CHAPTER 1

GENERAL PROVISIONS

1.1 TITLE

This shall be known as the Embedded Generator's Operational and Connection Requirements.

1.2 PURPOSE

This Addendum is intended to:

1.2.1 Establish the minimum connection and operational requirements of Embedded Generators in the Distribution System for integration with the Philippine Distribution Code; and

1.2.2 Provide direction for existing and new project proponents seeking connection to the Distribution System, Variable Renewable Energy developers and manufacturers, fabricators and suppliers of renewable energy equipment by setting the technical standards, design and operational criteria for conventional or Variable Renewable Energy sources.

1.3 GUIDING PRINCIPLES

All Conventional and Variable Renewable Energy Embedded Generators, operator and developers, System Operator and Transmission Network Provider and all relevant parties shall comply with the technical specifications, performance standards, operation criteria and other requires as prescribed in the Addendum. In all other cases not specified in this document, the general provisions of the Philippine Distribution Code shall apply.

1.4 SCOPE OF APPLICATION

This document shall apply to all Conventional and Variable Renewable Energy Embedded Generating Facilities, as defined in these rules, the Transmission Network Provider and the System Operator.

1.5 DEFINITION OF TERMS

For the purposes of this document, the following terms shall be given the following definitions:

Conventional Generator. Refers to Generation Company that is authorized by the ERC to operate a facility used in Generation of Electricity which is not a Variable Renewable Energy facility.

Conventional Generating Facility. Any Generating Unit/Plant which is not a Variable Renewable Energy facility.

Dedicated Feeder: A Medium Voltage or Low Voltage Feeder utilized for a single User, either a Customer or an Embedded Generator.

EPC Contractor. A company contracted by the Generator to carry out the engineering, procurement and construction works of a VRE Generating Facility

Grid Impact Study. As defined in the Philippine Grid Code.

Installed Capacity. Expressed in MW (or kW), it refers to the sum of rated generating capacity of each Generating Unit.

Large Embedded Generator: A Generation Company whose generating facility at the Connection Point has an aggregate installed capacity of 10 MW or more.

Loss of Mains. A situation in which, due to an incident and/or abnormal situation, a portion of the distribution network, to which the Embedded Generation Plant is connected, separates from the main Distribution System forming an island.

Manufacturer. A person or organization that manufactures Embedded Generating Plants and also 'packages' components manufactured by others to make a Generating Plant which can be Type Tested to meet the requirements of this Distribution Code.

Minimum Load means the arithmetic average of the registered daily minimum Loads at a specific location during the previous year.

Photovoltaic (PV). A method of generating electrical Energy by converting solar radiation into direct current electricity using semiconductors that directly produce electricity when exposed to light.

Photovoltaic Generation System (PVS). A power system which is made up of one or more solar panels, a controller or Inverter, and the interconnections and mounting for the other components, which is connected to the system at a single Connection Point

System Operator. The party responsible for generation dispatch, or the implementation of the generation dispatch schedule of the Market Operator, the provision of ancillary services, and operation to ensure safety, Power Quality, Stability, Reliability and Security of the Grid.

Type Tested. A Generating Plant design which has been tested by the Manufacturer, component manufacturer or supplier, or a third party, to ensure that the design meets the requirements of this Distribution Code, and for which the Manufacturer has declared that all products supplied will be constructed to the same standards, and with the same protection settings as the tested product.

Variable Renewable Energy Installed Capacity (VRE Installed Capacity). Expressed in MW (or kW), it refers to the sum of rated generating capacity of each Wind Turbine Generating Unit in a Wind Farm or the sum of rated generating capacity of each solar panel in a Photovoltaic Generation System.

Variable Renewable Energy Generator (VRE Generator). Refers to Generation Company that is authorized by the ERC to operate a Variable Renewable Energy Facility.

Variable Renewable Energy Generating Facility (VRE Facility). A facility, consisting of one or more Generating Units, where electric Energy is produced from a source that is renewable, cannot be stored by the facility owner or operator and has inherent variability that is beyond the control of the facility owner or operator. For the avoidance of doubt, it includes Wind Farms and Photovoltaic Generation Systems.

Wind Farm. A collection of Wind Turbine Generating Units that are connected to the grid at a single Connection Point

Wind Turbine Generating Unit: A Generating Unit that uses wind as primary resource.

CHAPTER 2

EMBEDDED GENERATOR CONNECTION REQUIREMENTS

2.1 DISTRIBUTION TECHNICAL, DESIGN, AND OPERATIONAL CRITERIA

2.1.1 Power Quality Standards

2.1.1.1 The Embedded Generator shall ensure that the Power Quality standards specified in Section 2.4.4 are complied with.

2.1.1.2 Users of the Distribution System and Users seeking connection to the Distribution System or modification of an existing connection shall ensure that their Equipment can operate reliably and safely within the limits specified in Article 3.2 of the Philippine Distribution Code during normal conditions, and can withstand the limits specified in this Article.

2.1.2 Frequency Variations

2.1.2.1 The Embedded Generator shall in accordance with its corresponding classification, ensure that the standards for frequency variations for Large Conventional, Large VRE, Medium, Intermediate, Small and Micro Embedded Generators are complied with as prescribed in Sections 2.5.2, 2.6.2, 2.7.2, 2.8.2 and 2.9.2 respectively.

2.1.3 Voltage Variations

2.1.3.1 The Long Duration Voltage Variation at any Connection Point during normal conditions shall be within the limits specified in Section 3.2.3 of the Philippine Distribution Code.

2.1.3.2 The Distribution Utility shall consider the maximum estimated Voltage Swell in the selection of the voltage ratings of Distribution Equipment.

2.1.3.3 Any extension or connection to the Distribution System shall be designed in such a way that it does not adversely affect the Voltage Variation in the Distribution System.

2.1.3.4 The Embedded Generator shall in accordance with its corresponding classification, ensure that the standards for voltage variations for Large Conventional, Large VRE, Medium, Intermediate, Small and Micro Embedded Generators are complied with as prescribed in Sections 2.5.1.2, 2.6.1.2, 2.7.1.2, 2.8.1.2 and 2.9.1.2 respectively.

2.1.4 Power Factor

2.1.4.1 The Embedded Generator shall in accordance with its corresponding classification, ensure that the standards for Power Factor for Large Conventional, Large VRE, Medium, Intermediate, Small and Micro Embedded Generators are complied with as prescribed in Sections 2.5.5, 2.6.3, 2.7.3, 2.8.3 and 2.9.3 respectively.

2.1.4.2 The Distribution Utility shall correct feeder and substation feeder bus Reactive Power demand to a level that will economically reduce the Technical Loss.

2.1.4.3 The Distribution Utility may establish penalties and incentives for User Power Factor at the Connection Point based on the target level.

2.1.5 Voltage Unbalance

2.1.5.1 The maximum Voltage Unbalance at any Connection Point in the Distribution System shall not exceed the limits specified in Section 3.2.5 of the Philippine Distribution Code during normal operating conditions.

2.1.5.2 The User shall ensure that its System shall not cause the Voltage Unbalance in the Distribution System to exceed the limits specified in Section 3.2.5 of the Philippine Distribution Code.

2.1.6 Flicker Severity

2.1.6.1 The Flicker Severity at any Connection Point in the Distribution System shall not exceed the limits specified in Section 3.2.6 of the Philippine Distribution Code and Section 2.4.4.1.

2.1.6.2 The User shall ensure that its System shall not cause the Flicker Severity in the Distribution System to exceed the limits specified in Section 3.2.6 of the Philippine Distribution Code and ensure that the standards specified in Section 2.4.4.1 are complied with.

2.1.7 Transient Voltage Variations

2.1.7.1 The Distribution System and the system of the User System shall be designed and operated to include devices that will mitigate the effects of transient Overvoltages on the Distribution System and the User System.

2.1.7.2 The Distribution Utility and the User shall take into account the effect of electrical transients when specifying the insulation of their electrical Equipment.

2.1.8 Protection Arrangements

2.1.8.1 The Embedded Generator shall in accordance with its corresponding classification, ensure that the standards for protection arrangements for Large Conventional, Large VRE, Medium, Intermediate, Small and Micro Embedded Generators are complied with as prescribed in Sections 2.5.8, 2.6.7, 2.7.6, 2.8.6 and 2.9.5 respectively.

2.1.8.2 The requirements for the protection system at the Connection Point shall be agreed upon by the Distribution Utility and the User during the application for connection or modification of an existing connection and shall be reviewed from time to time by the Distribution Utility, with the concurrence of the User.

2.1.8.3 The User System shall be designed and operated with protective devices in accordance with the requirements of the Distribution Utility.

2.1.8.4 Unless the Distribution Utility advises otherwise, the User shall not use current- limiting protective devices to limit the fault current infeed to the Distribution System.

2.1.8.5 The Fault Clearance Time shall be within the limits established by the Distribution Utility in accordance with the protection policy adopted for the Distribution System.

2.1.8.6 The Distribution Utility shall provide the details of any auto-reclosing or sequential switching features in the Distribution System so that the User may take this into account in the design of its protection System.

2.1.8.7 The User shall consider in the design of its protection System the possible disconnection of only one phase or two phases during fault conditions.

2.1.9 Equipment Short Circuit Rating

2.1.9.1 The Distribution Utility shall inform the User of the designed and the existing Fault Levels of the Distribution System at the Connection Point.

2.1.9.2 The User shall consider the designed and the existing Fault Levels at the Connection Point in the design and operation of the User System.

2.1.10 Grounding Requirements

2.1.10.1 The Distribution Utility shall inform the User of the Grounding method used in the Distribution System. The specification of Distribution Equipment shall consider the maximum Voltage Swell that will be imposed on the Equipment during faults involving ground.

2.1.10.2 The method of Grounding at the User System shall comply with the Grounding standards and specifications of the Distribution Utility.

2.1.10.3 Where there are multiple sources of power, the User shall ensure that the effects of circulating currents with respect to the grounded neutral are either prevented or mitigated.

2.1.11 Monitoring and Control Equipment Requirements

2.1.11.1 The Distribution Utility and the User shall agree on the mode of monitoring and control.

2.1.11.2 The Distribution Utility shall provide, install, and maintain the telemetry outstation and all associated Equipment needed to monitor the User System.

2.1.11.3 If the User agrees that the Distribution Utility shall control the switchgear in the User System, the Distribution Utility shall install the necessary control outstation, including the control interface for the switchgear.

2.1.12 Equipment Standards

2.1.12.1 All Equipment at the Connection Point shall comply with the requirements of the IEC Standards or their equivalent national standards.

2.1.12.2 All Equipment at the Connection Point shall be designed, manufactured, and tested in accordance with IEC Standards or its equivalent national standards.

2.1.12.3 The prevailing standards at the time when the Connection Point was designed or modified, rather than the Test and Commissioning date or the Asset Transfer Date, shall apply to all Equipment at the Connection Point.

2.1.13 Maintenance Standards

2.1.13.1 All Equipment at the Connection Point shall be operated and maintained in accordance with international standards or its equivalent national standards and in

a manner that shall not pose a threat to the safety of any personnel or cause damage to the Equipment of the Distribution Utility or the User.

2.1.13.2 The Distribution Utility shall maintain a log containing the test results and maintenance records relating to its Equipment at the Connection Point and shall make this log available when requested by the User.

2.1.13.3 The User shall maintain a log containing the test results and maintenance records relating to its Equipment at the Connection Point and shall make this log available when requested by the Distribution Utility.

2.2 PROCEDURES FOR DISTRIBUTION CONNECTION OR MODIFICATION

2.2.1 Connection Agreement

2.2.1.1 Any User seeking a new connection to the Distribution System shall secure the required Connection Agreement with the Distribution Utility prior to the actual connection to the Distribution System.

2.2.1.2 The Connection Agreement shall include provisions for the submission of information and reports, Safety Rules, Test and Commissioning programs, Electrical Diagrams, statement of readiness to connect, certificate of approval to connect, and other requirements prescribed by the ERC.

2.2.2 Amended Connection Agreement

2.2.2.1 Any User seeking to modify an existing connection to the Distribution System shall secure the required Amended Connection Agreement with the Distribution Utility prior to the actual modification.

