Networks

Conditions Governing Connection to the Distribution System:

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

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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It is anticipated that this document will be superseded in time by additions to the Distribution Code and to the National Code of Practice.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 1.2/50μS	**125kV** peak	
		38kV		Phase-Phase & Phase-Earth	Across isolating distance**
			Power Frequency	**95kV** rms	**110kV** rms
			Impulse Level 1.2/50μS	**250kV** peak	**290kV** peak
4.	**Short Circuit Rating (RMS Symmetrical)** Always confirm with ESB Networks	**MV and 38kV (Normally)**		**12.5kA**	
		MV and 38k (Designated Areas)*		**20kA**	
		MV Dual Radial		**20kA**	
5.	**Rated Frequency**	**50Hz.**			
6.	**No. of Poles**	**3**			
7.	**Earthing Switch**	**Capable of short-circuiting and earthing the ESB Networks main incomer cable** For single Circuit Breaker connections an earthing switch is required on the incoming and outgoing sides of the Circuit Breaker.			
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 Networks danger lock** (7mm. minimum diameter hole)			

<table>
<tr><td rowspan="5">10.</td><td rowspan="5">Visible point of Disconnection</td><td colspan="4">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.</td></tr>
<tr><td colspan="2">Insulation Level</td><td>Phase-Phase & Phase-Earth</td><td>Across isolating distance**</td></tr>
<tr><td rowspan="2">MV</td><td>Power Frequency</td><td>50kV rms</td><td>60kV rms</td></tr>
<tr><td>Impulse Level 1.2/50μS</td><td>125kV peak</td><td>145kV peak</td></tr>
<tr><td colspan="4">Test 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 ESB Networks on request.</td></tr>
<tr><td colspan="4">Conformance with IEC 62271-102 Clause 5.502</td></tr>
</table>

***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 will confirm the fault level for the Customer by carrying out the required calculations taking into account the contribution of the Customers 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**	**Manual closing of either the generator circuit breaker or the main incoming circuit breaker circuit breakers shall be disabled when either the ESB Networks or generator source is live.** **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**
		Interlocking shall prevent closure of interconnecting switchgear when both the generator and ESB Networks sources of supply are dead. It shall only be possible to close onto a dead busbar when either ESB Networks or generator source of supply is isolated

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.

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 Networks main incomer cable
2.	No. of Poles	3
3.	Short-Circuit Withstand	≥ Circuit Breaker
4.	Locking	Lockable in 'ON' and 'OFF' positions with ESB Networks 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

Table 4A: Isolation and Maximum Permitted Relay Settings

No.	Item	Provided by	Necessity
1.	Isolation of ESB Networks equipment from Customers equipment	Customer	Customer to provide a means of isolating ESB Networks equipment in the event of a fault on the Customers equipment.
2.	Max. Permitted Relay Settings on Main Incomer CB	ESB Networks	ESB Networks determined settings on the Customer's relay are necessary to provide selectivity with ESB Networks Distribution protection.

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	2
			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	Individual phase CT's for overcurrent protection may not be fitted on ESB Networks incoming cable. If a core balance CT is required to achieve the earth fault sensitivity specified above, then it may be fitted to ESB Networks incoming cable, provided that: ❑ 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. or ❑ 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.	Customers Protection Scheme	To take account of the main incomer circuit breakers maximum permissible relay settings

4.1 Additional Requirements for Interface Protection of Embedded Generator Installations

Generator interface protection is designed to disconnect the generator from the ESB networks during abnormal system conditions by tripping the main incoming circuit breaker or generator circuit breaker.

The objective of generator interface protection is to preserve the safety of ESB personnel, the general public and avoid damage to the Distribution system. It also lends protection to the customer's generator installation during these conditions.

