

Engineering Recommendation No-4  
of the Electricity Distribution Code

# Security of Supply Standard for the Electricity Distribution System

Version 3.0  
17 June 2019

Issued by:

Al Ain Distribution Company,  
Abu Dhabi Distribution Company,

Approved by:

Department of Energy

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# 1. INTRODUCTION

- 1.1 Condition 29 of the distribution License provides for the requirement that License holders must develop, and keep under review, security standards for their Distribution Systems.
- 1.2 Security standards define the ability of the Distribution System to provide electricity to end-users with a specified level of continuity and quality of supply.
- 1.3 The distribution License allows the licensee to seek derogation from the Department of Energy (DoE) if security standards cannot be met on specific parts of its system, subject to consultation with affected Customers.
- 1.4 This document supersedes version 2.0 of the Security of Supply Standard for the Electricity Distribution System (issued in FEB 2007) and includes the following additions:
  - (a) Standard connection arrangements for embedded generation;
  - (b) Clarification of connection arrangements at the interface with TRANSCO;
  - (c) Consideration of Distribution Management System (DMS) technologies; and
  - (d) Consideration of 22 kV Distribution Systems in newly developing networks.
- 1.5 This document has six sections:
  - (a) Section 1 – introduction;
  - (b) Section 2 – definitions;
  - (c) Section 3 – statutory obligations;
  - (d) Section 4 – criteria for the Main Distribution System;
  - (e) Section 5 – criteria for grid stations at the interface with TRANSCO; and
  - (f) Section 6 – criteria for embedded generation connections

## 2. DEFINITIONS

<b>Term</b>	<b>Definition</b>
<b>Circuit</b>	means that part of an electricity Distribution System between two or more circuit breakers, switches, etc. It may include transformers, reactors, cables or overhead lines or busbars.
<b>Circuit Capacity</b>	means the appropriate cyclic rating or emergency rating relevant to all Circuit equipment.
<b>Class (of supply)</b>	means a category of supply defined in section 4 of this document; Classes of supply are defined in MVA but due regard shall be given to MW and MVAR capability where appropriate.
<b>Customer</b>	means any person, corporate body, or company who has an agreement with a Distribution Company for the supply of electricity .
<b>Distribution Code</b>	means the document prepared and maintained by each Distribution Company pursuant to its License and approved by the DoE.
<b>Distribution Company</b>	means a company or a body holding a License from the DoE, pursuant to the Law.
<b>DoE</b>	means Department of Energy of the Emirates of Abu Dhabi as established under Law No.(11) of 2018
<b>Engineering Recommendations</b>	means technical documents and standards issued under the Distribution Code.
<b>First Circuit Outage</b>	signifies a single fault or an arranged Circuit outage.
<b>Group Demand</b>	for a single site or electrically connected group of sites, the appropriate maximum demand given by the Distribution Company's estimates, based on historic data.
<b>Law</b>	means Law No (2) of 1998 and Law No. (11) of 2018.
<b>License</b>	means a License issued by the DoE authorizing the distribution, generation, supply or transmission of electricity as described in the Law.
<b>Distribution System</b>	means a 33kV and lower voltage electricity network operated by a Distribution Company, but excluding embedded generation connections and customer connections
<b>Second Circuit Outage</b>	signifies an unplanned interruption following an arranged outage. Levels of security for Second Circuit Outages conditions are not intended to cover cases of a first fault outage followed by a second fault, or for a simultaneous double fault outage.

<b>Transfer Capability</b>	means the extent to which transferable load and transferable capacity may be utilized or provided in the event of a system being affected by outages.
<b>Maintenance Period</b>	The period of the year typically from November to April, during which maintenance of equipment is normally undertaken, and the demand is dropped upto 50 %).
<b>Repair Time</b>	The time required for repairing the equipment under fault (either from first or second outage)
<b>Full DMS Control</b>	Full Automated Circuit / equipment by the means of monitoring and controlling for all grids and primaries and also at other / <b>key network points</b> on 11/22 kV networks.
<b>Partial DMS Control</b>	Automated Circuit / equipment on the main sources ( primaries).

<u>LEGEND:</u>	
Symbol	Equipment
	Power/Distribution Transformer
	Busbar
	Tripple Ring Main (TRM)
	Qudriple Ring Main (QRM)
	Package Unit (P/U)
	Sub Station (S/S)
	Open CB
	Closed CB
	Open Isolator
	Closed Isolator
	Open Point
	Outgoing Feeder
	OHL Conductor
	Auto Re closer
	OHL Switch
	Ground Mounted Transformer (GMT)
	Pole Mounted Transformer (PMT)
	H- Pole
	Fault Indicator
	Generator

### 3. STATUTORY OBLIGATIONS

- 3.1 This security standard has been developed to meet the requirements of the Licenses granted by the DoE to Abu Dhabi Distribution Company and to Al Ain Distribution Company.
- 3.2 This security standard shall be maintained and developed by the Distribution Companies through the Electricity Distribution Code, as required by the Licenses.
- 3.3 Pursuant to Condition 29 of the distribution License, this security standard details a set of criteria and methodologies which Distribution Companies shall use in the planning and development of their relevant Distribution Systems.
- 3.4 The Electricity Distribution Code and the Engineering Recommendations contained in Annex 1 to the Code cover additional criteria related to aspects such as quality of supply, voltage fluctuations and other disturbances in the electricity system. The Electricity Distribution Code should therefore be read in conjunction with this document.
- 3.5 The effective date of this security standard is the date of approval of this document version (Version 3) by the DoE. Any network designed or constructed after the effective date shall meet the requirements of this standard. Distribution System networks existing or designed prior to the effective date of this standard and resulting in non-compliance to this standards shall not require any derogation from this standards, but comply with previous security standards in force during the design and execution of the network. However, wherever practicable such installations **might be** progressively developed or upgraded to meet the requirements of this standard.

## 4. THE MAIN DISTRIBUTION SYSTEM

- 4.1 This section defines the security criteria for the Main Distribution System. Table 4.1 sets out the levels of security required, classified in a range of Group Demands, connection types and the maximum interruption times permissible.

### Classes of Supply

- 4.2 **Class A1** represents parts of networks supplied by 11/0.4 kV distribution substations (ground mounted or pole mounted) with one or more transformers of capacity up to 1500 kVA each, and where the Group Demand is up to 3000 kVA, as illustrated in figure 4.1 and 4.2. In such cases, for a First Circuit Outage condition (transformer fault, switchgear fault, etc), the supply must be restored after the time to repair the fault and there is no redundancy of supply.

Figure 4.1 Class A1 – single 11/0.4 kV transformer

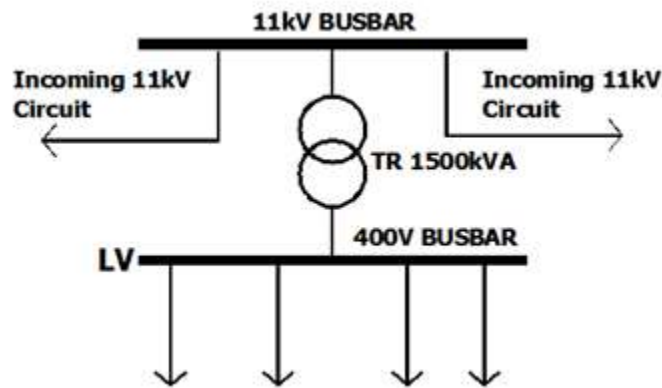
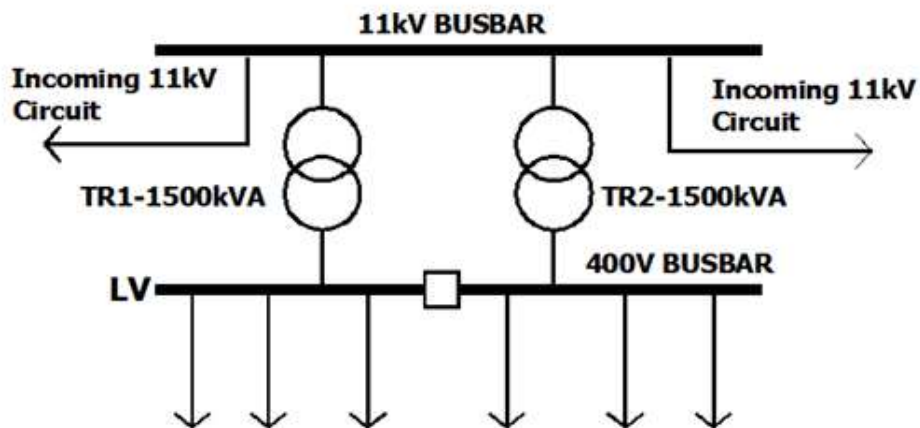


