distribution System.
- 3.7 Distribution System** refers to the system of wires and associated facilities belonging to a franchised distribution utility extending between the delivery points on the transmission or sub-transmission system or generator connection and the point of connection to the premises of the end-user, as defined in Section 4(o) of Republic Act No. 9136.
- 3.8 Distribution Utility (DU)** refers to any electric cooperative, private corporation, government-owned utility or existing local government unit which has an exclusive franchise to operate a Distribution System in accordance with its franchise and R.A. No. 9136, as defined in Section 4(l) of Republic Act No. 9513.
- 3.9 Energy Regulatory Commission (ERC)** refers to the independent quasi-judicial regulatory agency created pursuant to Republic Act No. 9136, as defined in Section 4(n) of Republic Act No. 9513.
- 3.10 Flicker** *refers to the impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time.*
- 3.11 Grounding** *refers to a conducting connection by which an electrical circuit or Equipment is connected to earth or to some conducting body of relatively large extent that serves as ground.*
- 3.12 Harmonics** *refers to sinusoidal voltages and currents having Frequencies that are integral multiples of the fundamental Frequency.*
- 3.13 Interconnection** refers to the result of the process of adding an RE system to the Distribution System.
- 3.14 Island** refers to a condition in which a portion of the DU's distribution network is energized solely by one or more RE systems.
- 3.15 Metering Service Provider (MSP)** refers to a person or entity authorized by ERC to provide Metering Services. The DU shall be the sole metering service provider for the retail market until such time that the ERC determines the provision of metering services at the retail level as competitive.

- 3.16 Net-Metering** refers to a system, appropriate for distributed generation, in which a distribution grid user has a two-way connection to the grid and is only charged or credited, as the case may be, the difference between its import energy and export energy.
- 3.17 Net-Metering Agreement** refers to the agreement between a QE and the DU governing the commercial and inter-connection arrangements between the DU and the QE (See Annex "A-2").
- 3.18 Parallel Operation** refers to the operation of an RE system with or without an exporting capacity while connected to DU's Distribution System.
- 3.19 Philippine Distribution Code (PDC)** refers to the set of Rules, requirements, procedures and standards governing DUs and Users of Distribution System in the operation, maintenance and development of the Distribution System. It also defines and establishes the relationship of the Distribution System with the facilities or installations of the parties connected thereto.
- 3.20 Philippine Electrical Code (PEC)** refers to the electrical safety Code that establishes basic materials quality and electrical work standards for the safe use of electricity for light, heat, power, communications, signaling, and for other purposes.
- 3.21 Qualified End-user (QE)** refers to entities that generate electric power from an eligible on-site RE generating facility, such as, but not limited to, house or office building with photovoltaic system that can be connected to the grid, for the purposes of entering into a Net-Metering agreement, as defined in Section 7 of the Implementing Rules and Regulations of R.A. 9513.
- 3.22 Reclosing** refers to the automatic return of power lines to service following their disconnection for fault conditions.
- 3.23 Renewable Energy (RE) Certificate** refers to a certificate issued by the RE Registrar to electric power industry participants showing the energy sourced, produced, and sold or used. RE Certificates may be traded in the RE Market in complying with the RPS, as defined in Section 3(tt) of the Implementing Rules and Regulations of R.A. 9513.
- 3.24 Renewable Energy Facility (RE system)** refers to the generator(s) and/or inverter(s) together with all protective, safety, and associated equipment located on the QE's side of the

Connection Point which the QE requests to interconnect to the DU's Distribution System.

**3.25 Renewable Energy Resources (RE Resources)** refers to energy resources that do not have an upper limit on the total quantity to be used. Such resources are renewable on a regular basis, and whose renewal rate is relatively rapid to consider availability over an indefinite period of time. These include, among others, biomass, solar, wind, geothermal, ocean energy, and hydropower conforming with internationally-accepted norms and standards on dams, and other emerging renewable energy technologies, as defined in Section 4(uu) of Republic Act No. 9513.

**3.26 Standard Planning Data** refers to the general data required by the distribution utility as part of the application for a net-metering interconnection.

**3.27 Synchronization** refers to the process of attaining the state when connected Generating Units and/or interconnected AC Systems operate at the same Frequency and where the phase angle displacements between their voltages vary about a stable operating point.

#### **IV. GENERAL GUIDELINES**

**4.1** A QE who intends to operate in parallel with the DU's Distribution System shall, in consultation with the DU, design, install, operate, and maintain all necessary equipment on its property for interconnection, unless otherwise stated in the Net-Metering Agreement.

