



Conditions Governing Connection to the Distribution System:

- **Connections at MV and 38kV**
- **Embedded Generators at LV, MV and 38kV**

CONTENTS	PAGE
1.0 ABOUT THIS DOCUMENT	3
2.0 INCOMER CIRCUIT BREAKER.....	4
3.0 EARTHING SWITCH	6
4.0 PROTECTION	7
5.0 SYNCHRONISING.....	26
6.0 BOUNDARIES.....	26
7.0 WARNING NOTICES AND LABELS	27
8.0 OPERATION.....	28
9.0 CABLE TERMINATION.....	30
10.0 METERING	31
11.0 TERMINAL STATION.....	32
12.0 EARTHING	34
13.0 COMMISSIONING AND CERTIFICATION.....	36
APPENDIX 1 SCHEMATICS.....	39
APPENDIX 2 TEST SCHEDULE FOR GENERATORS	45
APPENDIX 3 DECLARATION OF FITNESS FOR SERVICE	55
APPENDIX 4 EGIP DESIGN REFERENCES.....	57

1.0 About this document

1.1 Context

This document is referenced in the Distribution Code and sets out requirements for Customer equipment at the interface between the Distribution System and the Customer's installation.

For interface arrangements at low voltage please refer to the National Code of Practice for Customer Interface 3rd Edition 2002.

1.2 Scope

This document applies to demand installations connected to the Distribution System (users of category A, B1 and B2 in the Distribution Code). It replaces documents previously known as:

- Conditions Governing Electricity Supply at Medium Voltage
- Conditions Governing Electricity Supply at Medium Voltage using dedicated Dual Radial Incomers
- Conditions Governing Electricity Supply at 38kV
- Requirements for Connection of Generators to ESB Distribution Network

ETCI are currently developing requirements for LV, MV and 38kV connections, should there be any conflict between this document and documents produced by ETCI, ETCI documents shall prevail.

1.3 Associated Documentation

Documents associated with these conditions are:

- Distribution Code
- National Code of Practice for Customer Interface 3rd Edition 2002.
- S.I. no.44 of 1993. Part VIII. A Statutory Instrument i.e. government legislation.
- Guide to the Process for Connection to the Distribution System.

It is anticipated that this document will be superseded in time by additions to the Distribution Code and to the National Code of Practice.

Please note:

- Where there is a conflict between these conditions and the Distribution Code, the Distribution Code will prevail.
- References to S.I. 44 1993 in this document are for the convenience of readers, these references are not DSO requirements, should there be any conflict between these documents, S.I. 44 1993 shall prevail.

2.0 Incomer Circuit Breaker

Table 2A: Customer's MV/38kV Main Incomer Circuit Breaker Requirements

No.	Item	Requirement				
1.	Standard	IEC 60056 or equivalent				
2.	Rated Voltage	MV	24kV			
		38kV	52kV			
3.	Insulation Level	MV	Power Frequency	50kV rms		
			Impulse Level 1.2/50 μ S	125kV peak		
		38kV		Phase-Phase & Phase-Earth	Across isolating distance**	
			Power Frequency	95kV rms	110kV rms	
			Impulse Level 1.2/50 μ S	250kV peak	290kV peak	
4.	Short Circuit Rating (RMS Symmetrical) Always confirm with ESB Networks Ltd	MV and 38kV (Normally)		12.5kA		
		MV and 38kV (Designated Areas)*		20kA		
		MV Dual Radial		20kA		
5.	Rated Frequency	50Hz.				
6.	No. of Poles	3				
7.	Earthing Switch	<p>Capable of short-circuiting and earthing the ESB network main incomer cable</p> <p>For single Circuit Breaker connections an earthing switch is required on the incoming and outgoing sides of the Circuit Breaker.</p>				
8.	Interlocking	Between Earthing Switch and Circuit Breaker such that the circuit breaker cannot remake onto a circuit without first removing the earthing mechanism				
9.	Locking	Lockable in 'OFF' position with ESB network danger lock (7mm. minimum diameter hole)				

10.	Visible point of Disconnection	If the Main Incomer Circuit Breaker, does not contain a visible break in the circuit, for example, is not withdrawable, the following additional requirements shall apply.		
	Insulation Level		Phase-Phase & Phase-Earth	Across isolating distance**
	MV	Power Frequency	50kV rms	60kV rms
		Impulse Level 1.2/50µS	125kV peak	145kV peak
	Tests on the kinematic chain associated with the disconnector and earthing switch, shall be carried out in accordance with Annex A of IEC 62271-102. These tests shall be carried out by a recognised test laboratory. Copies of certification must be made available to Networks Ltd on request.			
Conformance with IEC 62271-102 Clause 5.502				

***Designated Areas** are within Dublin and Cork Cities and similar areas where the fault level could rise above 12.5kA because of the strength of the electrical network in that particular area.

On request, ESB Networks Ltd will confirm the fault level for the Customer by carrying out the required calculations taking into account the contribution of the Customer's proposed system.

**Applies to the disconnector, if separate from Circuit Breaker

Table 2B: Additional Interlocking Requirements in Embedded Generator Installations

No.	Mode	Requirement
1.	Interlocking	<p>Manual closing of either the generator circuit breaker or the main incoming circuit breaker circuit breakers shall be disabled when either the ESB network or generator source is live.</p> <p>In the exceptional circumstances of loss of either supply source and the generator LV control system, manual closing may be re-enabled, while having due regard to the consequences of unsynchronised paralleling</p> <p>Interlocking shall prevent closure of interconnecting switchgear when both the generator and ESB network sources of supply are dead. It shall only be possible to close onto a dead busbar when either ESB network or generator source of supply is isolated</p> <p>It shall not be possible for the generator circuit breaker or the main incoming circuit breaker to close or to remain closed unless all three phases of the mains supply are normal.</p>

3.0 Earthing Switch

Table 3: Customer's Main Incomer Circuit Breaker Earthing Facilities Requirements

No.	Facility	Requirements
1.	Earthing Switch	Capable of short-circuiting and earthing the ESB network main incomer cable
2.	No. of Poles	3
3.	Short-Circuit Withstand	≥ Circuit Breaker
4.	Locking	Lockable in 'ON' and 'OFF' positions with ESB network danger lock (Minimum diameter hole = 7mm)
5.	Interlocking with Circuit Breaker	Circuit breaker cannot remake onto a circuit without first removing the earthing mechanism

4.0 Protection

4.1 Incomer Protection

Table 4A: Isolation and Maximum Permitted Relay Settings

No.	Item	Provided by	Necessity
1.	Isolation of ESB equipment from Customer's equipment	Customer	Customer to provide a means of isolating ESB equipment in the event of a fault on the Customer's equipment.
2.	Max. Permitted Relay Settings on Main Incomer CB	ESB Networks Ltd	ESB Networks Ltd determined settings on the Customer's relay are necessary to provide selectivity with ESB Distribution protection.
3.	Relay Settings on Main Incomer CB	Customer	The Customer determines the optimal settings on the Customer's Main Incomer protection relay appropriate to the installation. These may not exceed the maximum settings permissible as advised by ESB Networks Ltd (see Row 2. above)

Table 4B: Protection Requirements

Item	Protection Type	Plant	Requirement	
Main Incomer CB's	Overcurrent	CT's	Standard	IEC 60044 or equivalent
		Relays	Standard	A, B and C of IEC 60255.
			Min. no. of elements	3
			Sensitivity	50AMPS @ MV
	Earth Fault	CT's and VT's as required	Standard	IEC 60044 or equivalent
		Relays	Standard	A, B, C and DT of IEC 60255
			Min. number elements	1
			Sensitivity	2AMPS @ MV

Table 4C: Protection Recommendations

No.	Facility	Recommendation
1.	Directional SEF	Recommended where SEF is applied at the main incomer circuit breaker and the Customer's network could contribute more than 2Amps of EF current
2.	Protection CT's	<p>Individual phase CT's for overcurrent protection may be fitted on ESB incoming cable, provided that they are:</p> <ul style="list-style-type: none"> <input type="checkbox"/> encapsulated in the switchgear <input type="checkbox"/> of solid resin block type <input type="checkbox"/> mounted directly below the main incomer circuit breaker <p>If a core balance CT is required to achieve the earth fault sensitivity specified above, then it may be fitted to ESB incoming cable, provided that:</p> <ul style="list-style-type: none"> <input type="checkbox"/> the terminations comprise bolt-up tees or other such facility, whereby the cables and terminations are completely safe to touch, even when energised, with the cover removed. <p style="text-align: center;">or</p> <ul style="list-style-type: none"> <input type="checkbox"/> interlocking is in place such that access to the incomer cable chamber can only be gained, if the incomer CB is open and earths applied to the incomer cables.
3.	Core Balance CT's	Recommended where SEF is installed.
3.	CT Shorting Links	Recommended on CT's
4.	Customer's Protection Scheme	To take account of the main incomer circuit breakers maximum permissible relay settings
5.	Protection VT's	Individual phase VT's for voltage measurement or directional protection may <u>not</u> be fitted on the ESB incoming cable, unless they are providing voltage measurements for the Embedded Generator Interface Protection

4.2 Embedded Generator Interface Protection (EGIP)

Generator interface protection is designed to disconnect the generator from the ESB network during abnormal system conditions by tripping a dedicated circuit breaker or recloser, located as close as practically possible to the interface between the IPP equipment and the ESB distribution network. See section 4.4 for possible variations in the target circuit breaker in some cases.

The objective of generator interface protection is to preserve the safety of ESB personnel, the general public and avoid damage to the Distribution system.

This protection is in addition to and separate from the generator protection and other protection fitted by the installer to protect the customer’s personnel and installation.

Table 4D: Additional Requirements for Embedded Generator Installations –Generator Interface Protection Devices

No.	Device	Requirement
1.	Protection Devices	Independent of other equipment and protection
		Located in a separate and secure compartment that can be sealed
		Comply with IEC Standard 60255
		Protection Relay types specified by ESB Networks Ltd
		Accessible from ground level
		Clearly identified
		Monitor installation at ESB Distribution Connection Voltage
		Monitor Line Voltage for Under and Over Voltage protection
		Fail safe operation In the event that the LSC or watchdog contacts energise, indicating the failure of an EGIP relay or DC supply: - Generator or main incomer CB should be tripped - Alarm should be sent to the Distribution Control Centre (DCC)
		Prevent reclosure of the CB that EGIP trips, until all EGIP relays have fully reset, and conditions on the ESB network system have returned within normal parameters for at least 5 minutes'

4.2.1 Required Protection Functionality and Settings

This section is intended for Independent Power Producers (IPPs) to determine what Embedded Generation Interface Protection (EGIP) they are required to install, as well as the settings which should be applied to each protection function. The requirements in this document only apply to generators connected to the ESB distribution system at MV and HV.

Tables 4E to 4K in Section 4.2.1 should be used to determine which protection types are required for a particular Embedded Generator (EG) installation. The protection requirements have been categorised by connection voltage, generator type and connection type, as listed in the first three rows of each of Tables 4E to 4K. The correct table must first be chosen for a particular generation installation. The single line diagrams shown for each voltage level in Figures 1 to 9 should be referred to in order to define the connection type of the generator installation.

For example, considering a windfarm consisting of Inverter Interfaced Embedded Generators (IIEG), connected via dedicated 20kV overhead line, the interface protection requirements are as listed in Table 4F. The connection type is as illustrated in Figure 1.

Once the protection types have been established from the correct Protection Requirements Table (from Tables 4E to 4K), the relevant settings for the required EGIP relays can then be read from Table 4L. The drawing numbers for the required relay elementary drawings can then be found in Appendix A4.