2.2.2.2 The Amended Connection Agreement shall include provisions for the submission of additional information required by the Distribution Utility and prescribed by the ERC.

2.2.3 Distribution Impact Studies

2.2.3.1 Any User applying for connection or a modification of an existing connection to the Distribution System shall take all necessary measures to ensure that its proposed connection or modification shall not result in the Degradation of the Distribution System.

2.2.3.2 The Distribution Utility shall conduct Distribution Impact Studies to evaluate the impact of the proposed connection or modification to an existing connection on the Distribution System. The evaluation shall include, at least, the following:

(a) Power flows, both in Normal State and in case of contingencies, to assure the Distribution System can properly accommodate the flows of both the Embedded Generation Plants and existing loads,;

(b) Voltage control studies, to assure that voltage can be properly maintained within the prescribed limits;

(c) Impact of short circuit infeed to the Distribution Equipment in order to verify that the Equipment limits are not exceeded;

(d) Definition and coordination of protection System; and

(e) Impact of User Development on Power Quality.

2.2.3.3 In the case of Large Embedded Generating Plants, as defined in 2.1 , the User will inform the System Operator, which will liaise the Transmission Network Provider, about the application for connection. The Transmission Network Provider will evaluate the application and it will communicate to the Project Proponent if:

(a) The connection of the Embedded Generating Plant can be accepted;

(b) The connection of the Embedded Generating Plant can be accepted subject to certain conditions or special requirements, which shall be clearly stated and justified; or

(c) The connection of the Embedded Generating Plant shall not be accepted, clearly indicating in this case the reasons for the rejection.

The Transmission Network Provider shall formally inform the User of the results of its evaluation whether the Embedded Generating Plant could be connected or not. The Distribution Utility shall likewise be furnished the results of the evaluation.

In cases in which the connection is allowed, the Transmission Network Provider shall include in its recommendation, among others, any Grid or system potential restriction or network congestion, which may significantly influence the dispatch of the Large Embedded Generating Plant. The Transmission Network Provider shall have the right to verify their effective implementation at the moment the facility is commissioned.

2.2.3.4 For Intermediate Embedded Generating Plants or Medium Embedded Generating Plants lower than 2 MW, as defined in Table 2-1connected to an existing Medium Voltage feeder with other customers connected, following rules as guide will apply:

(a) The total installed capacity of the Intermediate or Medium Embedded Generating Plant requesting connection plus the aggregated capacity of all other Embedded Generating Plants connected to the same feeder, regardless of their types, shall not exceed 25-30% of the thermal capacity of the MV feeder.

(b) The total installed capacity of the Medium Embedded Generating Plant requesting connection plus the aggregated capacity of all other Embedded Generating Plants, regardless of their type, connected to the substation to which the MV feeder is connected, shall not exceed the Minimum Load in a year of the HV/MV transformer at the substation. In case there are no registers of such minimum load, the value will be estimated as 25% of the transformer thermal capacity.

(c) The maximum Voltage changes at the Connection Point due to the switching operation of the Medium or Intermediate Embedded Generating Plant shall not exceed 2% of the nominal voltage.

2.2.3.5 For Medium Embedded Generating Plants, as defined in Table 2-1 connected to an HV/MV substation through a dedicated feeder, the total installed capacity of the Medium Embedded Generating Plant requesting connection plus the aggregated capacity of all other Embedded Generating Plants, regardless of their type, connected to the substation, shall not exceed the Minimum Load of the HV/MV transformer at the substation. In case there are no registers of such

minimum load, the value will be estimated as 25% of the transformer thermal capacity.

2.2.3.6 For Small Embedded Generating Plants, as defined in Table 2-1, following rules as guide will apply:

(a) In case of connection to an existing LV feeder with other customers connected, the total installed capacity of the Small Embedded Generating Plant requesting connection plus the aggregated capacity of all other Embedded Generating Plants, regardless of their type, connected to the same LV feeder, shall not exceed 25-30% of the thermal capacity of the LV feeder.

(b) The total installed capacity of the Small Embedded Generating Plant requesting connection plus the aggregated capacity of all other Embedded Generating Plants, regardless of their type, connected to the same busbar of the MV/LV substation, shall not exceed one third of the thermal capacity of the MV/LV transformer.

(c) The maximum Voltage changes at the Connection Point due to the switching operation of the Medium or Intermediate Embedded Generating Plant shall not exceed 2% of the nominal voltage.

2.2.3.7 In case Sections 2.2.3.4, 2.2.3.5 or 2.2.3.6 as it corresponds, do not apply or in cases the conditions stated in such sections are not fulfilled, the Distribution Utility may impose other requirements than those stated in Section 2.4 in order to allow the connection of the Embedded Generating Plant to the Distribution System.

2.2.3.8 For Micro Embedded Generating Plants, as defined in Table 2-1, it should be determined before connection that:

(a) The Micro Embedded Generating Plant and all other associated equipment to be installed have been Type Tested safe and to cause no unwanted disturbance to the distribution system. The Project Proponent shall submit to the Distribution Utility the Type Tests Report.

(b) The total amount of Small and Micro Embedded Generating Plants connected to the LV feeder does not exceed 25-30% of the thermal capacity of distribution transformer.

2.2.3.9 The Distribution Utility may disapprove an application for connection or a modification of an existing connection to the Distribution System if it is determined through the Distribution Impact Studies that the proposed connection or modification will result in the Degradation of the Distribution System.

2.2.4 Application for Connection or Modification

2.2.4.1 Any User applying for connection or a modification of an existing connection to the Distribution System shall submit to the Distribution Utility the completed application form for connection or modification of an existing connection to the Distribution System. The application form shall include the following information:

(a) A description of the proposed connection or modification to an existing connection, which shall comprise the User Development at the Connection Point;

(b) The relevant Standard Planning Data listed in Article 5.4 of the Philippine Distribution Code; and

(c) The Completion Date of the proposed User Development.

2.2.4.2 The User shall submit the planning data in three (3) stages, according to their degree of commitment and validation as described in Section 4.9.2 of the Philippine Distribution Code. These include:

(d) Preliminary Project Planning Data;

(e) Committed Project Planning Data; and

(f) Connected Project Planning Data.

2.2.5 Processing of Application

2.2.5.1 The Distribution Utility shall establish the procedure for the processing of applications for connection or modification of an existing connection to the Distribution System.

2.2.5.2 The Distribution Utility shall process the application for connection or modification to an existing connection within 30 days from the submission of the completed application form.

2.2.5.3 The Distribution Utility shall evaluate the impact of the proposed User Development on the Distribution System.

2.2.5.4 After evaluating the application submitted by the User, the Distribution Utility shall inform the User whether the proposed User Development is acceptable or not.

2.2.5.5 If the application of the User is acceptable, the Distribution Utility and the User shall sign a Connection Agreement or an Amended Connection Agreement, as the case may be.

2.2.5.6 If the application of the User is not acceptable, the Distribution Utility shall notify the User why its application is not acceptable. The Distribution Utility shall include in its notification a proposal on how the User's application will be acceptable to the Distribution Utility.

2.2.5.7 The User shall accept the proposal of the Distribution Utility within 30 days, or a longer period specified in the Distribution Utility's proposal, after which the proposal automatically lapses.

2.2.5.8 The acceptance by the User of the Distribution Utility's proposal shall lead to the signing of a Connection Agreement or an Amended Connection Agreement.

2.2.5.9 If the Distribution Utility and the User cannot reach agreement on the proposed connection or modification to an existing connection, the Distribution Utility or the User may bring the matter before the ERC for resolution.

2.2.5.10 If a Connection Agreement or an Amended Connection Agreement is signed, the User shall submit to the Distribution Utility, within 30 days from signing or a longer period agreed to by the Distribution Utility and the User, the Detailed Planning Data pertaining to the proposed User Development, as specified in Article 5.5 of the Philippine Distribution Code.

2.2.6 Submittals Prior to the Commissioning Date

2.2.6.1 The following shall be submitted by the User prior to the commissioning date, pursuant to the terms and conditions and schedules specified in the Connection Agreement:

(a) Specifications of major Equipment not included in the Standard Planning Data and Detailed Planning Data;

(b) Details of the protection arrangements, its settings and communication link setup as referred to in Sections 2.5.8, 2.5.9, 2.6.7, 2.6.8, 2.7.6, 2.8.6 and 2.9.5 for Embedded Generators;

(c) Information to enable the Distribution Utility to prepare the Fixed Asset Boundary Document referred to in Article 4.6 of the Philippine Distribution Code including the names of Accountable Persons;

(d) Electrical Diagrams of the User's Equipment at the Connection Point as described in Article 4.7 of the Philippine Distribution Code;

(e) Information that will enable the Distribution Utility to prepare the Connection Point Drawings, referred to in Article 4.8 of the Philippine Distribution Code;

(f) Copies of all Safety Rules and Local Safety Instructions applicable to the User's Equipment and a list of Safety Coordinators, pursuant to the requirements of Article 6.8 of the Philippine Distribution Code;

(g) A list of the names and telephone numbers of authorized representatives, including the confirmation that they are fully authorized to make binding decisions on behalf of the User;

(h) Proposed Maintenance Program; and

(i) Test and Commissioning procedure for the Connection Point and the User Development.

2.2.7 Commissioning of Equipment and Physical Connection to the Distribution System

2.2.7.1 Upon completion of the User Development, including work at the Connection Point, the Equipment at the Connection Point and the User Development shall be subjected to the Test and Commissioning procedure specified in Section 2.2.6 of the Philippine Distribution Code.

2.2.7.2 The User shall then submit to the Distribution Utility a statement of readiness to connect, which shall include the Test and Commissioning report.

2.2.7.3 Upon acceptance of the User's statement of readiness to connect, the Distribution Utility shall, within 15 days, issue a certificate of approval to connect.

2.2.7.4 The physical connection to the Distribution System shall be made only after the certificate of approval to connect has been issued by the Distribution Utility to the User.

2.3 CLASSIFICATION OF EMBEDDED GENERATING PLANTS

2.3.1 The Embedded Generating Plant shall be classified according to its characteristics and installed capacity in any of the following categories:

Table 2-1
Classification of Embedded Generating Plants

Category	Installed Capacity and Characteristics
Large Conventional	Conventional Embedded Generating Plant with an aggregated installed capacity of 10 MW or more.
Large VRE	VRE Embedded Generating Plant with an aggregated installed capacity of 10 MW or more.
Medium	Conventional or VRE Embedded Generating Plants with Installed Capacity larger than 1 MW which do not qualify as Large Embedded Generating Plant.
Intermediate	Conventional or VRE Embedded Generating Plants with Installed Capacity larger than 100 kW and lower than or equal to 1 MW; and Conventional Embedded Generating Plants with Installed Capacity lower than or equal to 100 kW connected to MV networks.
Small	Embedded Generating Plant with installed capacity larger than 10 kW and less than or equal to 100 kW connected to LV networks.
Micro	Embedded Generating Plants with installed capacity lower or equal to 10 kW connected to LV networks.

2.4 REQUIREMENTS FOR ALL EMBEDDED GENERATING PLANTS

2.4.1 Requirements Relating to the Connection Point

2.4.1.1 The Embedded Generation Company's Equipment shall be connected to the Distribution System at the voltage level agreed to by the Distribution Utility and the Generation Company based on the Distribution Impact Studies.

2.4.1.2 The Connection Point shall be controlled by a Circuit Breaker that is capable of interrupting the maximum short circuit current at the point of connection.

2.4.1.3 Disconnect switches, or other isolating means, shall also be provided and arranged to isolate the Circuit Breaker for maintenance purposes.

2.4.2 Black Start Capability

2.4.2.1 The Generation Company shall specify in its application for a Connection Agreement or an Amended Connection Agreement if its Embedded Generator has a Black Start capability.

2.4.2.2 The Embedded Generator providing Ancillary Services for Black Start shall be capable of initiating a Black Start procedure in accordance with Section 4.3.2 of the Philippine Distribution Code.

2.4.3 Fast Start Capability

2.4.3.1 The Embedded Generation Company shall specify in its application for a Connection Agreement or Amended Connection Agreement if its Embedded Generator has a Fast Start capability.