This protection is in addition to 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
		Provide backup protection to ensure isolation of the generator in the event of failure of primary protection
		Comply with IEC Standard 60255
2.	Relays	Protection Grade
		Visible indication of operation
		Accessible from ground level
		Clearly identified
		Monitor installation at ESB Networks Distribution Connection Voltage unless otherwise agreed between ESB Networks and the Customer
		Monitor Line Voltage for Under and Over Voltage protection in MV and 38kV installations
		Fail safe operation which will result in tripping of the generator or main incomer CB if relay develops a fault
		Prevent reclosure of generator or main incomer CB until all relays have reset correctly

Table 4E: Additional Requirements for Embedded Generators Installations - Summary of Generator Interface Protection Requirements

No.	Generator	Use	Requirement
1.	Synchronous Generator	- Continuous	**Under and Over Voltage**
			Under and Over Frequency
			Directional Overcurrent (Note: may not be required if generator rating is: <1MVA @ MV PCC or <200kVA @ LV PCC)
			Loss of Mains
			Earth Fault (Note: There are exceptional circumstances where EF protection may not be required, these will be evaluated on a case by case basis)
		- Peak Shaving	**Under and Over Voltage**
			Under and Over Frequency
			Directional Overcurrent (Note: may not be required if generator rating is: <1MVA @ MV PCC or <200kVA @ LV PCC)
			Loss of Mains
			Earth Fault (Note: There are exceptional circumstances where EF protection may not be required, these will be evaluated on a case by case basis)
		- Peak Lopping	**Under and Over Voltage**
			Directional Overcurrent (Note: may not be required if generator rating is: <1 PCC or <200kVA @ LV PCC)

Table 4E: Additional Requirements for Embedded Generators Installations - Summary of Generator Interface Protection Requirements

No.	Generator	Use	Requirement
2.	Asynchronous Generator	- Self Excited	**Under and Over Voltage**
			Under and Over Frequency
			Directional Overcurrent (Note: may not be required if generator rating is: <1 PCC or <200kVA @ LV PCC)
			Loss of Mains
			Earth Fault (Note: There are exceptional circumstances where EF protection may not be required, these will be evaluated on a case by case basis)
		- Mains Excited	**Under and Over Voltage**
			Under and Over Frequency

Table 4F: Additional Requirements for Embedded Generators Installations - Protection Type

No.	Protection Type	Item	Requirement	
1.	Over and Under Voltage	Voltage variation	+10% to - 10% from nominal	
		Time Delay	Typical < 0.5[1] seconds	
		No. Phases	3	
2.	Over and Under Frequency	Frequency variation	+1% to – 4% from 50 Hertz	
		Time Delay	Typical < 0.5 seconds	
		No. Phases	Minimum of 1 phase	
3.	Loss of Mains **Note**: Where asynchronous machines are used, LOM. Protection may not be required where the installed P.F. Correction is less than 80% of the no load kVAR requirements of the machine.	Operation	For loss of any 1 phase of mains supply	
		Time Delay total	Relay + CB ≤ 0.5 seconds	
		Operation setting	Rate of change of frequency	Typical - 0.4Hz/sec
			Vector shift	Typical - 6 degrees
4.	Directional Overcurrent **Note:** May not be required if generator rating is: < 1MVA @ MV or < 200kVA @ LV always check with ESB Networks	Setting	No-Export Generators	≤ 50% of Gen. current
			Generators with agreed export	To be agreed with ESB Networks
		Time Delay	< 0.5[1] sec as advised by ESB Networks	
		No Phases	Provided on 3 phases by a current based quadrature connected relay with a +45° or +60° RCA.	
5.	Earth Fault **Note**: In exceptional cases may not be required, always check with ESB Networks	Operation	To trip CB for Earth fault on ESB Networks Distribution system during parallel operation	
		Time Delay	Typically ≤ 30 seconds - or as agreed with ESB Networks	
6.	Relay DC Supply	Failure of Supply	Tripping of main incoming circuit breaker or generator circuit breaker.	
7.	Trip Circuit Supervision	Fault in Trip Circuit	Alarm to be sounded and immediate isolation of the generator	

[1] Or as advised by ESB Networks depending on local network parameters.

Table 4G: Additional Requirements for Embedded Generators Installations - Summary of Protection Settings

No.	Interface Protection	Monitoring Details	Operating Setting	Trip Time	Notes
1.	Under Voltage	ESB Networks Supply 3Ph	-10%	< 0.5sec Typical	
2.	Over Voltage	ESB Networks Supply 3Ph	+10%	< 0.5sec Typical	
3.	Under Frequency	ESB Networks Supply 1Ph	-4%	< 0.5sec	
4.	Over Frequency	ESB Networks Supply 1PH	+1%	< 0.5sec	
5.	Directional Overcurrent	3 Phase	≤ 50% or ≤ 120%	< 0.5sec	May not be required if Generator Rating is: < 1MVA @ MV PCC or < 200kVA @ LV PCC
6.	Loss of Mains	3 phase, or 1 phase + asymmetry relay	Typical 0.4Hz/sec Typical 6 Degrees	< 0.5sec < 0.5sec	Rate of Change of Frequency (ROCOF) and/or Vector Shift
7.	Earth Fault	ESB Networks MV or 38kV Supply (Depending on PCC)	30% NVD	≤ 30sec	