Table 4E: Embedded Generation Interface Protection Requirements – MV Category 1**Generator Installation Type**

Connection Voltage:	MV (10kV or 20kV)
Generator Type:	Synchronous (not Inverter-Connected)
Connection Types:	Dedicated feeder (A) Shared feeder (B) Transformer feeder (C)
Operation:	Continuous / Peaking Shaving / Peak Lopping
System Neutral Earthing Types:	Resistance-Earthed Neutral Isolated Neutral
Earth Fault Operation Types:	EFT (Earth Fault Tripping) – Set to trip for single phase earth faults FPE (Faulted Phase Earthing) – Indicate only for single phase earth faults ESB Networks Ltd will advise the type of earth fault operation in service on a case-by-case basis

Required Interface Protection for this Generator Installation

No.	Protection Required	Notes / Exceptions
1	Under and Over Voltage	Required
2	Under and Over Frequency	Not required for embedded generators used exclusively for Peak Lopping
3	Loss of Mains	Not required for embedded generators used exclusively for Peak Lopping
4	Directional Overcurrent	Required
5	Earth Fault	Resistance-Earthed Neutral with EFT: NVD protection, and earth fault functionality of overcurrent protection, to be set to trip for single-phase earth faults Isolated Neutral with EFT: NVD protection, and earth fault functionality of overcurrent protection, to be set to trip for single-phase earth faults Isolated Neutral with FPE: NVD protection, and earth fault functionality of overcurrent protection, to be set to indicate only for single phase earth faults

Table 4F: Embedded Generation Interface Protection Requirements – MV Category 2**Generator Installation Type**

Connection Voltage:	MV (10kV or 20kV)
Generator Type:	Asynchronous or Inverter-Connected Synchronous
Connection Types:	Dedicated feeder (A) Shared feeder (B) Transformer feeder (C)
Operation:	Continuous / Peaking Shaving / Peak Lopping
System Neutral Earthing Types:	Resistance-Earthed Neutral Isolated Neutral
Earth Fault Operation Types:	EFT (Earth Fault Tripping) – Set to trip for single phase earth faults FPE (Faulted Phase Earthing) – Indicate only for single phase earth faults ESB Networks Ltd will advise the type of earth fault operation in service on a case-by-case basis

Required Interface Protection for this Generator Installation

No.	Protection Required	Notes / Exceptions
1	Under and Over Voltage	Required
2	Under and Over Frequency	Not required for embedded generators used exclusively for Peak Lopping
3	Loss of Mains	Not required for embedded generators used exclusively for Peak Lopping
4	Backup Under Voltage	Not required for mains-excited embedded generators
5	Earth Fault	Resistance-Earthed Neutral with EFT: NVD protection to be set to trip for single-phase earth faults
		Isolated Neutral with EFT: NVD protection to be set to trip for single-phase earth faults
		Isolated Neutral with FPE: NVD protection to be set to indicate only for single phase earth faults

Figure 1: Dedicated MV Feeder Connection

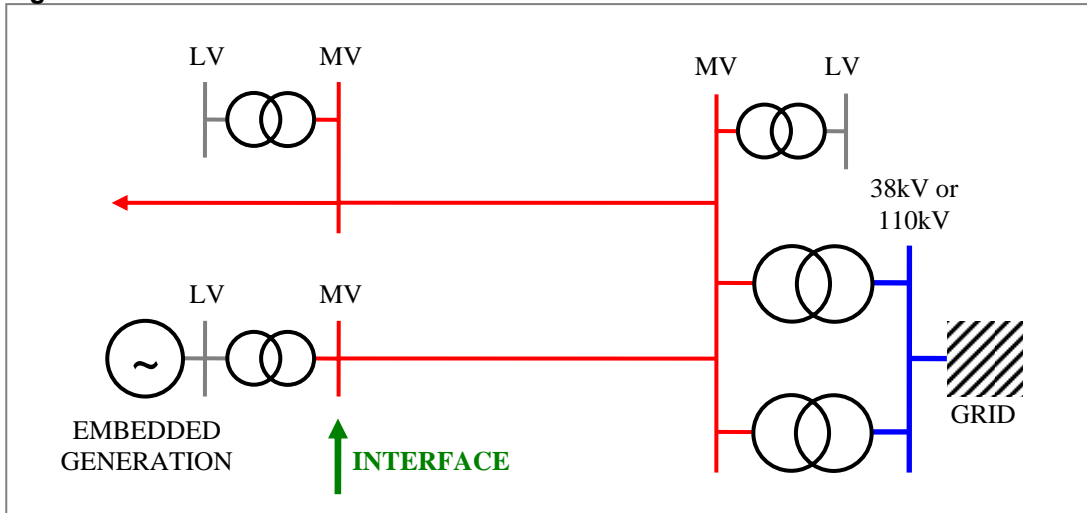


Figure 2: Shared MV Feeder Connection

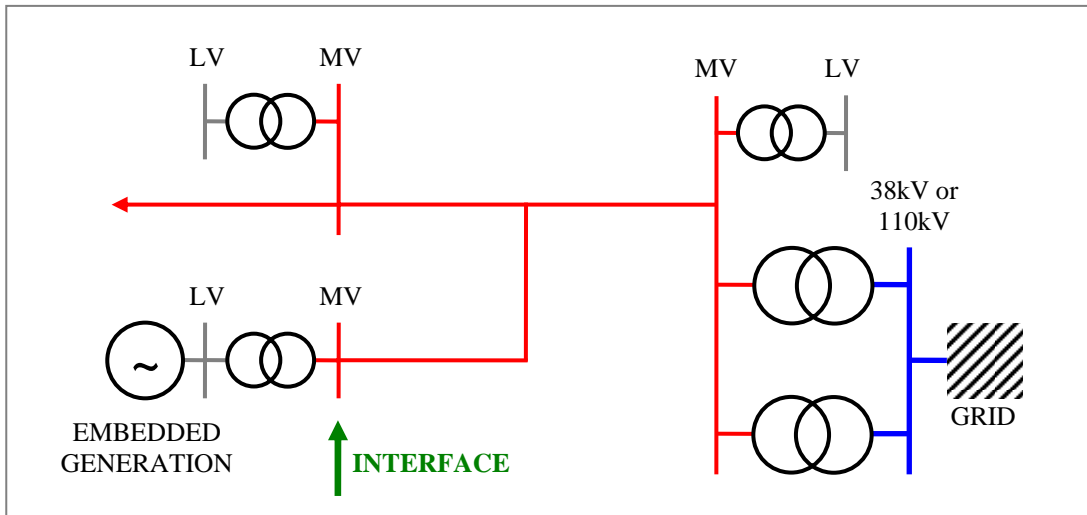


Figure 3: MV Transformer Feeder Connection

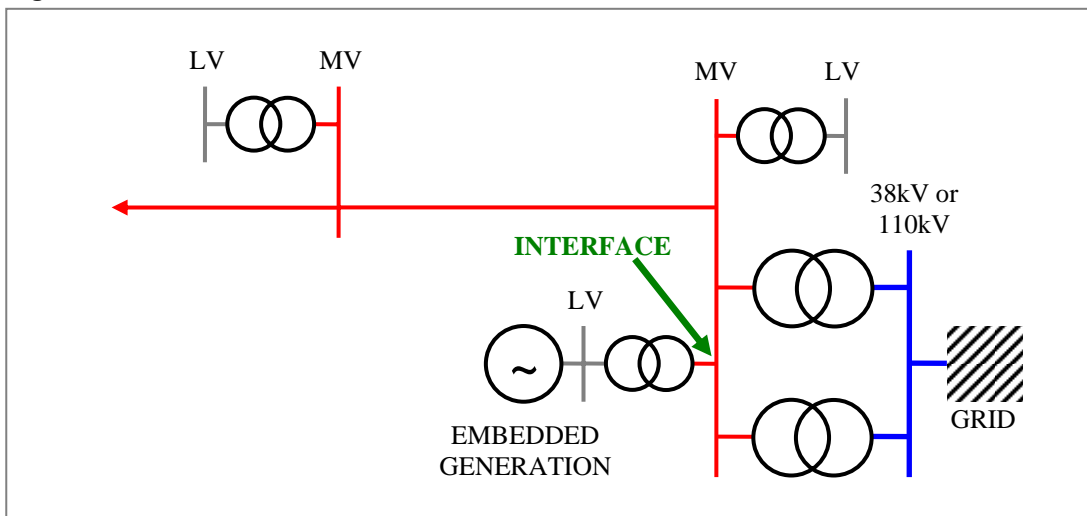


Table 4G: Embedded Generation Interface Protection Requirements – 38kV Category 1

Generator Installation Type

Connection Voltage:	38kV
Generator Type:	All generator types
Connection Type:	Dedicated feeder (A) Shared feeder (B)
Operation:	Continuous / Peaking Shaving / Peak Lopping
System Neutral Earthing Type:	Arc-Suppressed Neutral
Earth Fault Operation Type:	Indicate only for single phase earth faults

Required Interface Protection for this Generator Installation

No.	Protection Required	Notes / Exceptions
1	Under and Over Voltage	Required
2	Under and Over Frequency	Not required for embedded generators used exclusively for Peak Lopping
3	Loss of Mains	Intertripping should be used instead of ROCOF where a suitable communications channel is available Not required for embedded generators used exclusively for Peak Lopping
4	Impedance	Intertripping must be enabled where a suitable communications channel is available
5	Earth Fault	NVD protection, and earth fault functionality of impedance protection, to be set to indicate only for single phase earth faults
6	Differential	Fully cabled feeders only

Table 4H: Embedded Generation Interface Protection Requirements – 38kV Category 2

Generator Installation Type

Connection Voltage:	38kV
Generator Type:	All generator types
Connection Type:	Transformer feeder (C)
Operation:	Continuous / Peaking Shaving / Peak Lopping
System Neutral Earthing Type:	Arc-Suppressed Neutral
Earth Fault Operation Type:	Indicate only for single phase earth faults

Required Interface Protection for this Generator Installation

No.	Protection Required	Notes / Exceptions
1	Under and Over Voltage	Required
2	Under and Over Frequency	Not required for embedded generators used exclusively for Peak Lopping
3	Loss of Mains	Not required for embedded generators used exclusively for Peak Lopping
4	Busbar Impedance	Required
5	Busbar Differential	Required
6	Earth Fault	NVD protection, and earth fault functionality of impedance protection, to be set to indicate only for single phase earth faults