2.4.3.2 The Embedded Generator providing Ancillary Services for Fast Start shall automatically Start-Up in response to frequency-level relays with settings in the range of 57.6 Hz to 62.4 Hz.

2.4.4 Power Quality

2.4.4.1 With the system in Normal State, upon the connection of the Embedded Generating Plant, the Flicker Severity at the Connection Point shall not exceed the values established in Sections 3.2.4 and 3.2.6 of the Philippine Distribution Code. The maximum long-term flicker introduced by an Embedded Generating Plant shall be determined as the maximum allowed flicker at the Connection Point, multiplied by the ratio of the Embedded Generating Plant's Installed Capacity to the total capacity of all other interference sources connected at the same Connection Point.

2.4.4.2 Upon the connection of Embedded Generating Plant, the Total Harmonic Distortion (THD) of the voltage and the Total Demand Distortion (TDD) of the current at the Connection Point shall not exceed the limits established in Section 3.2.4 of the Philippine Distribution Code. The maximum harmonic current injection from an Embedded Generating Plant to the grid shall be determined as the maximum allowed harmonic current injection at the Connection Point, multiplied by the ratio of Embedded Generating Plant's Installed Capacity to the total capacity of all power generation/supply equipment with harmonic source at the Connection Point.

2.4.4.3 The Embedded Generating Company shall comply with the following permissible voltage fluctuation limits at the Connection Point:

(a) Voltage fluctuation limit for step changes which may occur repetitively is 1%.
(b) Voltage fluctuation limit for occasional fluctuations other than step changes is 3%.

For clarity, these limits apply to any possible fluctuation in voltage caused by the any kind of switching operations (i.e. capacitor banks, start/stop of Embedded Generating Units, inrush currents during Embedded Generating Units connection) and/or by any kind of fluctuation of the primary energy in case of VRE Embedded Generating Plants.

2.4.4.4 The Embedded Generator shall demonstrate to the Distribution Utility that the Embedded Generating Plant Facilities installed complies with the prescriptions indicated in Sections 2.4.4.1 to 2.4.4.3 through a certification issued by the Embedded Generating Plant manufacturer, stating that its Embedded Generating Units has been tested and certified in a reputable laboratory showing compliance with the stated requirements. Copy of the laboratory certification shall be included. In case such certification is not available, specific tests shall be performed in order to assess compliance.

2.4.5 Transformer Connection and Grounding

2.4.5.1 The Distribution Utility shall specify the transformer connection and grounding requirements for the transformer, in accordance with the provisions of Section 2.1.10 of the Philippine Distribution Code.

2.4.5.2 Where there are multiple sources of power, the Embedded Generation Company shall ensure that the effects of circulating currents with respect to the grounded neutral are either prevented or mitigated.

2.5 REQUIREMENTS FOR LARGE CONVENTIONAL EMBEDDED GENERATING PLANTS

2.5.1 Embedded Generator Power Output

2.5.1.1 The Large Conventional Embedded Generator shall be capable of continuously supplying its Active Power output, as specified in the Generation Company's Declared Data, within the System Frequency range of 59.7 to 60.3 Hz. Any decrease of power output occurring in the Frequency range of 59.7 to 57.6 Hz shall not be more than the required proportionate value of the System Frequency decay.

2.5.1.2 The Large Conventional Embedded Generator shall be capable of supplying its Active Power output and the interchange of Reactive Power at the Connection Point, as specified in the Generation Company's Declared Data, within the Voltage Variations within the range +/- 5% during normal operating conditions. Outside this range, and up to a Voltage Variation specified in Section 2.1.3 of the Philippine Distribution Code, a reduction on Active Power and/or Reactive Power can be allowed, provided that this reduction does not exceed 5% of the Generation Company's Declared Data.

2.5.2 Frequency Withstand Capability

2.5.2.1 If the System frequency momentarily rises to 62.4 Hz or falls to 57.6 Hz, Large Conventional Embedded Generators shall remain in synchronism with the Grid for at least five (5) seconds. The Distribution Utility, in consultation with the System Operator, may waive this requirement, if there are sufficient technical reasons to justify the waiver.

2.5.2.2 Large Conventional Embedded Generator shall be capable to operate, for at least 5 minutes, in case of increase in Frequency within the range of 61.8 to 62.4 Hz; and for at least 60 minutes, in case of a decrease in Frequency within the range of 57.6 to 58.2 Hz, in both cases provided the voltage at the Connection Point is within +/- 10% of the nominal value.

2.5.2.3 The Generation Company shall be responsible for protecting its Embedded Generators against damage for frequency excursions outside the range of 57.6 Hz and 62.4 Hz. The Generation Company shall decide whether or not to disconnect its Embedded Generator from the Distribution System.

2.5.2.4 The Large Conventional Generation Plant shall remain synchronized during a rate of change of Frequency of values up to and including plus or minus 1.0 Hz per second measured as a rolling average over 500 ms. As voltage dips may cause localized rate of change of Frequency values in excess of 1 Hz per second for short periods, the Large Conventional Embedded Generating Plant shall remain

synchronized for at least 600 ms for Voltage dips at the Connection Point up to 95% (Voltage at the Connection Point larger than 5%).

2.5.3 Unbalance Loading Withstand Capability

2.5.3.1 The Embedded Generator shall meet the requirements for Voltage Unbalance as specified in Section 2.1.6.

2.5.4 Performance under Disturbances

2.5.4.1 The Embedded Generator shall also be required to withstand without tripping, the Voltage Sags on unbalance loading during clearance by the Backup Protection of a close-up phase-to-phase fault on the Distribution System.

2.5.5 Reactive Power Capabilty

2.5.5.1 The Large Conventional Embedded Generator shall be capable of supplying its Active Power output, as specified in the Generation Company's Declared Data, within the limits of 0.85 Power Factor lagging and 0.90 Power Factor leading at the Large Conventional Generating Unit's terminals, in accordance with its Reactive Power Capability Curve.

2.5.6 Reactive Power Control and Excitation Control System

2.5.6.1 The Large Conventional Embedded Generator shall be capable of contributing to Voltage Control by continuous regulation of the Reactive Power supplied to the Distribution System in any of the following modes, as it will be determined by the Distribution Utility:

(a) Maintaining constant Reactive Power injection/absorption at the Connection Point, at a value prescribed by the Distribution Utility;
(b) Maintaining a constant power factor of the injected Energy at the Connection point, at a value prescribed by the Distribution Utility; or
(c) Maintain the voltage at the HV busbar of the Large Conventional Embedded Generating Plant, at a set point instructed by the Distribution Utility.

Provided the limits of Reactive Power output established in Section 2.5.5 are not exceeded.

2.5.6.2 In order to comply with the requirements established in Section 2.5.6.1, the Large Conventional Embedded Generating Plant shall be equipped with a continuously acting automatic excitation control system to control the terminal voltage without instability over the entire operating range of the Embedded Generator.

2.5.6.3 The performance requirements for excitation control facilities, including power System stabilizers, where necessary for System operations shall be specified in the Connection Agreement or Amended Connection Agreement.

2.5.7 Active Power Control and Speed-Governing System

2.5.7.1 The Large Conventional Embedded Generator shall be fitted with a fast-acting speed-governing system. The speed-governing System shall have an overall speed-droop characteristic of five (5) percent or less. Unless waived by the Distribution Utility in consultation with the System Operator, the speed-governing System shall be capable of accepting raise and lower signals from the Control

Center of the System Operator. If the active power for any Large Conventional Embedded Generator is regulated downward below its Minimum Technical Load (P_{min}) shutting-down of individual Large Conventional Embedded Generator is allowed.

2.5.7.2 During Island Grid operation, an Embedded Generator providing Ancillary Services for regulating Frequency shall provide Frequency Control to the Island Grid.

2.5.8 Protection Arrangements

2.5.8.1 The protection of Large Conventional Embedded Generating Plants and Equipment and their connection to the Distribution System shall be designed, coordinated, and tested to achieve the desired level of speed, sensitivity, and selectivity in fault clearing as well as in other system troubles and to minimize the impact of these on the Distribution System. In particular, the Large Conventional Generator shall agree with the Distribution Utility the protection measures required to prevent unintended Islanding operation.

2.5.8.2 The Distribution Utility and the Large Conventional Embedded Generation Company shall be solely responsible for the protection System of the electrical Equipment and facilities at their respective sides of the Connection Point.

2.5.9 Information Interchange

2.5.9.1 A communication system shall be established so that the System Operator, the Distribution Utility Operator and Large Conventional Embedded Generation Company can communicate with one another, as well as exchange data signals for monitoring and controlling the Distribution System during normal and emergency conditions.

2.5.9.2 The Large Conventional Embedded Generation Company shall provide the RTU and complete communication Equipment required for the monitoring and control of the Connection Point and the Generating Units with the Distribution Utility Operator. In case the Transmission Network Provider considers that a Large Conventional Embedded Generator will be under its direct control, the Equipment required for the monitoring and control of the Connection Point and the Generating Units shall be provided by the Transmission Network Provider.

2.5.9.3 Following information shall be sent to the Distribution Utility Operator or to the Transmission Network Provider, as it corresponds:

(a) Operation status of the Large Conventional Embedded Generation Plant;

(b) Voltage at HV busbar of the Large Conventional Embedded Generation Plant;

(c) Active Power, Reactive Power and electric current at high voltage side of step-up transformer of the Large Conventional Embedded Generation Plant; and

(d) Status of high voltage circuit breakers and isolator switches.

2.5.9.4 Provision of additional signals may be agreed between the Distribution Utility Operator and the Large Conventional Embedded Generation Plant, in which case they will be reflected in the Connection Agreement or Amended Connection Agreement.

2.5.9.5 The System Operator may agree with the Large Conventional Embedded Generating Plant using the SCADA system to communicate instructions to the

Generators, in which case this situation will be reflected in the Connection Agreement or Amended Connection Agreement. The instructions of the System Operator may include, but not limited to:

(a) Instructions for Active Power curtailment;

(b) Modes of control of voltage regulation and set points; and

(c) Start/stop instructions.

2.5.9.6 Large Conventional Embedded Generating Plant Operators may agree with the System Operator to automatically interface these signals/instructions with the plant control system. In this case, this agreement should be clearly reflected in the Connection Agreement or Amended Connection Agreement

2.6 REQUIREMENTS FOR LARGE VRE EMBEDDED GENERATING PLANTS

2.6.1 Embedded Generating Plant Power Output

2.6.1.1 The Large VRE Embedded Generator shall be capable of continuously supplying its Active Power output, depending on the availability of the primary resource, and its Reactive Power Output within the Power System Frequency range of 59.7 to 60.3 Hz.

2.6.1.2 The Large VRE Embedded Generator shall be capable of supplying its Active Power output, depending on the availability of the primary resource, and the interchange of Reactive Power at the Connection Point, as specified in Section 2.6.3 within the voltage variation range of +/- 5% during normal operating conditions. Outside this range, and up to a voltage variation of +/-10%, a reduction on Active Power and/or Reactive Power can be allowed, provided that this reduction does not exceed five (5) percent of the Generator's Declared Data.

2.6.2 Frequency Withstand Capability

2.6.2.1 Any variation of the Power System Frequency within the range of 58.2 Hz to 61.8 Hz should not cause the disconnection of the Large VRE Embedded Generator.

2.6.2.2 The Large VRE Embedded Generator shall be capable to operate, for at least 5 minutes, in case of increase in Frequency within the range of 61.8 to 62.4 Hz; and for at least 60 minutes, in case of a decrease in Frequency within the range of 57.6 to 58.2 Hz, in both cases provided the voltage at the Connection Point is within +/- 10% of the nominal value.

2.6.2.3 The Large VRE Generation Company Operator shall be responsible for protecting its Large VRE Embedded Generator against damage for frequency excursions outside the range of 57.6 Hz and 62.4 Hz, provided that in case the Frequency momentarily falls below 57.6 Hz the Large VRE Embedded Generator shall remain connected for at least five (5) seconds. In case of increase in Frequency above 62.4 Hz the Large VRE Generation Company Operator shall decide whether or not to disconnect the Embedded Generating Plant and/or its Embedded Generating Units from the Grid.