4.2 Variations in settings for embedded wind generation

Additional technical requirements for wind generation are given in detail in Section 10 of the Distribution Code. In order to aid operation of the transmission system, and avoid large scale loss of wind generation for some contingencies, some inteface protection settings differ to those applied to other form of embedded generation. Table 4H below summarises these differences.

Table 4H: Additional Requirements for Embedded Wind Generators Installations - Summary of Protection Setting variations.

No.	Interface Protection	Monitoring Details	Operating Setting	Trip Time	Notes
1.	Under Voltage	ESB Networks Supply 3Ph	-20% [80% retained]	1s	
3.	Under Frequency	ESB Networks Supply 3Ph	47 Hz	0.5sec	
4.	Over Frequency	ESB Networks Supply 3PH	50.8 Hz	0.5sec	
6.	Loss of Mains	3 phase	0.55 Hz/sec	< 0.5sec	Rate of Change of Frequency (ROCOF)

Monitoring Details:

Relays shall monitor the installation at ESB Networks connection voltage unless otherwise agreed between ESB **Networks and the Customer.**

5.0 Synchronising

Table 5: Synchronising Requirements in Embedded Generator Installations

No.	Mode	Requirement
2.	Synchronising	Synchronising facilities shall be provided on either the generator circuit breaker or the main incoming circuit breakers
		Synchronising shall be fully automatic
		The closing operation of switchgear at all points where the Customer could parallel unsynchronised generator equipment with ESB Networks system shall be prevented by check synchronising facilities, or, by the use of mechanical or electrical interlocking provided by the Customer

6.0 Boundaries

Table 6: Ownership and Operational Boundaries

No.	Item	Boundary
1.	Ownership	The ownership boundary between ESB Networks Distribution circuits and Customer circuits is the termination point of ESB Networks main incomer cable on the Customers plant
2.	Operational	The system/operational boundary between ESB Networks Distribution circuits and Customer circuits is the Customers 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 Networks Incomer '
			'<feeder designation> '
		Warning Notices	'The system boundary between the ESB Networks 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> '
3.	Earthing Sw. (for earthing ESB Networks Main Incomer Cable)	Warning Notice	'This earthing switch is under the control of ESB Networks and must be operated by ESB Networks operator only.'
4.	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 Networks 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
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 Customers Network	Customers 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 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 Networks 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 Customers 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
		Peak Lopping	This refers to where the Customer's generator supplies the Customer's entire load and operates independently of ESB Networks. 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 Networks 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 ESB Networks connection. (Upon restoration, ESB Networks connection shall be resumed)	
4.	Standby Generators	Standby generators do not have the facility to operate in parallel with ESB Networks 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 and the Customer The decision to override the timing mechanism to allow such operation shall be agreed between ESB Networks 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	No. cables	3 per CB (normally) (some connections may require 6 per CB, always check with ESB Networks)
			No. cores per cable	1
			Insulation	XLPE
			Sheath	Black(PE) polyethylene
2.	Terminating Kits for Main Incomer Circuit Breaker	Customer	Suitable for terminating ESB Networks main incomer cable (see table 9b below)	
3.	Space in Customer's Switchroom	Customer	Adequate space to terminate ESB Networks main incomer cable	

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

Subject to change. Always confirm with ESB Networks

Item	Voltage	Core Size (mm2)	Core Type	Screen	
				Size (mm2)	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.