Figure 4: Dedicated 38kV Feeder Connection

Note: This includes dedicated 38kV feeder connections into 38kV/MV stations

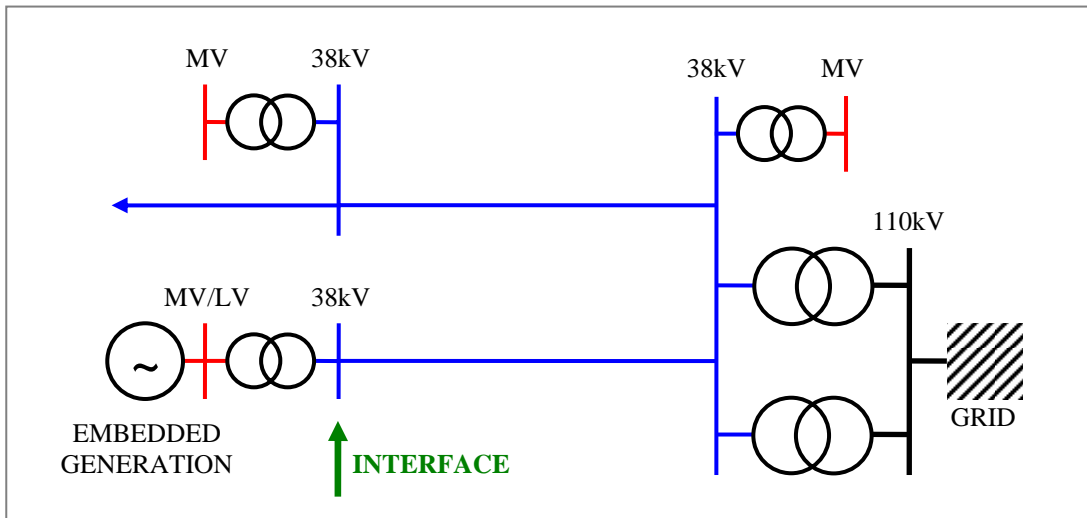


Figure 5: Shared 38kV Feeder Connection

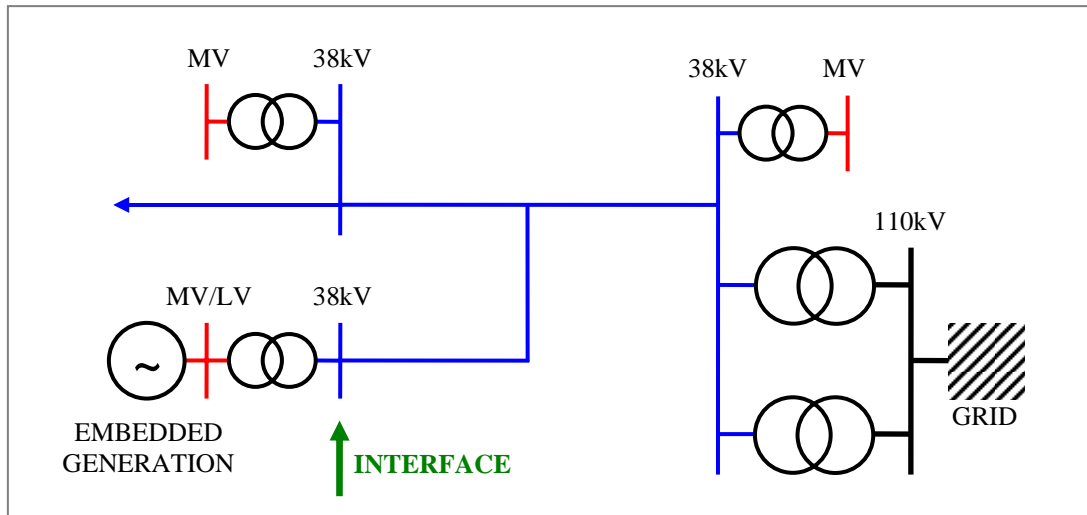


Figure 6: 38kV Transformer Feeder Connection

Note: This includes 38kV cubicle connections in 38kV/MV stations

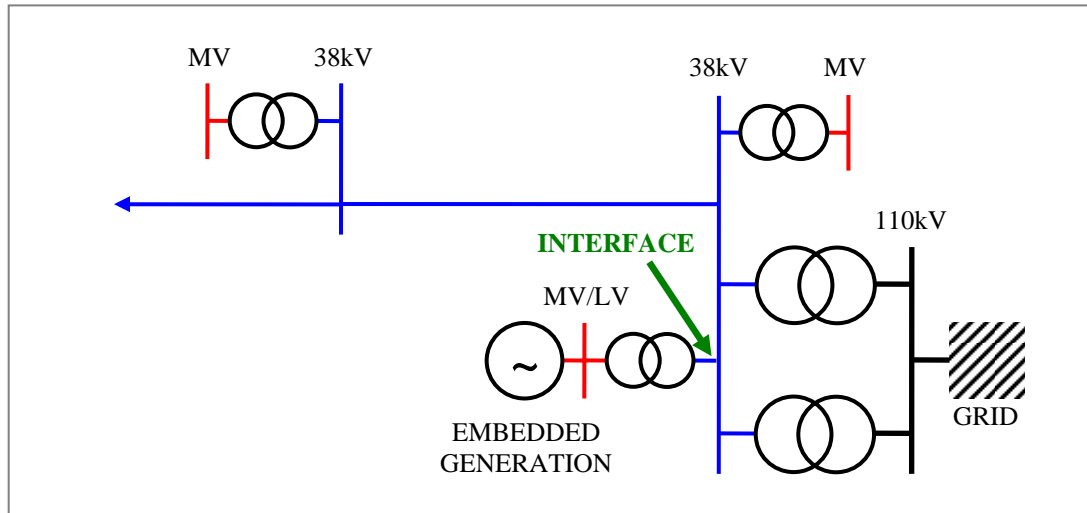


Table 4I: Embedded Generation Interface Protection Requirements -110kV Category 1**Generator Installation Type**

Connection Voltage:	110kV
Generator Type:	All generator types
Connection Type:	Dedicated feeder (A) – Fully cabled underground Shared feeder (B) – Fully cabled underground
Operation:	Continuous / Peaking Shaving / Peak Lopping
System Neutral Earthing Type:	Solidly-earthed Neutral
Earth Fault Operation Type:	Trip for single phase earth faults

Required Interface Protection for this Generator Installation

No.	Protection Required	Notes / Exceptions
1	Under and Over Voltage	Required
2	Under and Over Frequency	Not required for embedded generators used exclusively for Peak Lopping
3	Loss of Mains	A Special Protection Scheme should be used to provide Loss of Mains protection Not required for embedded generators used exclusively for Peak Lopping
4	Impedance	Intertipping must be enabled using impedance protection
5	Earth Fault	NVD protection, and earth fault functionality of impedance protection, to be set to trip for single phase earth faults
6	Differential	Required

Table 4J: Embedded Generation Interface Protection Requirements -110kV Category 2

Generator Installation Type

Connection Voltage:	110kV
Generator Type:	All generator types
Connection Type:	Dedicated feeder (A) – Overhead line Shared feeder (B) – Overhead line
Operation:	Continuous / Peaking Shaving / Peak Lopping
System Neutral Earthing Type:	Solidly-earthed Neutral
Earth Fault Operation Type:	Trip for single phase earth faults

Required Interface Protection for this Generator Installation

No.	Protection Required	Notes / Exceptions
1	Under and Over Voltage	Required
2	Under and Over Frequency	Not required for embedded generators used exclusively for Peak Lopping
3	Loss of Mains	A Special Protection Scheme should be used to provide Loss of Mains protection Not required for embedded generators used exclusively for Peak Lopping
4	Impedance (Duplicate)	Duplicate impedance protection must be installed, with intertripping enabled
5	Earth Fault	NVD protection, and earth fault functionality of impedance protection, to be set to trip for single phase earth faults Directional Comparison Sensitive Earth Fault protection is also required

Table 4K: Embedded Generation Interface Protection Requirements -110kV Category 3

Generator Installation Type

Connection Voltage:	110kV
Generator Type:	All generator types
Connection Type:	Transformer feeder (C)
Operation:	Continuous / Peaking Shaving / Peak Lopping
System Neutral Earthing Type:	Solidly-earthed Neutral
Earth Fault Operation Type:	Trip for single phase earth faults

Required Interface Protection for this Generator Installation

No.	Protection Required	Notes / Exceptions
1	Under and Over Voltage	Required
2	Under and Over Frequency	Not required for embedded generators used exclusively for Peak Lopping
3	Loss of Mains	A Special Protection Scheme should be used to provide Loss of Mains protection Not required for embedded generators used exclusively for Peak Lopping
4	Busbar Impedance	Required
5	Busbar Differential	Required
6	Earth Fault	NVD protection, and earth fault functionality of differential and overcurrent protection, to be set to trip for single phase earth faults

Figure 7: Dedicated 110kV Feeder Connection

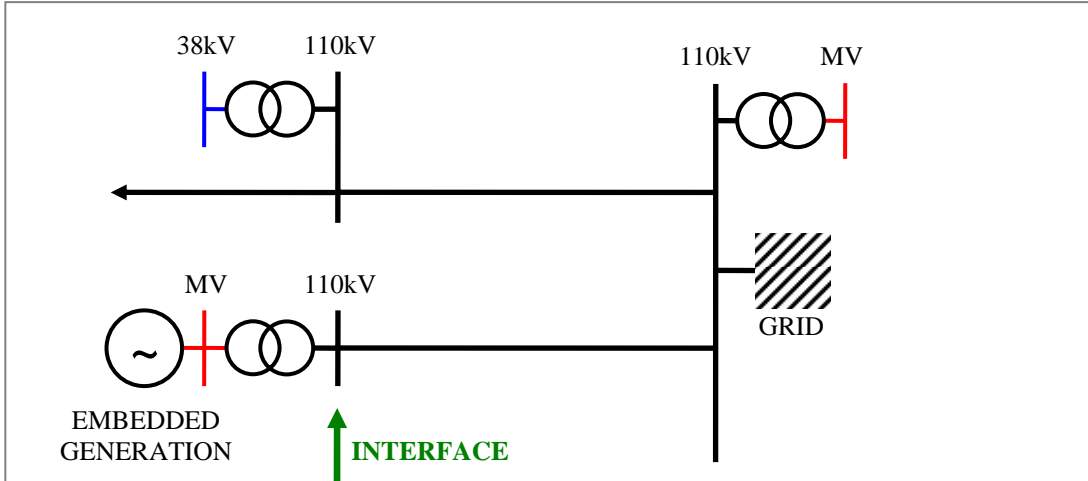


Figure 8: Shared 110kV Feeder Connection

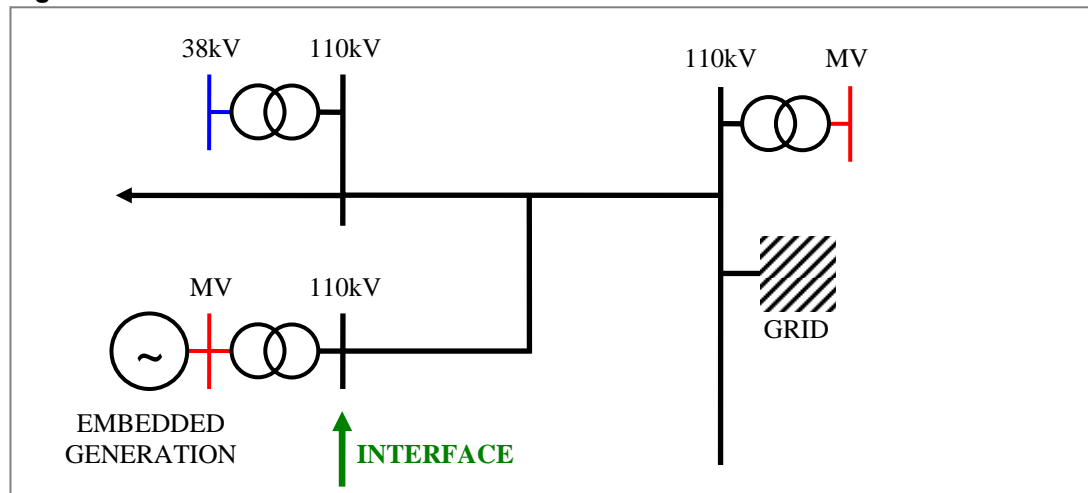


Figure 9: 110kV Transformer Feeder Connection

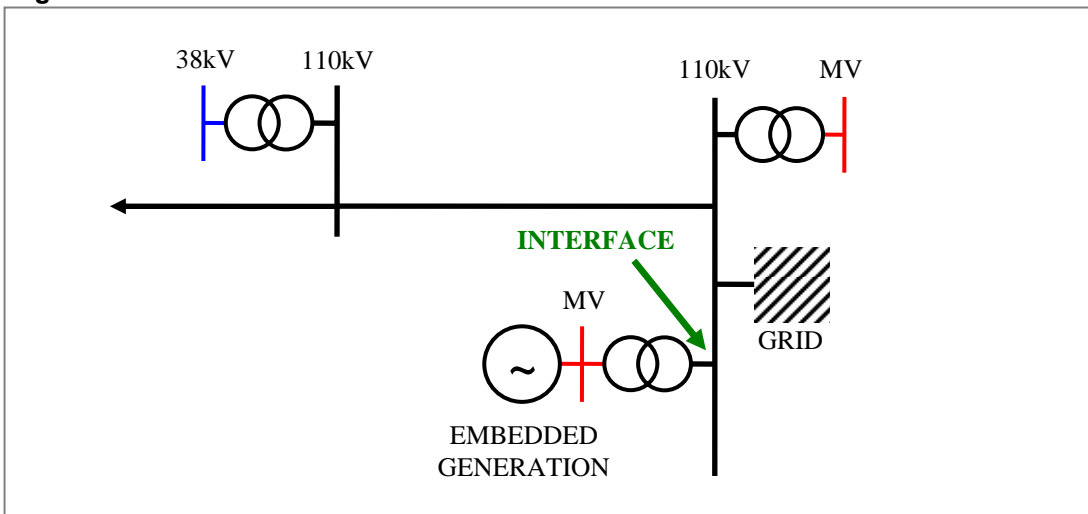


Table 4L below summarises the recommended protection settings for Embedded Generation installations. Note: Tables 4E to 4K must first be used to determine which of the protection types listed below are required a specific EG installation.

Table 4L: Additional Requirements for Embedded Generators – Protection Types and Summary of Protection Settings

No.	Protection Type	Item	Requirement	
1	Under-Voltage	Type A Windfarms (as per Distribution Code DCC11.1.4)		
		Voltage Variation/Trip Time	< 0.87pu < 0.50pu	3.00s 1.85s
		Number of Phases	3	
		Type B,C,D & E Windfarms (as per Distribution Code DCC11.1.4)		
		Voltage Variation/Trip Time	< 0.87pu < 0.80pu	3.00s 1.10s
		Number of Phases	3	
		Non-Windfarm EG		
		Voltage Variation/Trip Time	< 0.87pu < 0.80pu	2.50s 0.70s
2	Over-Voltage	Voltage Variation/Trip Time	> 1.12pu	0.70s
		Number of Phases	3	
3	Under-Frequency	Frequency Variation/Trip Time	≤ 47.5Hz ≤ 47.0Hz	20s 0.50s
		Number of Phases	3	
4	Over-Frequency	Frequency Variation/Trip Time	≥ 52.0Hz ≥ 52.5Hz	20s 0.50s
		Number of Phases	3	
5	Loss of Mains	Rate of Change of Frequency Operational Setting	As issued by ESB Networks Ltd	
6	Impedance Protection	Operational Settings	As issued by ESB Networks Ltd	
		Number of Phases	3	
7	Directional Overcurrent Protection	Operational Settings	As issued by ESB Networks Ltd	
		Number of Phases	3	
8	Differential Protection	Operational Settings	As issued by ESB Networks Ltd	
		Number of Phases	3	
9	Earth Fault	Directional Comparison Earth Fault	As issued by ESB Networks Ltd	
		Neutral Voltage Displacement Settings	30%, 5s	
		Neutral Voltage Displacement Trip	Systems with Solidly-Earthed Neutral, Resistance-Earthed Neutral or Isolated Neutral with EFT	
		Neutral Voltage Displacement Alarm	Systems with Isolated Neutral with FPE or Arc-Suppressed (Reactance-Earthed) Neutral	
10	Watchdog Alarm	DC supply and Relay Healthy Watchdog Alarm	<p>In the event that the LSC or watchdog contacts energise, indicating the failure of an EGIP relay or CD supply:</p> <ul style="list-style-type: none"> -Generator or main incomer CB should be tripped - Alarm should be sent to the Distribution Control Centre (DCC) 	

4.3 Ownership and Control of EGIP

In all cases, the installed protection must be to ESB Networks Ltd specifications, including relay models used and elementary drawings used in the protection system design. The relevant drawings are listed in Appendix A1 of this document and copies of these, including any subsequent revision, are available on request from the ESB network project team.