2.6.2.4 The Large VRE Generation Plant shall remain synchronized during a rate of change of Frequency of values up to and including plus or minus 1.0 Hz per second measured as a rolling average over 500 ms. As voltage dips may cause localized rate of change of Frequency values in excess of 1 Hz per second for

short periods, the Large VRE Embedded Generating Plant shall remain synchronized if the Voltage dips at the Connection Point are within the values established in Section 2.6.6.

Table 2-2
Requirements for different Frequency Ranges

Frequency		Time
Hz	**P.u.**	
> 62.4	> 1.04	Automatic disconnection allowed, is so decided by the VRE Operator
> 61.8 – 62.4	> 1.03 – 1.04	5 minutes
58.2 – 61.8	0.97 - .03	Continuous Operation
57.6 - < 58.2	0.96 - < 0.97	60 minutes
<57.6	< 0.96	5 seconds

2.6.3 Reactive Power Capability

2.6.3.1 The Large VRE Embedded Generating Plant shall be capable of supplying Reactive Power output, at its Connection Point, within the following ranges:

(a) +/- 20 % of its Embedded Generator Capacity, as specified in the Generator's Declared Data, if its Active Power Output, depending on the availability of the primary resource, is equal or above 58% of the Embedded Generator Installed Capacity;

(b) Any Reactive Power value within the limits of 0.95 Power Factor lagging to 0.95 Power Factor leading, if its Active Power Output, depending on the availability of the primary resource, is within the 10% and 58% of the Embedded Generator Installed Capacity; and

(c) No Reactive Power interchange if the Active Power Output, depending on the availability of the primary resource, is equal or less than 10% of the Embedded Generator Installed Capacity.

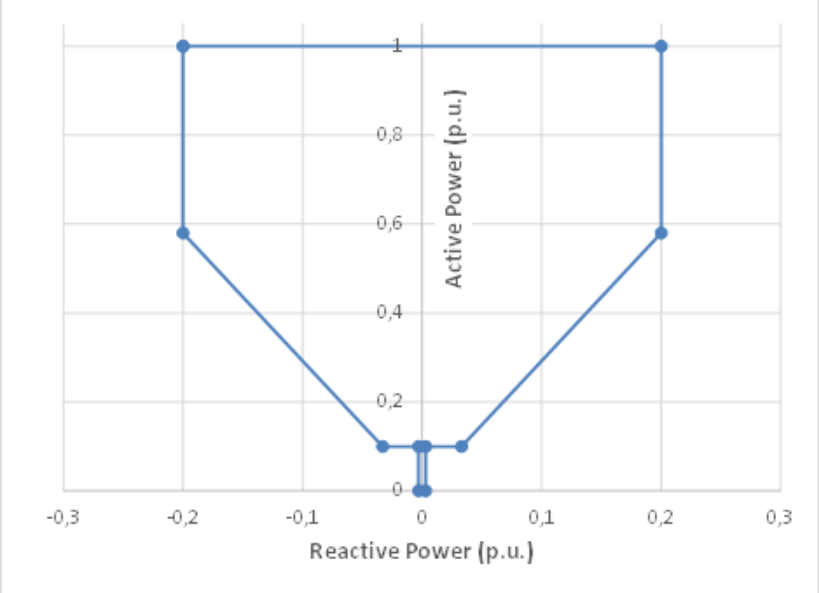

Figure 2-1
Reactive Power Requirements – Large VRE Embedded Generating Plants

2.6.4 Reactive Power Control

2.6.4.1 The Large VRE Embedded Generating Plant shall be capable of contributing to Voltage Control by continuous regulation of the Reactive Power supplied to the Distribution System in any of the following modes, as it will be determined by the Distribution Utility:

(a) Maintaining a constant power factor of the injected Energy at the Connection Point, at a value prescribed by the Distribution Utility; or

(b) Maintain the voltage at the Connection Point of the Large VRE Embedded Generating Plant, at a set point instructed by the Distribution Utility.

Provided the limits of Reactive Power output established in Section 2.6.3 are not exceeded.

2.6.4.2 In order to comply with the requirements established in Section 2.6.4.1 the Large VRE Embedded Generating Plant shall be equipped with an appropriate control system able to control voltage/Reactive Power interchange over the entire operating range, which shall not create oscillations in the network.

2.6.5 Active Power Control

2.6.5.1 Large VRE Embedded Generating Plants should be equipped with an Active Power regulation control system able to operate, at least, in the following control modes, provided that System Frequency is within the range 59 Hz – 61 Hz:

(a) Free Active Power Production (no Active Power control): The Large VRE Embedded Generating Plant operates producing maximum Active Power output depending on the availability of the primary resource.

(b) Active Power Constraint: The Large VRE Embedded Generating Plant should operate producing Active Power output equal to a value specified by the System Operator (set-point) provided the availability of the primary resource is equal or higher than the prescribed value; or producing the maximum possible Active Power in case the primary resource availability is lower than the prescribed set-point.

2.6.5.2 In cases the Large VRE Embedded Generating Plant operates in Active Power Constraint, whenever any control parameter is changed, such change must be commenced within two seconds and completed not later than 30 seconds after receipt of an order to change any parameter. The accuracy of the control performed must be within ±2% of the entered value or by ±0.5% of the rated power, depending on which yields the highest tolerance.

2.6.5.3 In case of System Frequency exceeds 61.0 Hz the Active Power control system should reduce the Active Power generated previously according with the following formula:

$$\Delta P = 45 \cdot P_m \cdot \left(\frac{61.0 - f_n}{60} \right)$$

Where:

ΔP: is the variation in Active Power output that should be achieved
P_m: is the Active Power output before this control is activated
f_n: is the network frequency

The reduction in Active Power output shall be performed at the maximum possible gradient, provided the technical capabilities of the Large VRE Embedded Generators are not exceeded.

If the active power for any Large VRE Embedded Generator is regulated downward below its Minimum Technical Load (P_{min}) shutting-down of individual Large VRE Embedded Generator is allowed.

2.6.5.4 In case of System Frequency drops below 59.0 Hz the Active Power control system should change to Free Active Power Production mode, generating the maximum possible Active Power output, compatible with the availability of the primary resource.

2.6.5.5 The actions specified in Articles 2.6.5.3 and 2.6.5.4 should be performed automatically, unless:

(a) The System Operator considers that the control system proposed by the Large VRE Embedded Generator, although not automatic, is enough appropriate for appropriate operation of the system, taken into account (i) the characteristics of the Large VRE Generating Plant, its and location; and (ii) Power System current situation and its probable future evolution. In this case, the explicit consent from the System Operator shall be included in the Connection Agreement or Amended Connection Agreement signed between the Embedded Generation Company and with the Distribution Utility; or

(b) The System Operator instructs the Large VRE Embedded Generating Plant Operator to disable this mode of control.

2.6.6 Performance during network disturbances

2.6.6.1 The Large VRE Embedded Generator shall be able to withstand without disconnection Voltage Sags at the Connection Point, produced by fault or disturbances in the network, whose magnitude and duration profiles are within the shaded area in Figure 2-2. This area is defined by following characteristics:

2.6.6.2 If the voltage at the Connection Point falls to below 20% of nominal value, the Large VRE Embedded Generator shall remain connected for at least 0.150 seconds.

(a) If the voltage at the Connection Point falls but it is still above 20% of the nominal value, in all the three phases, the Large VRE Embedded Generator shall remain connected for at least 0.625 seconds;

(b) If the voltage at the Connection Point is equal or above 90% of the nominal value, in all the three phases, the Large VRE Embedded Generator shall remain connected indefinitely, up to fault clearance

(c) For voltages between 20% and 90% of the nominal value, the time the Large VRE Embedded Generator shall remain connected is determined by linear interpolation between following pairs of values [voltage = 20%; time = 0.625 seconds] and [voltage = 90%; time = 3.0 seconds].

In the case of larger voltage deviations and/or lasting longer, the Large VRE Embedded Generator is allowed to be disconnected from the network.

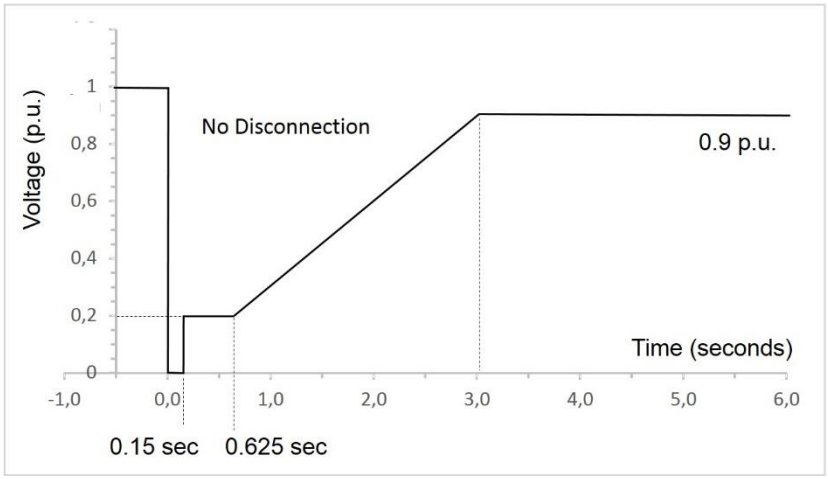

Figure 2-2
Low voltage withstand Capability – Large VRE Embedded Generators

2.6.6.3 In case of three phase faults on the network, at least the following performance should be achieved:

(a) As a general rule, both during the time the fault exists in the network and during the voltage recovery period after fault elimination, there should be no Reactive Power consumption by the Large VRE Embedded Generating Plant at the Connection Point). Reactive Power consumption is only allowed during the first 150 milliseconds after the initiation of the fault and during the 150 milliseconds immediately after fault elimination, provided that during these periods the net consumption of Reactive Power of the Large VRE Embedded Generating Plant is not greater than 60% of the registered nominal capacity of the facility;

(b) As a general rule, both during the time the fault exists in the network and during the voltage recovery period after fault elimination, there should be no consumption of active power by the Large VRE Embedded Generating Plant. Small consumptions of active power are allowed during the first 150 milliseconds immediately after the initiation of the fault and during the first 150 milliseconds immediately after the fault clearing could be allowed.

(c) Both during the fault period and during the recovery period after the fault elimination, the Large VRE Embedded Generating Plant should inject into the system the maximum possible current (I_{total}). This injection of current shall be carried out in such a way that the operation of the facility is situated inside of the shaded area of Figure 2-3, after 150 milliseconds from the initiation of the fault or the moment the fault has been eliminated.

2.6.6.4 In case of unbalanced faults (single-phase faults and/or two-phase faults), at least the following performance should be achieved:

(a) As a general rule, both during the fault period and the recovery period after fault elimination, there should be no Reactive Power consumption by the Large VRE Embedded Generating Plant at the Connection point. Small amounts of Reactive Power consumption are allowed during the first 150 milliseconds immediately after the start of fault and immediately after its elimination. In addition, transitory consumptions are allowed during the fault period, provided that the following conditions are met:

(1) Net consumption of Reactive Power by the Large VRE Embedded Generating Plant shall not exceed an amount equivalent to 40% of the VRE Installed Capacity of the Large VRE Embedded Generating Plant during any 100 milliseconds period; and

(2) Net consumption of Reactive Power, in each cycle (16.6 milliseconds), shall not exceed 40% of VRE Installed Capacity of the Large VRE Embedded Generating Plant.

(b) As a general rule, both during the period of existence of the fault and during the recovery period after fault elimination, there should be no consumption of Active Power by the Large VRE Embedded Generating Plant at the Connection Point. Transitory consumptions of Active Power are allowed, during the first 150 milliseconds after the initiation of the fault and the first 150 milliseconds after fault elimination, provided following conditions are met:

(1) Net consumption of Active Power by the Large VRE Embedded Generating Plant is lower than 45% of the VRE Installed Capacity of the Large VRE Embedded Generating Plant during a period of 100 milliseconds; and

(2) Consumption of Active Power in each cycle (16.6 milliseconds), shall not exceed 30% of VRE Installed Capacity of the Large VRE Embedded Generating Plant.