Figure 4.2 Class A1- double 11/0.4 kV transformer



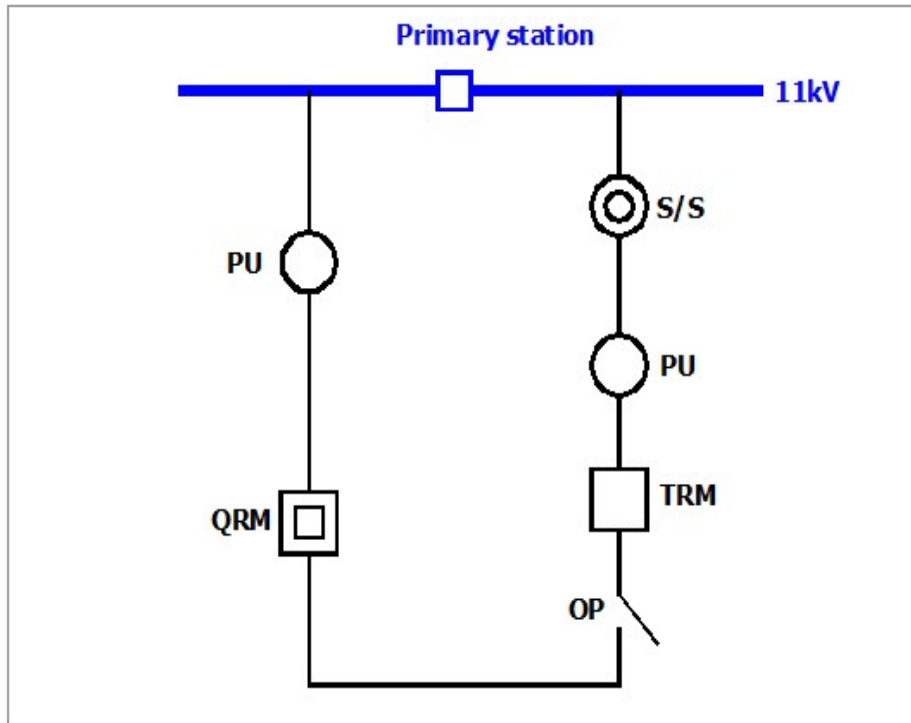


- 4.3 **Class A2** represents parts of networks supplied by 22/0.4 kV distribution substations with single or double transformers where the Group Demand is up to 3000 kVA. In such cases, for a First Circuit Outage condition (transformer fault, switchgear fault, etc), the supply must be restored after the time to repair the fault and there is no redundancy of supply. The arrangement follows the figures for Class A1.

Note: this arrangement assumes a maximum of 3000 kVA transformer capacity connected to a single HV unit (e.g. a ring main unit) or HV switchgear with a single busbar and no bus section switch. Where a demand of greater than 3000 kVA is required arrangement must be made for two ring main units or switchgear with a bus section separating the transformers.

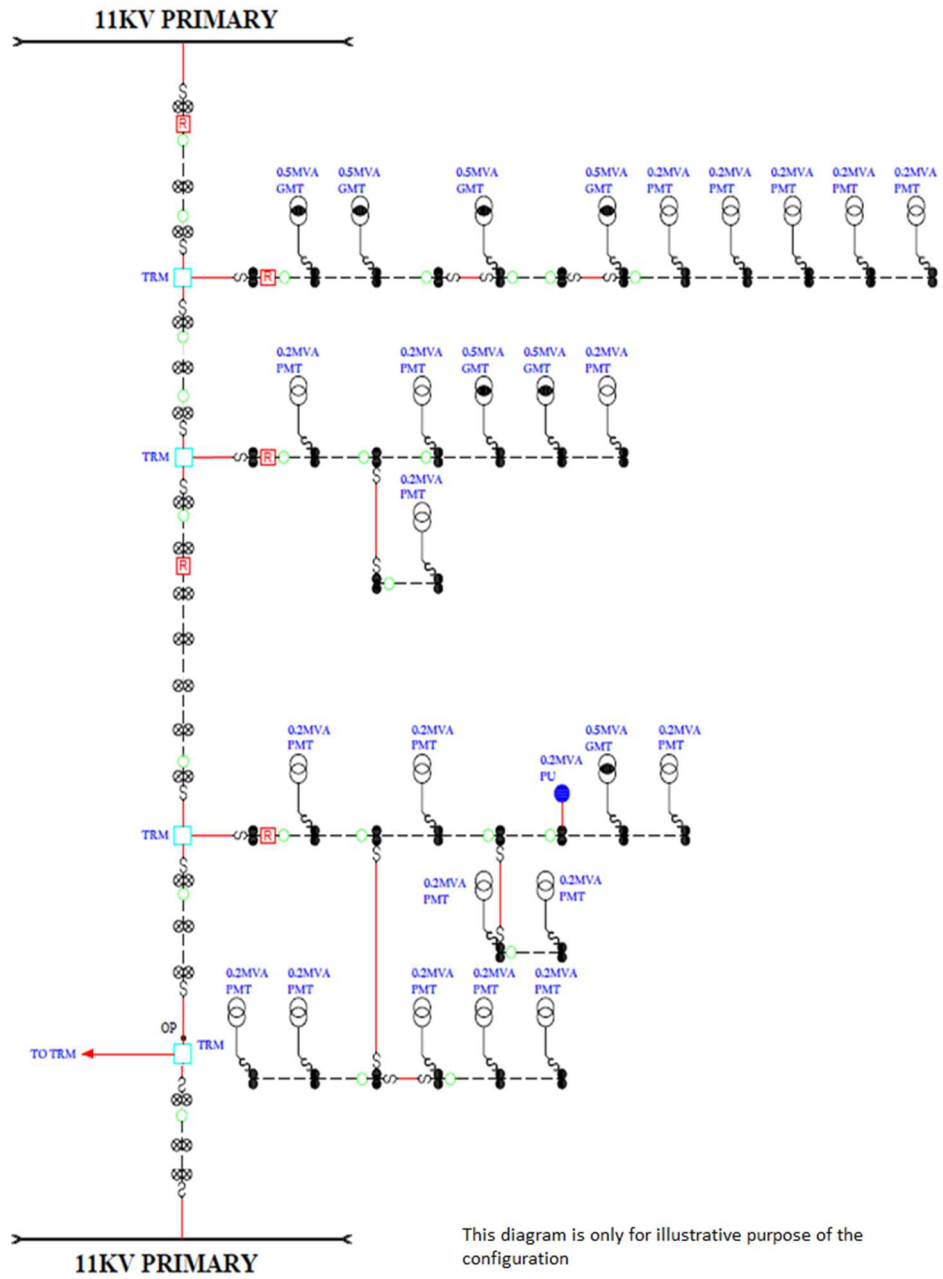
- 4.4 **Class B1** represents a Group Demand of up to 6.5 MVA which may be fed by an 11kV feeder (open ring configuration) as shown in figure 4.3. Following the outage of such a Circuit in an urban or rural area, normally 50% of the demand shall be restored within 20 minutes (assuming the Circuit is equipped with remote/auto switching capability at the primary substation, half way on the feeder, and at the normally open point) but without unit protection. Total demand shall be restored within 2 hours. If the outage is due to a fault at a distribution substation the demand of that substation may be excluded from the Group Demand and for which the restoration criteria of Class A1 will apply.
- 4.5 **Class B2** represents a Group Demand of up to 6.5 MVA which may be fed by an 11kV feeder open ring Circuit in rural or urban areas. In this case the total demand shall be restored within 2 hours, assuming partial use of remote switching capability (i.e. at the primary substation and also at other strategic locations) and without unit protection. If the outage is due to a fault at a distribution substation the demand of that substation may be excluded from the Group Demand and for which the restoration criteria of Class A1 will apply.
- 4.6 **Class B3** represents a Group Demand up to 6.5 MVA which may be fed by an 11 kV feeder open ring Circuit in rural or urban areas. Total demand shall be restored within 3 hours assuming No DMS control ( feeders connected in between two non-monitored 33/11 kV PU's) and without unit protection. If the outage is due to a fault at a distribution substation the demand of that substation may be excluded from the Group Demand and for which the restoration criteria of Class A1 will apply.