**4.2** The DU shall allow interconnection of RE systems with a maximum capacity of  $100\text{kW}_{AC}$  per QE account to its Distribution System, *except for Solar Photovoltaic (PV) which will be  $100\text{kW}_{DC}$ .*

**4.3** The DU shall conduct inspections and witness the calibration and testing of the QE's lines, wires, and switches.

**4.4** The DU shall *disconnect* the QE's generation facility from the Distribution System at any time, *using the disconnect device as specified in 7.4.1 of these Rules, whenever the DU deems it necessary to conduct* maintenance, test, repair, or emergency condition or *other* safety concerns related to it.

**4.5** All specifications and detailed plans for the installation of the communication, control and protective devices shall be of the DU's standards.

- 4.6** The QE shall inform and seek the approval of the DU prior to the execution of any changes or modifications in the RE system or to the connection point. *The QE shall be liable for any costs and/or damages incurred by the DU as a result of any changes or modifications in the RE system or to the connection point without the latter's approval.*
- 4.7** The RE system shall conform to the latest revision of the PEC, PDC, DSOAR, other local codes, and the Terms and Conditions of Service and Standard Rules and Regulations as approved by the ERC.

## **V. APPLICATION FOR INTERCONNECTION**

- 5.1** Upon written request and *within three (3) business days from receipt of such request*, the DU shall provide information and documents (such as the *pro forma* agreements and the application, technical requirements, specifications, listing of certified equipment, application fee information, applicable rate schedules and metering requirements) in response to a QE's inquiry. All such information shall be sent to the QE as agreed upon by the DU and the QE.
- 5.2** The application form shall include the following information:
- A description of the proposed connection or modification to an existing connection to the Distribution System;
  - The relevant Standard Planning Data as specified in Section 6.4 of the PDC;
  - *The manufacturer's simulation results on technical parameters such as abnormal voltage and abnormal frequency of the RE equipment or component; and other data as required by the DU; and*
  - The completion date of the proposed interconnection.
  - *Certificate of Compliance requirements as provided in Resolution No. 16, Series of 2014, "A Resolution Adopting the 2014 Revised Rules for the Issuance of Certificates of Compliance (COCs) for Generation Companies, Qualified End-Users and Entities with Self-Generation Facilities".*
- 5.3** The QE shall complete and file an application and any possible Detailed Planning Data as specified in Section 6.5 of the PDC. The

- filing must include the completed application and a fee (if required) for processing the application.
- 5.4 Within *three (3)* business days upon receiving the application, the DU shall acknowledge its receipt and state whether or not the application is complete.
  - 5.5 Once an application is accepted by the DU as complete, the DU shall determine in a non-discriminatory basis whether a specific DIS is necessary in accordance with the DSOAR.
  - 5.6 Upon completion of the study, the DU shall provide the applicant with the results of the study, including any additional interim agreements, such as construction agreements that may be necessary and a cost estimate to complete the interconnection.
  - 5.7 Prior to signing of the Net-Metering Agreement, the DU, together with the QE, shall inspect the RE system onsite and check its conformance to the technical requirements in the Net-Metering Agreement and of these guidelines. Any non-conformance shall be corrected first before the Net-metering Agreement is signed and the RE system is connected and energized.
  - 5.8 The DU and QE, taking into consideration the agreed target completion date, shall use their reasonable endeavors, in coordination with each other, to complete their respective connection arrangements as agreed in the Net-metering Agreement.

## **VI. SYSTEM PARAMETERS**

Any RE system causing interference, problems, or any unacceptable parameters to the DU's Distribution System shall be disconnected *by the DU* from the Distribution System and shall remain disconnected until the condition has been corrected, *provided that reasonable notice is given on the intent to disconnect, and the QE is given at least three (3) days within which to remedy the hazardous condition*. If the cause of the problem is the RE system, all costs associated with determining and correcting the problem shall be at the QE's expense.

### **6.1 Voltage Level**

The QE shall operate its facility maintaining the same voltage level as the DU's Distribution System at the Connection Point. The QE must provide an automatic method of disconnecting its facility from the Distribution System within DU's limits as stated in Table 1.



**Table 1 – Minimum Time Requirements for RE to Remain Connected at Different Voltage Ranges**

RE System	
Voltage Range (% of Base Voltage)	Time (s)
$V < 50$	0.16
$50 \leq V < 90$	2.00
$90 < V \leq 110$	<i>Normal Operating Range</i>
$110 < V < 120$	1.00
$V \geq 120$	0.16

## 6.2 Frequency

All RE systems shall operate at a frequency of 60 Hz. The QE shall provide automatic disconnection means from the DU's Distribution System within the time prescribed in Table 2.