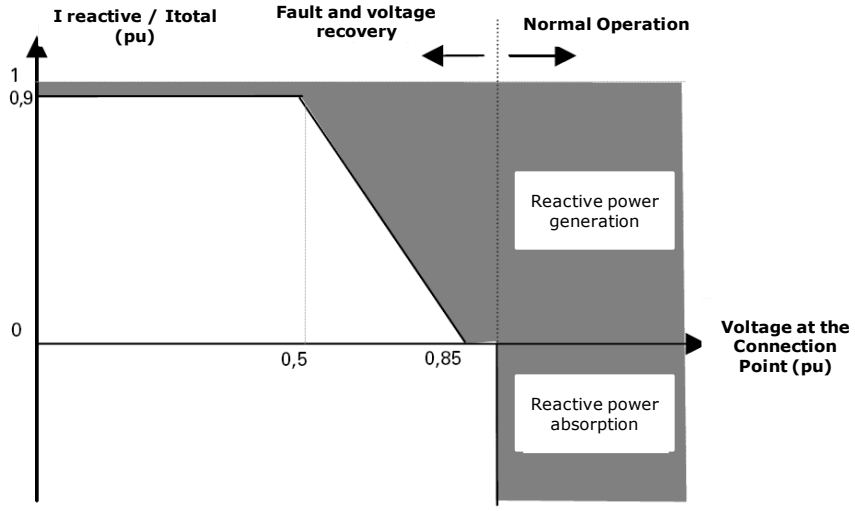

Figure 2-3
Allowed generation of Reactive Power during Voltage Sags – Large VRE Embedded Generating Plants

2.6.6.5 Large VRE Generation Company shall demonstrate to the Distribution Utility and the System Operator that the Large VRE Embedded Generating Facilities installed complies with the prescriptions indicated in Sections 2.6.6.1 to 2.6.6.4 through:

(a) A certification issued by the Facility manufacturer, stating that its Large VRE Embedded Generators has been tested and certified in a reputable laboratory showing compliance with the stated requirements. Copy of the laboratory certification shall be included to the Connection Agreement or Amended Connection Agreement.

(b) A formal declaration from the VRE Generator and/or its EPC Contractor indicating that the Large VRE Embedded Generating Plant installed protection system and their settings, do not impair the performance required by Sections 2.6.6.1 to 2.6.6.4. Copy of this declaration shall be included to the Connection Agreement or Amended Connection Agreement.

2.6.7 Protection Arrangements

2.6.7.1 The protection of Large VRE Embedded Generating Plants and Equipment and their connection to the Distribution System shall be designed, coordinated, and tested to achieve the desired level of speed, sensitivity, and selectivity in fault clearing as well as in other system troubles and to minimize the impact of these on the Distribution System. In particular, the Large Conventional Generator shall agree with the Distribution Utility the protection measures required to prevent unintended Islanding operation.

2.6.7.2 The Distribution Utility and the Large VRE Embedded Generation Company shall be solely responsible for the protection System of the electrical Equipment and facilities at their respective sides of the Connection Point.

2.6.8 Information Interchange

2.6.8.1 A communication system shall be established so that the System Operator, the Distribution Utility Operator and Large VRE Embedded Generation Company can

communicate with one another, as well as exchange data signals for monitoring and controlling the Distribution System during normal and emergency conditions.

2.6.8.2 The Large VRE Embedded Generation Company shall provide the complete RTU and communication Equipment required for the monitoring and control of the Connection Point and the Generating Units with the Distribution Utility Operator. In case the Transmission Network Provider considers that a Large VRE Embedded Generator will be under its direct control, the Equipment required for the monitoring and control of the Connection Point and the Generating Units shall be provided by the Transmission Network Provider.

2.6.8.3 Following information shall be sent to the Distribution Utility Operator or to the Transmission Network Provider, as it corresponds:

(a) Operation status of the Large VRE Embedded Generating Plant;

(b) Voltage at HV busbar of the Large VRE Embedded Generating Plant;

(c) Active Power, Reactive Power and electric current at high voltage side of step-up transformer of the Large VRE Embedded Generating Plant;

(d) Status of high voltage circuit breakers and isolator switches; and

(e) In the case of Wind Farms, real time wind speed and wind direction measured at wind measurement mast.

2.6.8.4 Provision of additional signals may be agreed between the Distribution Utility Operator and the Large VRE Embedded Generating Plant, in which case they will be reflected in the Connection Agreement or Amended Connection Agreement.

2.6.8.5 The System Operator may agree with the Large VRE Embedded Generating Plant using the SCADA system to communicate instructions to the Variable Renewable Energy Generators, in which case this situation will be reflected in the Connection Agreement or Amended Connection Agreement. The instructions of the System Operator may include, but not limited to:

(a) Modes of control and set-points for Active Power control;

(b) Instructions for Active Power curtailment;

(c) Modes of control of voltage regulation and set points; and

(d) Start/stop instructions.

2.6.8.6 Large VRE Embedded Generating Plant Operators may agree with the Distribution Utility to automatically interface these signals/instructions with the VRE control system. In this case, this agreement should be clearly reflected in the Connection Agreement or Amended Connection Agreement.

2.7 REQUIREMENTS FOR MEDIUM EMBEDDED GENERATING PLANTS

2.7.1 Embedded Generating Plant Power Output

2.7.1.1 The Medium Embedded Generator shall be capable of continuously supplying its Active Power output, depending on the availability of the primary resource in case of VRE generation, within the Power System Frequency range of 59.7 to 60.3 Hz.

2.7.1.2 The Medium Embedded Generator shall be capable of remain connected to the network, supplying its Active Power output and maintaining the interchange of Reactive Power at the Connection Point with voltage variations within the range

+/- 5% during normal operating conditions. Outside this range and up to a voltage variation of +/-10%, a reduction on Active Power can be allowed, provided that the Power Factor at the Connection Point remains within the limits specified in Section 2.7.3.

2.7.2 Frequency Withstand Capability

2.7.2.1 Any variation of the Power System Frequency within the range of 58.2 Hz to 61.8 Hz should not cause the disconnection of the Medium Embedded Generator.

2.7.2.2 The Medium Embedded Generator shall be capable to operate, for at least 5 minutes, in case of increase in Frequency within the range of 61.8 to 62.4 Hz; or decrease in Frequency within the range of 57.6 to 58.2 Hz, in both cases provided the voltage at the Connection Point is within +/- 10% of the nominal value.

2.7.2.3 The Medium Generation Company Operator shall be responsible for protecting its Medium Embedded Generator against damage for frequency excursions outside the range of 57.6 Hz and 62.4 Hz, provided that in case the Frequency momentarily falls below 57.6 Hz the Medium Embedded Generator shall remain connected for at least 5 seconds. In case of increase in Frequency above 62.4 Hz the Medium Generation Company Operator shall disconnect the Embedded Generating Plant and/or its Embedded Generating Units from the Grid.

The Medium Generation Plant shall remain synchronized during a rate of change of Frequency of values up to and including plus or minus 1.0 Hz per second measured as a rolling average over 500 ms. As voltage dips may cause localized rate of change of Frequency values in excess of 1 Hz per second for short periods, the Large VRE shall remain synchronized if the Voltage dips at the Connection Point are within the values established in Section 2.6.6.

Table 2-3
Requirements for different Frequency Ranges

Frequency		Time
Hz	**P.u.**	
> 62.4	> 1.04	Automatic disconnection
> 61.8 – 62.4	> 1.03 – 1.04	5 minutes
58.2 – 61.8	0.97 - .03	Continuous Operation
57.6 - < 58.2	0.96 - < 0.97	5 minutes
<57.6	< 0.96	5 seconds

2.7.3 Reactive Power Capability and Control

2.7.3.1 The Medium Embedded Generating Plant shall be capable of maintaining the Power Factor at its Connection Point within the range of 0.98 leading – 0.98 lagging, unless something different is agreed with the Distributor and reflected in the Connection Agreement or amended Connection Agreement.

2.7.3.2 The Power Factor to be maintained at each moments will be prescribed by the Distribution Utility. In order to comply with this requirement the Medium Embedded Generating Plant shall be equipped with an appropriate control system able to control the Reactive Power interchange over the entire operating range, which shall not create oscillations in the network.

2.7.4 Active Power Control

2.7.4.1 Medium Embedded Generating Plants should be equipped with an Active Power regulation control system able to reduce the Active Power in case of System Frequency exceeds 61.0 Hz. The reduction in Active Power to be achieved shall be calculated according with the following formula:

$$\Delta P = 45 \cdot P_m \cdot \left(\frac{61.0 - f_n}{60} \right)$$

Where:

ΔP: is the variation in Active Power output that should be achieved
P_m: is the Active Power output before this control is activated
f_n: is the network frequency

The reduction in Active Power output shall be performed at the maximum possible gradient, provided the technical capabilities of the Medium Embedded Generators are not exceeded. If the active power for any Medium Embedded Generator is regulated downward below its Minimum Technical Load (P_{min}) shutting-down of the Intermediate Embedded Generator is allowed.

2.7.5 Performance during network disturbances

2.7.5.1 The Medium Embedded Generator shall be able to withstand without disconnection Voltage Sags at the Connection Point, produced by fault or disturbances in the network, whose magnitude and duration profiles are within the shaded area in Figure 2-2 as indicated in Section 2.6.6.2.

2.7.5.2 Medium Generation Company shall demonstrate to the Distribution Utility and the System Operator that the Medium Embedded Generating Facilities installed complies with the prescriptions indicated in Section 2.7.5.1 through:

(a) A certification issued by the Facility manufacturer, stating that its Medium Embedded Generators has been tested and certified in a reputable laboratory showing compliance with the stated requirements. Copy of the laboratory certification shall be included to the Connection Agreement or Amended Connection Agreement.
(b) A formal declaration from the VRE Generator and/or its EPC Contractor indicating that the Medium Embedded Generating Plant installed protection system and their settings, do not impair the performance indicated in Section 2.7.5.1. Copy of this declaration shall be included to the Connection Agreement or Amended Connection Agreement.

2.7.6 Protection Arrangements

2.7.6.1 The protection of Medium Embedded Generating Plants and Equipment and their connection to the Distribution System shall be designed, coordinated, and tested to achieve the desired level of speed, sensitivity, and selectivity, which

includes Anti-Islanding among others, in fault clearing and to minimize the impact of faults on the Distribution System.

2.7.6.2 Unless something different is agreed with the Distribution Utility and reflected in the Connection Agreement, the Medium Embedded Generating Plant shall have a protection that disconnects it from the Distribution System in any event in which part of the Distribution System, to which Medium Embedded Generating Plant is connected become detached from the rest of the system

2.7.6.3 The Distribution Utility and the Medium Embedded Generation Company shall be solely responsible for the protection System of the electrical Equipment and facilities at their respective sides of the Connection Point.

2.7.7 Information Interchange

2.7.7.1 The Distribution Utility will determine, based on the results of the Distribution Impact Study if a communication system between the Distribution Utility Operator and Medium Embedded Generation Company is actually necessary in order to exchange data signals for monitoring and controlling the Distribution System during normal and emergency conditions.

2.7.7.2 The Medium Embedded Generation Company shall provide the communication Equipment (RTU) required for the monitoring and control of the Connection Point and the Generating Units with the Distribution Utility Operator.

2.7.7.3 The information that will be sent to the Distribution Utility Operator shall be mutually agreed between the Distribution Utility and the Medium Embedded Generation Company and it will be reflected in the Connection Agreement or Amended Connection Agreement.

2.8 REQUIREMENTS FOR INTERMEDIATE EMBEDDED GENERATING PLANTS

2.8.1 Embedded Generating Plant Power Output

2.8.1.1 The Intermediate Embedded Generator shall be capable of continuously supplying its Active Power output, depending on the availability of the primary resource in case of VRE generation, within the Power System Frequency range of 59.7 to 60.3 Hz.

2.8.1.2 The Intermediate Embedded Generator shall be capable of remain connected to the network, supplying its Active Power output and maintaining the interchange of Reactive Power at the Connection Point with voltage variations within the range +/- 5% during normal operating conditions. Outside this range and up to a voltage variation of +/-10%, a reduction on Active Power can be allowed, provided that the Power Factor at the Connection Point remains within the limits specified in Section 2.7.3.