Figure 4.3 - Class B1 and /or B2 and /or B3



- 4.7 **Class B4** represents a Group Demand of up to 5 MVA which may be fed by an 11kV overhead network with normally open main line ring Circuits with **monitored** Auto-reclosers (with or without sectionalisers). The Circuit is with Partial DMS Control at Primary substations as shown in figure 4.4. The overhead lines are divided into 3 sections with maximum of 2MVA demand on a section and a Group Demand of 5MVA on the feeder. Following the first outage on a single section of an 11kV main line ring Circuit and associated branch line radial Circuits (where it is not economical to complete a ring and demand not exceeding 1.5MVA), the healthy OHL portions shall be restored within 2 Hours by switching operations on 11 kV network, however, the remaining Group Demand shall be restored within the Repair Time. If the outage is due to a fault at a distribution substation, the demand of that substation may be excluded from the Group Demand and for which the restoration criteria of Class A1 will apply.

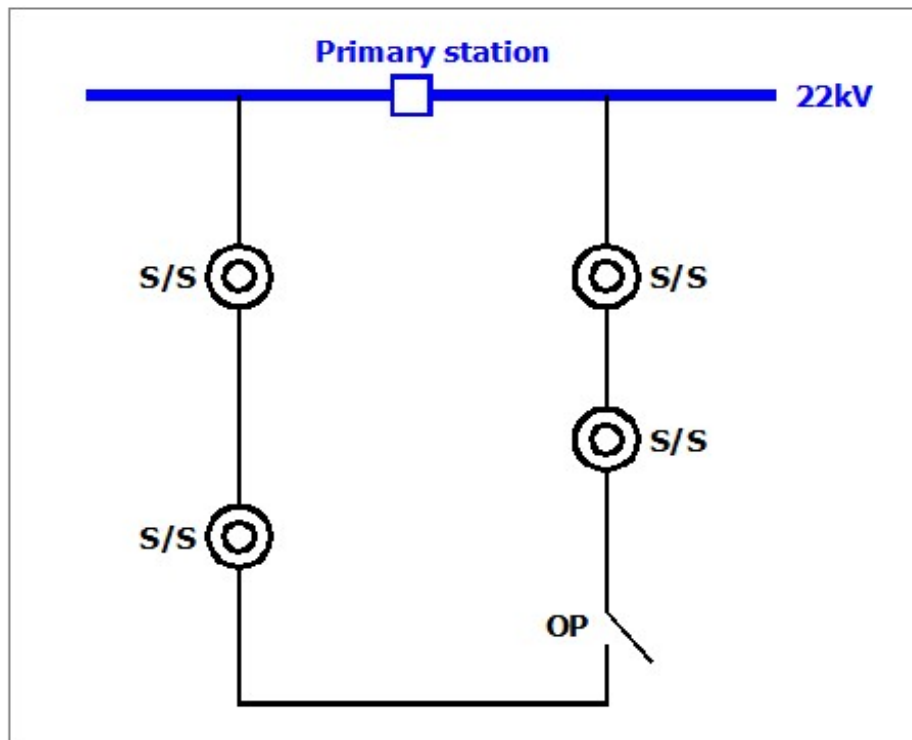
Figure 4.4 Class B4



4.8 **Class B5** represents a Group Demand up to 13 MVA which may be fed by an open loop 22 kV Circuit with Full DMS Control and without unit protection. This Class may be used in the newly developing networks in urban or rural areas. Following the outage of any Circuit 50% of the demand shall be restored within 20 minutes (assuming the Circuit is equipped with remote switching capability at the primary substation, half way on the feeder, and at the normally open point) and the total demand shall will be restored within 2 hours. If the outage is due to a fault at a distribution substation the demand of that substation may be excluded from the Group Demand and for which the restoration criteria of Class A2 will apply. (see [figure 4.5](#)).

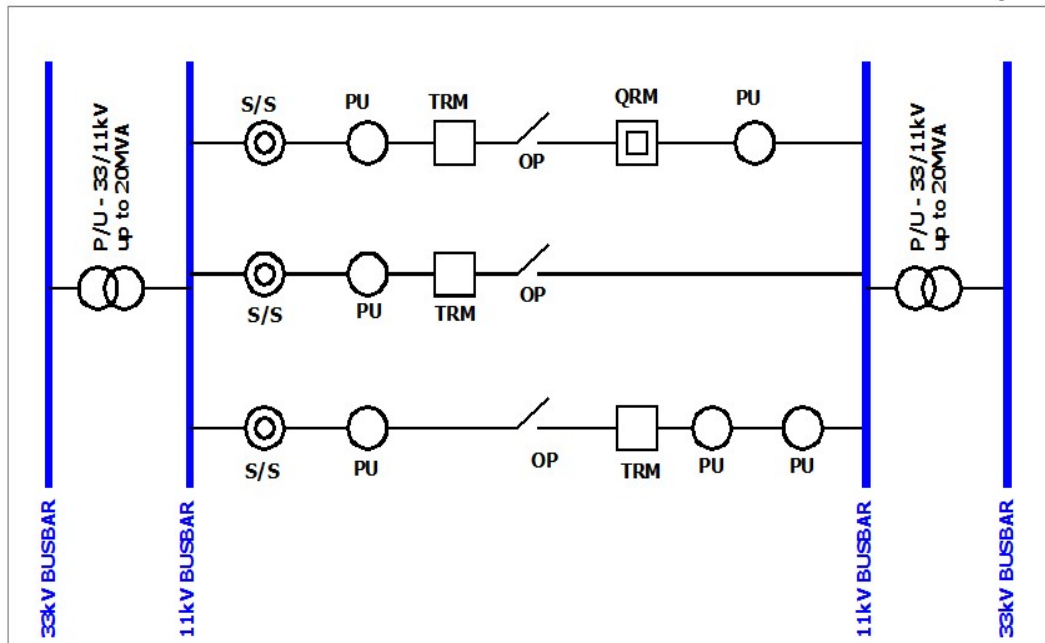
4.9 **Class B6** represents a Group Demand up to 13 MVA which may be fed by an open loop 22 kV Circuit without unit protection. This Class may be used in the newly developing networks in urban or rural areas. In this case the total demand shall be restored within 2 hours, assuming partial use of remote switching capability (i.e. at the primary substation and also at other strategic locations). If the outage is due to a fault at a distribution substation the demand of that substation may be excluded from the Group Demand and for which the restoration criteria of Class A2 will apply. (see [figure 4.5](#)).

