

**Engineering Recommendation No. 11
of the Electricity Distribution Code**

**Standard
Connection Arrangements**

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1.0 DESIGN PRINCIPLES

Introduction

- 1.1 The **DISCO** shall be responsible for the detailed design, engineering and agreement by the **User** of all connections where **User Systems** are connected to the **DISCO Distribution System**. The detailed design and engineering shall consider the **User System** contribution to fault current, voltage drop and effects on power quality as well as ensure compliance with the requirements of the **Electricity Supply Regulations** and the **Electricity Distribution Code**.
- 1.2 This Engineering Recommendation provides standard connection arrangements for the connection of **User Systems** to the **DISCO Distribution System**. The standard connection arrangements are relevant to connections at 400V, 11kV, 22kV and 33kV and for **User Systems** involving **Generator Units** and/or **Distribution Systems** and/or **Equipment** connecting **Generator Units** or **Distribution Systems**. In addition, it provides typical LV connections of small-scale Solar PV installation in the **User** premises in accordance with The Electricity Wiring Regulations (Third Edition), March 2014 as amended.
- 1.3 For all Embedded Generator connections, refer to Engineering Recommendation No.3 – Connection of Embedded Generating Plant up to and including 30MW.

Summary of design principles

- 1.4 The standard connection arrangements for connections of **User Systems** to the **DISCO Distribution System** are based on the following design principles:
 - (a) to meet the requirements of the **Distribution Planning and Connection Code (DPCC)** ;
 - (b) to meet the requirements of Engineering Recommendation No.4 - Security of Supply Standard for the Electricity Distribution System ;
 - (c) to provide for an easily defined and operationally practical **Ownership Boundary** i.e. at bolted connection locations of **User** cables on to **DISCO** switchgear ;
 - (d) to provide **DISCO** owned and operated interface switchgear at the **User** premises that enables integration with the **DISCO** distribution management system and disconnection through switching by the **DISCO** of the **User System**;
 - (e) to facilitate the remote disconnection by the **DISCO** of each metered **Customer** initiated by command via the associated tariff meter ;
 - (f) **DISCO** standard assets to be used whereby the design of the connection uses standard components rated to achieve the required capacity ;

- (g) on-going costs for operation, maintenance and repair of **DISCO** connection assets to be borne by the **DISCO** ;
- (h) land and buildings (for **DISCO** connection assets) at **User** premises to be funded, provided and maintained by the **User** with full access rights granted to the **DISCO**.

2.0 STANDARD CONNECTION ARRANGEMENTS

Introduction

- 2.1 There are five categories of standard connection arrangements.
- (a) Category A1 - Connections at 400V from LV network or HV/LV substation not located at the **User** premises.
 - (b) Category A2 - Connections at 400V from HV/LV substation(s) located at the **User** premises.
 - (c) Category B - Connections at 11kV.
 - (d) Category C - Connections at 22kV.
 - (e) Category D - Connections at 33kV.
- 2.2 Under special circumstances non-standard connections arrangements may be adopted subject to special **Connection Agreement** conditions and the specific approval of the **DISCO** Technical Committee.

Category A1 - Connections at 400V from LV network or HV/LV substation not located at the User premises

- 2.3 Category A1 connections are applicable where the **DISCO** existing or intended distribution architecture for the development area can accommodate a Category A1 connection of the capacity required. Should this not be the case then a Category A2 connection shall be applicable.
- 2.4 The various connection arrangements within Category A1 are shown in Figure 2.1.
- 2.5 These connections involve **DISCO** LV cable laid underground from a fuse way of a **DISCO** feeder pillar (or service turret) or from a fuse way or moulded case circuit breaker (MCCB) of a **DISCO** HV/LV substation not located at the **User** Premises.
- 2.6 The **DISCO** LV service cable will terminate at the LV incomer circuit breaker(s) of the **User** main distribution board(s) at the **User** premises located either in a dedicated room at the **User** premises (for premises with multiple **Users** and single **User** with multiple feeders for distribution within the same premises) OR wall mounted panel with the LV Incomer and meters (with / without CTs) for single **User** premises subject to the **DISCO** acquiring "Control Authority" of the LV incomer circuit breaker(s) and of the outgoing circuit breaker(s) for **User** connections i.e. the **User** cannot operate the LV

**** Disco Control authority** : is the authority of providing the approval on the point of isolation by Disco's to users for any means of operations and Disco's shall confirm the safety locks and proper earthing been applied by users in both ends (isolation points) as

incomer circuit breaker(s) without first obtaining approval from the **DISCO**. Such Control Authority ** arrangement shall be formalised in a **Connection Agreement** and would require the **User** appointed electrical contractor or facilities manager to liaise with the **DISCO** before any operation on the LV incomer circuit breaker(s) or outgoing circuit breaker(s) is carried out in case of multiple **User** sites and the provision of access to the **DISCO**. In case of Single **User** sites the LV Incomer may be operated by DISCO or the User's representative under the supervision of DISCO for isolation purpose.

The **User** main distribution board(s) may be wall mounted or back to wall in order to conserve space.

- 2.7 The User main Distribution boards(s) shall be of type tested design, metal enclosed, approved by the **DISCO** and shall include where applicable:
- (a) A Moulded case circuit breaker (MCCB) for the incomer **User** feeder.
 - (b) An outgoing moulded case circuit breaker (MCCB) for each **User** feeder.
 - (c) Metering current transformers (CTs) for each **User**.
 - (d) Current and fused voltage metering circuits.
 - (e) Tariff meter for each **User** feeder.
 - (f) Control circuitry for tripping and lockout of each MCCB by command from the associated tariff meter.
 - (g) Facilities for locking and sealing to prevent tampering of the metering circuitry and meter connections.
 - (h) For small-scale solar PV installations, an additional meter dedicated to monitoring the amount of electricity generation¹ and a switch disconnect².

