Distribution Connection Code (DCC)

By :

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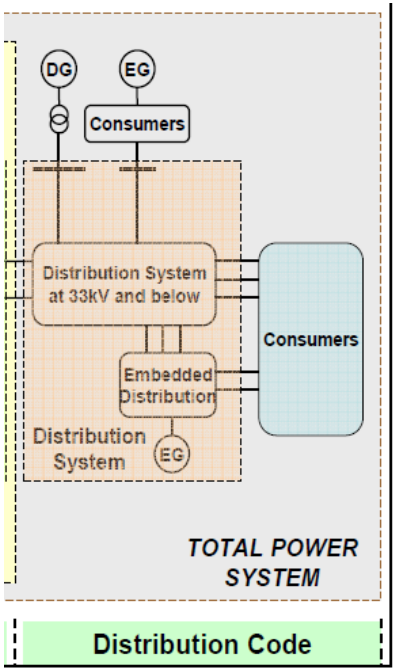
Contents

TERMS

User

A term used in various sections of the Distribution Code to refer to the persons using the Distributor's Distribution System, more particularly identified in each section of the Distribution Code, but excluding the Transmission System Licensee or Grid System Operator



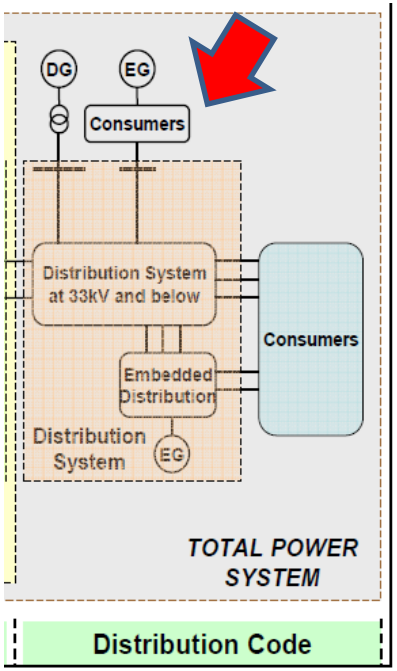
TERMS

Consumer

A person who is supplied with electricity or whose premises are for the time being connected for the purpose of supply of electricity by a supply authority or Licensee

Consumer With Own Generation

A Consumer with one or more Generating Unit(s) connected to the Consumer's System, providing all or part of the Consumer's electricity requirements, and which may use the Distributor's Distribution System for the transport of any surplus of electricity being exported.

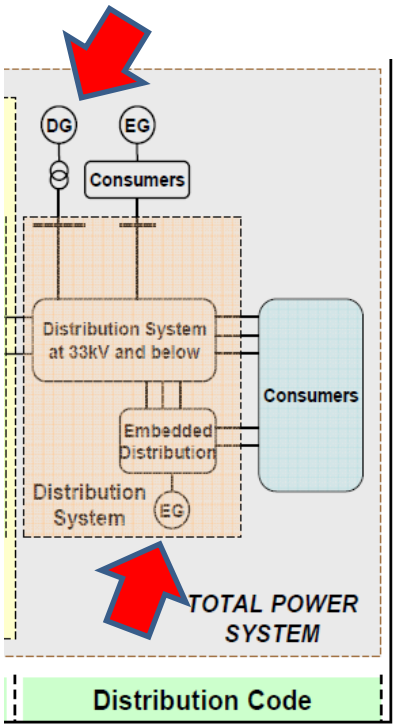


TERMS

Distributed Generator

A Generator, including a Consumer With Own Generation, whose Generating Units are

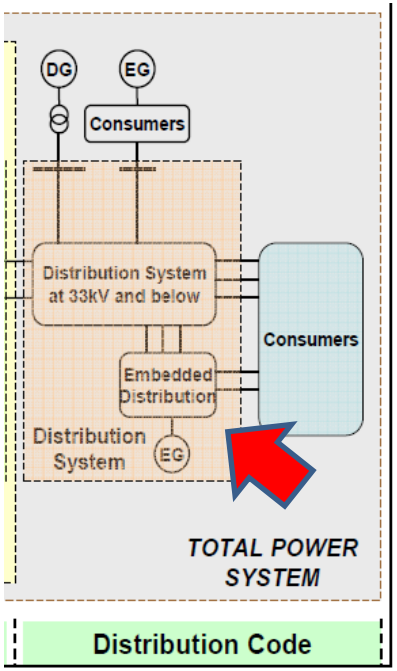
- directly connected to the Distributor's Distribution System or
- to the Distribution System of an Embedded Distributor which is connected to the Distributor's Distribution System,
- and not having any connection with the Transmission System



TERMS

Embedded Distributor

A person who distributes electricity under a Licence issued under the Act and whose Distribution System is connected to the Distributor's Distribution System under a Connection Agreement and not having any connection with the Transmission System; and who is required to comply with the Distribution Code as a User at a Connection Point with the Distributor's Distribution System and also as a Distributor in respect of his own Distribution System.



7.1 INTRODUCTION

7.1.1 The Distribution Connection Code (DCC) specifies the

- technical,
- design,
- operational and
- data exchange

requirements to be complied with by Users connected to or seeking connection to the Distributor's Distribution System.

7.2 SCOPE

7.2.1 The DCC applies to all

- Distributors,
- Consumers,
- Distributed Generators and
- Embedded Distributors.

All Distributors and Users connected to the Distributor's Distribution System or seeking connection to the Distributor's Distribution System shall comply with the requirements of the DCC.

7.3 OBJECTIVES

(a) to enable the Distributor to provide Users with a connection to the Distribution System through planning, design, construction, commissioning and operation to meet existing and planned loads and to meet the requirements of the Electricity Supply Laws, the Licence and the Distribution Code and Grid Code;

(b) to specify the technical requirements of the Distributor and Users in relation to providing a User with a connection to the Distribution System; and

(c) to establish requirements for exchange of data and information between the Distributor and Users to enable the Distributor to make an offer of connection.