Figure 4.5 :Class B5 and/or B6



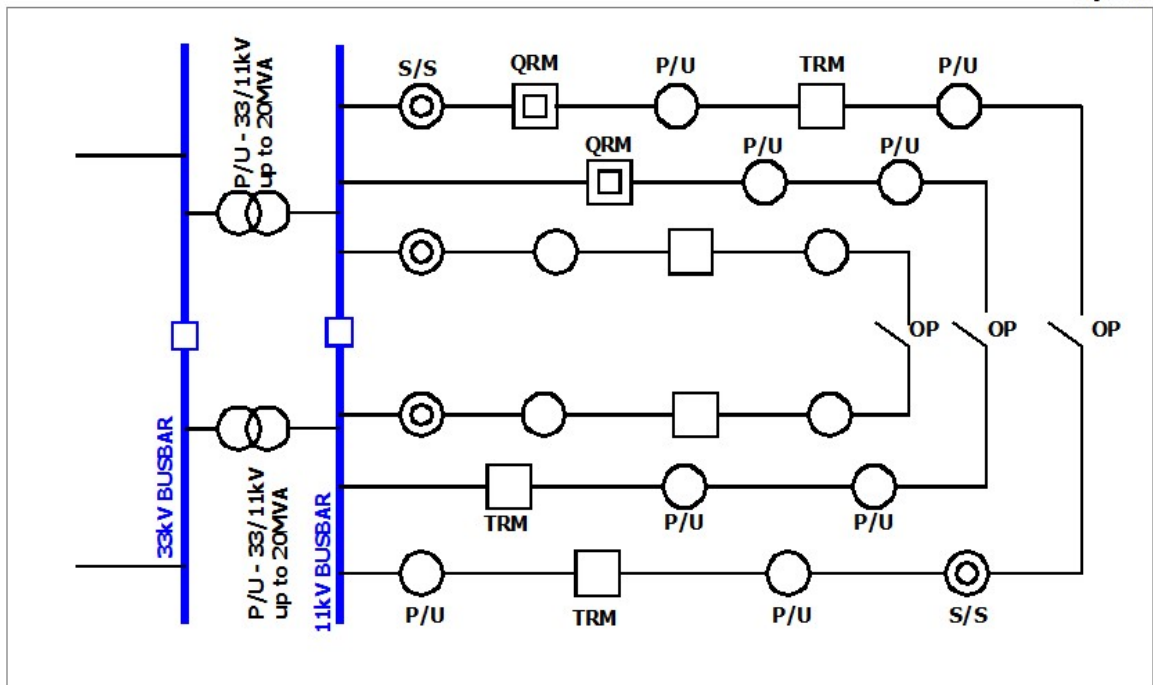
- 4.10 **Class B7** represents 11 kV Busbar with Group Demand up to 60 MVA supplied by a 33/11kV primary substation with two, three or four transformers 20 MVA each, normally operated in parallel (or parallel pairs for four transformers configuration) and with Partial DMS Control of substation and 11kV network. In this Class the demand lost as a result of first 11 kV busbar outage shall be restored within 3 hours. The demand lost as a result of the Second busbar outage shall be restored after Repair Time or the time to restore the planned first outage.
- 4.11 **Class C1** represents the outage of up to 20 MVA Group Demand in rural areas where the demand is supplied by two or more 33/11 kV substations, which are interconnected through their 11 kV feeders, as illustrated in figure 4.6. Remote switching capability may not be installed or may be partially installed. Following the First Circuit Outage (loss of one of the substation transformers or 33kV feeders) the Group Demand must be restored within 3 hours, by closing the open points on the 11 kV feeders. Following a Second Circuit Outage (at either substation) the power will be restored after the Repair Time or the time to restore the planned first outage. (see figure 4.6).

Figure 4.6 Class C1



- 4.12 **Class C2** represents the outage of up to 20 MVA Group Demand in urban or rural areas where the demand is supplied by two 33/11 kV package unit substations, interconnected at the same site (see figure 4.7). Remote switching capability will be installed to enable Group Demand to be restored in 20 minutes following a First Circuit Outage. Following a Second Circuit Outage, the supply will be restored after the Repair Time or the time to restore the planned first outage.

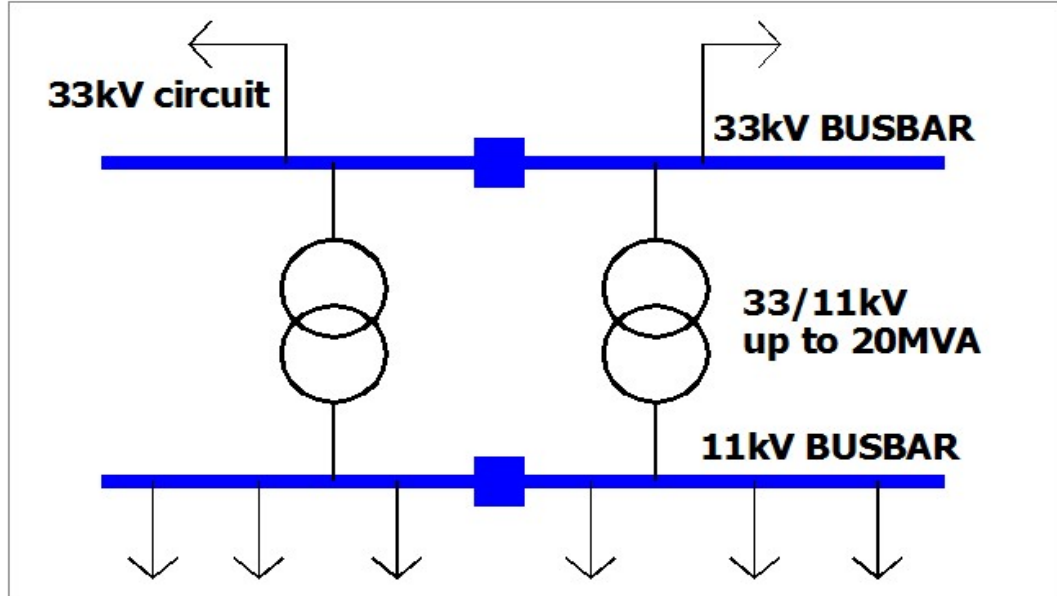
Figure 4.7 Class C2



4.13 **Class D1** represents Group Demand up to 20 MVA supplied by a 33/11kV primary substation with two transformers of up to 20 MVA each, normally operated in parallel and with Partial DMS Control of substation and 11kV network. In this Class there must not be any supply interruption following a First Circuit Outage (33kV Circuit / Busbar or Transformer outage). The demand lost as a result of the Second Circuit Outage shall be restored after Repair Time or the time to restore the planned first outage (see figure 4.8).

Note: For some primary substations, it may not be possible to run all transformers in parallel due to fault level limitations or due to incomers being from different busses of upstream grid station. In such cases, the transformers may be run independently and Class C1 or C 2 shall be applied as applicable (Note 4 – Table 4.1).

Figure 4.8 Class D1



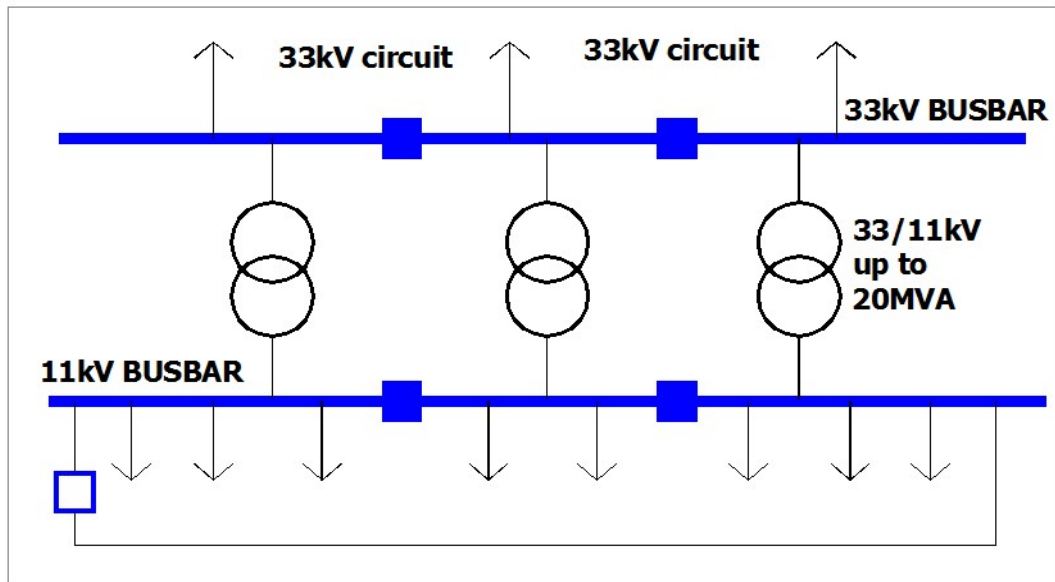
- 4.14 **Class D2** represents Group Demand up to 40 MVA supplied by a 33/11kV primary substation with three transformers of up to 20 MVA each normally operated in parallel , and with Partial DMS Control of substation and 11kV network, as shown in figure 4.9. In this Class there must not be any supply interruption following a first 33kV Circuit , busbar or transformer outage for the parallel transformers. Following the Second Circuit Outage 50% of the total demand must be restored in 1 hour. In such case the third transformer may trip and should be restored by DMS, together with closure of the bus section and some or all of the 11kV feeders. The remainder of Group Demand must be restored in Repair Time.

Note: For some primary substations it may not be possible to run all transformers in parallel due to fault level limitations or due to incomers being from different busses of upstream grid station. In such cases, the transformers may be run independently, the independent transformer may follow the same condition of Class C1.