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			

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 Networks Terminal Station		
		MV Dual Radial	Two cubicles required in Customers Switchroom		
		Size (mm)	Width	height	depth
			1350	1500	750
		38kV	Equipment installed in ESB Networks Terminal Station or in location agreed between Customer and ESB Networks		

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 and Customer		ESB Networks
2.	Terminal Station	MV	Built to ESB Networks specification 13320	Customer
			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 specification 13320	
		MV Dual Radial	A separate Terminal Station is not required for MV Dual Radial Connections. ESB Networks equipment is installed in Customers switchroom	
			Two cable ducts 1m deep with removable covers to be provided in the Customers switchroom to accommodate ESB Networks MV cables from the metering cubicles to their associated MV Circuit Breakers on the Customers 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 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 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's SCADA system.		
6.	Indemnity	Indemnify ESB Networks 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 Networks 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 Networks 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 specification 13320		
2.	MV Dual Radial	Customer's MV Earth Grid	Max Resistance	20 Ohms
			Min size of Conductor	25mm2 Copper
			Equipment Bonded to MV Earth Grid	All MV equipment and exposed metalwork
				Earth screens on ESB Networks 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 Drawing No. 205724 provided to the Customer by ESB Networks 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**	**Minimum of five working days before Operational Date** These relay settings will be supplied to the Customer at an earlier date - provided the ESB Networks System Performance Team have been given all the relevant Customer information	**ESB Networks**
2.	**Customer Protection CT Ratios** Note: Should be chosen in accordance with the sensitivity requirements	**Terminal Station Completion**	**Customer**
3.	**Protection Relay Type**		
4.	**Primary and Secondary Test Sheets for the Main Incomer Circuit Breakers Protection Relays**	**Two working days before Operational Date**	
5.	**Confirmation of Relay Settings**		
6.	**Declaration of Fitness for Service**	**Operational Date**	
7.	**Earthing has been installed as outlined in this document**	**Operational Date**	

Table 13B: Additional Information Required for Dual Radial Installations

No.	Certification/Information	When	Provided By
1.	**Measured resistance of MV and LV earth grids**	**Operational 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.

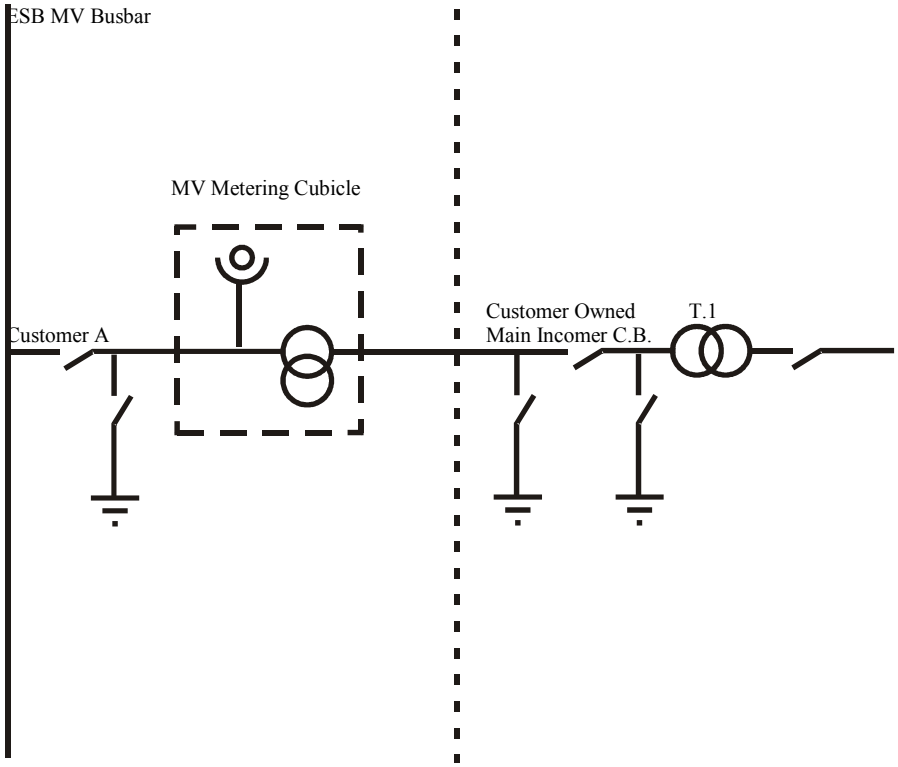
No.	Tests	Requirement	Carried out by	Witnessed by	Notice
1.	Synchronising Facilities and Interface Protection	Pre-commissioning Tests to be carried out prior to Compliance Tests	Customer on site		
		Compliance Tests to be carried out in accordance with Test Schedule in Appendix 2 of this document	Customer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