Category A2 - Connections at 400V from HV/LV substation(s) located at the User premises

- 2.8 Category A2 connections are applicable where the **DISCO** existing or intended distribution architecture for the development area includes for 11kV or 22kV feeders and where the connection capacity cannot be accommodated by a Category A1 connection.
- 2.9 The various connection arrangements within Category A2 are shown in Figure 2.2 for single **Customer** premises and Figures 2.3 for multiple **Customers** premises.
- 2.10 If determined by the DISCO, multiple Category A2 connections shall be provided at the **User** premises as required to meet the demand or contingency associated with the

¹ Small-Scale Solar Photovoltaic Energy Netting Regulations (First Edition), January 2017 as amended

² The Electricity Wiring Regulations (Third Edition), March 2014 as amended

User System. For example larger high rise buildings and commercial / retail complexes may require numerous Category A2 connections.

- 2.11 These connections involve multiple **DISCO** LV cables laid on trays, in ducts or in cable troughs from the transformer(s) of **DISCO** HV/LV substation(s). The **DISCO** HV/LV substation(s) as required shall be constructed within the **User** premises.
- 2.12 The **DISCO** LV cables will terminate at the LV incomer circuit breaker(s) of the **User** main distribution board(s) located in a dedicated room(s) at the **User** premises subject to the **DISCO** acquiring “Control Authority” of the LV incomer circuit breaker(s), i.e. the **User** cannot operate the LV incomer circuit breaker(s) without first obtaining approval from the **DISCO**. Such Control Authority arrangement shall be formalised in a **Connection Agreement** and would require the **User** appointed electrical contractor or facilities manager to liaise with the **DISCO** before any operation on the LV incomer circuit breaker(s) is carried out and the provision of access to the **DISCO**.
- 2.13 The **User** main distribution board(s) shall be of type design tested, metal enclosed, approved by the **DISCO** and shall include:
 - (a) An air circuit breaker (ACB) or moulded case circuit breaker (MCCB) for the incomer **User** feeder.
 - (b) Control circuitry for tripping and lockout of the incomer ACB or MCCB by command from the associated **DISCO** tariff meter.
 - (c) For small-scale solar PV installations, an additional meter dedicated to monitoring the amount of electricity generation and a switch disconnecter.

Category B - Connections at 11kV

- 2.14 2.15 Category B connections are applicable for **User Systems** that include 11kV loads or HV generation and where the **DISCO** existing or intended distribution architecture for the development area caters for 11kV feeders.
- 2.15 The various connection arrangements within Category B are shown in Figure 2.4 to Figure 2.6.
- 2.16 If determined by the **DISCO** multiple Category B connections shall be provided at the **User** premises as required to meet the demand, generation capacity or contingency associated with the **User System**. For example district cooling plants, pumping stations, factories and larger than 6MVA generation plants may require numerous Category B connections.
- 2.17 The **DISCO** shall determine the number of Category B connections provided at the **User** premises giving due consideration to Engineering Recommendation No.4 - Security of Supply Standard for the Electricity Distribution System and to the configuration of the primary substations (quantity and rating of transformers) existing and intended for the development area.

- 2.18 Category B connections involve a number of **DISCO** 11kV cables laid underground from circuit breakers at **DISCO** primary substation(s) or from **DISCO** ring main HV/LV substations.
- 2.19 In order of preference, the following **DISCO/User** interface arrangements shall apply; subject to mutual agreement between both **DISCO** and **User**:
- (a) Each of the **DISCO** 11kV cables shall terminate at separate **DISCO** interface switchgear located at the **User** premises. The separate **DISCO** interface switchgear shall be located in a dedicated single room or in dedicated separate rooms at different locations with direct access for **DISCO** authorised staff. (or)
 - (b) Each of the **DISCO** 11kV cables shall terminate at the 11kV incomer circuit breaker(s) of the **User** HV switchgear panel(s) located in a dedicated room(s) at the **User** premises subject to the **DISCO** acquiring “Control Authority” of the 11kV incomer circuit breaker(s), i.e. the **User** cannot operate the 11kV incomer circuit breaker(s) without first obtaining approval from the **DISCO**. Such Control Authority arrangement shall be formalised in a **Connection Agreement** and would require the **User** HV authorised staff to liaise with the **DISCO** before any operation on the 11kV incomer circuit breaker(s) is carried out and the provision of access to the **DISCO**. Where access is restricted within the **User** premises, then the above option would apply. Note that this arrangement is applicable for dedicated 11kV connections only.
- 2.20 For connections above 3MVA to **User Systems** which are effectively single **Customer** installations, the **User System** shall enable the transfer of load in the case of an outage on any one of the **DISCO** incomer feeders. The **User System** shall meet the approval of the **DISCO** in this regard.
- 2.21 The **DISCO** interface switchgear shall be of type tested design, metal enclosed, approved by the **DISCO** and shall include:
- (a) A load break / fault make switch or vacuum circuit breaker (VCB) for each **DISCO** feeder.
 - (b) Isolation and earthing facility for each **DISCO** feeder.
 - (c) A VCB for each **User** feeder (from generation and to demand).
 - (d) Isolation and earthing facility for each **User** feeder (from generation and to demand).
 - (e) Metering current transformers (CTs) and voltage transformer (VT) on each **User** feeder (from generation and to demand).
 - (f) Current and fused voltage metering circuits.
 - (g) Tariff meters for each **User** feeder (from generation and to demand).
 - (h) Facilities for integration with the **DISCO** distribution management system.

- (i) Control circuitry for tripping and lockout of the VCB of each **User** feeder by command from the associated **DISCO** tariff meter.
- (j) Facilities for locking and sealing to prevent tampering of the metering circuitry and meter connections.