4.3.1 Smaller generators connected at MV

In the case of EG installations connected to the ESB network system at MV (10kV or 20kV), ownership and maintenance of the EGIP relays and the breaker used for EGIP remains with the IPP if the installed capacity of the installation is up to and including 2MVA.

4.3.2 Larger generators connected at MV and at HV

In the case of EG installations connected to the ESB network system at MV with an installed capacity in excess of 2MVA as well as all EG installations connected at HV (38kV or 110kV), the following sections apply.

4.3.2.1 Generation only installations

Ownership of the EGIP relays and the breaker used for EGIP shall be with ESB.

4.3.2.2 Generation is but one part of an installation (e.g. CHP in a factory)

Ownership of the EGIP relays and the breaker used for EGIP shall be with ESB. Additionally the customer may elect that EGIP also trips an in-plant (generator) circuit breaker.

4.4 Protection Coordination and EGIP Target Circuit Breaker

In all cases it EGIP must measure system quantities and be wired to trip a circuit breaker or recloser, located as close as practically possible to the interface between the IPP equipment and the ESB distribution network. This is readily achievable for dedicated generation installations.

In cases where the embedded generation is but one part of a customer installation (e.g. CHP in a large factory) an additional approach may be considered by the customer, whereby EGIP is configured for two-stage tripping of circuit breakers with downstream customer generator breakers tripping faster than the main incomer circuit breaker. In such instances, ESB Networks Ltd may at its discretion, specify alternative EGIP trip times to be applied to the main incoming circuit breaker and the generator circuit breaker to allow time coordination.

Where a customer is concerned about the potential impact of Rate of Change of Frequency protection on the non-generation part of the plant, the required loss-of-mains protection can instead be implemented by means of an intertripping scheme, as designed by ESB Networks Ltd.

See figures 10 to 12 overleaf, showing some example cases of MV connected installations and the locations of EGIP and the target circuit breaker in each case.

Figure 10: MV connected EG <2MVA installed capacity

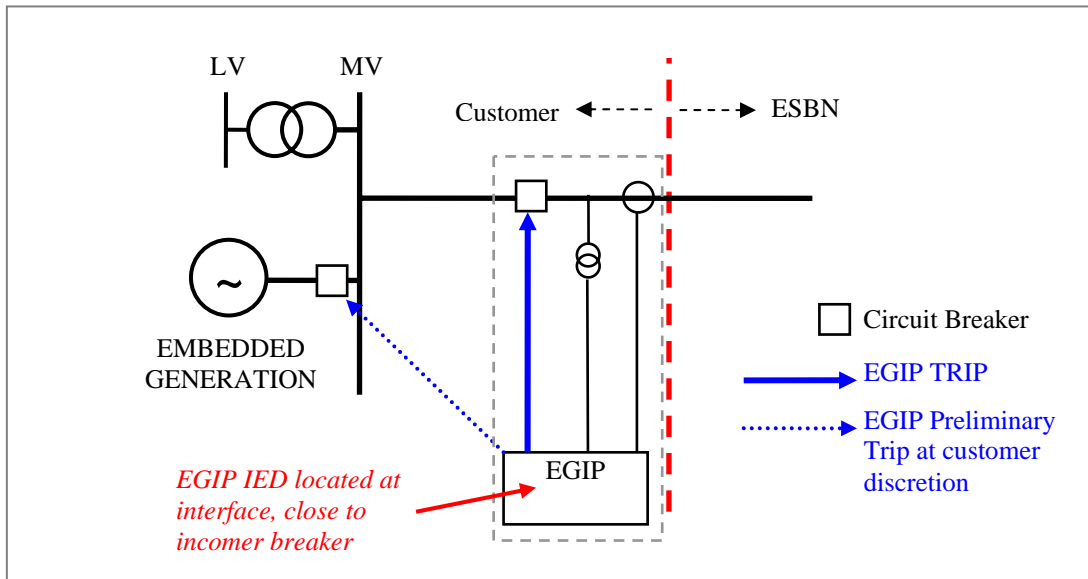


Figure 11: MV connected EG <2MVA installed capacity with LV generator

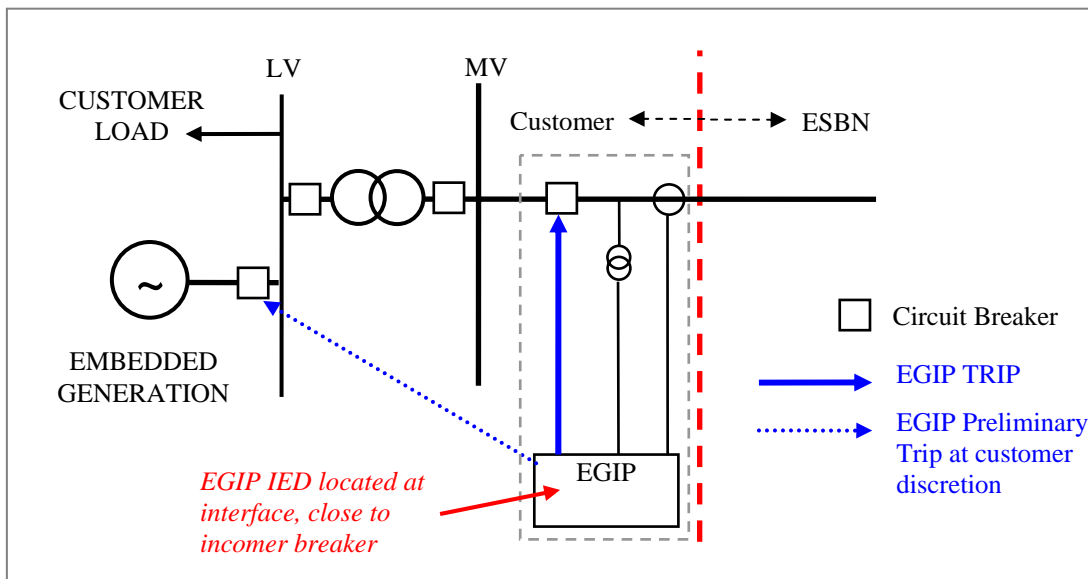
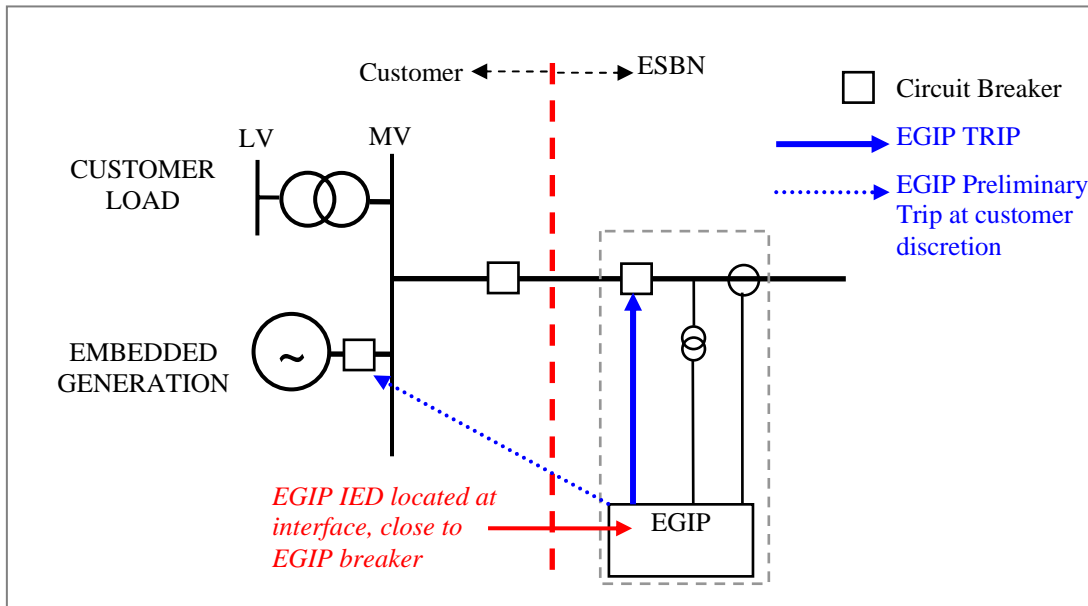


Figure 12: MV connected EG $\geq 2\text{MVA}$ installed capacity



5.0 Synchronising

Table 5: Synchronising Requirements in Embedded Generator Installations

No.	Mode	Requirement
1.	Synchronising	Upon closing of a circuit breaker that connects the generator to the ESB network system, synchronisation of the generator with the system is the responsibility of the IPP.

6.0 Boundaries

Table 6: Ownership and Operational Boundaries

No.	Item	Boundary
1.	Ownership	The ownership boundary between ESB Distribution circuits and Customer circuits is the termination point of ESB main incomer cable on the Customer's plant.
2.	Operational	The system/operational boundary between ESB Distribution circuits and Customer circuits is the Customer's main incomer circuit breaker

7.0 Warning Notices and Labels

Table 7A: Warning Notices and Labels

No.	Plant Item	Requirement	
1.	Main Incomer CB.	Labels	'Main ESB Incomer '
			'<feeder designation> '
		Warning Notices	'The system boundary between the ESB System and <Customer name> System is the Main Incomer Circuit Breaker '
			'The Main Incomer Circuit Breaker is under the operational control of <name of Customer's authorised person> '
4.	Earthing Sw. (for earthing ESB Main Incomer Cable)	Warning Notice	'This earthing switch is under the control of ESB Networks Ltd and must be operated by ESB operator only.'
5.	Relays	Labels	All protection relays must be clearly and correctly labelled

Table 7B: Additional Requirement for embedded Generator Installations

No.	Plant Item	Requirement	
1.	Main Incomer CB	Warning Notice	'Warning Generator may be operating in parallel with ESB Distribution System '

8.0 Operation

Table 8A: Operational Requirements

No.	Item	Requirement
1.	Operations Procedure	Document containing Operations Procedures to be agreed between the Customer and ESB Networks Ltd
2.	Customer Switchroom	Access to be restricted to competent personnel only
3.	Customer Equipment	Operation, Maintenance and Testing to be carried out by fully trained and competent personnel only
4.	Customer Switch Panel	Connection sequence of all connected equipment to be clearly shown
5.	Single Line Diagram	Single Line Diagram of the Customer's network to be mounted in prominent location in the Customer's switchroom

Table 8B: Additional Operational Requirements for MV Dual Radial Installations

No.	Item	Requirement
1.	Operation of Customer's Network	Customer's network shall be operated in radial configuration with normally open points at appropriate MV and LV locations
		The Customer shall transfer load to one feeder and switch off auto-changeover to facilitate ESB Networks Ltd annual maintenance

Table 8C: Additional Operational Requirements for Embedded Generator Installations

No.	Item	Requirement
1.	Operation of Neutral	Neutral of MV and 38kV Generators shall be unearthed when operated in parallel with ESB Distribution System
		Neutral of LV Generators shall operate in accordance with ETCI regulations