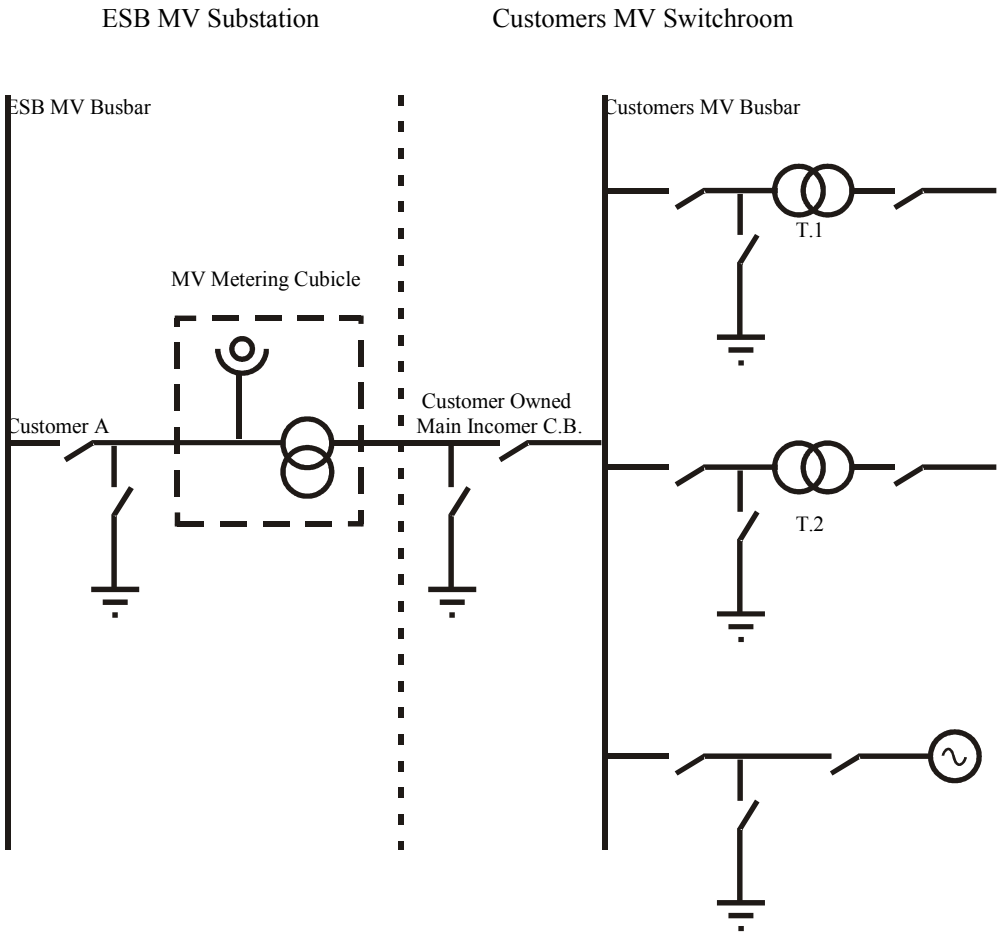
Appendix 1 Schematics
MV Single Transformer

ESB MV Substation Customers MV Switchroom



No.	Item	Reqd. by	Requirement
1.	Earthing Facilities	ESB	Earthing facility required on main incomer cable
		S.I. 44	Customer to consult S.I. 44 for earthing requirements on Customers equipment
2.	Interlocking	ESB	Interlocking to be provided between disconnection point and earthing facility on main incomer cable.
3.	Isolation of ESB Networks	ESB	Customer to provide a means of isolating ESB network in the event of a fault on Customers 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 will have to approve the use of the proposed Customers equipment as a 'point of disconnection'. ESB will require the Customer to carry out a risk assessment on the use of the equipment as part of the approval process.