NOTE:

- Nothing in this DCC will displace the requirements of the Electricity Supply Laws, or Licences,
- to maintain the safety of personnel and the public, and
- to provide an economic, adequate and secure supply of electricity to Users.

7.4 GENERAL REQUIREMENTS

7.4.1 Provision of an Electricity Supply to Users

a. duty on the Distributor to provide a supply of electricity, subject to certain provisions and exceptions

b. A connection to the Distribution System will be provided to a User by the Distributor exclusively under the terms of a Connection Agreement and such applicable “Tariff Categories” or “Riders” as from time to time may be approved by the Minister. A connection shall be supplied only at such Connection Points as are adjacent to the Distributor’s facilities which have adequate and suitable capacity and voltage for the service desired. Otherwise, special agreements between User and Distributor may be required

7.4 GENERAL REQUIREMENTS

7.4.2 Security and Quality of Supply

7.4.2.1 The Distributor will use reasonable diligence to supply a steady and continuous supply of electricity at the Connection Point in accordance with the security and power quality of supply requirements and planning and operation criteria set out in the DPC and DOC. On occasion irregularities or supply interruptions and short duration variations in voltage and frequency may occur as indicated in the DPC and DOC.

7.4.2.2 The Distributor and User may enter into special agreements for a higher or lower level of security of supply or power quality performance on terms that do not discriminate in favour of or against the User.

7.4 GENERAL REQUIREMENTS

7.4.3 Inspection of User Installations by the Distributor

7.4.3.1 The Distributor reserves the right, but does not assume the duty, to inspect a User's installation at any time and refuse to supply or continue to supply an electricity service whenever the Distributor considers that the User's installation does not comply with the regulations governing that installation or the Distribution Code. In case of discontinuation of supply on grounds of non-compliance to regulations/Distribution Code, the Distributor shall provide in writing to the User details of non compliance and action required to be taken by the User before supply can be restored

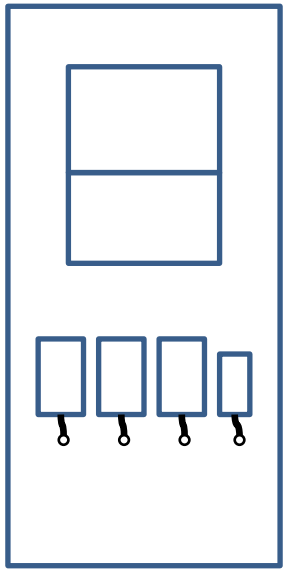
The Distributor does not assume any responsibility in connection with such installation or the inspection thereof. The Distributor's inspection or absence of it does not prelude any requirements established under law.

7.4 GENERAL REQUIREMENTS

7.4.4 Connection Point and Ownership Boundaries

7.4.4.1 Connection Point

7.4.4.1.1 The Connection Point at which the connection is made between the Distributor's Distribution System and the User's installation will be in accordance with the following, or will be agreed between the Distributor and the User as required for special conditions.



(a) Low Voltage: For supplies at Low Voltage of 230 volts or 400 volts, the general rule is that the Connection Point will be at the outgoing terminals of any isolating device immediately after the Distributor's owned metering equipment. The User's service terminals shall be

- installed in accordance with Distributor's specifications and
- be so located as to be readily accessible for connection to Distributor's service lines at a Connection Point to be determined by the Distributor.

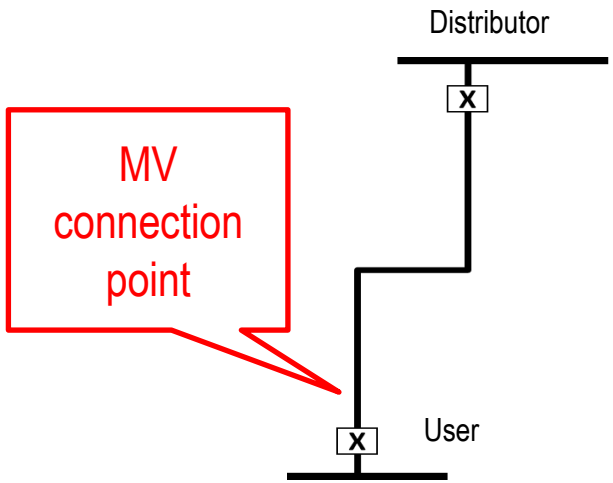
7.4 GENERAL REQUIREMENTS

7.4.4 Connection Point and Ownership Boundaries

7.4.4.1 Connection Point

7.4.4.1.1 The Connection Point at which the connection is made between the Distributor's Distribution System and the User's installation will be in accordance with the following, or will be agreed between the Distributor and the User as required for special conditions.

(b) Medium Voltage: For supplies at Medium Voltages of 6.6kV, 11kV, 22kV or 33kV the Connection Point will be subject to specific agreement between the parties in each case. Normally, the Connection Point is the Medium Voltage busbar connecting the Distributor's isolating devices and the User's isolating devices. This will include those cases where a busbar connects supply at Low Voltage.



7.4 GENERAL REQUIREMENTS

7.4.4 Connection Point and Ownership Boundaries

7.4.4.1 Connection Point

7.4.4.1.1 The Connection Point at which the connection is made between the Distributor's Distribution System and the User's installation will be in accordance with the following, or will be agreed between the Distributor and the User as required for special conditions.

(c) The Connection Point between a Distributor and Embedded Distributor shall be in accordance with provision 7.7.3.3 of the DCC.

(d) The Connection Point between a Distributor and Distributed Generator shall be in accordance with provision 7.8.3.2 of the DCC

7.4 GENERAL REQUIREMENTS

7.4.4.2 Plant or Apparatus Ownership

7.4.4.2.1 The respective ownership of Plant and Apparatus at the interface is to be recorded in a written agreement between the Distributor and User. In the absence of a separate agreement between the parties stating otherwise, construction, commissioning, control, operation and maintenance responsibilities follow ownership.