**Table 2 - Minimum Time Requirements for RE to Remain Connected at Different Frequency Ranges**

RE System	
Frequency Range (Hz)	Time
$F > 62.4$	<i>Automatic disconnection</i>
$61.8 < F \leq 62.4$	5 minutes
$58.2 \leq F \leq 61.8$	Continuous Operation
$57.6 \leq F < 58.2$	<i>5 minutes</i>
$F < 57.6$	5 seconds

## 6.3 Power Quality

### 6.3.1 Limitation of *Direct Current (DC)* Injection

The RE system and its interconnecting system shall not inject DC greater than 0.5% of the full load rated output current at the Connection Point.

### 6.3.2 Flicker Severity

The flicker severity at the Connection Point shall not exceed 1.0 unit for short term and 0.8 units for long term as specified in Section 3.2.6 of the PDC, or any subsequent amendments thereto.

### 6.3.3 Harmonics

The harmonic content of the voltage and current waveforms in the DU's Distribution System shall be restricted to levels that will not cause interference or equipment-operating problems. The harmonics shall be within the limits defined in Section 3.2.4 of the PDC or any *subsequent* amendments thereto.

### 6.4 Power Factor

The QE shall maintain a power factor of not less than 85% lagging, measured at the Connection Point. Failure to maintain the power factor within this range may result in rate penalties and/or discontinuation of interconnection with the DU's Distribution System.

## VII. SYSTEM PROTECTION

The QE shall be responsible for providing adequate protection for its *system* under any operating conditions, and regardless of whether or not the interconnected generation is in operation. Conditions include, but are not limited to, single phasing of supply, system faults, equipment failures, abnormal voltage or frequency, lightning and switching surges, excessive harmonic voltages, excessive negative sequence voltages and islanding.

### 7.1 Synchronization

The QE shall provide synchronizing devices for synchronizing the RE system to the DU's Distribution System. Automatic synchronization devices shall be installed to monitor and control the synchronism, frequency, power factor and the voltage level of the RE system. The DU shall review, approve, and inspect the method of synchronization. Automatic synchronizing settings shall not be changed following installation unless mutually agreed by both parties. Typical limits for synchronizing parameters are given in Table 3.

**Table 3 - Typical Synchronizing Parameter Limits**

Aggregate Rating of RE Resource (kW)	Maximum Frequency Difference $\Delta f$ (Hz)	Maximum Voltage Difference $\Delta V$ (%)	Maximum Phase Angle Difference $\Delta \Phi$ (Degrees)
$\leq 100$	0.3	10	20

## 7.2 Islanding

*In case the QE's interconnection system detects possible islanding, the QE shall disconnect from the Distribution System within two (2) seconds.* The QE shall provide systems against islanding to isolate and block the RE system from closing back into the Distribution System until the system is energized for *ten (10) minutes* from a normal utility source.

## 7.3 Integration with DU's Distribution System Grounding

The grounding scheme of the QE shall not cause over voltages that exceed the rating of the equipment connected to the DU's Distribution System and shall not disrupt the coordination of the ground fault protection on the Distribution System. All electrical systems and equipment shall be grounded in accordance with the requirements of the PEC.

## 7.4 Protective and Control Devices

The QE's protection system shall coordinate with the DU's protection system. The QE shall submit proposed fused types or relay settings to the DU for review and acceptance. Any subsequent relay changes shall also be submitted to the DU.

### 7.4.1 Disconnect Device

The QE shall provide a visible disconnect device to be used by the DU to electrically isolate the DU's Distribution System from the RE system and to establish working clearances for maintenance, safety and system considerations. The disconnect device shall be physically located within 10 feet from the Connection Point for ease of access by the DU personnel. If this is not practical, the disconnect device should be located between the RE system and the Connection Point. The type of disconnect device must allow for visual indication of the contact's position and the handle must be lockable in the open position with a padlock. *Only the DU personnel will have access to the disconnect device.*

*The RE system installed within the QE's premises must be properly labeled and marked at the Connection Point to guide the DU personnel.*

### 7.4.2 Protective Relays

Protective relays shall be installed to trip the corresponding circuit breaker during abnormal conditions. Protective relays

for a given RE Resource rating typically include, but are not limited to, the lists shown in Tables 4, 5 and 6.