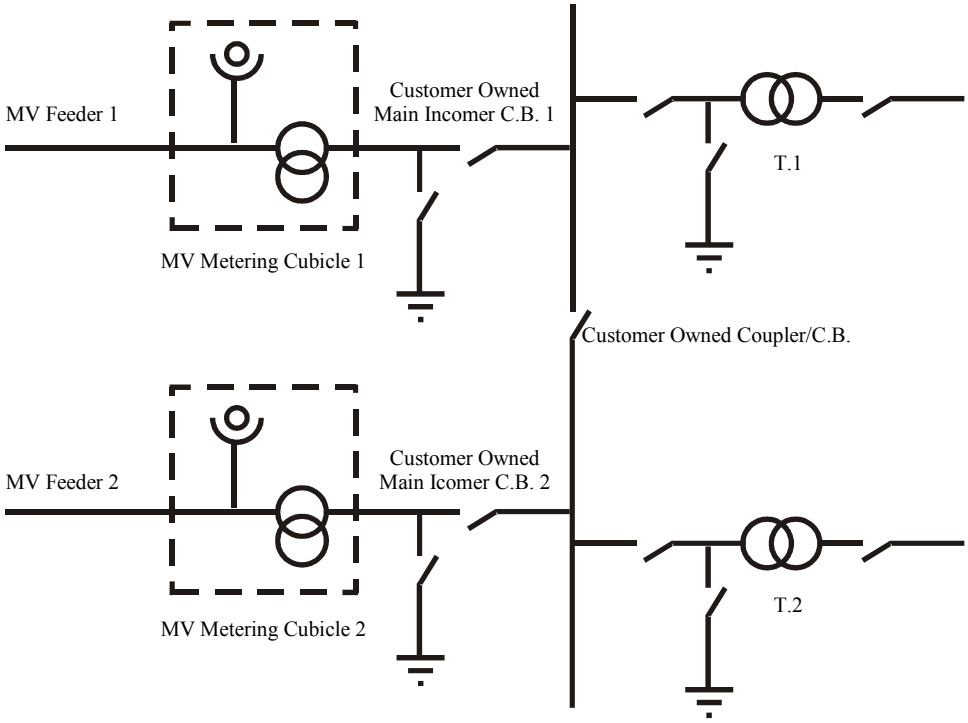
MV Multi Transformer



No.	Item	Reqd. by	Requirement
1.	Earthing Facilities	ESB	Earthing facility required on main incomer cable
		S.I. 44	Customer to consult S.I. 44 for earthing requirements on Customers equipment
2.	Interlocking	ESB	Interlocking to be provided between disconnection point and earthing facility on main incomer cable.
3.	Isolation of ESB Networks	ESB	Customer to provide a means of isolating ESB network in the event of a fault on Customers 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 will have to approve the use of the proposed Customers equipment as a 'point of disconnection'. ESB will require the Customer to carry out a risk assessment on the use of the equipment as part of the approval process.