Paralleling of the 33/11 kV transformers are subject to the following:

- No violation of Firm capacity.
- Similar Transformers characteristics
- Feeding source are from paralleled transformers.
- Short circuit current levels shall not exceed the permitted levels at 33 kV and 11 kV sides

Figure 4.9: Class D2



- 4.15 **Class D3** represents Group demand up to 60 MVA supplied by a 33/11kV primary substation with four transformers of up to 20 MVA each run in parallel pairs with availability of ATS, and with Partial DMS Control of substation and 11kV network, as shown in figure 4.10. In this Class, there must be no supply interruption following a first 33kV Circuit / bus bar or transformer outage. Following the Second Circuit or transformer outage, 50% of the total demand must be restored within one hour. In such case, the third transformer may trip and should be restored by closure of the bus section and 11 kV switching operations. The remainder of Group Demand must be restored in Repair Time or restoration of the planned outage period.

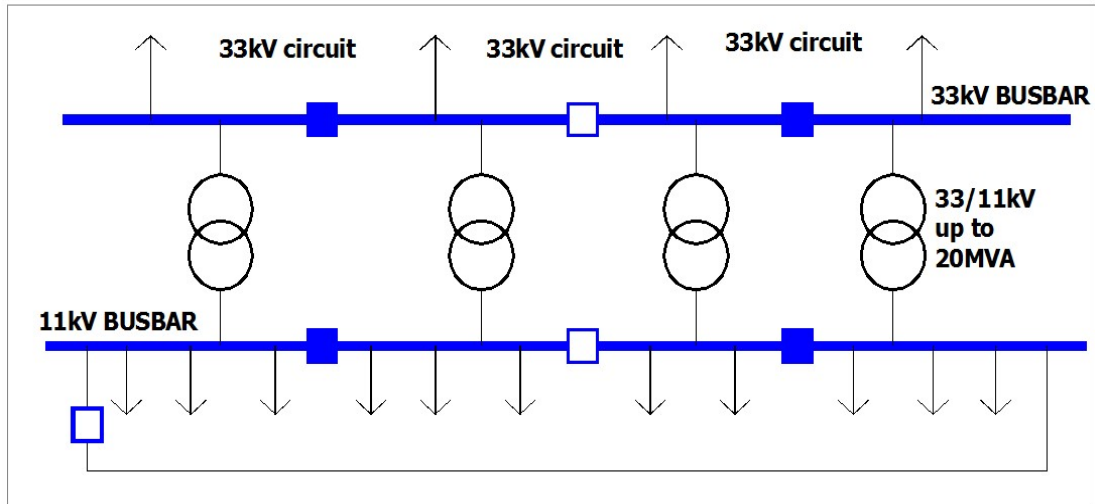
Note: For some primary substations, it may not be possible to run all transformers in parallel due to fault level limitations or due to incomers being from different busses of upstream grid station. In such cases, the transformers may be run independently and transformer may follow the same condition of Class C1.

Paralleling of the 33/11 kV transformers are subject to the following:

- No violation of Firm capacity.
- Similar Transformers characteristics
- Feeding source are from paralleled transformers.
- Short circuit current levels shall not exceed the permitted levels at 33 kV and 11 kV sides

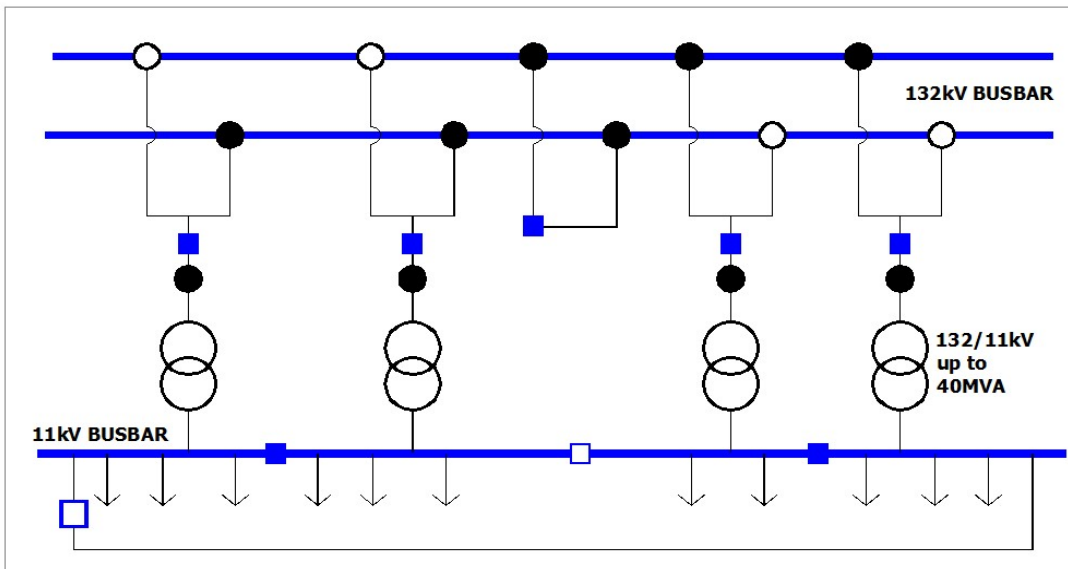


Figure 4.10 Class D3



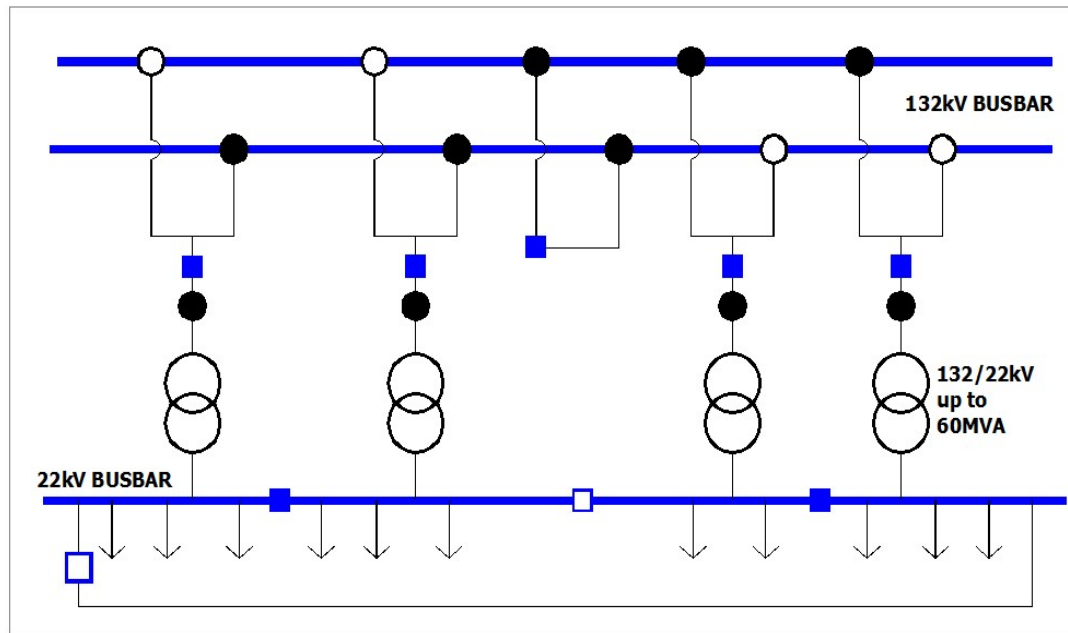
4.16 **Class E1-bb** represents a network Group Demand up to 120 MVA supplied by a 132/11kV primary grid substation with four 40 MVA transformers running in parallel pairs and with Partial DMS Control of substation and 11kV network as in Figure 4.11. In this Class, the demand lost as a result of first 11kV busbar outage shall be restored within 2 hours. Following the Second busbar outage, the full demand to be restored within 4 Hrs.