Category C - Connections at 22kV

- 2.22 Category C connections are applicable for **User Systems** that include 22kV loads or HV generation and where the **DISCO** existing or intended distribution architecture for the development area caters for 22kV feeders.
- 2.23 The various connection arrangements within Category B are shown in Figure 2.7 to Figure 2.9.
- 2.24 If determined by the **DISCO** multiple Category C connections shall be provided at the **User** premises as required to meet the demand, generation capacity or contingency associated with the **User System**. For example, district cooling plants, pumping stations, factories and larger than 12MVA generation plants may require numerous Category C connections.
- 2.25 The **DISCO** shall determine the number of Category C connections provided at the **User** premises giving due consideration to Engineering Recommendation No.4 - Security of Supply Standard for the Electricity Distribution System and to the configuration of the primary substations (quantity and rating of transformers) existing and intended for the development area.
- 2.26 Category C connections involve a number of **DISCO** 22kV cables laid underground from circuit breakers at **DISCO** primary substation(s) or from **DISCO** ring main HV/LV substations.
- 2.27 In order of preference, the following **DISCO/User** interface arrangements shall apply; subject to mutual agreement between both **DISCO** and **User**:
 - (a) Each of the **DISCO** 22kV cables shall terminate at separate **DISCO** interface switchgear located at the **User** premises. The separate **DISCO** interface switchgear shall be located in a dedicated single room or in dedicated separate rooms at different locations with direct access for **DISCO** authorised staff.
 - (b) Each of the **DISCO** 22kV cables shall terminate at the 22kV incomer circuit breaker(s) of the **User** HV switchgear panel(s) located in a dedicated room(s) at the **User** premises subject to the **DISCO** acquiring "Control Authority" of the 22kV incomer circuit breaker(s), i.e. the **User** cannot operate the 22kV incomer circuit breaker(s) without first obtaining approval from the **DISCO**. Such Control Authority arrangement shall be formalised in a **Connection Agreement** and would require the **User** HV authorised staff to liaise with the **DISCO** before any operation on the 22kV incomer circuit breaker(s) is carried out and the provision of access to the **DISCO**. Where access is restricted within the **User** premises,

than the above option would apply. Note that this arrangement is applicable for dedicated 22kV connections only.

- 2.28 For connections above 3MVA to **User Systems** which are effectively single **Customer** installations, the **User System** shall enable the transfer of load in the case of an outage on any one of the **DISCO** incomer feeders. The **User System** shall meet the approval of the **DISCO** in this regard.
- 2.29 The **DISCO** interface switchgear shall be of type tested design, metal enclosed, approved by the **DISCO** and shall include:
- (a) A load break / fault make switch or vacuum circuit breaker (VCB) for each **DISCO** feeder.
 - (b) Isolation and earthing facility for each **DISCO** feeder.
 - (c) A VCB for each **User** feeder (from generation and to demand).
 - (d) Isolation and earthing facility for each **User** feeder (from generation and to demand).
 - (e) Metering current transformers (CTs) and voltage transformer (VT) on each **User** feeder (from generation and to demand).
 - (f) Current and fused voltage metering circuits.
 - (g) Tariff meters for each **User** feeder (from generation and to demand).
 - (h) Facilities for integration with the **DISCO** distribution management system.
 - (i) Control circuitry for tripping and lockout of the VCB of each **User** feeder by command from the associated **DISCO** tariff meter.
 - (j) Facilities for locking and sealing to prevent tampering of the metering circuitry and meter connections.

Category D - Connections at 33kV

- 2.30 Category D connections are applicable for **User Systems** that include HV loads or HV generation and where the **DISCO** existing or intended distribution architecture for the development area caters for 33kV feeders and where the connection capacity cannot be accommodated by a Category B connection.
- 2.31 The various connection arrangements within Category D are shown in Figure 2.10 to Figure 2.12.
- 2.32 If determined by the **DISCO** multiple Category D connections shall be provided at the **User** premises as required to meet the demand, generation capacity or contingency associated with the **User System**. For example, district cooling plants, pumping stations, factories and larger than 18MVA generation plants may require numerous Category D connections.

- 2.33 The **DISCO** shall determine the number of Category D connections provided at the **User** premises giving due consideration to Engineering Recommendation No.4 - Security of Supply Standard for the Electricity Distribution System and to the configuration of the primary substations (quantity and rating of transformers) existing and intended for the development area.
- 2.34 Category D connections involve a number of **DISCO** 33kV cables laid underground from circuit breakers at grid stations or from **DISCO** 33kV network.
- 2.35 In order of preference, the following **DISCO/User** interface arrangements shall apply; subject to mutual agreement between both **DISCO** and **User**:
- (a) Each of the **DISCO** 33kV cables shall terminate at separate **DISCO** interface switchgear located at the **User** premises. The separate **DISCO** interface switchgear shall be located in a dedicated single room or in dedicated separate rooms at different locations with direct access for **DISCO** authorised staff.
 - (b) Each of the **DISCO** 33kV cables shall terminate at the 33kV incomer circuit breaker(s) of the **User** HV switchgear panel(s) located in a dedicated room(s) at the **User** premises subject to the **DISCO** acquiring "Control Authority" of the 33kV incomer circuit breaker(s), i.e. the **User** cannot operate the 33kV incomer circuit breaker(s) without first obtaining approval from the **DISCO**. Such Control Authority arrangement shall be formalised in a **Connection Agreement** and would require the **User** HV authorised staff to liaise with the **DISCO** before any operation on the 33kV incomer circuit breaker(s) is carried out and the provision of access to the **DISCO**. Where access is restricted within the **User** premises, than the above option would apply. Note that this arrangement is applicable for dedicated 33kV connections only.
- 2.36 For connections above 3MVA to **User Systems** which are effectively single **Customer** installations, the **User System** shall enable the transfer of load in the case of an outage on any one of the **DISCO** incomer feeders. The **User System** shall meet the approval of the **DISCO** in this regard.
- 2.37 The **DISCO** interface switchgear shall be of type tested design, metal enclosed, approved by the **DISCO** and shall include:
- (a) A load break / fault make switch or vacuum circuit breaker (VCB) for each **DISCO** feeder.
 - (b) Isolation and earthing facility for each **DISCO** feeder.
 - (c) A VCB for each **User** feeder (from generation and to demand).
 - (d) Isolation and earthing facility for each **User** feeder (from generation and to demand).