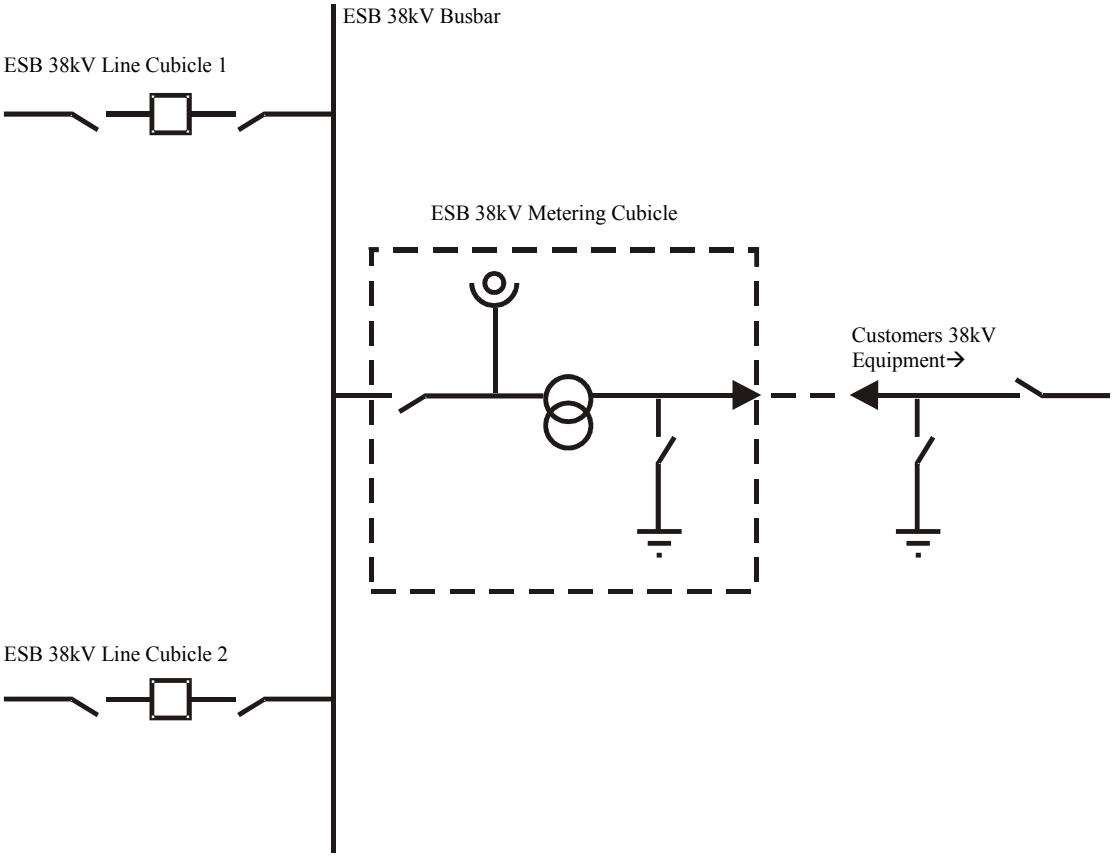
MV Dual Radial Connection

Customers MV Switchroom



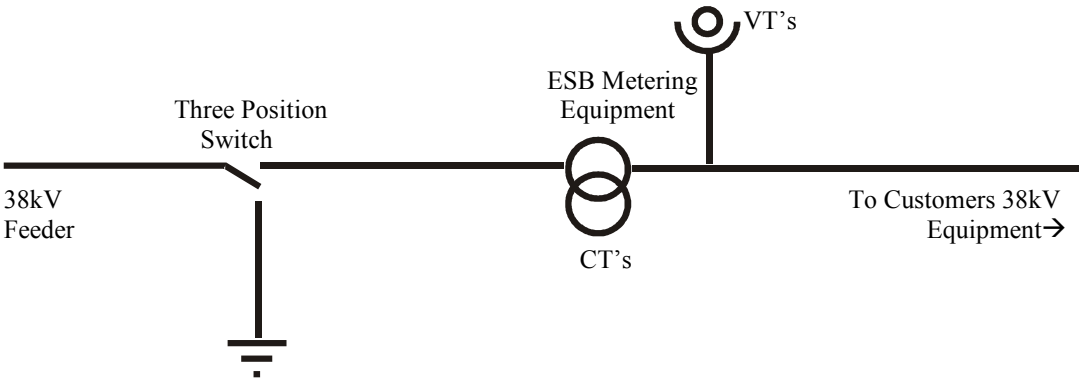
No.	Item	Reqd. by	Requirement
1.	Earthing Facilities	ESB	Earthing facility required on main incomer cable
		S.I. 44	Customer to consult S.I. 44 for earthing requirements on Customers equipment
2.	Interlocking	ESB	Interlocking to be provided between disconnection point and earthing facility on main incomer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