Figure 4.11 Class E1- bb



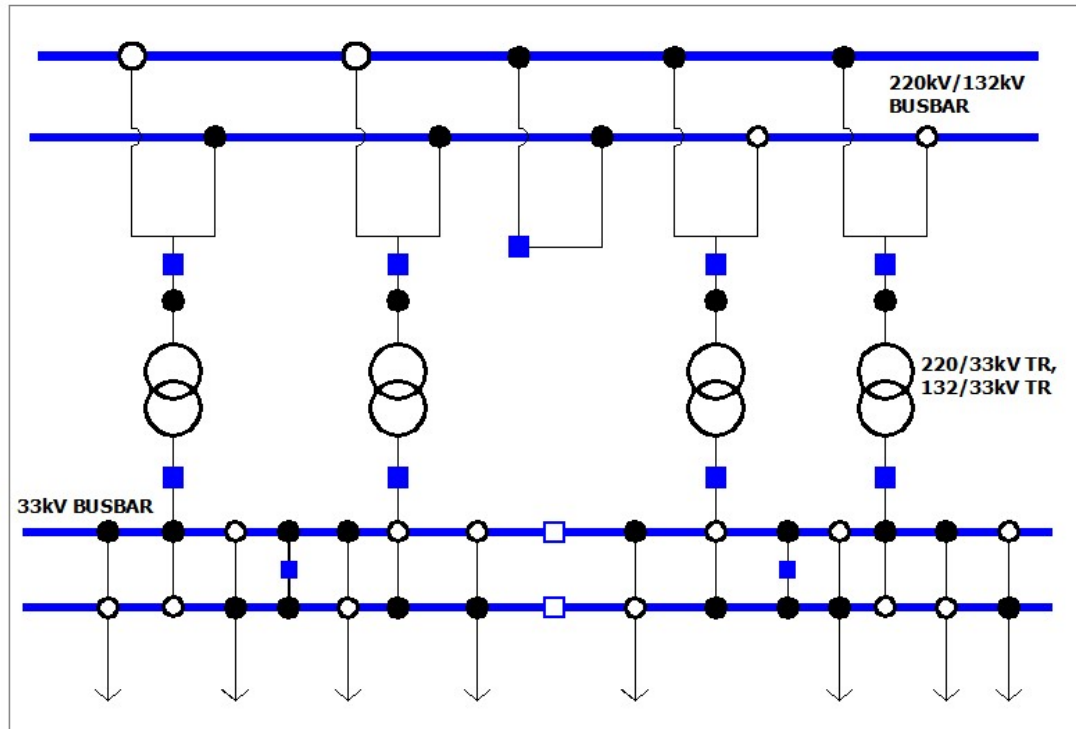
4.17 **Class F1 -bb** represents a network Group Demand up to 180MVA supplied by a 132/22 kV primary grid substation with four 60MVA transformers running in parallel pairs and with Partial DMS Control of substation and 22kV network as in Figure 4.12. In this Class, the demand lost as a result of first 22kV busbar outage shall be restored within 2 hour. Following the second busbar outage, the full demand to be restored within 4 Hrs.

Figure 4.12 Class F1 - bb



4.18 **Class G1 -bb** represents 33 kV Busbar in grid primaries with Group Demand up to the limit of (N-1) MVA -firm capacity-. The 33 kV busbars are fed from main Transco grid power transformers; which are running in parallel pairs and with Full DMS Control of substation and 33 kV network, Figure 4.13. In this Class the demand lost as a result of first 33kV busbar outage shall be restored within 30 minutes (assumption of having 33 kV double Bus configuration). Following the Second busbar outage, the full demand to be restored within 1 hour if the two busbars are from different Sections. Otherwise restoration to be upon restoring the planned outage or Repair Time.

Figure 4.13 Class G1 - bb (33 kV Busbar at grid station)



**Table 4.1 Security of supply standard for Classes of Group Demand**

<b>Class</b>	<b>Network Description</b>	<b>Group Demand</b>	<b>Outage condition due to 1no. fault only</b>	<b>Restoration time after outage condition due to 1no. fault only</b>	<b>Outage condition due to 1no. fault after a planned outage.(See Note5)</b>	<b>Restoration time after outage condition due to 1no. fault after a planned outage (Maintenance Period demand)</b>
A1	11/0.4kV secondary distribution substation fed via 11kV underground network with or without DMS control	up to 3 MVA	Outage on 11kV switchgear and/or associated 11/0.4kV transformers	(a) 100% of Group Demand in Repair Time	NA	NA
A2	22/0.4kV secondary distribution substation fed via 22kV underground network with or without DMS control	up to 3 MVA	Outage on 22kV switchgear and/or associated 22/0.4kV transformers	(a) 100% of Group Demand in Repair Time	NA	NA
B1	11kV underground network with normally open ring Circuits and with Full DMS Control and without unit protection	up to 6.5 MVA	Outage on a single section of an 11kV ring Circuit serving 11/0.4kV ring main substations	(a) 50% of Group Demand within 20 minutes (b) 100% of Group Demand within 2 hours (see Note1)	Outage on numerous sections of an 11kV ring Circuit serving 11/0.4kV ring main substations	(a) 100% of Group Demand within time to restore planned outage or repair
B2	11kV underground network with normally open ring Circuits and with Partial DMS Control and without unit protection	up to 6.5 MVA	Outage on a single section of an 11kV ring Circuit serving 11/0.4kV ring main substations	(a) 100% of Group Demand within 2 hours (see Note 1)	Outage on numerous sections of an 11kV ring Circuit serving 11/0.4kV ring main substations	(a) 100% of Group Demand within time to restore planned outage or repair
B3	11 kV underground network with normally open ring Circuits and with No DMS control and without unit protection	up to 6.5 MVA	Outage on a single section of an 11kV ring Circuit serving 11/0.4kV ring main substations	(a) 100% of Group Demand within 3 hours (see Note 1)	Outage on numerous sections of an 11kV ring Circuit serving 11/0.4kV ring main substations	(a) 100% of Group Demand within time to restore planned outage or repair

Class	Network Description	Group Demand	Outage condition due to 1no. fault only	Restoration time after outage condition due to 1no. fault only	Outage condition due to 1no. fault after a planned outage.(See Note5)	Restoration time after outage condition due to 1no. fault after a planned outage (Maintenance Period demand)
B4	11kV overhead network with normally open in main line ring Circuits ( <b>monitored</b> ARC with or without sectionalisers) and with partial DMS control at Primary substations.	up to 5 MVA	Outage on a single section of an 11kV main line ring Circuit and associated branch line /radial Circuits	<b>(a) Healthy OHL portions within 2 Hours</b> (b) 100% of Group Demand in Repair Time (see Note1)	Outage on numerous sections of an 11kV main line ring Circuit and associated branch line radial Circuits	(a) 100% of Group Demand within time to restore planned outage or repair
B5	22kV underground network with normally open ring Circuits and with Full DMS Control and without unit protection.	up to 13 MVA	Outage on a single section of a 22kV ring Circuit serving 22/0.4kV ring main substations	(a) 50% of Group Demand within 20 minutes (b) 100% of Group Demand within 2 hours (see Note 2)	Outage on numerous sections of a 22kV ring Circuit serving 22/0.4kV ring main substations	(a) 100% of Group Demand within time to restore planned outage or repair
B6	22 kV underground network with normally open ring Circuits and with Partial control and without unit protection	up to 13 MVA	Outage on a single section of an 22kV ring Circuit serving 22/0.4kV ring main substations	(a) 100% of Group Demand within 2 hours (see Note 2)	Outage on numerous sections of an 22kV ring Circuit serving 22/0.4kV ring main substations	(a) 100% of Group Demand within time to restore planned outage or repair
B7	11 kV BB at 33/11 kV substations with 2/3/ 4no. transformers up to 20 MVA each normally operated in parallel/parallel pairs and with Partial DMS Control of substation and 11kV network, Where BB protection is not available	up to 60 MVA	Outage on 1no. 11kV busbar	(a) Group Demand lost is up to 20 MVA and is restored within 3 Hour .Restored by switching operations on 11kV network	Outage on 2no. 11kV busbars	(a) 100% of Group Demand within time to restore planned outage or repair
C1	33/11kV substation with 1no. Transformer and with Partial DMS Control of substation and 11kV network.	up to 20 MVA	Outage on 1no. 33/11kV transformer or outage on 1no. 11kV busbar or 1 no. 33kV Incomer	(a) 100% of Group Demand within 3 hours Restored by switching operations on 11kV network.	Outage on 11kV busbar and outage on the supporting 11kV network	(a) 100% of Group Demand within time to restore planned outage or repair