- (e) Metering current transformers (CTs) and voltage transformer (VT) for each **User** feeder (from generation and to demand).
- (f) Current and fused voltage metering circuits.
- (g) Tariff meters for each **User** feeder (from generation and to demand).
- (h) Facilities for integration with the **DISCO** distribution management system.
- (i) Control circuitry for tripping and lockout of the VCB of each User feeder by command from the associated DISCO tariff meter.
- (j) Facilities for locking and sealing to prevent tampering of the metering circuitry and meter connections.

Figure 2.1 : Category A1 - Connections at 400V from LV network or HV/LV substation not located at the User premises

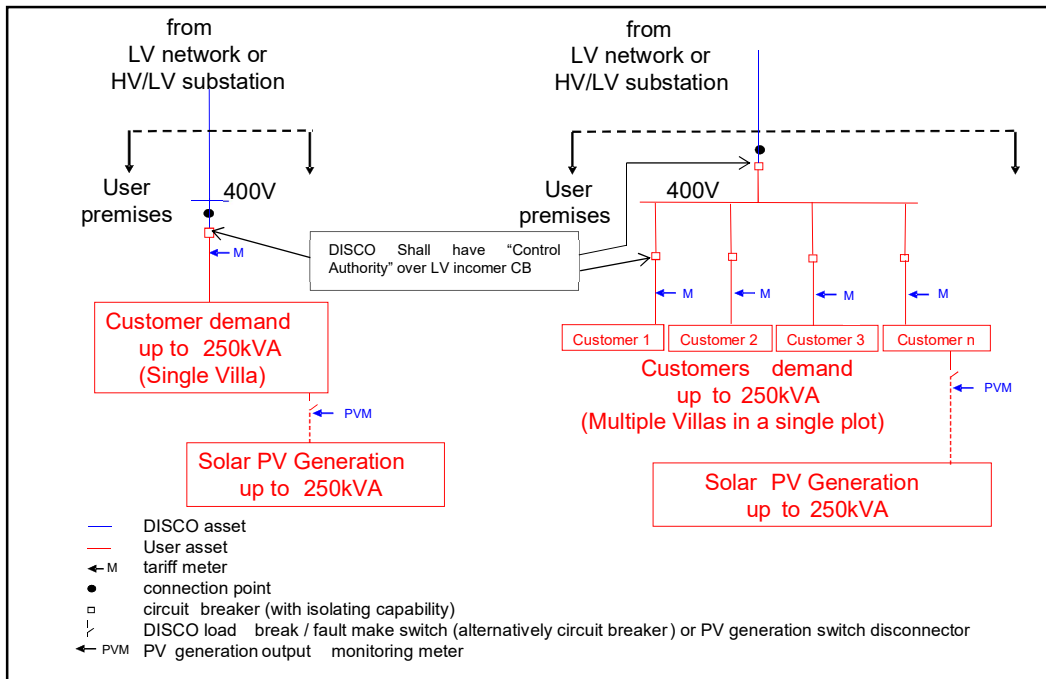


Figure 2.2 : Category A2 - Connections at 400V from HV/LV substation(s) located at the User premises – Single Customer

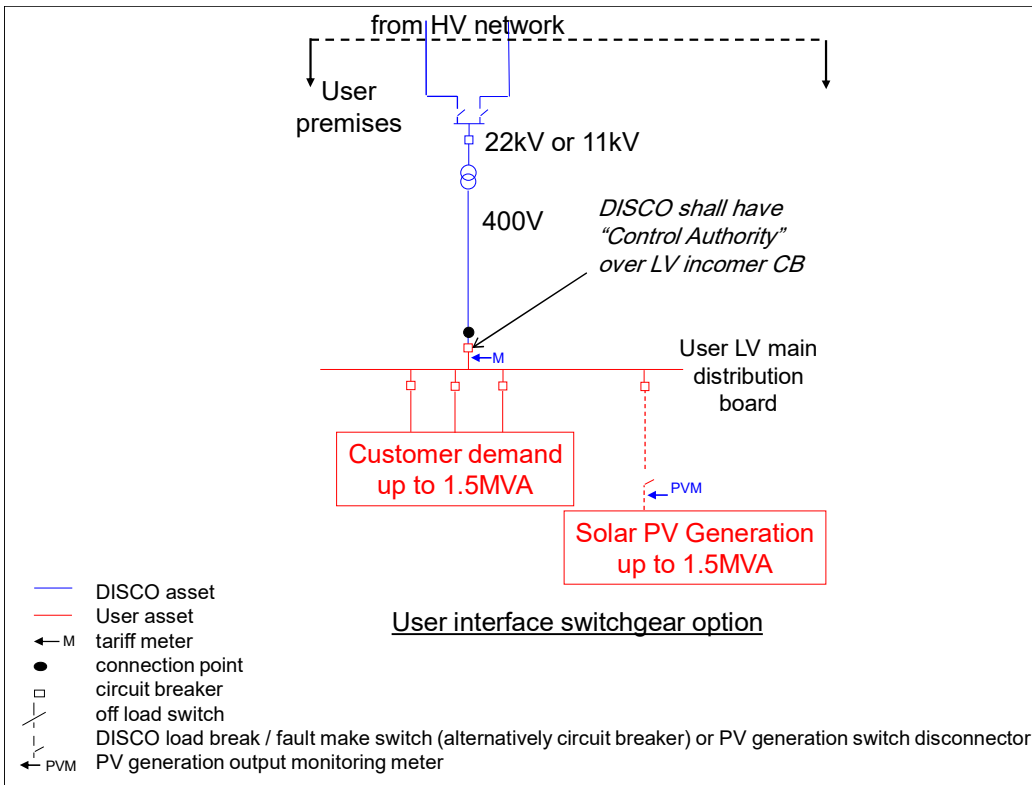


Figure 2.3 : Category A2 - Connections at 400V from HV/LV substation(s) located at the User premises – Multiple Customers in one premises (User interface switchgear)