**Table 4 - Interconnection Protective Function Requirements for Induction Generators**

Device #	Protective Equipment	<i>RE System Size</i>	
		<i>≤ 10 kW</i>	<i>&gt;10 kW - 100 kW</i>
27	Under Voltage Relay	x	x
27 GEN	Voltage Check Relay	x	x
59	Overvoltage Relay		x
81/O - 81/U	Over-Under Frequency Relay		x
	<i>Anti-Islanding Relay (phase shift or RoCoF)</i>	<i>x</i>	<i>x</i>

**Table 5 - Interconnection Protective Function Requirements for Synchronous Generators**

Device #	Protective Equipment	<i>RE System Size</i>	
		<i>≤10 kW</i>	<i>&gt;10 kW - 100 kW</i>
25	Synchronism-Check Relay	x	x
27	Under Voltage Relay	x	x
51V	Over current Relay, Voltage Restrained		x
59	Over-voltage Relay		x
81/O - 81/U	Over/Under frequency Relay	x	x
	<i>Anti-Islanding Relay (phase shift or RoCoF)</i>	<i>x</i>	<i>x</i>

**Table 6 - Interconnection Protective Function Requirements for Inverters**

Device #	Protective Equipment	<i>RE System Size</i>	
		<i>≤10kW</i>	<i>≤ 100 kW</i>
27	Under-voltage Relay	x	x
59	Over-voltage Relay	x	x
81/O – 81/U	Over/Under Frequency Relay	x	x

## 7.5 Reclosing

The RE system should immediately disconnect from the Distribution System when the system is down. For a Distribution System with automatic reclosing, the RE system should wait for *ten (10)* minutes until the recloser/*inverter* has normalized the portion of the system to which the RE system is connected before synchronizing back to the system.

## VIII. OPERATIONS & MAINTENANCE

- 8.1 A QE's RE system shall be capable of operating in parallel with the DU's Distribution System at the point of interconnection.
- 8.2 In the event there is no power from the DU, the RE system should automatically disconnect from the DU's system.
- 8.3 The QE shall provide the DU the contact number of the person who is responsible for the operation of the RE system.
- 8.4 The QE shall also maintain the RE system and interconnection facilities in a safe manner as approved by the DU and in conformity with all applicable laws, rules and regulations.

## IX. METERING

- 9.1 An RE system used for Net-Metering shall be equipped with metering equipment that can measure the flow of electricity in both directions at the same rate, through the use of a single bi-directional meter.
- 9.2 A generation check meter *shall* be installed in proximity to the RE system (at low voltage side) to record all energy production of the RE system for purposes of issuance of RE Certificate, which the DU can use to comply with its RPS obligations *and to determine the actual consumption for the non-exemption from paying the FIT-All, Lifeline Rate, Senior Citizen discount and such other subsidies that may be relevant.*
- 9.3 The Metering Service Provider (MSP) shall own and shall be responsible for the design, provision, installation, operation, maintenance, testing and sealing of the meter and associated metering equipment in accordance with Section 2.11 of the DSOAR.

**9.4** The QE shall provide the required space and the associated civil works for the location of the metering facilities.

**9.5** Metering facilities shall be installed in a clean place free of vibration and where it will be easily accessible and visible for reading and testing by both the DU and the QE. The applicable provisions of the DSOAR and Magna Carta for Residential Electricity Consumers shall apply.

## **X. TESTING AND COMMISSIONING**

The DU shall have the right to witness the testing and commissioning upon completion of construction and shall have a copy of the test data. The commissioning test shall be conducted after the interconnection system is installed and is ready for operation. Commissioning test shall include the following:

- Verification and inspections
- Production test
  - Response to abnormal voltage
  - Response to abnormal frequency
  - Synchronization
- Unintentional islanding functionality test
- Cease-to-energize functionality test
- *Flicker Severity Test*
- *Harmonics Test*

The DU and the RE system shall be equipped with whatever equipment is required to perform these tests. The DU shall not be responsible for verifying any control or signal wiring not directly related to the interconnection protection.

Prior to final approval by the DU or any time thereafter, the DU reserves the right to test the relaying and control related to the protection of the DU's Distribution System.