Table 8D: Modes of Operation of Embedded Generators covered by this document

No.	Mode	Operation	
1.	Continuous Parallel	Unrestricted periods of operation, subject to Connection Agreement conditions are permitted under continuous parallel mode for asynchronous and synchronous machines.	
2.	Peak Reduction	Generators may operate in two short time parallel modes, Peak Shaving or Peak Lopping in order to reduce the Customer's maximum demand and avail of the Winter Demand Reduction Incentive (WDRI) during November, December, January and February.	
		Peak Shaving	Refers to the parallel operation of a Customer's generator where the generator supplies part of, or, the Customer's entire load. Normally the generator would operate for 2 hrs/day as agreed with ESB Networks Ltd
		Peak Lopping	This refers to where the Customer's generator supplies the Customer's entire load and operates independently of the ESB network. It is however, operated in parallel for short periods at start-up and shutdown of the generator to facilitate a smooth transfer of power from the mains to the generator. The generator may operate in parallel with ESB Distribution System for period's not exceeding 3 minutes at start-up and shutdown of the generator.
3.	Automatic Mains Failure (AMF) Standby Feature	Generators under 1 and 2 above with AMF standby usage in the event of failure of the ESB connection. (Upon restoration, the ESB network connection shall be resumed)	
4.	Standby Generators	Standby generators do not have the facility to operate in parallel with the ESB network therefore the rules of the Electro-Technical Council of Ireland shall apply	
5.	Testing	PARALLEL OPERATION FOR TEST PURPOSES LIMITED TO 6 MINUTES PER 24 HOURS (OUTSIDE WDRI PERIOD)	
6.	Emergency	Sustained parallel operation in emergency conditions such as Load Shedding may be agreed between ESB Networks Ltd and the Customer The decision to override the timing mechanism to allow such operation shall be agreed between ESB Networks Ltd and the Customer Note: Generators installed for Peak Lopping would not be permitted sustained parallel operation	

9.0 Cable Termination

Table 9A : Cable Termination Requirements for MV and 38kV Connections

No.	Plant Item	Provided by	Requirement	
1.	Main Incomer Cable	ESB Networks Ltd	No. cables	3 per CB (normally) (some connections may require 6 per CB, always check with ESB Networks Ltd)
			No. cores per cable	1
			Insulation	XLPE
			Sheath	Black(PE) polyethylene
2.	Terminating Kits for Main Incomer Circuit Breaker	Customer	Suitable for terminating ESB main incomer cable (see table 9b below)	
3.	Space in Customer's Switchroom	Customer	Adequate space to terminate ESB main incomer cable	

Table 9B: Guide to typical Distribution System MV and 38kV Cable Sizes

Subject to change. Always confirm with ESB Networks Ltd

Item	Voltage	Core Size (mm ²)	Core Type	Screen	
				Size (mm ²)	Type
1.	MV	185	Aluminium	25	Cu
		400	Aluminium	25	Cu
		630	Copper	35	Cu
2.	38kV	630	Aluminium	35	Cu

10.0 Metering

Table 10A: Location and Space Requirements of Metering Cabinets

Number of metering cabinets required may vary, always confirm with ESB Networks Ltd

Plant	Item	Requirements			
Metering Cabinet	Size(mm)		width	height	depth
		MV	580	580	185
		MV Dual Radial	600	1800	600
		38kV	600	1000	600
	Location	To be agreed between Customer and ESB Networks Ltd			

Table 10B: Location and Space Requirements of Metering Cubicles containing metering VT's and CT's.

Plant	Item	Requirements			
Metering Cubicles	Location	MV	Installed in ESB Terminal Station		
		MV Dual Radial	Two cubicles required in Customer's Switchroom		
			Size (mm)	Width	height
			1350	1500	750
		38kV	Equipment installed in ESB Terminal Station or in location agreed between Customer and ESB Networks Ltd		

11.0 Terminal Station

Table 11: Terminal Station and Site Requirements

No.	Item	Requirement	Provided By																
1.	Connection	Provide connection at one point in a position agreed between ESB Networks Ltd and Customer	ESB Networks Ltd																
2.	Terminal Station	<table border="1"> <tr> <td>MV</td> <td>Built to ESB Networks Ltd specification 13320</td> </tr> <tr> <td></td> <td>Provide unrestricted access to the Terminal Station at all times over a surfaced right-of-way in accordance with the dimensions specified in ESB Networks Ltd specification 13320</td> </tr> <tr> <td>MV Dual Radial</td> <td>A separate Terminal Station is not required for MV Dual Radial Connections. ESB equipment is installed in Customer's switchroom</td> </tr> <tr> <td></td> <td>Two cable ducts 1m deep with removable covers to be provided in the Customer's switchroom to accommodate ESB MV cables from the metering cubicles to their associated MV Circuit Breakers on the Customer's MV Board.</td> </tr> <tr> <td></td> <td>Three metres of clear space in front of each metering cubicle for operational purposes</td> </tr> <tr> <td>38kV</td> <td>Built in accordance with drawings provided to the Customer by ESB Networks Ltd local office</td> </tr> <tr> <td></td> <td>Provide unrestricted access to the Terminal Station at all times over a surfaced right-of-way of 5 metres minimum width</td> </tr> <tr> <td></td> <td>Construct safety fence around Terminal Station to ESB Networks Ltd specification 10241</td> </tr> </table>	MV	Built to ESB Networks Ltd specification 13320		Provide unrestricted access to the Terminal Station at all times over a surfaced right-of-way in accordance with the dimensions specified in ESB Networks Ltd specification 13320	MV Dual Radial	A separate Terminal Station is not required for MV Dual Radial Connections. ESB equipment is installed in Customer's switchroom		Two cable ducts 1m deep with removable covers to be provided in the Customer's switchroom to accommodate ESB MV cables from the metering cubicles to their associated MV Circuit Breakers on the Customer's MV Board.		Three metres of clear space in front of each metering cubicle for operational purposes	38kV	Built in accordance with drawings provided to the Customer by ESB Networks Ltd local office		Provide unrestricted access to the Terminal Station at all times over a surfaced right-of-way of 5 metres minimum width		Construct safety fence around Terminal Station to ESB Networks Ltd specification 10241	Customer
MV	Built to ESB Networks Ltd specification 13320																		
	Provide unrestricted access to the Terminal Station at all times over a surfaced right-of-way in accordance with the dimensions specified in ESB Networks Ltd specification 13320																		
MV Dual Radial	A separate Terminal Station is not required for MV Dual Radial Connections. ESB equipment is installed in Customer's switchroom																		
	Two cable ducts 1m deep with removable covers to be provided in the Customer's switchroom to accommodate ESB MV cables from the metering cubicles to their associated MV Circuit Breakers on the Customer's MV Board.																		
	Three metres of clear space in front of each metering cubicle for operational purposes																		
38kV	Built in accordance with drawings provided to the Customer by ESB Networks Ltd local office																		
	Provide unrestricted access to the Terminal Station at all times over a surfaced right-of-way of 5 metres minimum width																		
	Construct safety fence around Terminal Station to ESB Networks Ltd specification 10241																		
3.	Power	Provide 5kVA LV supply free of charge for heating and lighting of Terminal Station																	
4.	Cable Trenching	Excavation, ducting and reinstatement of cable/earthing trenches within confines of site																	
5.	SCADA	Where the Maximum Export Capacity is 1 MVA or greater, the customer/generator is required to provide a dial-up telephone line to the terminal station for use by ESB SCADA system.																	
6.	Indemnity	Indemnify ESB Networks Ltd against any claim that may arise by reason of excavation, ducting, trenching or backfilling																	

Table 11: Terminal Station and Site Requirements

No.	Item	Requirement	Provided By
7.	Planning Permission and Site Transfer	It is the responsibility of the Customer to obtain and comply with planning permission for the site and the legal transfer of the site to ESB as per 'Acceptance of Offer' requirements detailed in clause 6. 0 in the 'Guide to the Process for Connection to the Distribution System'	
8.	Arrangements for Occupation of site	If necessary, grant possession rights in writing to ESB pending completion of legal formalities of the site transfer	

12.0 Earthing

Table 12A: Earthing Requirements

No.	Connection Type	Requirement			
1.	MV	Earthing in Terminal Station to be carried in accordance with ESB Networks Ltd specification 13320			
2.	MV Dual Radial	Customer's MV Earth Grid	Max Resistance	20 Ohms	
			Min size of Conductor	25mm ² Copper	
			Equipment Bonded to MV Earth Grid	All MV equipment and exposed metalwork	
				Earth screens on ESB MV Cables	
				Enclosures for metering equipment	
				Enclosures for metering VT/CT secondary leads	
				Metal doors and frames	
				Earth Mat - installed 0.2 metres below ground level (1 metre wide x full width of metal doors)	
		If combined resistance of LV and MV earth grid ≤ 1 Ohm then Customer's LV earth grid must be bonded to MV earth grid If combined resistance > 1 Ohm then, LV and MV Earths Grids must be separated. See table 12B below			
Customer's LV Earth Grid	Customer's LV neutral and LV equipment in MV switchroom to be earthed in accordance with ETCI Regulations				
3.	38kV	Earthing in Terminal Station to be carried out in accordance with ESB Networks Ltd Drawing No. 205724 provided to the Customer by ESB Networks Ltd local office			

Table 12B: Additional Requirements for MV Dual Radial Installations where Combined Resistance of LV and MV Earth Grid >1 Ohm

No.	Item	Earthing Requirement		
1.	Separation of MV and LV Earth Grids	Soil Type	Normal	Minimum Separation 4 Metres
			Rocky	Minimum Separation 10 Metres
2.	LV Switchgear in immediate vicinity of MV Equipment	Metal frames of LV Switchgear must be bonded to MV Earth Grid		
		20mm min clearance in air between metal frame of LV switchgear and LV phase and neutral conductors		
3.	Outer Walls of Switchroom	Constructed from Non-conductive material		

13.0 Commissioning and Certification

Table 13A: Commissioning, Certification and Test Information

No.	Certification/Information	When	Provided By
1.	Main Incomer Circuit Breaker Protection Relay Settings	<p>Minimum of five working days before Energisation Date</p> <p>These relay settings will be supplied to the Customer at an earlier date - provided the ESB System Performance Team have been given all the relevant Customer information</p>	ESB Networks Ltd
2.	ESB Protection Equipment	<p>Minimum of five working days before Energisation Date</p> <p>These relay settings will be supplied to the Customer at an earlier date - provided the ESB System Performance Team have been given all the relevant Customer information</p>	ESB Networks Ltd
3.	<p>Customer Protection CT Ratios</p> <p>Note: Should be chosen in accordance with the sensitivity requirements</p>	Terminal Station Completion	Customer
4.	Protection Relay Type		
5.	Primary and Secondary Test Sheets for the Main Incomer Circuit Breakers Protection Relays	Two working days before Energisation Date*	
6.	Confirmation of Relay Settings		
7.	Declaration of Fitness for Service	Energisation Date	
8.	Earthing has been installed as outlined in this document	Energisation Date	

*except where an active connection is required for the test to be carried out

Table 13B: Additional Information Required for Dual Radial Installations

No.	Certification/Information	When	Provided By
1.	Measured resistance of MV and LV earth grids	Energisation Date	Customer
2.	Distance separating MV and LV earth grids if combined resistance >1 Ohm		

Table 13C: Additional tests required for Embedded Generation Installations

Note: Paralleling shall not take place for testing, pre-commissioning or commissioning purposes without the prior consent of ESB Networks Ltd.

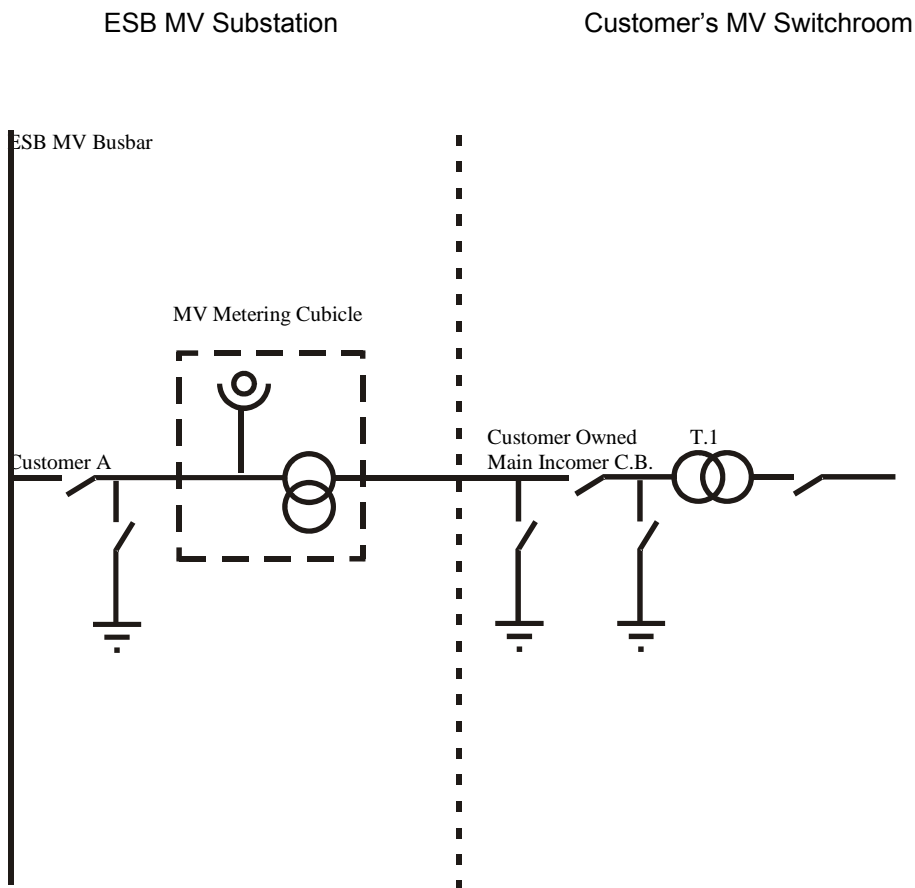
No.	Tests	Requirement	Carried out by	Witnessed by	Notice
1.	Synchronising Facilities and Interface Protection	Pre-commissioning Tests to be carried out prior to Compliance Tests	Customer on site		
		Compliance Tests to be carried out in accordance with Test Schedule in Appendix 2 of this document	Customer on site	ESB Networks Ltd	Minimum of two weeks
2.	Interface Protection	Commissioning	ESB Networks Ltd		Minimum of two weeks