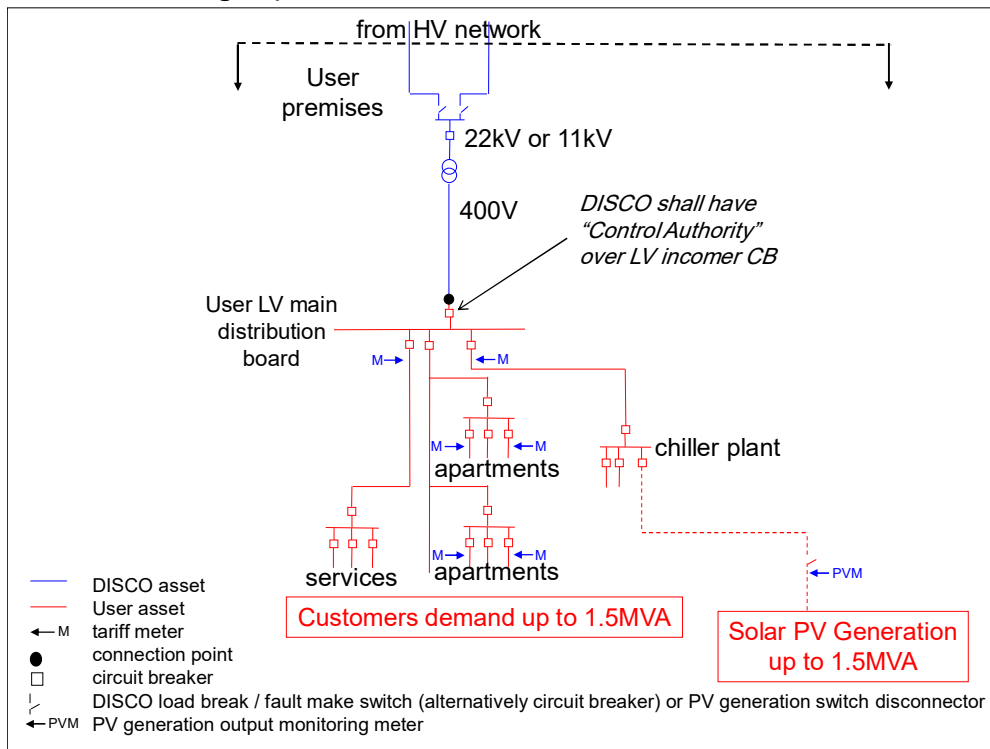


Figure 2.4 : Category B - Connections at 11kV (DISCO interface switchgear)

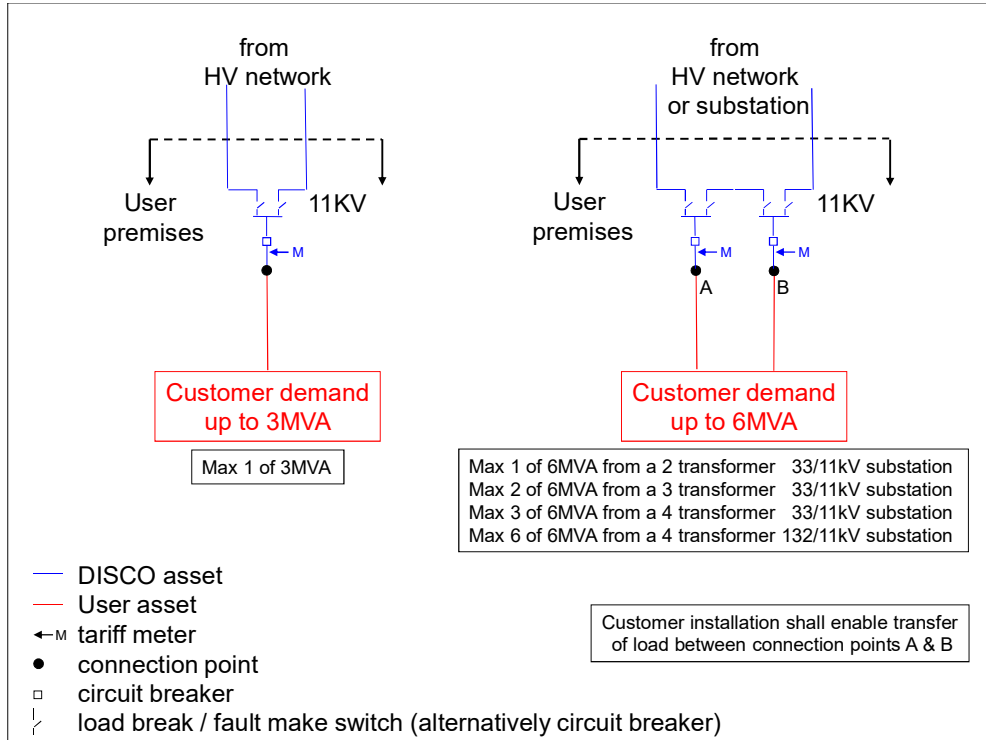


Figure 2.5 : Category B - Connections at 11kV (User interface switchgear)