7.4 GENERAL REQUIREMENTS

7.4.5 User to Furnish Right of Way

7.4.5.1 The User at his own cost shall make or procure conveyance to the Distributor for a right-of-way or wayleave agreement, satisfactory to the Distributor, across property owned or controlled by the User, for the placement of the Distributor's Equipment for the purpose of providing an electricity service. (Access to land for construction, operation and maintenance of Distributor's facilities necessary or incidental to the supplying of electrical service to the User is provided for under part IV of the Act).

7.4.6 Service to Contiguous Property

7.4.6.1 Except with the written consent of the Distributor, the User shall not extend, or connect his installation to lines across or under a street, alley, lane, court, avenue or other public or private space, in order to obtain service for an adjacent property through one meter, even though such adjacent property is owned by the User.

7.4 GENERAL REQUIREMENTS

7.4.7 User to Protect Distributors Property

7.4.7.1 The User shall protect all the Distributor's property on the User's premises and shall permit only the Distributor's agents or persons authorized by law to inspect or handle such property. The User shall be responsible for any loss or damage to such property of the Distributor resulting from carelessness, neglect or misuse by the User or by any member of this family, or by any agent, employee or representative of the User, or by other unauthorized persons on the User's premises with the User's knowledge and consent.

7.4 GENERAL REQUIREMENTS

7.4.8 Exchange of Data between User and Distributor

7.4.8.1 The data exchange between the User and Distributor is specified in the DPC and DOC and in each section of this DCC relevant to each category of User and is summarized in the Data Registration Code. In all cases the data required may be greater than or less than that specified above and shall be sufficient for the Distributor to assess the impact of the proposed connection on the Distribution System. In case, the data required is more than that specified in the Distribution Code, the Distributor shall provide reasons while asking for the same.

7.4 GENERAL REQUIREMENTS

7.4.8 Exchange of Data between User and Distributor

7.4.8.2 Declaration of Load Characteristics by a User

7.4.8.2.1 To enable the Distributor to plan for connection of Consumers, Distributed Generators and Embedded Distributors to the Distribution System, the Distributor requires adequate information on the magnitude and characteristics of the loads or generation to be connected and Users are required to provide the data requested by the Distributor, more specifically set out in each section of this DCC applying to each category of User.

7.4 GENERAL REQUIREMENTS

7.4.9 Power Quality Disturbances

7.4.9.1 The User shall not employ or utilize any Equipment, appliance, or device so as to adversely affect the Distributor's electricity supply to other Users. Where a User uses or intends to use the electricity supply for the operation of hoists, welding machines, x-ray machines, electric furnaces or ovens, variable frequency drives, AC to DC converters, saturable power transformers, motor starting, switching power supplies, equipment employing semiconductor switching technology or otherwise having load characteristics which produce harmonics, voltage step changes or voltage fluctuations that may be outside the limits specified in provisions of 5.4.6.6 of the DPC, or which otherwise may adversely affects voltage regulation, then the User shall may be required to install and maintain, suitable Apparatus or take action to limit the effect of such Equipment to such values as are permissible at the connection point.

7.4 GENERAL REQUIREMENTS

7.4.10 Limitation of Use by the User

7.4.10.1 The electric service or energy supplied by the Distributor shall be used by the User subject to the limitations contained in the applicable “Tariff Schedule” or “Rider and Guidelines” as from time to time may be approved by the Minister and the Connection Agreement and within the capacity of the Distribution System at the Connection Point.

7.4.10.2 When the Distributor provides a polyphase service, the User’s load shall be maintained in electrical balance between phases at the Connection Point as specified in the section 5.4.6.6(c) of DPC. Single phase motors in excess of 5 horsepower capacity shall not be connected without specific approval of the Distributor.

7.4 GENERAL REQUIREMENTS

7.4.11 Design Principles

7.4.11.1 In planning the Distribution System for connections to a User, the Distributor shall plan the connection to satisfy the planning and design requirements of the DPC and the operation requirements of the DOC and in compliance with the Electricity Supply Laws, the Licence, any Licence Standards the Distributor is required to produce for the concurrence of the Commission, the Distribution Code and Grid Code.

7.4.11.2 The User shall be responsible for all electrical wiring and equipment on the User's side of the Connection Point and all wiring, appliances, and Apparatus for the utilization of electric service on the User's side of the Connection Point shall be installed by Competent Persons unless otherwise provided for in the Service Agreement or applicable Tariff Schedule or Rider and shall conform to the Electricity Supply Laws governing such installations and with the Distribution Code and Grid Code.

7.4 GENERAL REQUIREMENTS

7.4.11 Design Principles, *continue*

7.4.11.3 The User shall cooperate with the Distributor in the design of the User's electrical installation and provide all information requested by the Distributor, to ensure that the Distribution System is planned and can be operated in compliance with the Electricity Supply Laws, the Licence, any Licence Standards the Distributor is required to produce for the concurrence of the Commission and the Distribution Code.

7.4.11.4 The Distributor is entitled to assume that the information provided by the Consumer as requested by the Distributor is complete and accurate and that the Consumer's installation complies with the Electricity Supply Laws and the Connection Agreement.

7.4 GENERAL REQUIREMENTS

7.4.11 Design Principles, *continue*

7.4.11.5 No Consumer connected to the Distribution System shall connect a Generating Unit to operate in parallel with the Distribution System without the consent of the Distributor. Where a Consumer wishes to connect a Generating Unit to operate in parallel with the Distribution System the Consumer shall comply with the requirements of section 7.8 of the DCC (Connection Requirements for Distributed Generators).