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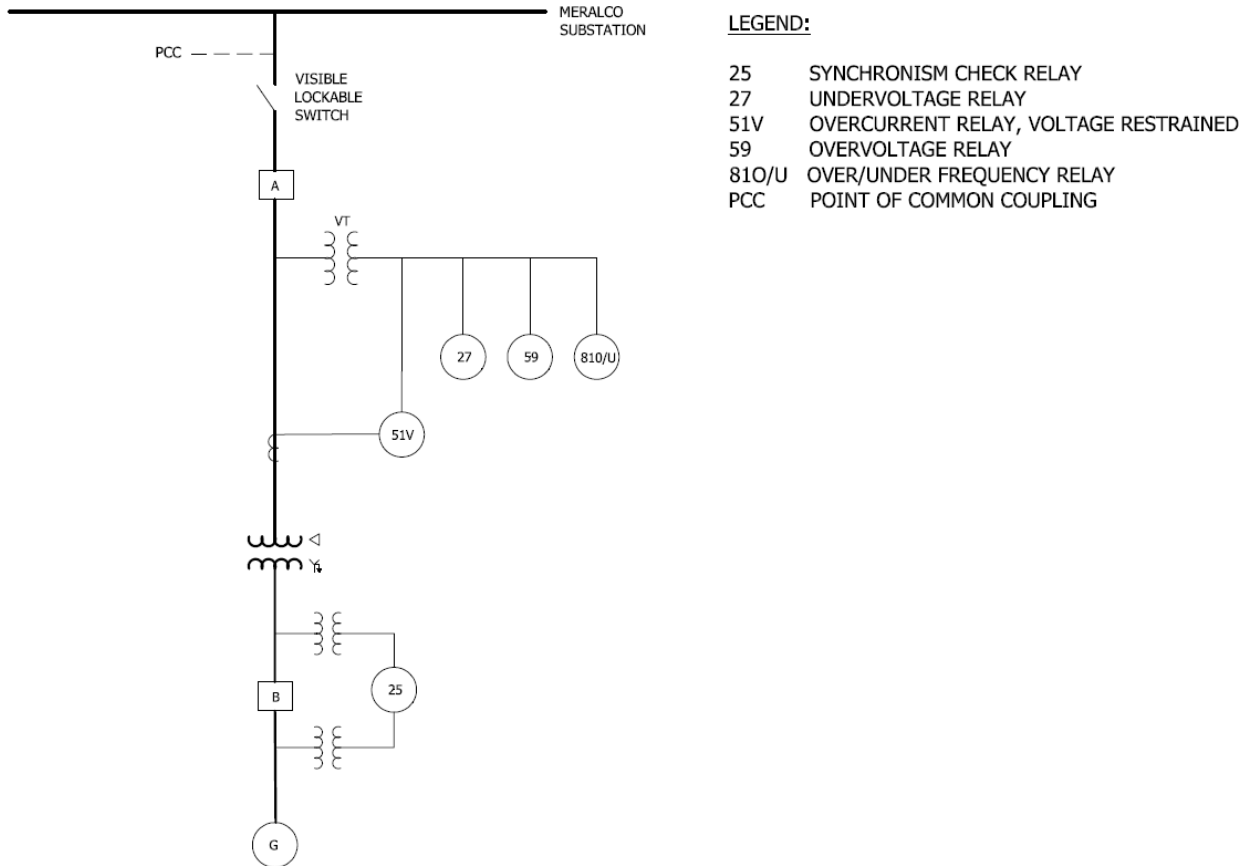
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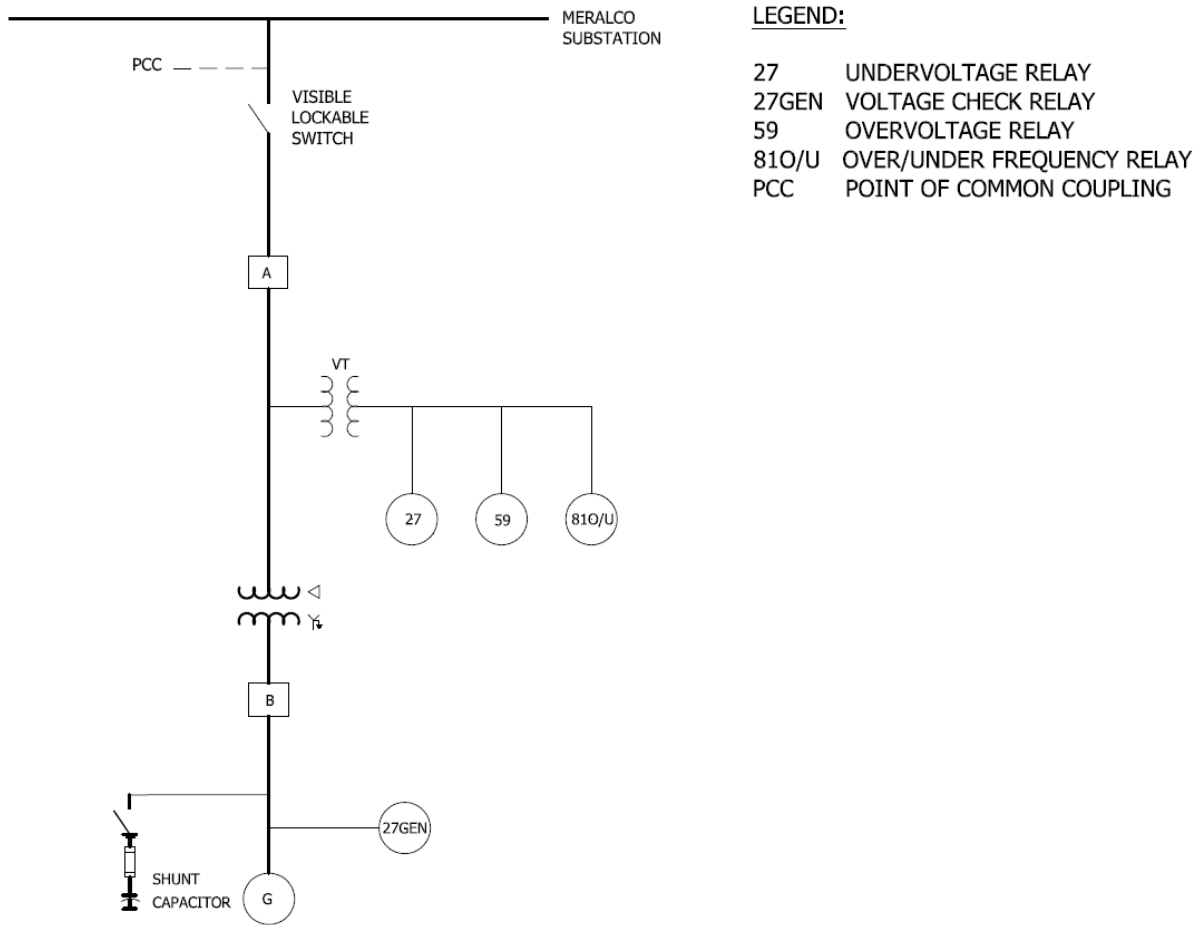
## XII. APPENDIX