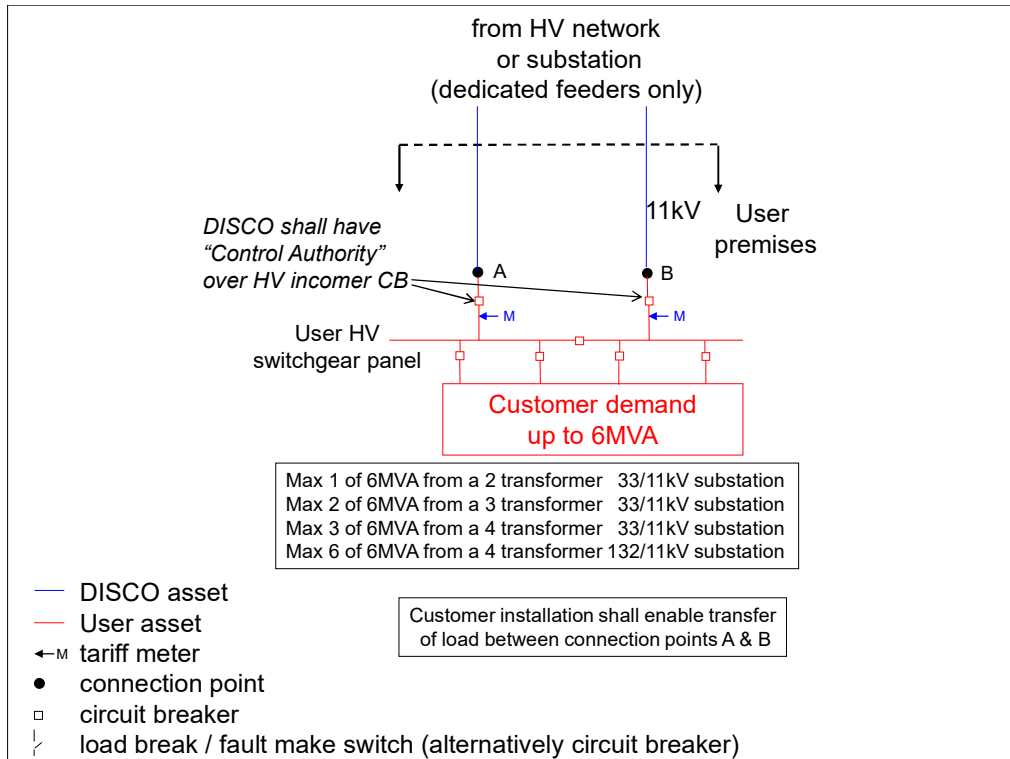


Figure 2.6 : Category B - Connections at 11kV (Embedded Generator)

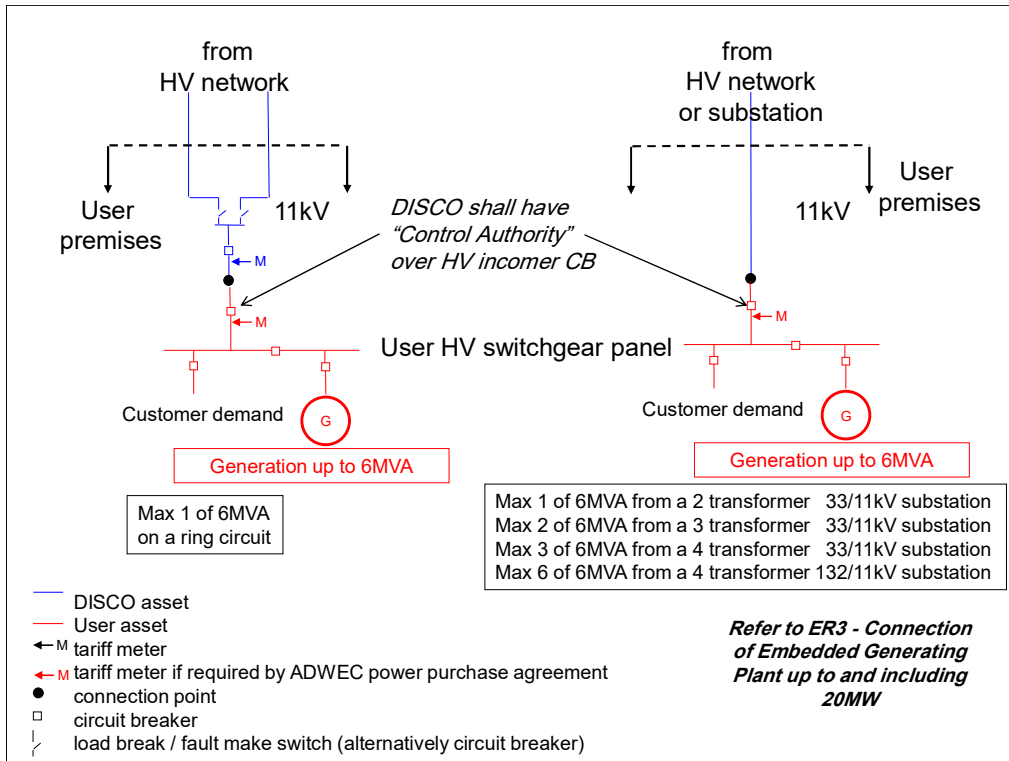


Figure 2.7 : Category C - Connections at 22kV (DISCO interface switchgear)