Table 13D: Additional information required prior to Compliance Test date for Embedded Generation Installations

No.	Information	When	Provided by
1.	Confirmation that testing can proceed on agreed test date	Minimum of one working day before agreed test date	Customer
2.	Confirmation of completion of Customer's pre-commissioning tests		
3.	Completed pre-commissioning test result sheets		
4.	Details of equipment to be used on the test date		

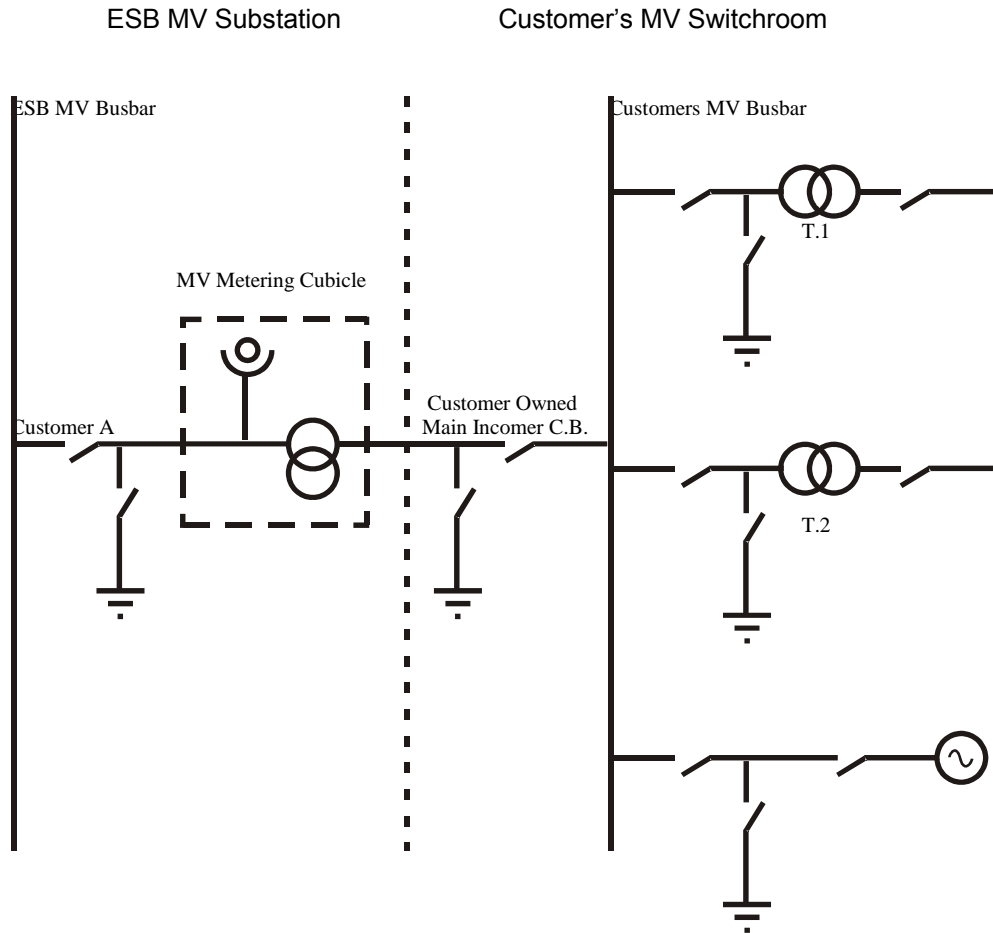
APPENDIX 1 SCHEMATICS

MV Single Transformer



No.	Item	Reqd. by	Requirement
1.	Earthing Facilities	ESB Networks Ltd.	Earthing facility required on main incomer cable
		S.I. 44	Customer to consult S.I. 44 for earthing requirements on Customer's equipment
2.	Interlocking	ESB Networks Ltd.	Interlocking to be provided between disconnection point and earthing facility on main incomer cable.
3.	Isolation of ESB Network	ESB Networks Ltd.	Customer to provide a means of isolating ESB network in the event of a fault on Customer's equipment.
4.	Disconnection Point	ESB Safety Rules	If a visible point of disconnection is not provided at the interface point, then under ESB safety rules, ESB Networks Ltd. will have to approve the use of the proposed Customer's equipment as a 'point of disconnection'. ESB Networks Ltd. will require the Customer to carry out a risk assessment on the use of the equipment as part of the approval process.

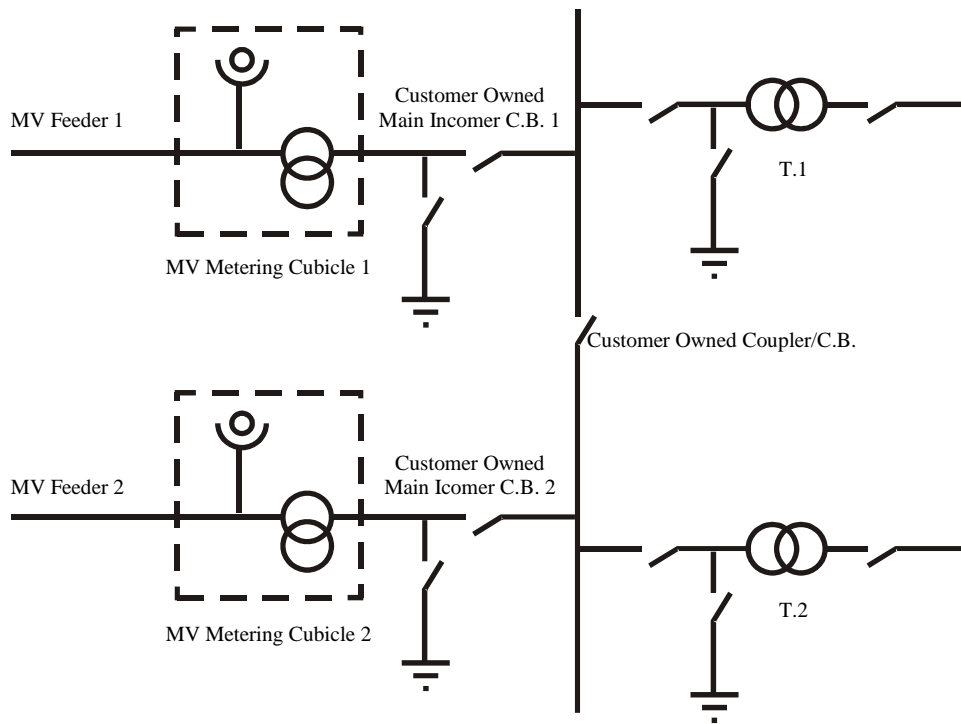
MV Multi Transformer



No.	Item	Reqd. by	Requirement
1.	Earthing Facilities	ESB Networks Ltd.	Earthing facility required on main incomer cable
		S.I. 44	Customer to consult S.I. 44 for earthing requirements on Customer's equipment
2.	Interlocking	ESB Networks Ltd.	Interlocking to be provided between disconnection point and earthing facility on main incomer cable.
3.	Isolation of ESB Network	ESB Networks Ltd.	Customer to provide a means of isolating ESB network in the event of a fault on Customer's equipment.
4	Disconnection Point	ESB Safety Rules	If a visible point of disconnection is not provided at the interface point, then under ESB safety rules, ESB Networks Ltd. will have to approve the use of the proposed Customer's equipment as a 'point of disconnection'. ESB Networks Ltd. will require the Customer to carry out a risk assessment on the use of the equipment as part of the approval process.

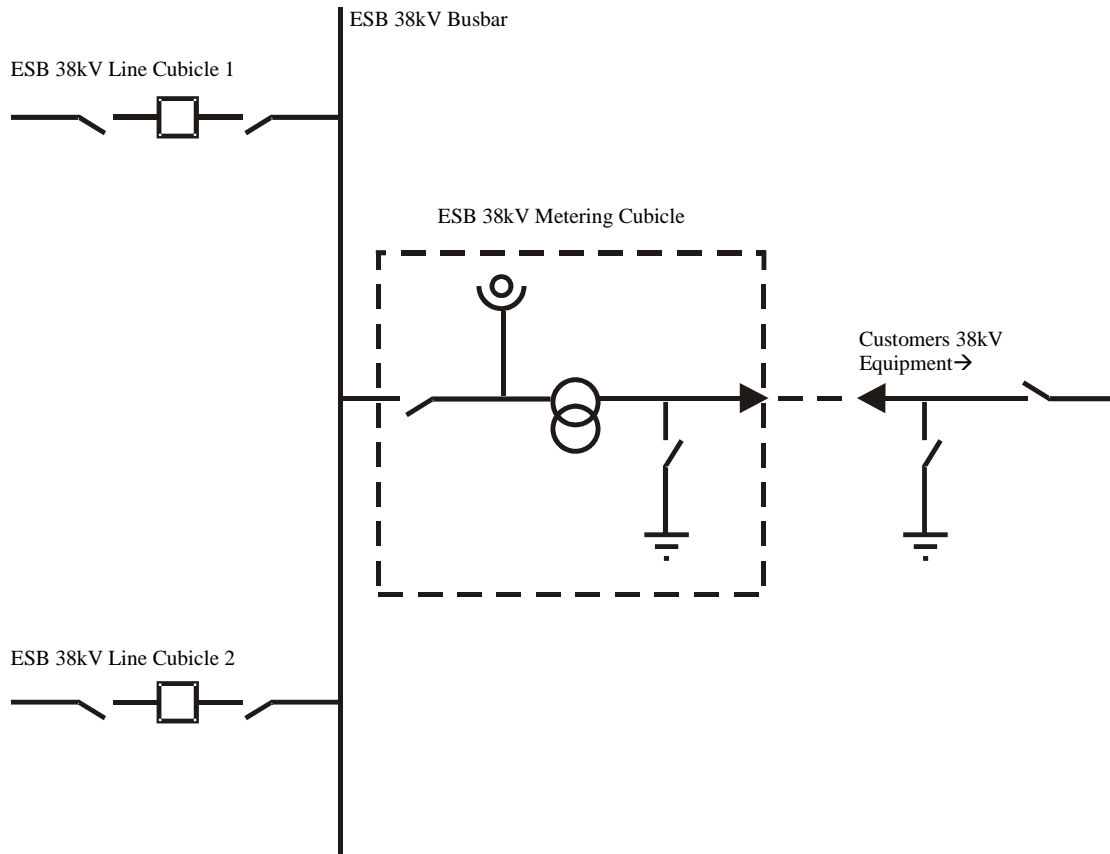
MV Dual Radial Connection

Customer's MV Switchroom



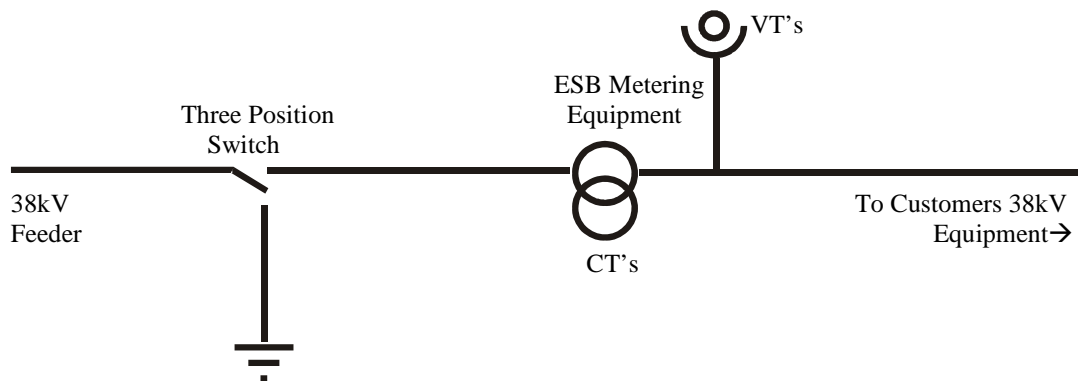
No.	Item	Reqd. by	Requirement
1.	Earthing Facilities	ESB Networks Ltd.	Earthing facility required on main incomer cable
		S.I. 44	Customer to consult S.I. 44 for earthing requirements on Customer's equipment
2.	Interlocking	ESB Networks Ltd.	Interlocking to be provided between disconnection point and earthing facility on main incomer cable.
3.	Isolation of ESB Network	ESB Networks Ltd.	Customer to provide a means of isolating ESB network in the event of a fault on Customer's equipment.
4.	Disconnection Point	ESB Safety Rules	If a visible point of disconnection is not provided at the interface point, then under ESB safety rules, ESB Networks Ltd. will have to approve the use of the proposed Customer's equipment as a 'point of disconnection'. ESB Networks Ltd. will require the Customer to carry out a risk assessment on the use of the equipment as part of the approval process.