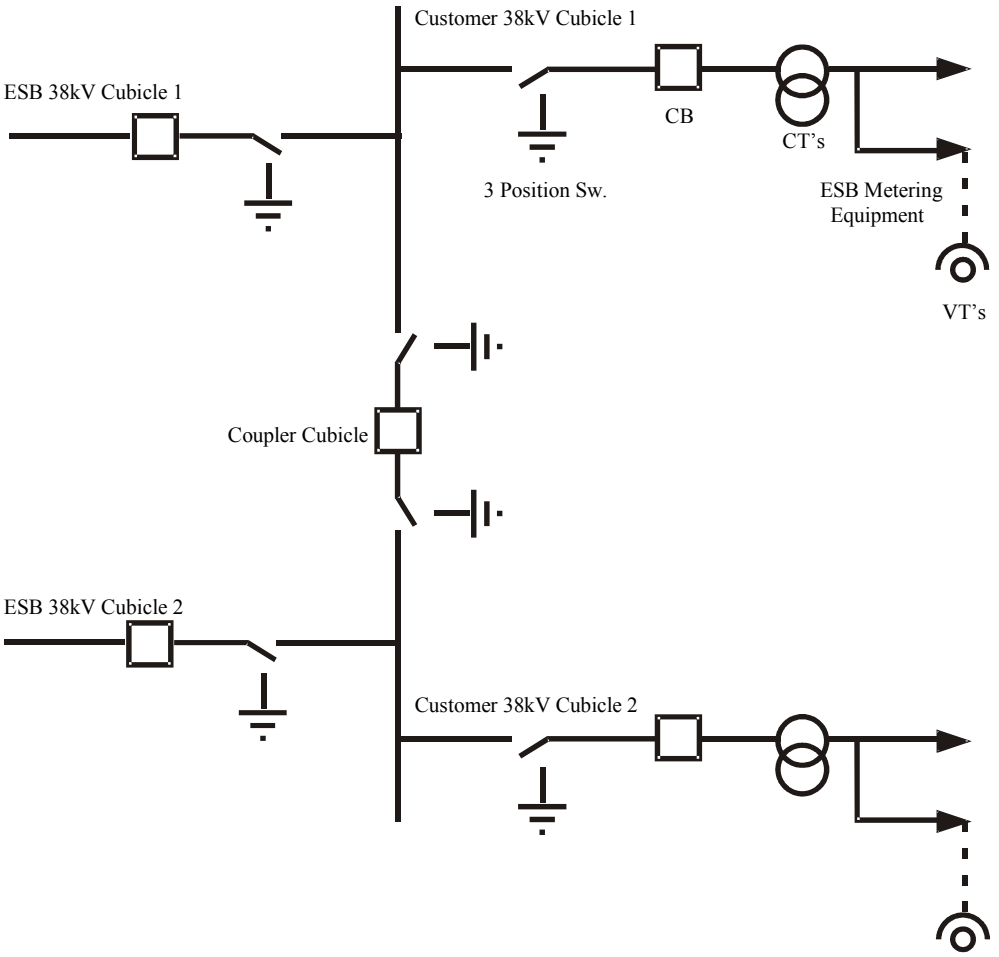
No.	Item	Reqd. by	Requirement
1.	Earthing Facilities	ESB	Earthing facility required on main incomer cable
		S.I. 44	Customer to consult S.I. 44 for earthing requirements on Customers equipment
2.	Interlocking	ESB	Interlocking to be provided between disconnection point and earthing facility on main incomer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

38kV Windfarm



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

38kV G.I.S. SF6 Connection



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

APPENDIX 2 TEST SCHEDULE FOR GENERATORS

INTERFACE PROTECTION
TEST SCHEDULE FOR CONNECTION OF GENERATORS
TO ESB NETWORKS 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 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 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 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 **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 NETWORKS 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 CUSTOMERS 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 Networks 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 Networks 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 Networks Switch, in which case it will be necessary for the Customer to make an arrangement with the relevant ESB Networks 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 Networks 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 Networks, 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 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 Networks system is fitted to the Main Incoming Circuit Breaker.

TEST SCHEDULE

FOR CONNECTION OF GENERATORS TO ESB NETWORKS DISTRIBUTION SYSTEM

TEST RESULTS SHEETS

TEST RESULTS SHEET

SITE DETAILS	*GENERATOR DETAILS*
Location:	Type:
	Operating Mode:
Owner:	Rating:
Contractor:	Voltage:
Telephone No(s):	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					
R-N or R-S	V	+10%	V		V
S-N or S-T	V		V		V
T-N or T-R	V	Time Typical ≤ 0.5 sec	V		V
Under Voltage					
R-N or R-S	V	-10%	V		V
S-N or S-T	V		V		V
T-N or T-R	V	Time 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 120%	A		
T Phase	A	Time ≤0.5 sec	A		
Loss of Mains					
R Phase	df/dt	Trip on Loss of Mains	Hz/s		
S Phase					
T Phase	Hz/s	Time ≤ 0.5 sec			
Three Phase					
Earth Fault Detection	V	Trip for Earth Fault Time < 1 min.	V		V

Test Results Sheet

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	
After a Protection Trip - Relay/s cannot be reset until ESB Networks supply is normal - Isolating CB cannot be closed until Relay/s reset	
SEALING : Relays can accept Seals	

	FUNCTIONAL OPERATION TEST	
PROTECTION FUNCTION	**ISOLATING CB OPEN Y/N?**	**GENERATOR SHUTDOWN Y/N?**
Emergency Stop Voltage Relay OV Voltage Relay UV Frequency Relay OF Frequency Relay UF Directional OC Relay Earth Fault Relay Protection Fail-safe Trip Circuit Supervision Loss of Mains Relay - Single Phase - Three Phase		

After ESB Networks 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 CUSTOMERS 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 ESB Network.

_____

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

_____

Name of Company and Position within Company.

Date: _____