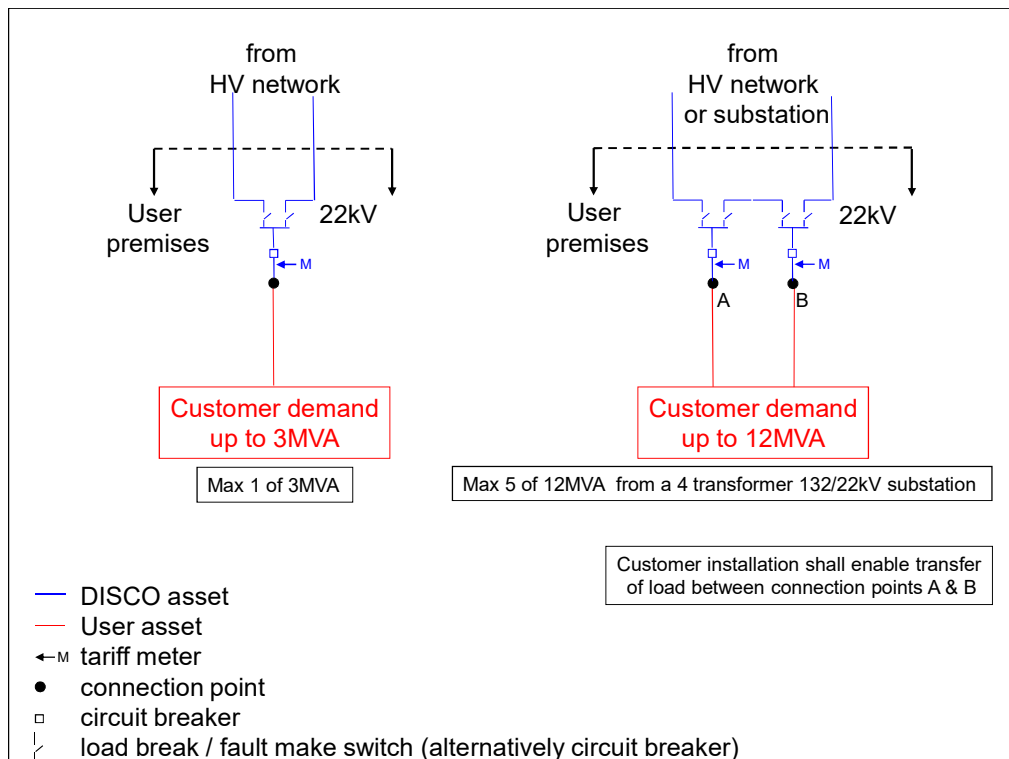


Figure 2.8 : Category C - Connections at 22kV (User interface switchgear)

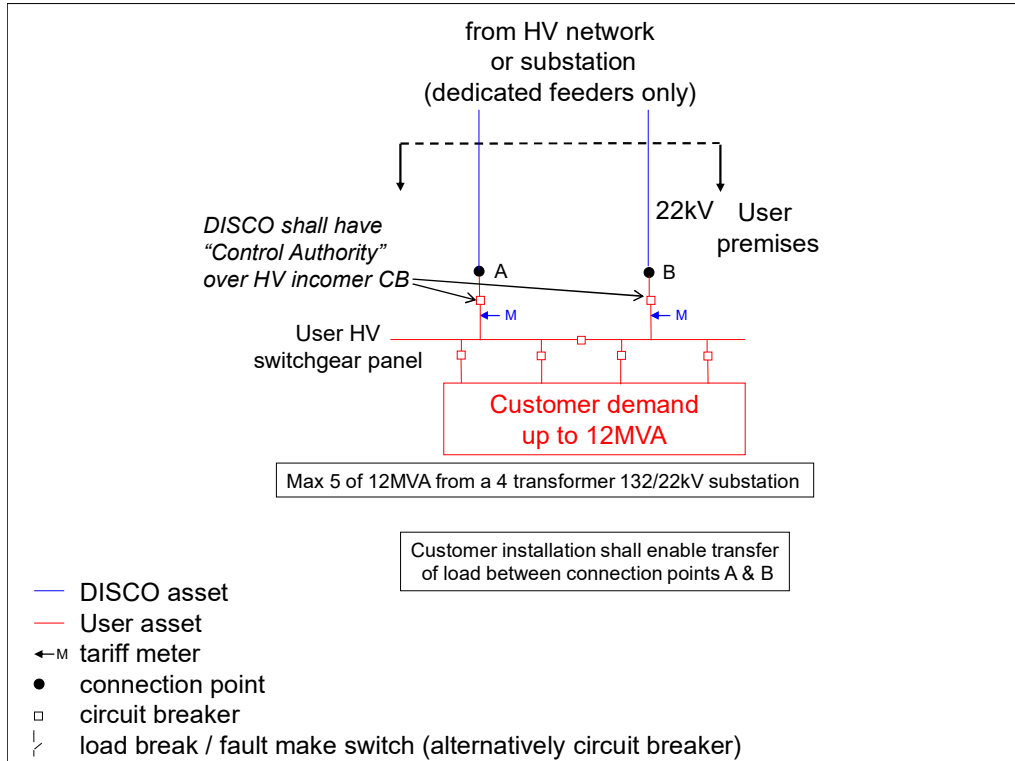


Figure 2.9 : Category C - Connections at 22kV (Embedded Generator)

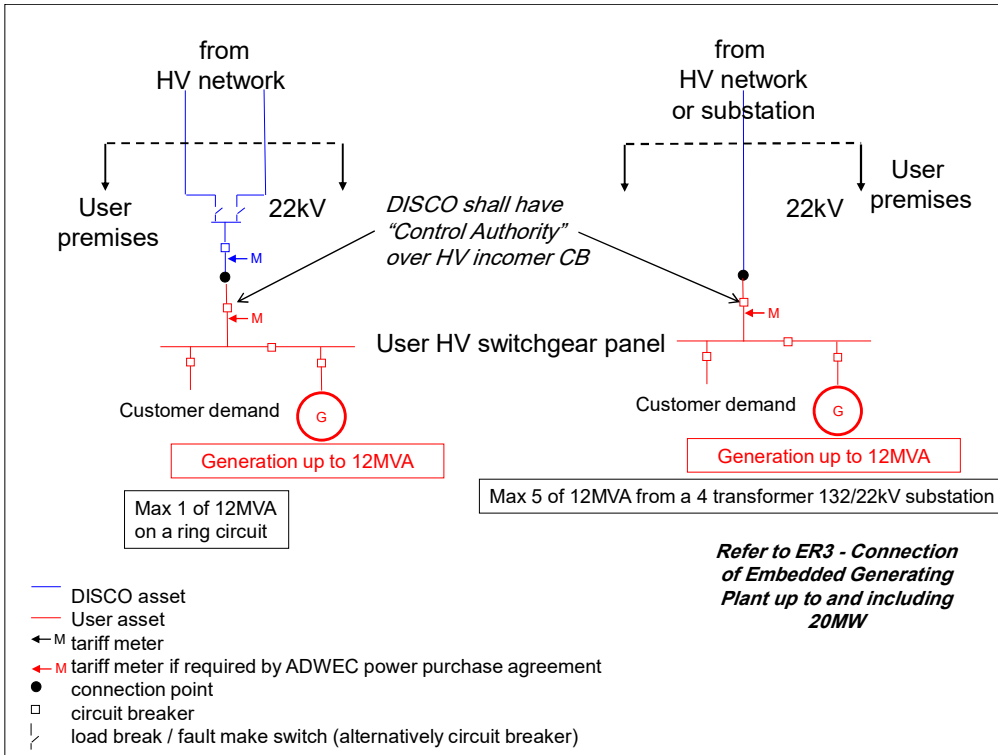


Figure 2.10 : Category D - Connections at 33kV (DISCO interface switchgear)