38kV A.I.S. Connection



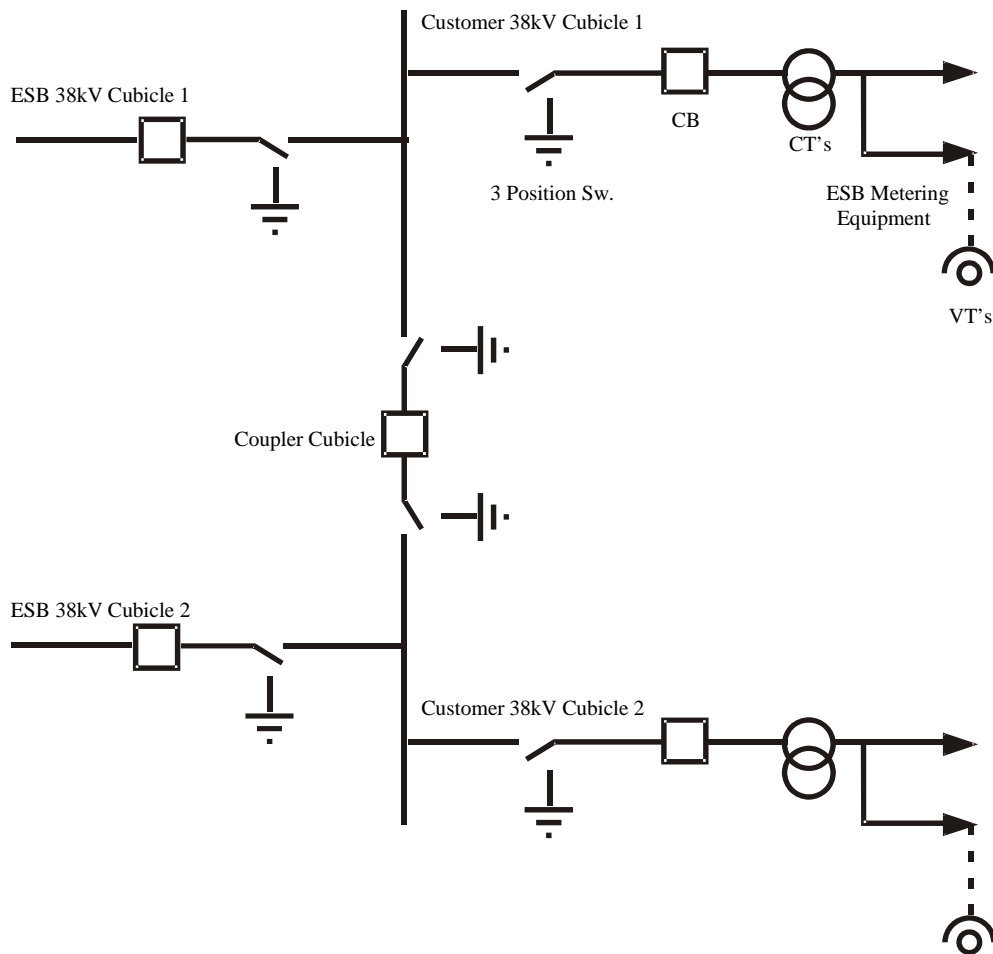
No.	Item	Reqd. by	Requirement
1.	Earthing Facilities	ESB Networks Ltd.	Earthing facility required on main incomer cable
		S.I. 44	Customer to consult S.I. 44 for earthing requirements on Customer's equipment
2.	Interlocking	ESB Networks Ltd.	Interlocking to be provided between disconnection point and earthing facility on main incomer cable.
3.	Isolation of ESB Network	ESB Networks Ltd.	Customer to provide a means of isolating ESB network in the event of a fault on Customer's equipment.

38kV Windfarm



No.	Item	Reqd. by	Requirement
1.	Earthing Facilities	ESB Networks Ltd.	Earthing facility required on main incomer cable
		S.I. 44	Customer to consult S.I. 44 for earthing requirements on Customer's equipment
2.	Interlocking	ESB Networks Ltd.	Interlocking to be provided between disconnection point and earthing facility on main incomer cable.
3.	Isolation of ESB Network	ESB Networks Ltd.	Customer to provide a means of isolating ESB network in the event of a fault on Customer's equipment.
4.	Interface Protection	ESB	Interface breaker and Protection as per Section 4

38kV G.I.S. SF6 Connection



No.	Item	Reqd. by	Requirement
1.	Earthing Facilities	ESB Networks Ltd.	Earthing facility required on main incomer cable
		S.I. 44	Customer to consult S.I. 44 for earthing requirements on Customer's equipment
2.	Interlocking	ESB Networks Ltd.	Interlocking to be provided between disconnection point and earthing facility on main incomer cable.
3.	Isolation of ESB Network	ESB Networks Ltd.	Customer to provide a means of isolating ESB network in the event of a fault on Customer's equipment.
4.	Interface Protection	ESB Networks Ltd.	Interface breaker and Protection as per Section 4

APPENDIX 2 TEST SCHEDULE FOR GENERATORS

INTERFACE PROTECTION TEST SCHEDULE FOR CONNECTION OF GENERATORS TO ESB DISTRIBUTION SYSTEM

As already stated the Customer is responsible for carrying out the pre-commissioning and compliance tests and should ensure that the following are provided:

- (a) All test equipment, including:
 - Variable voltage supply (3 phase if necessary),
 - Variable frequency signal generator,
 - Phase shifting current/voltage injection kit (for DOC),
 - Rate-of-change-of-frequency/vector-shift kit (for LOM)
 - Timer.
- (b) Competent personnel to operate the equipment.

The purpose of the tests is to check each protection element specified in the requirements for:

- Functional operation by secondary injection.
- Calibration by secondary injection.
- Fail-safe operation.

Operational tests are to be carried out to verify:

- Automatic synchronising and interlocking.
- Tripping of the isolating circuit breaker for protection operation.
- Fail safe operation of the trip circuit with back-up circuit breaker operation.

The Test Schedule has been drafted to include all protection elements. Depending on the type of machine and operating regime, some protection elements may not be required. If in doubt please check with ESB Networks Ltd to confirm which tests are applicable.

TEST PROCEDURE

The following test procedure is an example of the normal means of testing the elements of interface protection. Alternative test procedures may be acceptable but should be advised to ESB Networks Ltd prior to tests being arranged.

It is advisable that the people doing the tests understand what is required, and any queries on any aspects of the tests should be directed towards ESB Networks Ltd in advance of the agreed date. **Two weeks notice of this date is required.**

Confirmation (in the form of completed test reports) that all pre-commissioning tests have been completed and that the protection is ready for final testing should be sent to ESB Networks Ltd **at a minimum of 24 hours in advance** of the agreed date.

Notes: **PARALLEL OPERATION FOR TEST PURPOSES SHOULD NOT TAKE PLACE WITHOUT PRIOR WRITTEN PERMISSION FROM THE RELEVANT ESB SYSTEM CONTROLLER.**

SOME TESTS WILL REQUIRE A SHORT DURATION SUPPLY INTERRUPTION TO THE INSTALLATION, SUCH INTERRUPTIONS ARE THE RESPONSIBILITY OF THE CUSTOMER AND CARRIED OUT AT THE CUSTOMER'S EXPENSE.

The following tests will verify the operation and calibration of individual protection elements. The attached blank 'Test Results Sheet' should be filled in while doing the tests.

1. VOLTAGE PROTECTION

Over Voltage - Calibration

- (a) Secondary-inject each phase in turn, raising the voltage until the relay operates for the over voltage setting required.
- (b) Note the total operating time.
- (c) Reduce the voltage and check the reset value.

Under Voltage - Calibration

- (a) Secondary-inject each phase in turn, lowering the voltage until the relay operates for the under voltage setting required.
- (b) Note the total operating time.
- (c) Raise the voltage and check the reset value.

Over Voltage - Operation

- (a) With the generator running in parallel, lower the voltage setting of each phase in turn, until the relay operates on over voltage, tripping the Isolating Switch.
- (b) Note the total tripping time.
- (c) Check that the Isolating Switch cannot be reclosed until the relay has reset correctly.

If the protection cannot be checked in this way, the correct operation of the relay and tripping of the Isolating Switch should be verified by secondary injection.

Under Voltage - Operation

- (a) With the generator running in parallel, raise the voltage setting of each phase in turn, until the relay operates on under voltage, tripping the Isolating Switch.
- (b) Note the total tripping time.
- (c) Check that the Isolating Switch cannot be reclosed until the relay has reset correctly.

If the protection cannot be checked in this way, the correct operation of the relay and tripping of the Isolating Switch should be verified by secondary injection.

2. FREQUENCY PROTECTION

Over Frequency - Calibration

- (a) Secondary-inject the relay, raising the frequency until the relay operates for the over frequency setting required.
- (b) Note the total operating time.
- (c) Reduce the frequency and check the reset value.

Under Frequency - Calibration

- (a) Secondary-inject the relay, lowering the frequency until the relay operates for the under frequency setting required.
- (b) Note the total operating time.
- (c) Raise the frequency and check the reset value.

Over Frequency - Operation

- (a) With the generator running in parallel, lower the frequency setting until the relay operates on over frequency, tripping the Isolating Switch.
- (b) Note the total tripping time.
- (c) Check that the Isolating Switch cannot be reclosed until the relay has reset correctly.

If the protection cannot be checked in this way, the correct operation of the relay and tripping of the Isolating Switch should be verified by secondary injection.

Under Frequency - Operation

- (a) With the generator running in parallel, raise the frequency setting until the relay operates on under frequency, tripping the Isolating Switch.
- (b) Note the total tripping time.
- (c) Check that the Isolating Switch cannot be reclosed until the relay has reset correctly.

If the protection cannot be checked in this way, the correct operation of the relay and tripping of the Isolating Switch should be verified by secondary injection.

3. DIRECTIONAL OVERCURRENT PROTECTION

Directional Overcurrent - Calibration

- (a) Secondary-inject each phase in turn, raising the current until the relay operates for the current setting required.
- (b) Using a phase shifting kit, verify that the relay is directional, the characteristic is correct and that the relay blocks in the reverse mode.
- (c) Note the total operating time.

Directional Overcurrent - Operation

- (a) With the generator running in parallel, arrange for it to supply an overcurrent to the ESB network system. Confirm the relay operates tripping the Isolating Switch.
- (b) Note the total tripping time.
- (c) Check that the Isolating Switch cannot be reclosed until the relay has reset correctly.

If the protection cannot be checked in this way, the correct operation of the relay and tripping of the Isolating Switch should be verified by secondary injection.

4. LOSS OF MAINS PROTECTION

ROCOF - Calibration

- (a) Using a rate of change of frequency test kit, secondary-inject the relay raising the rate of change of frequency until the relay operates for the required setting.
- (b) Note the total operating time.

Vector Shift - Calibration

- (a) Using a vector shift test kit, secondary-inject the relay raising the vector shift angle until the relay operates for the required setting.
- (b) Note the total operating time.

Loss of Mains - Operation

The Loss of Mains test will require an interruption in ESB supply. The Customer should arrange this for the date upon which the witnessing of the final compliance tests is to take place. Usually this will involve the opening of an ESB Switch, in which case it will be necessary for the Customer to make an arrangement with ESB Networks Ltd via the relevant system controller.

- (a) With the generator running in parallel, simulate a single-phase loss of mains by opening a single pole switch on the supply side of the main incomer CB. Confirm the relay operates tripping the Isolating Switch.
- (b) Note the total tripping time.
- (c) Reset all relays and check that the Isolating Switch cannot be reclosed until the mains supply has been restored to normal.
- (d) With the generator running in parallel, simulate a three-phase loss of mains by opening a switch on the supply side of the main incomer CB. Confirm the relay operates tripping the Isolating Switch.
- (e) Note the total tripping time.
- (f) Reset all relays and check that the Isolating Switch cannot be reclosed until the mains supply has been restored to normal.