<b>Class</b>	<b>Network Description</b>	<b>Group Demand</b>	<b>Outage condition due to 1no. fault only</b>	<b>Restoration time after outage condition due to 1no. fault only</b>	<b>Outage condition due to 1no. fault after a planned outage.(See Note5)</b>	<b>Restoration time after outage condition due to 1no. fault after a planned outage (Maintenance Period demand)</b>
C2	Two 33/11kV package substation with DMS control of substation and 11kV network.	up to 20 MVA	Outage on 1no. 33/11kV transformer or outage on 1no. 11kV busbar or 1 no. 33kV Incomer	(a) Group Demand restored within 20 minutes Restored by switching operations on 11kV network.	Outage on 11kV busbar and outage on the supporting 11kV network	(a) 100% of Group Demand within time to restore planned outage or repair
D1	33/11kV substation with 2no. transformers up to 20 MVA normally operated in parallel and with Partial DMS Control of substation and 11kV network	up to 20 MVA	Outage on 1no. 33/11kV transformer or 1no. 33kV Incomer or 1no. 33kV busbar	(a) 100% of Group Demand is secure for a first outage (see Note 3)	Outage on 2nd 33/11kV transformer or 2nd 33kV Incomer or 2nd. 33kV busbar	(a) 100% of Group Demand within time to restore planned outage or repair.
D2	33/11kV substation with 3no. transformers up to 20 MVA normally operated in parallel and with Partial DMS Control of substation and 11kV network	up to 40 MVA	Outage on 1no. 33/11kV transformer or 1 no. 33kV Incomer or 1no. 33kV busbar	(a) 100% of Group Demand is secure for a first outage (see Note 4)	Outage on 2nd 33/11kV transformer or 2nd 33kV Incomer or 2nd. 33kV busbar	Group Demand lost is up to 40 MVA as the 1no. remaining transformer could trip due to overload (a) 50% of Group Demand within 1 hour .Restored by switching operations on bus couplers and 11kV network. (b) 100% of Group Demand within time to restore planned outage or repair

<b>Class</b>	<b>Network Description</b>	<b>Group Demand</b>	<b>Outage condition due to 1no. fault only</b>	<b>Restoration time after outage condition due to 1no. fault only</b>	<b>Outage condition due to 1no. fault after a planned outage.(See Note5)</b>	<b>Restoration time after outage condition due to 1no. fault after a planned outage (Maintenance Period demand)</b>
D3	33/11kV substation with 4no. transformers up to 20 MVA normally operated in parallel pairs with availability of ATS and with Partial DMS Control of substation and 11kV network	up to 60 MVA	Outage on 1no. 33/11kV transformer or 1 no. 33kV Incomer or 1no. 33kV busbar	(a) 100% of Group Demand is secure for the paralleled ones for a first outage (see Note4)	Outage on 2nd 33/11kV transformer or 2nd 33kV Incomer or 2nd. 33kV busbar	Group Demand lost is up to 60 MVA as the 2no. remaining transformer could trip due to overload (a) 50% of Group Demand within 1 hour , (b) 100% of Group Demand within time to restore planned outage or repair
E1-bb	132/11kV substation with 4no. 40 MVA transformers normally operated in parallel pairs and with Partial DMS Control of substation and 11kV network	up to 120 MVA	Outage on 1no. 11kV busbar	(a) Group Demand lost is upto 40 MVA and is restored within 2 Hour .Restored by switching operations on 11kV network	Outage on 2no. 11kV busbars	Group Demand lost is up to 120 MVA . a) 100% of Group Demand within 4 Hrs Restored by switching operations on bus couplers and 11kV network
F1-bb	132/22kV substation with 4no. 60MVA, transformers normally operated in parallel pairs and with Partial DMS Control of substation and 22kV network	up to 180MVA	Outage on 1no. 22kV busbar	(a) Group Demand lost is upto 60 MVA and is restored within 2 Hour .Restored by switching operations on 22kV network	Outage on 2no. 22kV busbars	Group Demand lost is up to 180 MVA . a) 100% of Group Demand within 4 Hrs Restored by switching operations on bus couplers and 22kV network

<b>Class</b>	<b>Network Description</b>	<b>Group Demand</b>	<b>Outage condition due to 1no. fault only</b>	<b>Restoration time after outage condition due to 1no. fault only</b>	<b>Outage condition due to 1no. fault after a planned outage.(See Note5)</b>	<b>Restoration time after outage condition due to 1no. fault after a planned outage (Maintenance Period demand)</b>
G1-bb	33 kV BB in substation with double busbar 33 kV configuration fed from Transco Grid power transformer running in parallel pairs.	Up to ( N-1) firm capacity	Outage on 1no. 33kV busbar	(a) Group Demand lost is (subject to Grid power transformer Transformer's capacity) is restored within 30 minutes Restored by switching operations on 33kV network.	Outage on 2no. 33kV busbars.	Group Demand lost is subject to firm capacity in, MVA (a) 100% of Group Demand within 1 Hrs. ;if the two BB's are from different Sections otherwise restoration time of full demand to be upon restoring the planned outage or Repair Time. Restored by switching operations on bus couplers and 33kV network.
Note 1	If the outage is due to a fault at a distribution substation the demand of that substation may be excluded from the Group Demand and for which the restoration criteria of Class A1 will apply.					
Note 2	If the outage is due to a fault at a distribution substation the demand of that substation may be excluded from the Group Demand and for which the restoration criteria of Class A2 will apply.					
Note 3	For some primary substations, it may not be possible to run all transformers in parallel due to fault level limitations or due to incomers being from different busses of upstream grid station (s). In such cases, the transformers may be run independently.					



Class	Network Description	Group Demand	Outage condition due to 1no. fault only	Restoration time after outage condition due to 1no. fault only	Outage condition due to 1no. fault after a planned outage.(See Note5)	Restoration time after outage condition due to 1no. fault after a planned outage (Maintenance Period demand)
<b>Note4</b>	<p>For some primary substations it may not be possible to run all transformers in parallel due to fault level limitations or due to incomers being from different busses of upstream grid station.</p> <p>In such cases, the transformers may be run independently transformers may follow the same condition of Class C1</p> <p>Paralleling of the 33/11 kV transformers are subject to the following:</p> <ol style="list-style-type: none"> <li>1. No violation of Firm capacity.</li> <li>2. Similar Transformers characteristics</li> <li>3. Feeding source from paralleled transformers.</li> <li>4. Short circuit current levels shall not exceed the permitted levels at 33 and KV sides.</li> </ol>					
<b>Note 5</b>	<p>Following the Second Circuit Outage situation the Group demand shall be the maximum demand expected during the normal Maintenance Period.</p>					
<b>Note6</b>	<p>For any loss of supply exceeding the standard restoration time may be acceptable if this leads to significant economies ,and has prior approval of DoE .</p>					

## 5. INTERCONNECTIONS WITH TRANSCO

- 5.1 In accordance with the transmission system security standard (issue 1 – Revision 1-dated June 2018.) the interconnection between TRANSCO and the Distribution Companies (DISCOs) shall comply with table 5.1.