7.4.11.6 Where a Consumer intends to connect a Generating Unit that does not operate in parallel with the Distribution System then adequate means shall be installed and used to prevent inadvertent parallel operation of the Generating Unit with the Distribution System.

7.5 CONNECTION REQUIREMENT FOR CONSUMERS CONNECTED AT LV

7.5.1 Declaration of Load and its Characteristics

7.5.1.1 For supplies at Low Voltages of 230V and 400V, the Consumer shall, in the appropriate application forms for connection obtainable from the Distributor provide the following data:

(a) maximum power requirements in kVA;

(b) types and number of equipment and its corresponding connected load in kVA;

(c) shunt connected reactors and capacitors in kVAr;

(d) the date when connection is required; and

(e) for single-phase 230V motors with rating of greater than 6 KVA and/or three-phase 400V motors with rating greater than 75 kVA;

(i) rating in HP or KVA;

(ii) types of control equipment;

(iii) methods of starting and starting current;

(iv) frequency of starting (number/hour);

(v) rated power factor; and

(vi) voltage sensitive loads (indicating sensitivity)

7.5.1.2 Where a preliminary examination of the above data indicates that more detailed information is required, the Consumer shall provide additional information on the request of the Distributor. The Distributor shall provide reasons for asking for the same.

7.5 CONNECTION REQUIREMENT FOR CONSUMERS CONNECTED AT LV

7.5.2 Technical Requirements for Connection

7.5.2.1 For connections at Low Voltage the Consumer's installation shall comply with the Electricity Supply Laws and Malaysian Wiring Regulations and standard requirements specified by the Distributor to ensure that the installation complies with the Distribution Code.

7.5.2.2 In the case of connections to Consumers at Low Voltage, the Distributor has the responsibility to specify any technical requirements for the connection. This includes specification of technical requirements associated with loads which may give rise to voltage fluctuations and harmonics to ensure compliance with the limits specified in the provision 5.4.6.6 of the DPC.

7.6 CONNECTION REQUIREMENT FOR CONSUMERS CONNECTED AT MV

7.6 Connection Requirements for Consumers Connected at MV

7.6.1 Declaration of Load and its Characteristics

7.6.1.1 For supplies at Medium Voltages of 6.6 kV, 11 kV, 22 kV and 33 kV, the Consumer shall provide information on the loads and their characteristics including but not limited to the following:

(b) For all types of loads:

(i) Maximum Active Power consumption in kW; and

(ii) Maximum Reactive Power consumption in kVAr.

(c) For motor loads:

(i) rating of motor (in HP/kVA);

(ii) types of control equipment;

(iii) methods of starting;

(iv) magnitude and duration of the starting current;

(v) frequency of starting (number/hour);

(vi) under voltage setting and time;

(vii) negative phase sequence protection

(viii) sub-transient and/or locked rotor reactance of the motor.

7.6 CONNECTION REQUIREMENT FOR CONSUMERS CONNECTED AT MV

7.6 Connection Requirements for Consumers Connected at MV

7.6.1 Declaration of Load and its Characteristics

7.6.1.1 For supplies at Medium Voltages of 6.6 kV, 11 kV, 22 kV and 33 kV, the Consumer shall provide information on the loads and their characteristics including but not limited to the following:

(d) For nonlinear loads with harmonic current injections:

(i) harmonic current spectrum including harmonic number and the corresponding maximum current.

(e) For fluctuating loads:

(i) The rates of change of Active Power and Reactive Power consumption in kW/minute and kVAr/minute respectively, both increasing and decreasing;

(ii) The shortest repetitive time interval between fluctuations for Active Power and Reactive Power in minutes; and

(iii) The magnitude of the largest step changes in Active Power and Reactive Power in kW and kVAr respectively, both increasing and decreasing.

7.6 CONNECTION REQUIREMENT FOR CONSUMERS CONNECTED AT MV

7.6 Connection Requirements for Consumers Connected at MV

7.6.1 Declaration of Load and its Characteristics

7.6.1.1 For supplies at Medium Voltages of 6.6 kV, 11 kV, 22 kV and 33 kV, the Consumer shall provide information on the loads and their characteristics including but not limited to the following:

(f) For voltage sensitive loads:

(i) steady-state voltage tolerance limits of the equipment in percentage of the nominal voltage;

(ii) intrinsic immunity limits to short duration voltage duration;

(iii) transient voltage tolerance limits of the equipment in percentage of the nominal voltage and the corresponding duration;

(iv) harmonic voltage distortion tolerance limits for the equipment in % total harmonic distortion and individual harmonic distortion.

(g) For Shunt Connected Reactors and Capacitors:

(i) configuration and sizes of individual banks;

(ii) types of switching and control equipment; and

(iii) types of harmonic filtering reactors.

7.6.1.2 Should a preliminary examination of the above data indicate that more detailed information is required, the Consumer shall provide additional information on the request of the Distributor. The Distributor shall provide reasons for asking for the same.

7.6 CONNECTION REQUIREMENT FOR CONSUMERS CONNECTED AT MV

7.6.2 Technical Requirements for Connection

7.6.2.1 The Distributor upon receipt of the information specified in provision 7.6.1.1 of the DCC shall perform an assessment of the impact of the loads on the Distributor's Distribution System and if necessary advice the Consumer to contain the impact of the Consumer's load in compliance with the limits and standards specified in DPC and DOC of the Distribution Code.

7.6.2.2 Certain types of User Equipment connected to the Distributor's Distribution System may give rise to voltage fluctuations and/or voltage distortion which result in disturbance to other Users or damage to the Distribution System or connected User Equipment. Voltage fluctuations include voltage step changes due to switching of User or Distributor Demand or Equipment, voltage flicker due to the operation of User Equipment such as welding machines and arc furnaces, Voltage Unbalance due to unbalanced loads. Harmonic voltage distortion may arise due to the connection of converters. In order to limit these effects both the Distributors and Users shall take into account their responsibilities as follows:

(a) The Distributor shall through the planning and connection process maintain voltage fluctuations due to step changes, flicker, Voltage Unbalance and harmonic distortion within the limits specified in as set out in provision 5.4.6.6.