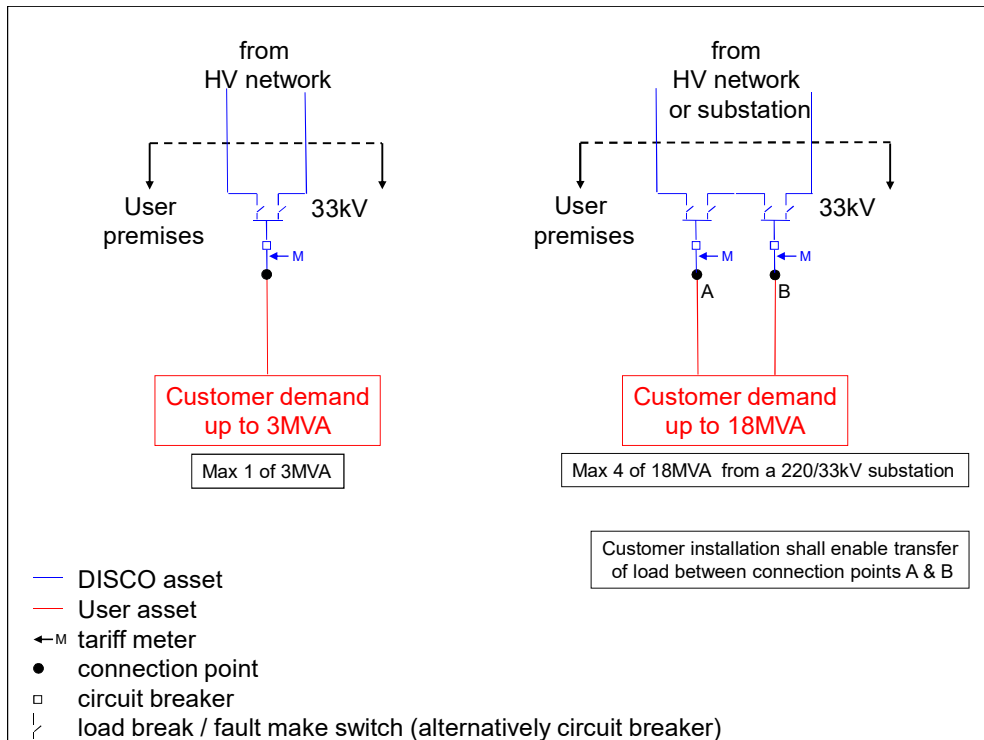


Figure 2.11 : Category D - Connections at 33kV (User interface switchgear)

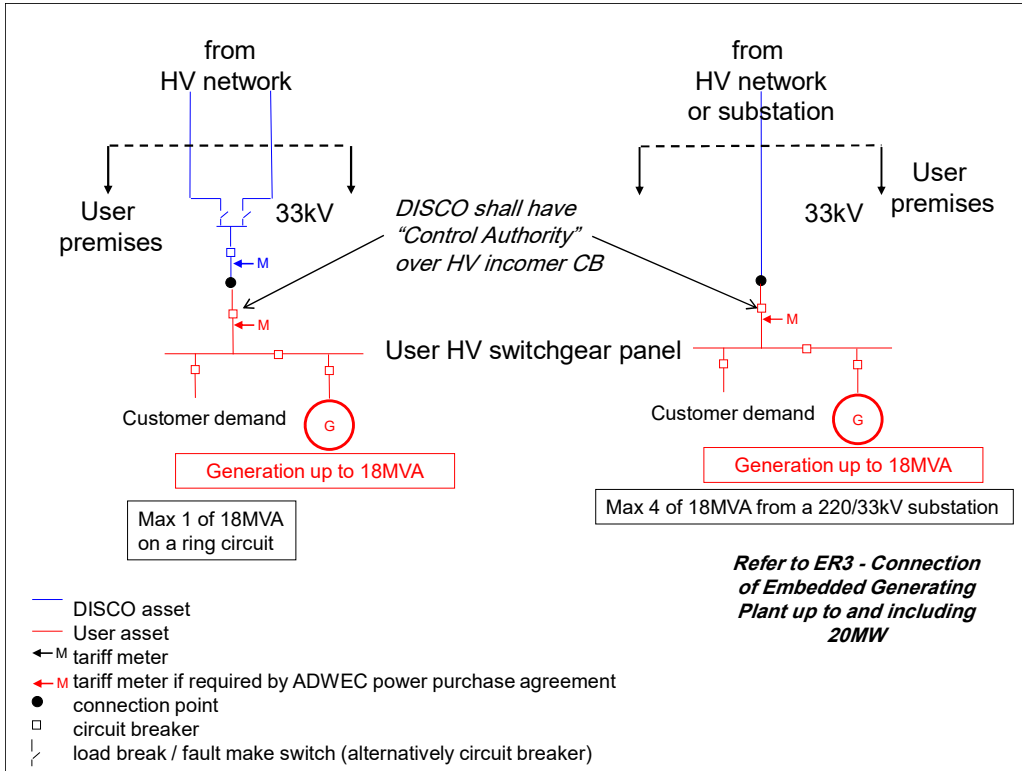


Figure 2.12 : Category D - Connections at 33kV (Embedded Generator)