2.8.2 Frequency Withstand Capability

2.8.2.1 Any variation of the Power System Frequency within the range of 58.2 Hz to 61.8 Hz should not cause the disconnection of the Intermediate size Embedded Generator.

2.8.2.2 The Intermediate Embedded Generator shall be capable to operate, for at least 5 minutes, in case of increase in Frequency within the range of 61.8 to 62.4 Hz; or

decrease in Frequency within the range of 57.6 to 58.2 Hz, in both cases provided the voltage at the Connection Point is within +/- 10% of the nominal value.

2.8.2.3 The Intermediate Generation Company Operator shall be responsible for protecting its Intermediate size Embedded Generator against damage for frequency excursions outside the range of 57.6 Hz and 62.4 Hz, provided that in case the Frequency momentarily falls below 57.6 Hz the Intermediate size Embedded Generator shall remain connected for at least five (5) seconds. In case of increase in Frequency above 62.4 Hz the Intermediate size Generation Company Operator shall disconnect the Embedded Generating Plant and/or its Embedded Generating Units from the Grid.

2.8.2.4 The Intermediate Embedded Generation Plant shall remain synchronized during a rate of change of Frequency of values up to and including plus or minus 1.0 Hz per second measured as a rolling average over 500 ms. As voltage dips may cause localized rate of change of Frequency values in excess of 1.0 Hz per second for short periods, the Large VRE shall remain synchronized if the Voltage dips at the Connection Point are within the values established in Section 2.6.6 .

Table 2-4
Requirements for different Frequency Ranges

Frequency		Time
Hz	**P.u.**	
> 62.4	> 1.04	Automatic disconnection
> 61.8 – 62.4	> 1.03 – 1.04	5 minutes
58.2 – 61.8	0.97 - .03	Continuous Operation
57.6 - < 58.2	0.96 - < 0.97	5 minutes
<57.6	< 0.96	5 seconds

2.8.3 Reactive Power Capability and Control

2.8.3.1 The Intermediate Embedded Generating Plant shall be capable of maintaining the Power Factor at its Connection Point within the range of 0.98 leading – 0.98 lagging, unless something different is agreed with the Distributor and reflected in the Connection Agreement or amended Connection Agreement.

2.8.4 Active Power Control

2.8.4.1 Intermediate Embedded Generating Plants should be equipped with an Active Power regulation control system able to reduce the Active Power in case of System Frequency exceeds 61.0 Hz. The reduction in Active Power to be achieved shall be calculated according with the following formula:

$$\Delta P = 45 \cdot P_m \cdot \left(\frac{61.0 - f_n}{60} \right)$$

Where:

ΔP: is the variation in Active Power output that should be achieved
P_m: is the Active Power output before this control is activated
f_n: is the network frequency

The reduction in Active Power output shall be performed at the maximum possible gradient, provided the technical capabilities of the Intermediate Embedded Generators are not exceeded. If the active power for any Intermediate size Embedded Generator is regulated downward below its Minimum Technical Load (P_{min}) shutting-down of the Intermediate Embedded Generator is allowed.

2.8.5 Performance during network disturbances

2.8.5.1 The Medium Embedded Generator shall be able to withstand without disconnection Voltage Sags at the Connection Point, produced by fault or disturbances in the network, whose magnitude and duration profiles are within the shaded area in Figure 2-2 as indicated in paragraph 2.6.6.2.

2.8.5.2 Intermediate Generation Company shall demonstrate to the Distribution Utility that the Intermediate size Embedded Generating Facilities installed complies with the prescriptions indicated in paragraph 2.7.5.1 through a certification issued by the Facility manufacturer, stating that its Intermediate size Embedded Generators has been tested and certified in a reputable laboratory showing compliance with the stated requirements. Copy of the laboratory certification shall be included to the Connection Agreement or Amended Connection Agreement.

2.8.6 Protection Arrangements

2.8.6.1 The protection of Intermediate Embedded Generating Plants and Equipment and their connection to the Distribution System shall be designed, coordinated, and tested to achieve the desired level of speed, sensitivity, and selectivity, which includes Anti-Islanding among others, in fault clearing and to minimize the impact of faults on the Distribution System.

2.8.6.2 Unless something different is agreed with the Distribution Utility and reflected in the Connection Agreement, the Intermediate Embedded Generating Plant shall have a protection that disconnects it from the Distribution System in any event in which part of the Distribution System, to which Intermediate Embedded Generating Plant is connected, become detached from the rest of the system

2.8.6.3 The Distribution Utility and the Intermediate Embedded Generation Company shall be solely responsible for the protection System of the electrical Equipment and facilities at their respective sides of the Connection Point.

2.8.7 Information Interchange

2.8.7.1 The Distribution Utility will determine, based on the results of the Distribution Impact Study if a communication system between the Distribution Utility Operator and the Intermediate Embedded Generation Company is actually necessary in order to exchange data signals for monitoring and controlling the Distribution System during normal and emergency conditions.

2.8.7.2 If deemed appropriate, the Intermediate size Embedded Generation Company shall provide the communication Equipment (RTU) required for the monitoring and control of the Connection Point and the Generating Units with the Distribution Utility Operator.

2.8.7.3 The information that will be sent to the Distribution Utility Operator shall be mutually agreed between the Distribution Utility and the Intermediate size Embedded Generation Company and it will be reflected in the Connection Agreement or Amended Connection Agreement.

2.9 REQUIREMENTS FOR SMALL AND MICRO EMBEDDED GENERATING PLANTS

2.9.1 Embedded Generating Plant Power Output

2.9.1.1 The Small Embedded Generator shall be capable of continuously supplying its Active Power output, depending on the availability of the primary resource in case of VRE generation, within the Power System Frequency range of 59.7 to 60.3 Hz.

2.9.1.2 The Small Embedded Generator shall be capable of remain connected to the network with voltage variations within the range +/- 10% during normal operating conditions.

2.9.2 Frequency Withstand Capability

2.9.2.1 Any variation of the Power System Frequency within the range of 58.2 Hz to 61.8 Hz should not cause the disconnection of the Small Embedded Generator.

2.9.3 Reactive Power Capability and Control

2.9.3.1 The Small size Embedded Generating Plant shall be capable of maintaining the Power Factor of not less than 0.85 lagging at its Connection Point, unless something different is agreed with the Distributor and reflected in the Connection Agreement or amended Connection Agreement.

2.9.4 Performance during network disturbances

2.9.4.1 The Small Embedded Generator shall be able to withstand without disconnection Voltage Sags or over voltages at the Connection Point, produced by fault or disturbances in the network, whose magnitude and duration profiles are within the following limits:

Table 2-5
Minimum Time Requirements for Small Embedded Generators to Remain Connected at Different Voltage Ranges

Voltage Range (% of Base Voltage)	Time
V < 30	0.15
V = 30	0.6
30 < V ≤ 90	Linear interpolation between 0.600 second at 30% of base voltage and 3.0 seconds at 90% base voltage
90 < V ≤ 110	Continuous operation
110 < V < 120	1.0
V ≥ 120	0.16

2.9.5 Protection Arrangements

2.9.5.1 The Distribution Utility and the Small Embedded Generation Company shall be solely responsible for the protection System of the electrical Equipment and facilities at their respective sides of the Connection Point.

2.9.5.2 The Small or Micro Embedded Generating Plant shall be responsible for providing adequate protection for it facility under any operating conditions, and regardless 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, lighting and switching surges, excessive harmonic voltages, excessive negative sequence voltage and islanding.

2.9.5.3 The Small or Micro Embedded Generating Plant shall provide synchronizing devices for synchronizing the facility with the Distribution Utility network. Automatic synchronization devices shall be installed to monitor and control the synchronism. The Distribution Utility shall review, approve and inspect the method of synchronization. Automatic synchronizing settings shall not be changed following installation unless agreed with the Distribution Utility. Typical limits for synchronizing parameters are given in Table 2-6.

Table 2-6
Typical Synchronizing Parameters Limits

Maximum Frequency Difference □f [Hz]	Maximum Voltage Difference □V [%]	Maximum Phase Angle Difference □□ [Degrees]
0.3	10	20

2.9.5.4 To prevent islanding, in which Small or Micro Embedded Generator energizes a portion of the Distribution Utility network through the connection point, the Small or Micro Embedded Generator shall detect islanding and disconnect from the Distribution System within two seconds from the formation of the island. The Small or Micro Embedded Generator shall provide facilities again islanding to isolate and block the facility from closing back into the Distribution System until the system is energized for at least 10 minutes from the normal utility source.

2.9.5.5 The grounding scheme of the Small or Micro Embedded Generator shall not cause overvoltages that exceed the rating of the equipment connected to the 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.

2.9.5.6 The protection of Small or Micro Embedded Generating Plants and Equipment and their connection to the Distribution System shall be designed, coordinated, and tested to achieve the desired level of speed, sensitivity, and selectivity in fault clearing and to minimize the impact of faults on the Distribution System.

2.9.5.7 The Small and Micro size Embedded Generating Plants shall submit the proposed fused types and/or relay settings to the Distribution Utility for review and acceptance. Any subsequent relay or fuse change shall also be submitted to the Distribution Utility for acceptance.

2.9.5.8 The Small and Micro Embedded Generating Plant shall provide a visible disconnecting device for use by the Distribution Utility to electrically isolate the Distribution System from the Small or Micro Embedded Generating Plant and to establish working clearances for maintenance, safety and system considerations. The disconnecting device shall be physically located for ease of access by the Distribution Utility personnel located within 10 feet from the Connection Point. If this is not practical the disconnecting device shall be located between the Small Embedded Generating facility and the Connection Point. The type of disconnecting device must allow for visual indication of the contact position with a padlock. It shall be readily accessible at all times by the Distribution Utility personnel.

Labels, markings and warning signs shall be applied near the Connection Point to alert the Distribution Utility Personnel of a Generating facility installed within the Generator premises.

2.9.5.9 Protective relays shall be installed to trip the corresponding circuit breaker during abnormal conditions. Protective relays for a given Small or Micro Embedded Generating Plant are shown in Tables 2-7, 2-8 and 2-9.

Table 2-7
Interconnection Protective Function Requirements for Induction Generators

Device	Protective Equipment	Generator Size	
		≤ 10 kW	> 10 kW
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
	Anti-Islanding Relay (phase shift or RoCoF)	X	X

Table 2-8
Interconnection Protective Function Requirements for Synchronous Generators

Device	Protective Equipment	Generator Size	
		≤ 10 kW	> 10 kW
25	Synchronism-Check Relay	X	X
27	Under Voltage Relay	X	X
51V	Over current Relay – Voltage Restrained		X
59	Overvoltage Relay		X
81/O – 81/U	Over-Under Frequency Relay		X
	Anti-Islanding Relay (phase shift or RoCoF)	X	X

Table 2-9
Interconnection Protective Function Requirements for Inverters

Device	Protective Equipment	Generator Size	
		≤ 10 kW	> 10 kW
27	Under Voltage Relay	X	X
59	Overvoltage Relay	X	X
81/O – 81/U	Over-Under Frequency Relay	X	X
	Anti-Islanding Relay (phase shift or RoCoF)	X	X

2.9.5.10 The Small or Micro Embedded Generating Plant should immediately disconnect from the Distribution System when the system is down. For a Distribution System with automatic reclosing, the Small or Micro Embedded Generating Plant should wait for 10 minutes until the recloser has normalized the portion of the system to which the Small or Micro Embedded Generating Plant is connected before synchronizing back to the system.

CHAPTER 3

EMBEDDED GENERATOR PLANNING

3.1 STANDARD PLANNING DATA

3.1.1 Energy and Demand Forecast

3.1.1.1 The User shall provide the Distribution Utility with its Energy and Demand forecasts at each Connection Point for the five (5) succeeding years.

3.1.1.2 The Forecast Data for the first year shall include monthly Energy and Demand forecasts, while the remaining four years shall include only the annual Energy and Demand forecasts.