(b) The User shall maintain voltage distortion at points of common coupling (PCC) such that it does not result in voltage distortion in the Distributor's Distribution System beyond the limits specified in provision 5.4.6.6.

(c) The User shall make an appropriate assessment of the impact of the connection of such Equipment to the System and take measures to limit the distortion of the supply voltage of the Distributor's Distribution System within the limits specified in provision 5.4.6.6.

7.6 CONNECTION REQUIREMENT FOR CONSUMERS CONNECTED AT MV

7.6.2 Technical Requirements for Connection

(d) The User shall inform the Distributor in reasonable time of the intention to connect Equipment likely to have a distorting affect on the System voltage and provide the Distributor with the information specified in the Distribution Connection Code.

(e) The Distributor upon receipt of the above information shall make an appropriate assessment of the impacts of the connection of such Equipment to the System and recommend any further measures to be undertaken by Users if necessary to limit the distortion of the supply voltage of the Distributor's Distribution System within the limits specified in provision 5.4.6.6.

(f) The Distributor shall apply the best available engineering techniques and prudent utility practices in making such assessments following the procedures set out in the Licence Standard or where a Licence Standard has not been specified then the Distributor will comply with the relevant Malaysian Standards and IEC Standards (IEC 61000 series).

7.6 CONNECTION REQUIREMENT FOR CONSUMERS CONNECTED AT MV

7.6.2.3 Protection and Control Requirements

7.6.2.3.1 Protection requirements vary widely depending on practices and needs of the particular Distribution System. In all cases, the basic requirement is that the Consumer's arrangements for Protection at the Connection Point, including types of Equipment and Protection settings, shall be compatible with standard practices on the Distributor's Distribution System, comply with the requirements of section 5.7 of the DPC and shall take account of the following:

(a) maximum clearance times (from fault current inception to fault clearing) shall be within the limits established by the Distributor in their short circuit rating policy for the Distribution System;

(b) auto-reclosing or sequential switching features may be used on the Distributor's Distribution System. The Distributor will provide details on the operating sequence utilized for the supplies on the proposed installation so the Consumer can plan for this in the design and protection of his facility;

(c) On some Distribution systems, e.g. lateral feeders or tee-offs, certain types of faults may cause disconnection of one phase only of a three-phase supply.

7.6.2.3.2 The Protection facilities and settings shall be approved by the Distributor.

7.6.2.3.3 The Distributor and User shall agree on the SCADA and other control and monitoring facilities required at the interface

7.6 CONNECTION REQUIREMENT FOR CONSUMERS CONNECTED AT MV

7.6.2.4 Earthing Requirements

7.6.2.4.1 Earthing arrangements at the interface shall be in accordance with the Electricity Supply Laws and shall be approved by the Distributor.

7.6.2.5 Operational Requirements

7.6.2.5.1 Operational arrangements shall be in accordance with the DOC and the Distributor and Consumer shall agree in writing the following:

(a) requirements for demand forecasts in accordance with section 5.10 of the DPC and section 6.4 of the DOC;

(b) ownership, operation and maintenance boundaries and responsibilities in accordance with provision 6.7.1.1 of the DOC;

(c) numbering and nomenclature of all Plant and Apparatus at the interface substation in accordance with provision 6.7.1.2 of the DOC; and

(d) operational liaison arrangements and exchange of information on the 24-hour communications arrangements between the User and Control Centres, if required.

7.7 CONNECTION REQUIREMENT FOR EMBEDDED DISTRIBUTORS

7.7.1 General

7.7.1.1 The purpose of the connection between Distributors is to provide a continuous supply from a Distributor to an Embedded Distributor or to provide backup and reliability to the Embedded Distributor's Distribution System. The connection may also be required to provide mutual support between the two Distribution Systems in which case both parties may be considered to be an Embedded Distributor of the other from time to time, according to the prevailing operating conditions and each will have responsibilities accordingly.

7.7.2 Information to be Provided to the Distributor

7.7.2.1 For planning of the connection with Embedded Distributors, the following information shall be provided to the Distributor:

(a) maximum import / export in MW and MVAr;

(b) the configuration of the connection;

(c) voltage control at the point of connection, if applicable; and

(d) maximum and minimum 3-phase and single-phase to ground fault levels (MVA) at the point of interconnection before connection.

7.7.2.2 Should a preliminary examination of the above data indicate that more detailed information is required, the Embedded Distributor shall provide additional information on the request of the Distributor. The Distributor shall provide reasons for asking for the same.

7.7 CONNECTION REQUIREMENT FOR EMBEDDED DISTRIBUTORS

7.7.3 Technical Requirements for Connection

7.7.3.1 General

7.7.3.1.1 The Distributor and Embedded Distributor shall cooperate in the planning and operation of the connection to ensure that their respective Distribution Systems are planned and operated in accordance with the Electricity Supply Laws, Licence, Licence Standards, the Distribution Code and Grid Code.

7.7.3.1.2 On receipt of a request from the Embedded Distributor the Distributor shall provide an offer of connection to satisfy the demand and quality of supply requested by the Embedded Distributor.

7.7.3.2 Connection Point and Ownership Boundary

7.7.3.2.1 The Connection Point between the Distributor and the Embedded Distributor shall be agreed in writing between the Distributor and Embedded Distributor. The supply will be from a distribution circuit with a nominal operating voltage of 33kV, 11kV, 6.6kV or other voltage as may be agreed.

7.7.3.2.2 Having agreed a Connection Point and Ownership Boundary the Distributor and Embedded Distributor shall each be responsible for providing and operating and maintaining their own equipment either side of the Connection Point, unless otherwise agreed in writing.