5. EARTH FAULT PROTECTION

Earth Fault - Calibration

- (a) Secondary-inject the relay, raising the voltage until the relay operates for the voltage setting required.
- (b) Note the total operating time.
- (c) Reduce the voltage and check the reset value.

Earth Fault - Operation

- (a) With the generator running in parallel, lower the voltage setting until the relay operates, tripping the Isolating Switch.
- (b) Note the total tripping time.
- (c) Check that the Isolating Switch cannot be reclosed until the relay has reset correctly.

If the protection cannot be checked in this way, the correct operation of the relay and tripping of the Isolating Switch should be verified by secondary injection.

6. REVERSE POWER (IF APPLICABLE)

Reverse Power - Calibration

- (a) Secondary-inject the relay, raising the power injected until the relay operates for the specified setting.
- (b) Note the total operating time.

Reverse Power - Operation

- (a) With the generator running in parallel, arrange for it to supply power to the ESB network system. Lower the setting until the relay operates, tripping the Isolating Switch.
- (b) Note the total tripping time.
- (c) Check that the Isolating Switch cannot be reclosed until the relay has reset correctly.

If the protection cannot be checked in this way, the correct operation of the relay and tripping of the Isolating Switch should be verified by secondary injection.

7. PROTECTION FAILSAFE OPERATION

Disconnect the power supply from each relay in turn and check that a trip signal is sent to the Isolating Switch.

8. TRIP CIRCUIT SUPERVISION

Disconnect/interrupt the trip circuit from each relay in turn. This should bring up an audible alarm and trip the Isolating Switch.

Disable the tripping of the output circuit breaker and simulate the trip condition. Failure of the circuit breaker to trip should isolate the generator via an alternative circuit breaker.

9. NEUTRAL ISOLATION

Where neutral earthing is applied with an MV or 38kV generator operating independent of ESB network system, check that interlocking operates to disconnect this neutral during parallel operation of the generator.

10. SYNCHRONISING

- (a) Check that auto-synchronising operates correctly for each synchronising point.
- (b) Check that interlocking prevents closure onto a dead busbar, for all possible combinations of mains and generators.
- (c) Check that interlocking prevents unsynchronised paralleling at all possible points of paralleling.

11. TIMING CONTROL FOR PEAK LOPPING/PEAK SHAVING

- (a) Check that the time delay to trip is correct.
- (b) Check that the trip signal causes the Isolating Switch to trip.
- (c) Check that the override switch, if provided, can be sealed.

12. GENERATOR SHUTDOWN

For operation of the emergency stop or manual/automatic shutdown, verify that the Isolating Switch opens and the prime mover shuts down.

13. PROTECTION SEALS & LABELLING

Check that all protection relays specified in ESB Networks Ltd requirements are in a separate cabinet are labelled clearly and correctly and can be sealed.

14. WARNING NOTICE - PARALLEL OPERATION

Check that a warning notice of generator operating in parallel with the ESB network system is fitted to the Main Incoming Circuit Breaker.

TEST SCHEDULE

FOR CONNECTION OF GENERATORS TO ESB DISTRIBUTION SYSTEM

TEST RESULTS SHEETS

TEST RESULTS SHEET

SITE DETAILS	GENERATOR DETAILS
Location:	Type:
Owner:	Operating Mode:
Contractor:	Rating:
Telephone No(s):	Voltage:
	Supply Details:

Relay Details	Manufacturer	Type
Voltage:		
Frequency:		
Loss of Mains:		
Directional		
Overcurrent:		
Earth Fault:		

RELAY CALIBRATION					
PROTECTION FUNCTION	NOMINAL VALUE	OPERATION/SETTING	OPERATION VALUE TIME		RESET VALUE
Over Voltage		+10%			
R-N or R-S	V		V		V
S-N or S-T	V	Time	V		V
T-N or T-R	V	Typical ≤ 0.5 sec	V		V
Under Voltage		-10%			
R-N or R-S	V		V		V
S-N or S-T	V	Time	V		V
T-N or T-R	V	Typical ≤ 0.5 sec	V		V
Over Frequency	50Hz	+ 1%			
		Time < 0.5 sec	Hz		Hz
Under Frequency	50Hz	- 4%			
		Time < 0.5 sec	Hz		Hz
Directional Overcurrent					
R Phase	A	50%	A		
S Phase	A	or	A		
T Phase	A	120%	A		
		Time ≤ 0.5 sec			
Loss of Mains		Trip on			
R Phase	df/dt	Loss of Mains	Hz/s		
S Phase		Time ≤ 0.5 sec			
T Phase	Hz/s				
Three Phase					
Earth Fault Detection	V	Trip for Earth Fault			
		Time < 1 min.	V		V

Test Results Sheet

		FUNCTIONAL OPERATION TEST		
		PROTECTION FUNCTION	ISOLATING CB OPEN Y/N?	GENERATOR SHUTDOWN Y/N?
OPERATING CONDITIONS Y/N? Automatic Synchronising Interlocking to prevent closure onto Dead Busbar Standby/Independent operation – Auto/Man C/O Isolating CB manual close operation – Disabled		Emergency Stop		
		Voltage Relay OV Voltage Relay UV		
		Frequency Relay OF Frequency Relay UF Directional OC Relay Earth Fault Relay		
After a Protection Trip - Relay/s cannot be reset until ESB network supply is normal - Isolating CB cannot be closed until Relay/s reset		Protection Fail-safe Trip Circuit Supervision		
SEALING : Relays can accept Seals		Loss of Mains Relay - Single Phase - Three Phase		

After ESB network supply returns to normal, Automatic Restart / Resumption of Parallel Operation - Time Delay : 5 Minutes	
Timing Control - Hours of Operation :	2.5 Hours (Peak Shaving) 6 Minutes (Peak Lopping)

NOTES:

NAME OF TESTER (block capitals): _____

POSITION WITHIN COMPANY: _____

COMPANY NAME: _____

ADDRESS OF COMPANY: _____

SIGNATURE OF TESTER: _____

DATE : _____

APPENDIX 3 DECLARATION OF FITNESS FOR SERVICE

DECLARATION OF FITNESS FOR SERVICE

To : **Distribution System Operator, ESB**

Customer Name : _____

Address of Installation: _____

DETAILS OF CUSTOMER'S INSTALLATION:

Reference No. (Job ID or MPRN) _____

Supply Voltage _____

Number of circuit breakers (at supply voltage) _____

Length of cable (at supply voltage) _____

Number of Transformers (at supply voltage) _____

Other Equipment (at supply voltage) _____

Relay Settings (primary) (main incomer c/b) _____

Generator installed designed for operating in parallel with ESB network? **Y/N**

CERTIFICATION:

I certify that the electrical installation at the above address has been inspected and tested and complies with the relevant requirements of S.I. no.44 1993 Part VIII. I also confirm that the installation complies with the Distribution Code and is fit for connection to the ESB network.

Name (block capitals) and Signature of Customer's Contractor/Technical Representative.

Name of Company and Position within Company.

Date: _____

APPENDIX 4 EGIP DESIGN REFERENCES

EGIP protection system design must comply with ESB Networks Ltd standards. Guidance on the station design should be sought from the ESB Renewable Connections team (Contact details as per the connection offer letter).

The required standard protection elementary drawings for EGIP relays are listed below. The latest revision of these drawings should be sourced from ESB Renewable Connections.

Tables 4E to 4K in Section 4 of this document should first be used to establish which protection relays are required for a particular EG installation so that the correct elementary drawings can be selected from the list below.

A4.1 Relay Elementary Drawings for MV Interfaces

Protection Functions	Title	Drawing Number
Under and Over Voltage, Under and Over Frequency, Loss of Mains (ROCOF), Backup Under-Voltage	Elementary Diagram Of Protection For Embedded Generator Interfaces (EGIP) using the Siemens 7SJ804 Relay and Siemens 7RW600 Relay on MV Interfaces	PG406-D009-444-001
Directional Overcurrent	Elementary Diagram Of Directional Overcurrent Protection For Embedded Generator Interfaces (EGIP) using the Siemens 7SJ621 Relay on MV Interfaces	PG406-D009-354-001 PG406-D009-357-001
Earth Fault Protection (NVD)	Elementary Diagram Of Earth Fault Protection (NVD) For Embedded Generator Interfaces (EGIP) using the Siemens 7SJ804 Relay on MV Interfaces	PG406-D009-536-001-001 PG406-D010-550-001-000 PG406-D010-551-001-000

A4.2 Relay Elementary Drawings for 38kV Interfaces

Protection Functions	Title	Drawing Number
Under and Over Voltage, Under and Over Frequency, Loss of Mains (ROCOF)	Elementary Diagram Of Protection For Embedded Generator Interfaces (EGIP) using the Siemens 7SJ804 Relay and Siemens 7RW600 Relay on 38kV Interfaces	PG406-D009-444-002
Feeder Impedance Protection	Elementary Diagram Of Feeder Impedance Protection For Embedded Generator Interfaces (EGIP) using the Siemens 7SA611 Relay on 38kV Interfaces	PG406-D009-088-001 PG406-D010-285-001 PG406-D009-230-001
Feeder Impedance Protection with Intertripping	Elementary Diagram Of Feeder Impedance Protection with Intertripping For Embedded Generator Interfaces (EGIP) using the Siemens 7SA611 Relay on 38kV Interfaces	PG406-D009-527-001
Earth Fault Protection (NVD)	Elementary Diagram Of Earth Fault Protection (NVD) For Embedded Generator Interfaces (EGIP) using the Siemens 7SJ804 Relay on 38kV Interfaces	PG406-D009-536-001-001
Cable Differential	Elementary Diagram Of Feeder Differential Protection For Embedded Generator Interfaces (EGIP) using the Toshiba GRL150 Relay on 38kV Interfaces	PG406-D009-412-001 PG406-D010-463-001 PG406-D009-184-001 PG406-D010-462-001
Busbar Impedance	Elementary Diagram Of Busbar Impedance Protection For Embedded Generator Interfaces (EGIP) using the Siemens 7SA611 Relay on 38kV Interfaces	PG406-D010-326-001
Busbar Differential	Elementary Diagram Of Busbar Differential Protection For Embedded Generator Interfaces (EGIP) using the ABB REB 670 Relay on 38kV Interfaces	PG406-D009-456-002 to 008

A4.3 Relay Elementary Drawings for 110kV Interfaces

Protection Functions	Title	Drawing Number
Under and Over Voltage, Under and Over Frequency, Loss of Mains (ROCOF)	Elementary Diagram Of Protection For Embedded Generator Interfaces (EGIP) using the Siemens 7SJ804 Relay and Siemens 7RW600 Relay on 110kV Interfaces	PG406-D010-517-001
Loss of Mains (Special Protection Scheme)	Elementary Diagram Of Loss of Mains Protection For Embedded Generator Interfaces (EGIP) using a Special Protection Scheme (SPS) on 110kV Interfaces	PG406-D010-513-001
Feeder Impedance Protection with Intertripping. Trip for single phase earth faults	Elementary Diagram Of Feeder Impedance Protection For Embedded Generator Interfaces (EGIP) using the Siemens 7SA612 Relay on 110kV Interfaces	PG406-D010-284-001
Feeder Impedance Protection with Intertripping. Duplicate Impedance protection. Trip for single phase earth faults	Elementary Diagram Of Duplicate Feeder Impedance Protection For Embedded Generator Interfaces (EGIP) using the Toshiba GRZ100 Relay on 110kV Interfaces	PG406-D010-483-001
Overcurrent Protection of 38kV Transformer Feeders (in 38kV and 110kV substations)	Elementary Diagram Of Protection using the 7SJ804 Relays. Special Application to the 38kV-side of 38kV/MV power transformers	PG406-D010-548-001
Busbar Differential	Elementary Diagram Of Busbar Differential Protection For Embedded Generator Interfaces (EGIP) using the ABB REB 670 Relay on 110kV Interfaces	PG406-D010-544-002 to 009
Earth Fault Protection (NVD)	Elementary Diagram Of Earth Fault Protection (NVD) For Embedded Generator Interfaces (EGIP) using the Siemens 7RW600 Relay on 110kV Interfaces	PG406-D010-523-001
Busbar Impedance	Elementary Diagram Of Protection For Embedded Generator Interfaces (EGIP) using the Siemens 7SA611 distance Relay on 110kV Interfaces General Application (Non-SCS) as 110kV-Side "Backup" Protection to 110kV Busbar-Terminated 110/38kV and 110kV/MV Power Transformers	PG406-D010-509-001
Cable Differential	Elementary Diagram Of Feeder Differential Protection For Embedded Generator Interfaces (EGIP) using the Toshiba GRL100 Relay on 110kV Interfaces	PG406-D010-292-001