3.1.1.3 The Users shall provide the net values of Energy and Demand forecast after any deductions to reflect the output of a Customer Self-Generating Plant. Such deductions shall be stated separately in the Forecast Data.

3.1.1.4 The following factors shall be taken into account by the Distribution Utility and the User when forecasting Demand:

(e) Historical Demand data;

(f) Demand trends;

(g) Significant public events;

(h) Customer Self-Generating Plant Schedules;

(i) Demand transfers;

(j) Interconnection with adjacent Distribution Utilities; and

(k) Other relevant factors.

3.1.1.5 The Large, Medium, Intermediate and Small Embedded Generation Company shall submit to the Distribution Utility the projected Energy and Demand to be generated by each Embedded Generator

3.1.2 Embedded Generator Data

3.1.2.1 The Embedded Generation Company shall provide the Distribution Utility with data relating to the Embedded Generators.

3.1.2.2 The following information shall be provided for each Conventional Generating Plant:

(a) Rated Capacity (MVA and MW);

(b) Rated Voltage (kV);

(c) Type of Generating Unit and expected running mode(s);

(d) Direct axis subtransient reactance (%); and

(e) Rated capacity, voltage, and impedance of the Generating Unit’s step-up transformer.

3.1.2.3 The following information shall be provided for the Wind Generators:

(a) Name and location of the Wind Farm

(b) Wind Farm capacity

(c) Total VRE Installed Capacity

(d) Number of units and unit size

(e) Type of wind turbines used in the Wind Farm (fixed speed/variable speed)

(f) Wind turbine manufacturer

(g) Rated power of each wind turbine (kW)

(h) Rated apparent power (kVA)

(i) Rated frequency (Hz)

(j) Rated wind speed (m/s)

(k) Cut-in wind speed (m/s)

(l) Cut-off wind speed (m/s)

(m) Rated voltage (Volt)

3.1.2.4 The following information shall be provided for the PVSs:

(a) Name and location of the PVS Generator

(b) Total Installed Capacity, kW

(c) Number of units and unit size

(d) Inverter Power Rating, kW

(e) Inverter Manufacturer & Model

(f) Solar Panel Technology

(g) PVS transformer data (if applicable)

(h) Transformer Voltage Ratio (if applicable)

(i) Percentage Impedance (if applicable)

(j) Winding Connection (if applicable)

(k) Tap Settings (if applicable)

3.1.2.5 If the Generating Unit is connected to the Distribution System at a Connection Point with a bus arrangement which is, or may be operated in separate sections, the bus section to which each Generating Unit is connected shall be identified.

3.2 DETAILED PLANNING DATA

3.2.1 Embedded Generator Data

3.2.1.1 The following additional information shall be provided for each Large Conventional Embedded Generating Plant:

(a) Derated Capacity (MW) on a monthly basis if applicable;

(b) Additional capacity (MW) obtainable from Generating Units in excess of Net Declared Capacity;

(c) Minimum Stable Loading (MW);

(d) Reactive Power Capability Curve;

(e) Stator armature resistance;

(f) Direct axis synchronous, transient, and subtransient reactances;

(g) Quadrature axis synchronous, transient, and subtransient reactances;

(h) Direct axis transient and subtransient time constants;

(i) Quadrature axis transient and subtransient time constants;

(j) Turbine and Generating Unit inertia constant (MWsec/MVA);

(k) Rated field current (amps) at rated MW and MVAR output and at rated terminal voltage; and

(l) Short circuit and open circuit characteristic curves.

3.2.1.2 The following additional information shall be provided for each Large VRE Wind Farm:

(a) Dynamic model of the Wind Farm. In case the Wind Turbine Generating Units in the Wind Farm are not identical, the model shall incorporate separate modules to represent each type of Wind Turbine Generating Unit. Appropriate data and parameter values must be provided for each model. The dynamic model must represent the features and phenomena likely to be relevant to angular and voltage stability, such as generator model, blade pitch control, model of drive train and model of converter (if any).

(b) Reactive compensation. Provide the details of reactive compensation, operating power factor range

(c) Wind Turbine transformer data

(d) Transformer voltage ratio

(e) Percentage impedance

(f) Winding connection

(g) Tap settings

(h) Transformer data

(i) Percentage impedance

(j) Voltage ratio

(k) Winding connection

(l) Tap settings

The following additional information shall be provided f Synchronous machines, in general, are much better adapted to generate reactive power than non-conventional generators (asynchronous or inverter based machines). For this reason, it is common to impose stricter requirements for conventional generators (synchronous) than VRE ones (non-synchronous in many cases). In last case, the values stated in the code are a trade-off between system requirements (usually important) and the additional costs the developers should afford to comply with reactive power interchanges requirement.

3.2.1.3 The report will be amended to clarify this issue. ach PVS Generator:

(a) Solar Panel Data

(b) Solar Panel Manufacturer

(c) Rated Power per Solar Panel (kW)

(d) Solar Panel Generator Technology

(e) Rated Apparent Power (kVA)

(f) Frequency Tolerance Range (Hz)

(g) Width (mm)

(h) Height (mm)

(i) Area (m2)

(j) Rated Voltage (Volt)

(k) Rated Current (Ampere)

(l) Watts per square meter

(m) Efficiency, %

(n) Dynamic model of the PVS: Provide a dynamic model compatible with standard dynamic simulation tools

(o) Reactive compensation: Provide details of reactive compensation and operating power factor range.

(p) PVS Configuration: Single line diagram of connection scheme and details of the conductor used

3.2.1.4 The following information on Step-up Transformers shall be provided for each Embedded Generator:

(a) Rated MVA;

(b) Rated Frequency (Hz);

(c) Rated voltage (kV);

(d) Voltage ratio;

(e) Positive sequence reactance (maximum, minimum, and nominal tap);

(f) Positive sequence resistance (maximum, minimum, and nominal tap);

(g) Zero sequence reactance;

(h) Tap changer range;

(i) Tap changer step size; and

(j) Tap changer type: on load or off circuit.

3.2.1.5 The following excitation control system parameters shall be submitted for each Large Conventional or B Embedded Generator:

(a) DC gain of Excitation Loop;

(b) Rated field voltage;

(c) Maximum field voltage;

(d) Minimum field voltage;

(e) Maximum rate of change of field voltage (rising);

(f) Maximum rate of change of field voltage (falling);

(g) Details of Excitation Loop described in diagram form showing transfer functions of individual elements;

(h) Dynamic characteristics of overexcitation limiter; and

(i) Dynamic characteristics of underexcitation limiter.

3.2.1.6 The following speed-governing parameters for reheat steam Generating Units of Large Conventional shall be submitted:

(a) High pressure governor average gain (MW/Hz);

(b) Speeder motor setting range;

(c) Speed droop characteristic curve;

(d) High pressure governor valve time constant;

(e) High pressure governor valve opening limits;

(f) High pressure governor valve rate limits;

(g) Reheater time constant (Active Energy stored in reheater);

(h) Intermediate pressure governor average gain (MW/Hz);

(i) Intermediate pressure governor setting range;

(j) Intermediate pressure governor valve time constant;

(k) Intermediate pressure governor valve opening limits;

(l) Intermediate pressure governor valve rate limits;

(m) Details of acceleration sensitive elements in high pressure and intermediate pressure governor loop; and

(n) A governor block diagram showing the transfer functions of individual elements.

3.2.1.7 The following speed-governing parameters for Large Conventional non-reheat steam, gas turbine, geothermal, and hydro Embedded Generating Units shall be submitted:

(a) Governor average gain;

(b) Speeder motor setting range;

(c) Speed droop characteristic curve;

(d) Time constant of steam or fuel governor valve or water column inertia;

(e) Governor valve opening limits;

(f) Governor valve rate limits; and

(g) Time constant of turbine.

CHAPTER 4

EMBEDDED GENERATOR OPERATIONS

4.1 OPERATIONAL RESPONSIBILITIES

4.1.1 Operational Responsibilities of Embedded Generation Companies

4.1.1.1 The Embedded Generation Company is responsible for ensuring that its Generating Units can deliver the capabilities declared in its Connection Agreement or Amended Connection Agreement.

4.1.1.2 The Embedded Generation Company is responsible for providing accurate and timely planning and operations data to the Distributor.

4.1.1.3 The Embedded Generation Company is responsible for executing the instructions of the Distribution Utility during Normal, Alert or Emergency conditions.

4.1.1.4 The Embedded Generation Company shall be responsible for ensuring that its Generating Units will not disconnect from the Grid during disturbances except when:

(a) The Frequency or Voltage Variation would damage Generator's Equipment; or

(b) The Frequency or Voltage Variation is outside the prescriptions contained in Chapter 4; or

(c) When the System or Distribution Utility Operator has agreed for the Generator to do so.

4.1.2 Operation of Large VRE Generators

4.1.2.1 In Normal State, Large VRE Embedded Generating Plants shall be operated in the Free Active Power Production control mode (as defined in the Philippine Grid Code) or at any other control mode in case the Embedded Generator Operator decides it so.

4.1.2.2 In Alert State, the System Operator shall make its best endeavors to permit Large VRE Embedded Generating Plants continue operating in the Free Active Power Production control mode (as defined in the Grid Code). However, if it considers it necessary, in order to maintain the necessary security in the system, it may instruct the Embedded Generator Operators to change the Active Power control mode of their Generating Plants to any of those established in Section 2.6.5, issuing at the same time the information regarding the set points to be established to implement the requested type of control. The System Operator or the Distribution Utility Operator can send the mentioned instructions verbally or utilizing the SCADA system if this possibility is allowed in the Connection Agreement or Amended Connection Agreement.

4.1.2.3 In Emergency, Extreme or Restorative States the System Operator and/or the Distribution Utility Operators are entitled to issue any kind of instruction to Large VRE Embedded Generating Plants regarding the operation of this type of facilities. For the avoidance of doubt, these instructions may include the

immediate disconnection of the Large VRE Embedded Generating Plants from the network.

4.1.2.4 Unless the Connection Agreement or Amended Connection Agreement contain sections allowing the System Operator to have direct interface with the Large VRE Embedded Generating Plants control system, Large VRE Embedded Generating Plants shall permanently maintain Embedded Generator Operators capable to properly execute the instructions issued by the System or Distribution Utility Operators.

4.1.2.5 Embedded Generator Operators shall promptly follow the instructions issued by the System or Distribution Utility Operators implementing the actions requested in the Embedded Generator control system without any intentional delay.

Any instruction issued by the System Operator to Large VRE Embedded Generators which implied a change in the Active Power Production control mode shall be clearly reflected in the weekly reports on Grid Operation, containing an explanation of the causes and an assessment of the performance of the Large VRE Embedded Generator Operators in complying with the instructions.

4.1.3 Scheduling and Dispatch

4.1.3.1 Embedded Generators that have the obligation to register in the WESM shall comply with the prescriptions indicated in Chapter 7 of the Philippine Grid Code.

4.2 DETAILED PLANNING DATA

4.2.1 Voltage Control

The control of voltage can be achieved by managing the Reactive Power supply in the Distribution System. This shall include the operation of the following Equipment:

(a) Embedded Generation Units;

(b) Synchronous condensers;

(c) Static VAR compensators;

(d) Shunt capacitors and reactors; and

(e) On-Load tap changing transformers.

In order to perform the control of voltage, the Distribution Utility will send the instructions it considers appropriate to the Large Conventional, Large VRE or Medium Embedded Generators, provided such instructions implies providing reactive power within the limits indicated in Sections 2.5.5, 2.6.3 and 2.7.3 as it corresponds.

4.3 EMERGENCY PROCEDURES

4.3.1 Operation of Embedded Generator in Island Grid

4.3.1.1 If a part of the Distribution System to which an Embedded Generator is connected becomes isolated from the Distribution System, the Distribution Utility will agree with the Embedded Generator if it is possible and desirable for the Embedded Generator to continue operating.

4.3.1.2 If no facilities exist for the subsequent resynchronization with the rest of the Distribution System, the Distribution Utility shall issue an instruction to the Embedded Generation Company to disconnect its Embedded Generator so that the Island Grid may be reconnected to the rest of the Distribution System.