7.7 CONNECTION REQUIREMENT FOR EMBEDDED DISTRIBUTORS

7.7.3.3 Facilities at the Connection Point

7.7.3.3.1 Unless otherwise agreed, the connection between the Distribution Systems shall be by means of a manually operated, lockable, disconnecting device providing a visual break installed in close proximity to or at the Connection Point. Normally, this disconnecting device shall be provided, owned and maintained by the Distributor or Embedded Distributor and is to be arranged so that it can be locked in the fully open or closed position by a double locking arrangement accessible to authorized personnel of the Distributor and Embedded Distributor.

7.7.3.3.2 The disconnecting device, connection and connectors shall have a capacity in accordance with the contracted power interchange capability at the Connection Point and be the responsibility of the owner. Both the Distributor and the Embedded Distributor shall inspect and approve the installation. The Distributors may agree in writing to other arrangements and conditions for the connection.

7.7.3.3.3 The device at the Connection Point shall only be operated with the consent of the Control Centres of both the Distributor and Embedded Distributor.

7.7 CONNECTION REQUIREMENT FOR EMBEDDED DISTRIBUTORS

7.7.3.4 Voltage Control

7.7.3.4.1 The normal voltage variation on the Distribution System is specified in Section 5.4.4.1.1(a) of DPC.

7.7.3.4.2 The Distributor and Embedded Distributor shall be responsible for voltage regulation on its own Distribution System. Arrangements may be made for suitable automatic on-load tap changing or voltage regulating equipment installed at the Connection Point or on distribution circuits as necessary for providing an improved quality of supply.

7.7.3.5 Protection Requirements

7.7.3.5.1 The Protection arrangements shall be in accordance with the requirements set out in section 5.7 of the DPC and Protection facilities and settings shall be agreed by the Distributor and the Embedded Distributor.

7.7.3.5.2 The Distributor and Embedded Distributor shall:

(a) have responsibility for protecting its own Equipment and Distribution System from the Connection Point onward so that faults or other disturbances in one Distribution System do not cause damage to the other's Equipment.

(b) assure the other party that faults on its Distribution System are cleared within the agreed clearance time so as not to cause operational problems to the other's Distribution System.

7.7.3.5.3 Backup Protection shall be provided as required to clear faults in case of primary Protection failure.

7.7 CONNECTION REQUIREMENT FOR EMBEDDED DISTRIBUTORS

7.7.3.6 Earthing Requirements

7.7.3.6.1 Earthing arrangements at the interface shall be in accordance with the Electricity Supply Laws and shall be approved by the Distributor and Embedded Distributor.

7.7.3.7 Operational Requirements

7.7.3.7.1 Operational arrangements shall be in accordance with the DOC and the Distributor and Embedded Distributor shall agree the following in writing:

(a) requirements for demand forecasts in accordance with the section 5.10 of the DPC and section 6.4 of the DOC;

(b) ownership, operation and maintenance boundaries and responsibilities in accordance with 6.7.1.1 of the DOC;

(c) numbering and nomenclature of all Plant and Apparatus at the interface substation in accordance with 6.7.1.2 of the DOC; and

(d) operational liaison arrangements and exchange of information on the 24-hour communications arrangements between Control Centres.

7.7 CONNECTION REQUIREMENT FOR EMBEDDED DISTRIBUTORS

7.7.3.8 Demand Control

7.7.3.8.1 The Distributor and Embedded Distributor shall cooperate and agree the arrangements for Demand Control and Emergency Operations in accordance with the provisions of section 6.9 of the DOC.

7.7.3.9 Power Factor

7.7.3.9.1 The minimum power factor at the Connection Point shall be maintained to not less than 90% lagging.

7.8 CONNECTION REQUIREMENT FOR DISTRIBUTED GENERATORS

7.8.1 General

7.8.1.1 In addition to the requirements for connection set out in this section 7.8 of the DCC, a Distributed Generator is also required to comply with the relevant connection requirements for Consumers connected to the Distribution System at LV and MV set out in sections 7.5 and 7.6 respectively of the DCC

>> Technical & Operational Requirements of RE Act is also applicable for Feed-in Tariff projects

7.8 CONNECTION REQUIREMENT FOR DISTRIBUTED GENERATORS

7.8.1 General

7.8.1.1 In addition to the requirements for connection set out in this section 7.8 of the DCC, a Distributed Generator is also required to comply with the relevant connection requirements for Consumers connected to the Distribution System at LV and MV set out in sections 7.5 and 7.6 respectively of the DCC

7.8.1.2 Where the total output of Generating Units connected to the MV Distribution System at a single Connection Point exceeds 30 MW then, in addition to the requirements set out in sections 7.6 and 7.8 of the DCC, the Distributed Generator is also required to comply with the Grid Code including the provision of information. Any information provide to the GSO relating to Grid Code requirements shall also be provided to the Distributor.

>> Limit of DC is 30MW, MGC is applicable for output > 30MW

7.8 CONNECTION REQUIREMENT FOR DISTRIBUTED GENERATORS

7.8.2 Information to be Provided to the Distributor

7.8.2.1 For the purposes of planning the connection of a Distributed Generator to the Distribution System, the Distributor requires sufficient information to model the generating plant and carry out engineering studies for determining the method of connection to be employed, the voltage level of connection and its impacts on the Distribution System. The Distributed Generator shall provide the following information to the Distributor for planning purposes.

(a) For <u>all Generating Units</u>

(i) terminal voltage;

(ii) rated kVA;

(iii) rated kW;

(iv) maximum Reactive Power sent out or minimum lagging power factor;

(v) maximum Reactive Power absorbed or minimum leading power factor;

(vi) type of Generating Unit – synchronous, asynchronous, and inverter.