### Appendix A - Typical Single-Line Diagram for the Protection of Synchronous Generator

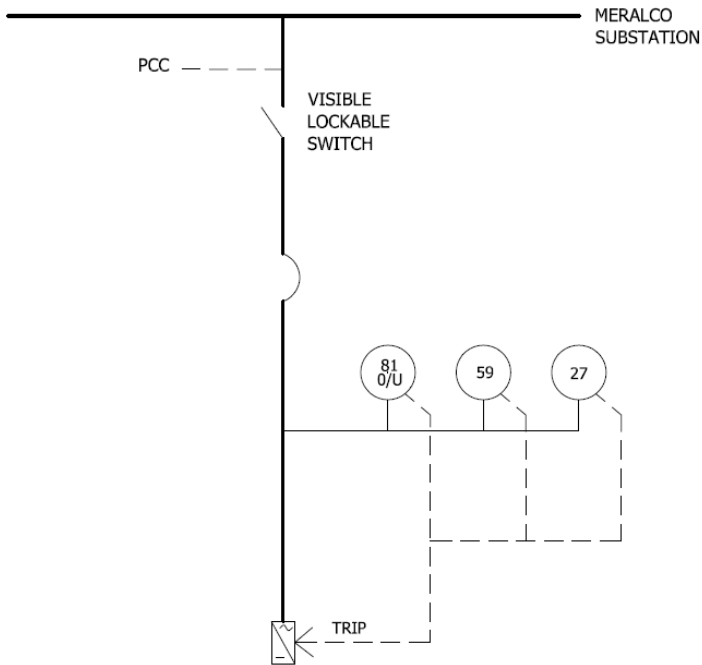




## Appendix B - Typical Single-Line Diagram for the Protection of Induction Generator



## Appendix C - Typical Single-Line Diagram for the Protection of Inverter



**LEGEND:**

- 27      UNDERVOLTAGE
- 59      OVERVOLTAGE
- 81O/U   OVER/UNDER FREQUENCY
- PCC     POINT OF COMMON COUPLING