4.3.2 Black Start and Resynchronization Procedures

4.3.2.1 If a Significant Incident resulted in a Total System Blackout or a Partial System Blackout and the isolated Distribution System has Embedded Generators with Black Start Capability, the Distribution Utility shall initiate a Black Start procedure upon instruction by the System Operator.

4.3.2.2 The System Operator, pursuant to the procedures in the Philippine Grid Code, shall be responsible in the resynchronization of the Island Grids after the Black Start procedure or after a Significant Incident has resulted in Island Grid operation.

4.3.2.3 After a Total System Blackout or a Partial System Blackout and during the whole restoration process Embedded generators of Large and Medium size Embedded Generators shall strictly follow the instructions issued by the System Operator or the Distribution Utility, as corresponds. They shall not reconnect to the network unless an instruction or an authorization has been provided by the System Operator or the Distribution Utility.

4.3.2.4 Intermediate, Small and Micro Embedded Generators are entitled to reconnect to the network when the system has been energized for at least 10 minutes from the normal utility source.

4.4 EMBEDDED GENERATOR CAPABILITY TESTS

4.4.1 Test Requirements for Large and Medium Size Embedded Generators

4.4.1.1 Tests shall be conducted, in accordance with the agreed procedures and standards, to confirm the compliance of Large and Medium size Embedded Generators for the following:

(a) Capability of Generating Units to operate within their registered Generation parameters;

(b) Capability of the Generating Units to meet the applicable requirements of the Philippine Grid Code and the Philippine Distribution Code;

(c) Capability to deliver the Ancillary Services that the Generation Company had agreed to provide; and

(d) Availability of Generating Units in accordance with their capability declaration.

4.4.1.2 All tests shall be recorded and witnessed by the authorized representatives of the Distribution Utility, Generation Company, and/or User.

4.4.1.3 The Generation Company shall demonstrate to the Distribution Utility the reliability and accuracy of the test instruments and Equipment to be used in the test.

4.4.1.4 The Distribution Utility may at any time issue instructions requiring tests to be carried out on any Large and Medium Size Embedded Generator. All tests shall be of sufficient duration and shall be conducted no more than twice a year except when there are reasonable grounds to justify the necessity for further tests.

4.4.1.5 If an Embedded Generator fails the test, the Generation Company shall correct the deficiency within an agreed period to attain the relevant registered parameters for that Embedded Generator.

4.4.1.6 Once the Generation Company achieves the registered parameters of its Embedded Generator that previously failed the test, it shall immediately notify the Distribution Utility. The Distribution Utility shall then require the Generation Company to conduct a retest in order to demonstrate that the appropriate parameter has already been restored to its registered value.

4.4.1.7 If a dispute arises relating to the failure of an Embedded Generator to pass a given test, the Distribution Utility, the Generation Company, and/or User shall seek to resolve the dispute among themselves.

4.4.1.8 If the dispute cannot be resolved, one of the parties may submit the issue to the DMC.

4.4.2 Tests to be Performed for Large and Medium size Embedded Generators

4.4.2.1 The Reactive Power test shall demonstrate that the Large or Medium Size Embedded Generator meets the registered Reactive Power Capability requirements specified in Sections 2.5.5, 2.6.3 or 2.7.3 as corresponds. The Embedded Generator shall pass the test if the measured values are within ±5 percent of the Capability as registered with the Transmission Network Provider through the Distribution Utility.

4.4.2.2 The frequency withstand test shall demonstrate that the Large or Medium Size Embedded Generating Unit has the capability to remain synchronized to the network for the time prescribed in Sections 2.5.5, 2.6.3 and 2.7.3 as it corresponds. The Generating Unit shall pass the test if it does not disconnect when System Frequency is within the permissible values.

4.4.2.3 The Primary Response test shall demonstrate that the Large or Medium Size Embedded Generating Unit has the capability to provide Primary Response, as specified in Section2.5.7, 2.6.5 or 2.7.4 as it corresponds. The Generating Unit shall pass the test if the measured response in MW/Hz is within ±5 percent of the required level of response within five (5) seconds.

4.4.2.4 The Reactive Power Control test shall demonstrate that the Large or Medium size Embedded Generating Unit has the capability to control the Reactive Power at the Connection Point, as specified in Sections 2.5.6, 2.6.4 or 2.7.3, as corresponds. The Embedded Generator shall pass the test if:

(a) In voltage control mode, the Large Embedded Generator is capable to control the voltage at the Connection Point within a margin not greater than 0.01 p.u., provided the reactive power injected or absorbed is within the limits specified in Sections 2.5.5, 2.6.3, as corresponds, with a steady state reactive tolerance no greater than five (5) percent of the maximum Reactive Power.

(b) Following a step change in Voltage, the Large Embedded Generator shall be capable of achieving 90 % of the change in Reactive Power output within a time less than five (5) seconds, reaching its final value within a time no greater than 30 seconds.

(c) In power factor control mode, the Large or Medium Embedded Generator is capable of controlling the Power Factor at the Connection Point within the required Reactive Power range, with a target Power Factor in steps no greater than 0.01.

4.4.2.5 The Fast Start capability test shall demonstrate that the Embedded Generator has the capability to automatically Start-Up, synchronize with the Grid through the Distribution System and be loaded up to its offered capability, as specified in Section 2.4.3. The Embedded Generator shall pass the test if it meets the Fast Start capability requirements.

4.4.2.6 The Black Start test shall demonstrate that the Embedded Generator with Black Start capability can implement a Black Start procedure, as specified in Section 2.4.2. To pass the test, the Embedded Generator shall start on its own, synchronize with the Grid through the Distribution System and carry load without the need for external power supply.

4.4.2.7 The Declared Data capability test, to be performed to Large or Medium Size Embedded Generator shall demonstrate that the Embedded Generator can be scheduled and dispatched in accordance with the Declared Data. To pass the test, the Embedded Generator shall satisfy the ability to achieve the Declared Data.

4.4.2.8 The Dispatch accuracy test, to be performed to Large or Medium size Embedded Generators shall demonstrate that the Embedded Generator meets the relevant Dispatch Scheduling and Dispatch Parameters. The Embedded Generator shall pass the test if:

(a) In the case of synchronization, the process is achieved within ±5 minutes of the registered synchronization time;

(b) In the case of synchronizing generation (if registered as a Dispatch Scheduling and Dispatch Parameters), the synchronizing generation achieved is within an error level equivalent to 2.5% of Net Declared Capacity;

(c) In the case of meeting ramp rates, the actual ramp rate is within ±10% of the registered ramp rate;

(d) In the case of meeting Load reduction rates, the actual Load reduction rate is within ±10% of the registered Load reduction rate; and

(e) In the case of all other Dispatch Scheduling and Dispatch Parameters, values are within ±1.5% of the declared values.

4.4.2.9 The SCADA and communications tests shall demonstrate that the Large or Medium size Embedded Generator is capable to

(a) Receive active power or voltage set-points and/or disconnection signals issued from the Distribution Utility or System Operator SCADA, provided that such possibilities has been agreed in the Connection Agreement and/or Amended Connection Agreement; and

(b) Send to the Distribution Utility the signals indicated in the Connection Agreement or Amended Connection Agreement.

4.4.2.10 The Protections Tests shall demonstrate that all the protections agreed with the Distribution Utility perform with the required speed and selectivity settings. It shall also demonstrate that the Embedded Generator disconnects from the Distribution System in case of Loss of Mains.

4.4.2.11 The Ancillary Services acceptability test shall determine the committed services in terms of parameter quantity or volume, timeliness, and other operational requirements. Generation Companies providing Ancillary Services shall conduct the test or define the committed service. However, monitoring by the System Operator or the Distribution Utility of the Ancillary Services performance in response to System-derived inputs shall also be carried out.

4.4.2.12 Following tests can be performed for Large or Medium size Embedded Generators in cases that, based on an analysis of one or more network incidents or claims, the SO, the Distribution Utility, the DMC or the ERC has grounds to consider the performance of the Embedded Generating Plant is not complying with the prescriptions stated in this Distribution Code:

(a) The Power Quality test shall demonstrate that the Embedded Generator complies with the requirements specified in Section 2.4.4. The Embedded Generator shall pass the test if the Flicker or Harmonics measured at the Connection Point are within ±5 percent of values indicated in the Tables in Sections 3.2.4 and 3.2.6.

(b) The performance under disturbances test shall demonstrate that the Embedded Generator is capable to withstand voltage drops as indicated in Sections 2.5.4, 2.6.6 or 2.7.5, as it corresponds. The Embedded Generator shall pass the test if its performance is equal or better than the prescriptions in the said sections. The SO, the Distribution Utility and the Embedded Generator shall agree the way that this tests should be carried out.

4.4.3 Test requirements for Intermediate, Small and Micro Embedded Generators

4.4.3.1 Following tests shall be conducted, in accordance with the agreed procedures and standards, to confirm the compliance of Intermediate, Small and Micro size Embedded Generators:

(a) The Reactive Power test shall demonstrate that the Intermediate, Small or Micro size Embedded Generator can be connected to the Distribution System, generating Active Power and interchanging Reactive Power within the limits established in Sections 2.8.3 or 2.9.3, as it corresponds. The Embedded Generator shall pass the test if the Reactive Power interchanged lies between power factor 0.98 leading and lagging.

(b) The Protections Tests shall demonstrate that all the protections installed, according with Section 2.9.5 perform with the required speed and selectivity settings as established in such Section. It shall also demonstrate that the Embedded Generator disconnects from the Distribution System in case of Loss of Mains.

(c) The reconnection timing test (blocking test) shall demonstrate that, after the Loss of Mains protection acts, the Embedded Generator remains blocked and it does not automatically reconnects to the network until the system is energized for at least 10 minutes, as indicated in Section 2.9.5.4.

(d) The Synchronization Test shall demonstrate that the Embedded Generator is capable to automatically synchronize with the Distribution System within the parameters indicated in Section 2.9.5.3; and

(e) In case of Intermediate size Embedded Generators, which have been required by the Distribution Utility to install a SCADA and communications facility, a communications tests shall demonstrate that the Embedded Generator is capable to send to the Distribution Utility the signals indicated in the Connection Agreement or Amended Connection Agreement,

4.4.3.2 Additional tests can be performed for Intermediate, Small and Micro size Embedded Generators in cases that, based on an analysis of one or more network incidents or claims, the Distribution Utility has grounds to consider the performance of the Embedded Generating Plant is not complying with the prescriptions stated in this Distribution Code.

4.4.3.3 All tests shall be recorded and witnessed by the authorized representatives of the Distribution Utility, Generation Company, and/or User.

4.4.3.4 If an Intermediate, Small or Micro size Embedded Generator fails the test, the Generation Company or the User, as it corresponds, shall correct the deficiency within an agreed period to attain the relevant performance requirements for that Embedded Generator.

4.4.3.5 If a dispute arises relating to the failure of an Embedded Generator to pass a given test, the Distribution Utility, the Generation Company, and/or User shall seek to resolve the dispute among themselves. If the dispute cannot be resolved, one of the parties may submit the issue to the DMC.

4.4.3.6 Type Tested certification is the responsibility of the Micro Embedded Generator Manufacturer. The Distribution Utility will issue such certification, if required by the Micro Embedded Generator Manufacturer, in case the Equipment evaluated complies with all provisions of this PDC.

4.4.3.7 The Intermediate, Small or Micro size Embedded Generator Manufacturer shall make available upon request by the Distribution Utility, a verification test report confirming that the specific Intermediate, Small or Micro Embedded Generation Plant model has been tested to satisfy the requirements of this Distribution Code. The report shall detail the model of the Embedded Generator tested, the test conditions and results recorded. All of these details shall be included on a test sheet.

4.4.3.8 Intermediate, Small or Micro Embedded Generator Manufacturer shall pass, at least, the following Type Tests:

(a) Harmonic Test;

(b) Flicker Test;

(c) DC Injection Test;

(d) Protection tests:

(1) Over-frequency;
(2) Under-frequency;
(3) Over and Under Voltage;
(4) Anti-Islanding (Loss of Mains);

(e) Reconnection Timer Test;
(f) Fault Level Contribution Test; and
(g) Self-Monitoring Test.