(vii) type of prime mover;

(viii) type of voltage control;

(ix) Generating Unit sub-transient reactance;

(x) Generating Unit transformer details;

(xi) requirements for Top-Up Supply and/or Standby Supply.

(xii) proposed synchronization point

(xiii) blackstart capability

Equipment details are required for Distributor to understand the proposed plant design & operation

7.8 CONNECTION REQUIREMENT FOR DISTRIBUTED GENERATORS

7.8.2.2 Should a preliminary examination of the above data indicate that more detailed information is required, the Distributed Generator shall provide additional information as follows on the request of the Distributor. The Distributor shall provide reasons for asking for the additional information.

(a) For a Generating Unit with a capacity greater than 2MW, the following additional information shall be provided to the Distributor by the Distributed Generator:

(i.a) Generating Unit electric and mechanical data (all impedance (unsaturated) in p.u. of rating and time constants in seconds)

- Type of prime mover
- Rated MVA
- Rated MW
- Generating Unit rotor and turbine moment of inertia or
- inertia constant
- Generating Unit MW / MVAr capability chart
- Type of excitation system
- Stator resistance
- Direct-axis sub-transient reactance
- Direct-axis transient reactance
- Direct-axis synchronous reactance
- Quadrature-axis sub-transient reactance
- Quadrature-axis transient reactance
- Quadrature-axis synchronous reactance
- Direct-axis sub- transient open circuit time constant
- Direct-axis transient open circuit time constant
- Quadrature-axis sub-transient open circuit time constant
- Quadrature-axis transient open circuit time constant
- Zero sequence resistance
- Zero sequence reactance
- Generating Unit open circuit saturation curve

7.8 CONNECTION REQUIREMENT FOR DISTRIBUTED GENERATORS

(i.b) Inverter

- Total Rated kWp
- PV module Type
- Solar Panel Installation
- PV Inverter Type
- PV Inverter Power Factor
- Number of inverter
- Compliance to Standard

(ii) Generating Unit transformer data

- MVA rating
- % resistance
- % reactance
- Tap range in p.u.
- Tap step in p.u.
- Vector group
- Method of earthing

(iii)Automatic voltage regulator (AVR) data

- A block diagram for model of the AVR including the data in gains, forward and feedback gains, time constant and voltage control limits and limit characteristics.

(iv) Speed governor and prime mover data

A block diagram for the model of the generating unit speed governor including its control parameters, time constants, gains, valve limits, temperature controls, deadbands, turbine rating, maximum and minimum power, penstock parameters, tunnel parameter, surge chamber parameters and all other relevant data.

7.8 CONNECTION REQUIREMENT FOR DISTRIBUTED GENERATORS

(b) For Fixed Speed Asynchronous Induction Generating Units the following data may be required:

- Stator Current at unity power factor
- Stator Current max at lagging power factor
- Stator Current min at lagging power factor
- Magnetizing reactance
- Stator resistance
- Stator reactance
- Inner cage or running rotor resistance
- Inner cage or running rotor reactance
- Outer cage or standstill rotor resistance
- Outer cage or standstill rotor reactance
- For the above state whether derived from inner outer cage or running-standstill measurements
- Slip at rated output per unit
- Load torque-speed coefficient B
- Load torque-speed coefficient C
- Inertia constant for generator prime mover drive chain

Note:

The torque-speed (T-N) relationship is defined as:

$T = T0 (A + BN = CN2)$ where $A = 1.0 – B – C$

Therefore only B & C are needed.

Alternatively a per unit torque-speed curve can be provided.

- Describe method of adding star capacitance over the operating range
- Capacitance connected in parallel at % of rated output starting : 20%, 40%, 60%, 80%, 100%
- Maximum starting current in Amps
- Starting Regime - Symmetrical RMS current at time t from energisation:

  - t = 0 ms

  - t = 50 ms

  - t = 200 ms

  - t = 1 s

  - t = 5 s
- The operating chart to show range of reactive import and export with compensation as a function of Active Power.
- Details of the turbine and governor model, described in block diagram form showing transfer functions of individual elements

  The Distributed Generator will need to provide the above characteristic for each asynchronous Generating Unit based on the number of pole sets (i.e. Two data sets are required for dual speed 4/6 pole machines).

7.8.2.3 For large sites, with multiple machines, the Distributed Generator may alternatively provide an equivalent network modelled as an asynchronous Generating Unit with matching Generating Unit Transformer at the Connection Point. This equivalent should also model the site electrical network and power factor correction, etc.

Should a preliminary examination of the above data indicate that more detailed information is required, the Distributed Generator shall provide additional information on the request of the Distributor. The Distributor shall provide reasons for asking for the same.

7.8 CONNECTION REQUIREMENT FOR DISTRIBUTED GENERATORS

7.8.3 Technical Requirements for Connection

7.8.3.1 General

7.8.3.1.1 The Distributor upon receipt of the information specified in provision 7.8.2 of the DCC shall perform an assessment of the impact of the generation on the Distribution System and if necessary advice the Distributed Generator to contain the impact of the generation in compliance with the limits and standards specified in DPC and DOC of the Distribution Code.

7.8 CONNECTION REQUIREMENT FOR DISTRIBUTED GENERATORS

7.8.3.2 Connection Point and Ownership Boundary

7.8.3.2.1 The Connection Point at which the Distribution System interface boundary is made between the Distributor and Distributed Generator shall be agreed in writing between the Distributor and Distributed Generator. The supply will be from a distribution circuit with a nominal operating voltage of 33kV, 22kV, 11kV, 6.6kV or another voltage as may be agreed. Unless agreed otherwise, the connection shall be made by means of a manually operated, lockable, disconnecting device providing a visual break installed in close proximity to or at the Connection Point. Normally, if the connection is on the Distribution System, this disconnecting device shall be furnished by the Distributed Generator, and handed over to the Distributor as specified in the "Technical & Operational Requirements". The device shall be owned and maintained by the Distributor and is to be arranged so that it can be locked in the fully open or closed position by a double locking arrangement and only accessible to authorized personnel of the Distributor.