Table 5.1 Minimum planning supply capacity following secured events

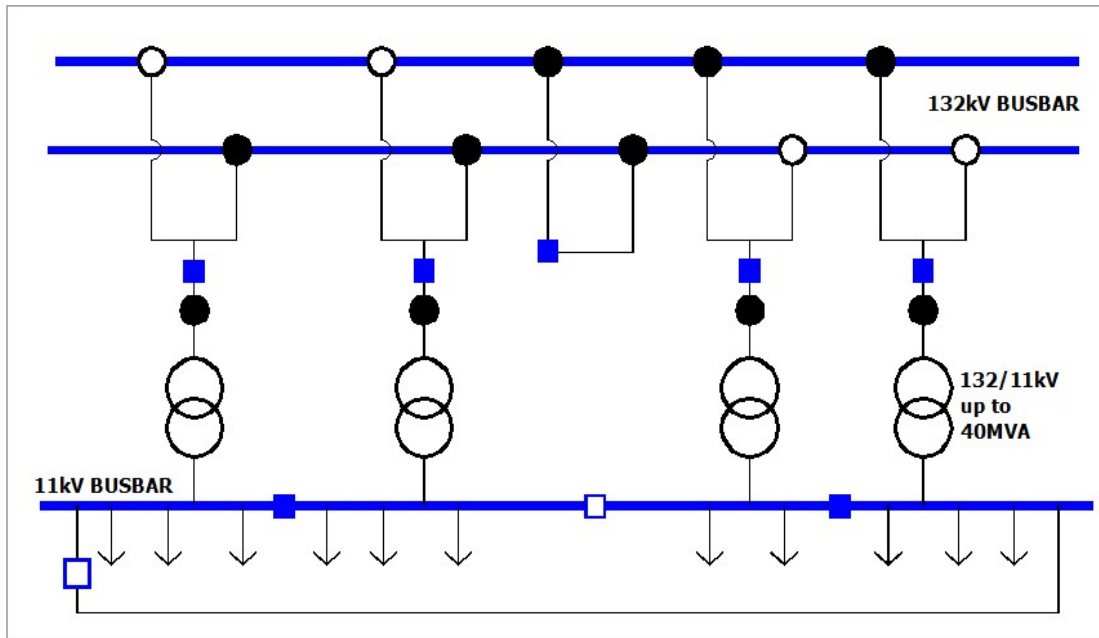
Group Demand (MVA)	Initial System Conditions	
	Intact System	With Single Planned Outage
In excess of 500 MVA	Immediately Group Demand	Immediately Maintenance Period Demand
120 – 500 MVA	Immediately NOTE 1 Group Demand	Immediately NOTE 1 Maintenance Period Demand
40 – 120 MVA	Immediately NOTE 1 Group Demand	5 minutes NOTE 2 Maintenance Period Demand
Up to 40 MVA	Immediately NOTE 2 Group Demand	5 minutes NOTE 3 Maintenance Period Demand

Notes:

- [1] A Loss of Supply not exceeding 5 minutes may be acceptable if this leads to significant economies.  
 [2] A Loss of Supply not exceeding 3 hours may be acceptable at certain sites if this leads to significant economies and has the prior approval of the Bureau following consultation with all stakeholders.  
 [3] A Loss of Supply not exceeding 6 hours may be acceptable at certain sites if this leads to significant economies and has the prior approval of the Bureau following consultation with all stakeholders.

- 5.2 Compliance with Table 5.1 above requires that grid or primary substations must be designed so that there is no loss of supply due to a First Circuit Outage. In addition, the Group Demand must be met for a Second Circuit Outage during Maintenance Periods. A typical substation arrangement to meet this requirement is shown in Figure 5.1 below.

Figure 5.1: Primary substation with parallel transformers



- 5.3 Other configurations may be used (e.g. 3 transformers with auto-switching) so that there is no loss of supply greater than 5 minutes.

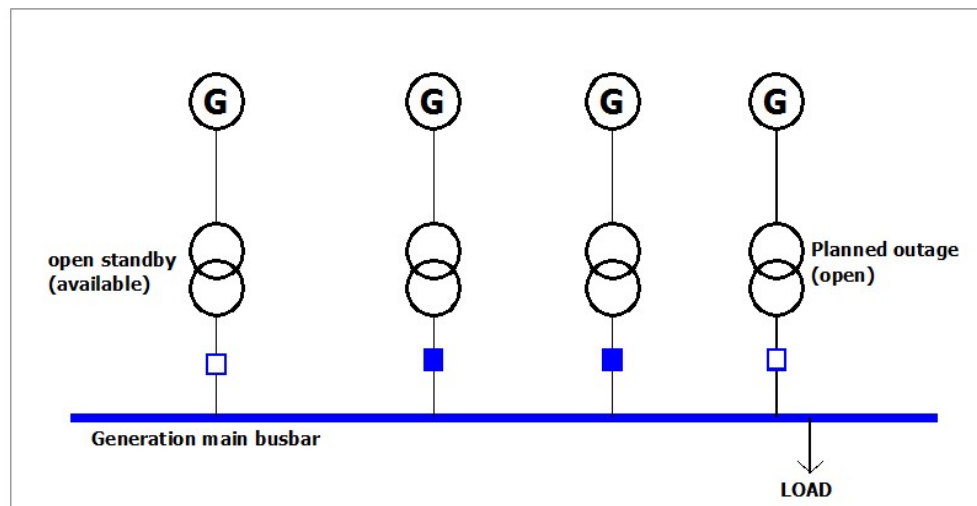
## 6. GENERATION CONNECTION CRITERIA

- 6.1 This section presents the planning and operational security criteria relating to embedded generation and standby generation.
- 6.2 The security criteria determines the Distribution System capacity required to avoid unacceptable network conditions for a set of events.

### 6.a) Islanded generation (continuous running)

- 6.3 Table 6.1 describes the operational and planning security criteria for a continuous running islanded generation plant feeding an isolated demand (not connected to the Main Distribution System or to the TRANSCO system).
- 6.4 For generation of greater than 1 MW the operational criteria should meet with N-1 requirements which means that the total number of the synchronized generation units to feed an isolated demand should be such that the forced outage of any one generation unit does not cause supply interruption and the islanded system remains stable. The planning criteria should meet with N-2 requirements which means that the plant capacity should be able to meet the demand whenever any two generators are unavailable (see figure 6.1 and table 6.1).

Figure 6.1 Connection of islanded generation (above 1 MW demand)



- 6.5 For generation of 1 MW or less the operational and planning criteria should meet N-1 requirements, as in paragraph 6.4 above.

**Table 6.1 – security criteria for islanded generation**

<b>Generation capacity</b>	<b>Operation criteria</b>	<b>Planning criteria</b>
1 MW or less	N-1	N-1
Greater than 1 MW	N-1	N-2

- 6.6 The distribution network in isolated areas shall meet the requirements of the Main Distribution System security standards as described in section 4.

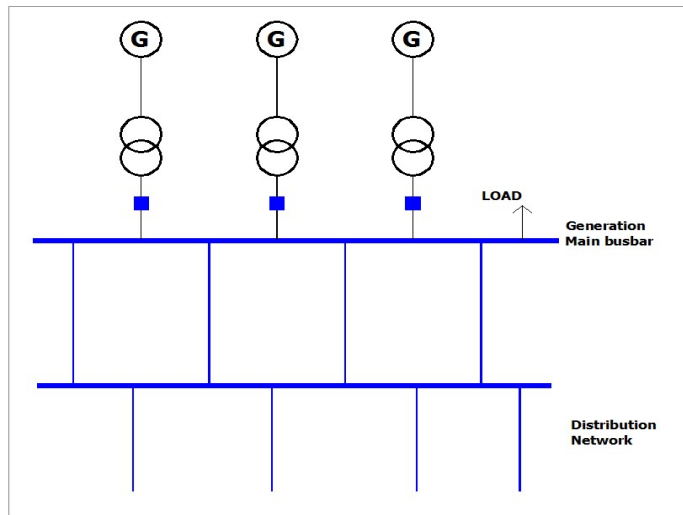
**Standby generation**

- 6.7 The number of standby generators and their total generation capacity will be defined based on the Customer’s requirements.
- 6.8 The security of the Distribution System at a standby generation site shall comply with the requirements of Main Distribution System security criteria, based on the Class of supply (see table 4.1).

**6.b) Embedded generation connected with TRANSCO Network**

- 6.9 The generation units size and number should comply with the Transmission System Security Standard.
- 6.10 The connection between the main generation busbar at an embedded generation plant centrally dispatched by TRANSCO and the Distribution System should be designed to meet the following conditions:
- (a) the outage of any Circuit between the main generation bus at the generation plant and the Distribution System should not result in a loss of power infeed to the Distribution System nor cause overloading on other Circuits between the power plant and the Distribution System nor result in any voltage deviation outside the statutory obligations (see figure 6.2); and
  - (b) the distribution network capacity at the point of connection should be appropriate to feed the total demand at that embedded generation point when the total generation plant is out of service.

Figure 6.2 Connection of embedded generation



### 6.c) Embedded generation connected with Disco's Network

- 6.11 Small embedded generation plants for the sole use of a Customer may be connected to the Distribution System. The connection criteria for such generation will be subject to special agreement between Customers with own generation and the Distribution Company. This is has to be reference to the Engineering Recommendation #3 that define all the technical references and requirements.
- 6.12 The forced outage of generation units should not cause any overloading or voltage deviation outside the statutory limits in the Distribution System.
- 6.13 Such connection agreements may provide that embedded generation is partially available to supply load at the site or to the Distribution System. Alternatively such generation may be arranged to be fully available under First Circuit Outage conditions (N-1 criteria).