7.8.3.2.2 The disconnecting device, connection and the connectors shall be [illegible] in accordance with the contacted interchange capability. The Distribu[illegible] Distributed Generator may agree, in writing, to other arrangement[illegible] conditions for the connection.

Upgrading of interconnection facility is to be provided by DG

7.8 CONNECTION REQUIREMENT FOR DISTRIBUTED GENERATORS

7.8.3.3 Generating Unit Specifications

7.8.3.3.1 A Generating Unit with a capacity greater than 12 kVA or as specified by the Distributor shall be a three-phase Generating Unit.

7.8.3.3.2 Any generation, utilizing a direct current (dc) generating device and an inverter, shall be capable of supplying energy with a voltage sine wave with a Total Harmonic Distortion Voltage (THDV) at the point of common coupling (PCC) with THDV of ≤ 5% (LV), ≤ 4 % (LV < Volt < 33 kV) and ≤ 3 % (Volt ≥ 33 kV)

7.8.3.3.3 In addition the Generating Unit shall not produce harmonics of a magnitude and frequency so as to interfere with communication and electronic equipment.

7.8 CONNECTION REQUIREMENT FOR DISTRIBUTED GENERATORS

7.8.3.4 Connection Requirements

7.8.3.4.1 Planning, design and operating requirements of Distributed Generation vary widely depending on practices and needs of the Distribution System. In all cases, the basic requirement is that the generation shall be compatible with planning and criteria specified in section 5.4 of the DPC and the operation criteria specified in section 6.5 of the DOC and the standard practices on the Distributor's Distribution System. Guidance is provided on the planning and design of generation connections in the TNB publication "Technical Guidebook for the Connection of Generation to the Distribution System" and "TNB Technical Guidebook on Grid-interconnection of Photovoltaic Power Generation System to LV and MV Networks".

Add TNB Technical Guidebook on inverter based generation

7.8 CONNECTION REQUIREMENT FOR DISTRIBUTED GENERATORS

7.8.3.4 Connection Requirements

7.8.3.4.1 The particular technical requirements for connection will be as agreed in writing by the Distributor and shall cover the following:

(a) Voltage control;

(b) Fault levels;

(c) Network capacity and export / import limits;

(d) Supply quality;

(e) Protection including minimum clearance times

(f) Control including any requirement for SCADA facilities;

(g) Earthing;

(h) Neutral earthing and generator and transformer winding configurations;

(i) Stability;

(j) Synchronizing arrangements; and

(k) Operation and safety

(l) Anti islanding technique

Requirement to avoid islanding

7.8 CONNECTION REQUIREMENT FOR DISTRIBUTED GENERATORS

7.8.3.5 Protection and Control Requirements

7.8.3.5.1 It will be necessary for the Protection associated with Distributed Generating Plant to co-ordinate with the Protection associated with the Distribution System as follows:

(a) maximum clearance times (from fault current inception to fault clearing) shall be within the limits established by the Distributor in their short circuit rating policy for the Distribution System;

(b) auto-reclosing or sequential switching features may be used on the Distribution System. The Distributor will provide details on the operating sequence utilized for the supplies on the proposed installation so the Consumer can plan for this in the design and protection of his facility; and

(c) On some Distribution systems, e.g. lateral feeders or tee-offs, certain types of faults may cause disconnection of one phase only of a three-phase supply.

7.8.3.5.2 The Protection facilities and settings shall be approved by the Distributor.

7.8.3.5.3 The Distributor and User shall agree on the SCADA and other control and monitoring facilities required at the interface.

7.8 CONNECTION REQUIREMENT FOR DISTRIBUTED GENERATORS

7.8.3.6 Operational Requirements

7.8.3.6.1 Operational arrangements shall be in accordance with the DOC and the Distributor and Distributed Generator shall agree the following in Writing

(a) requirements for demand forecasts in accordance with the section 5.10 of the DPC and section 6.4 of the DOC;

(b) ownership, operation and maintenance boundaries and responsibilities in accordance with 6.7.1.1 of the DOC;

(c) numbering and nomenclature of all Plant and Apparatus at the interface substation in accordance with 6.7.1.2 of the DOC; and

(d) operational liaison arrangements and exchange of information on the 24-hour communications arrangements between Control Centres.

7.8 CONNECTION REQUIREMENT FOR DISTRIBUTED GENERATORS

7.8.3.7 Demand Control

7.8.3.7.1 The Distributor and Distributed Generators shall cooperate and agree the arrangements for Emergency Operations in accordance with the provisions of section 6.9 of the DOC.

7.8.3.8 Power Factor

7.8.3.8.1 The Distributed Generator shall be responsible for maintaining a minimum power factor of 90% lagging for all machines larger than 12 kVA unless otherwise required by the Distributor.

Replace 10 to 12 to harmonise with T&O

7.8.4 Standby and Top Up Supply

7.8.4.1 Where a Distributed Generator requires Standby Supply or Top Up Supply, the Distributed Generator shall provide information on the nature of the supply required and will comply with the relevant sections of the DPC and DOC fulfilling the requirements both as a Consumer and as a Distributed Generator.

7.8 CONNECTION REQUIREMENT FOR DISTRIBUTED GENERATORS

7.8.3.6 Operational Requirements

7.8.3.6.1 Operational arrangements shall be in accordance with the DOC and the Distributor and Distributed Generator shall agree the following in Writing

(a) requirements for demand forecasts in accordance with the section 5.10 of the DPC and section 6.4 of the DOC;

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(d) operational liaison arrangements and exchange of information on the 24-hour communications arrangements between Control Centres.

THANK YOU

KeTTHA
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Suruhanjaya Tenaga

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