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National Grid

National Grid
Technical
Specification

**Mesh Station DAR and
Plant Isolation**

NGTS 3.24.63
Issue 1
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MESH STATION DAR AND PLANT ISOLATION

FOREWORD

This specification is a functional specification within the Substation Information, Control and Protection suite of technical specifications. It shall be called up and applied by appropriate bay level specifications.

1 SCOPE

This specification describes the functional and performance requirements for post-fault automatic switching (DAR and plant isolation) for National Grid's Mesh type substations. For the purposes of this specification Mesh type substations encompasses: four-switch mesh, three-switch with bypass, single-switch, banked plant substations and other related configurations operating at 400, 275 and 132 kV.

Figure 1 depicts typical National Grid plant configurations for four-switch mesh and single-switch stations.

Post-fault, protection initiated, automatic switching encompasses automatic isolation of Mesh Corner connected feeders, transformers or other plant by opening associated HV disconnectors as required followed by Delayed Automatic Reclosure (DAR) of Mesh Corner HV and LV circuit breakers as required to re-energise remaining non-isolated plant.

Where specified in the contract, the automatic switching functionality shall accommodate variations in plant topology and sizing.

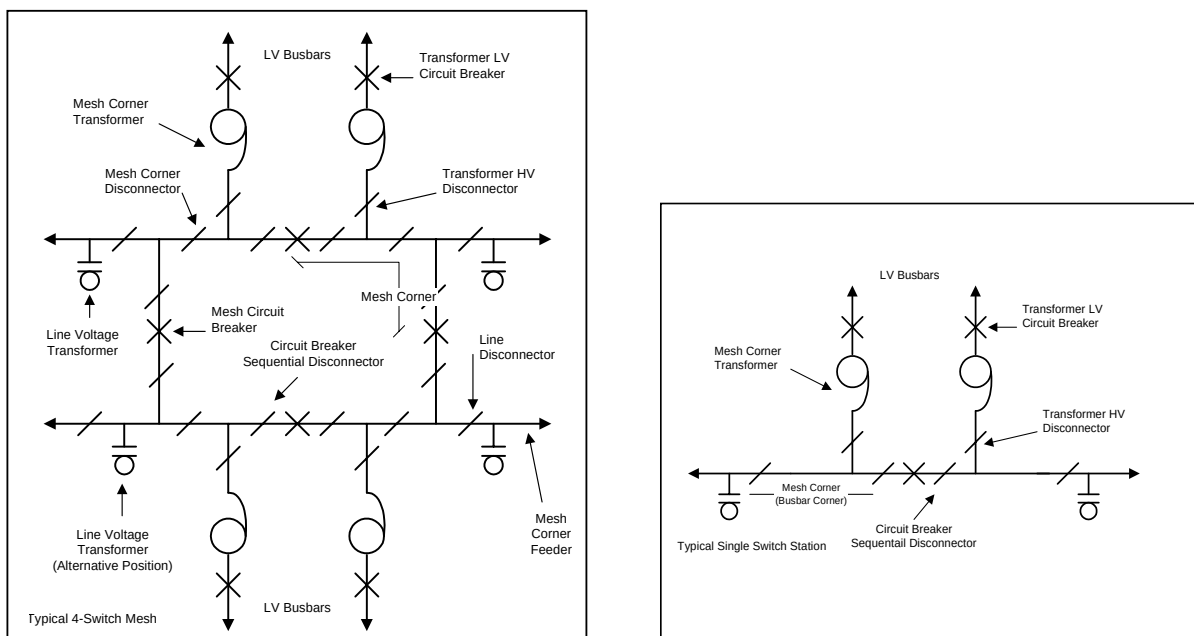


Figure 1: Typical Plant Configurations for Mesh/Single Switch Stations

2 REFERENCES

NGTS 3.24.4 Hardware Platform

NGTS 3.24.16 Delayed Automatic Reclose (DAR)

3 DEFINITIONS

DAR	Delayed Automatic Reclose.
Check Sync	Check Synchronisation.
In Sync	In Synchronism.
Mesh Corner	Copper-work connecting banked plant (Feeder/Transformer/Other Plant) with associated HV circuit breaker(s). Where there is only one HV circuit breaker this configuration may also be known as a busbar corner. Mesh Corners are typically associated with Mesh Stations and Single Switch stations. Each plant item, transformer, feeder or reactor, can be electrically isolated from the mesh corner by opening its associated disconnector.
Busbar Corner	See Mesh Corner.
Transient Fault	A fault condition where re-energisation by DAR of the plant that generated the trip condition is acceptable, for example a line fault.
Persistent Fault	A fault condition where re-energisation by DAR of the plant that generated the trip condition is not acceptable, for example a transformer fault.
Line Disconnector	Disconnector used to electrically isolate a line feeder from a mesh corner.
HV Disconnector	Disconnector used to electrically isolate the HV connection of a plant item such as transformer from a mesh corner.

4 MESH CORNER GENERAL REQUIREMENTS

General Requirements

- 4.1** The total functional requirements for a given mesh corner based substation shall be determined by plant type (circuit breakers, feeders and transformers or equivalent), quantity and connectivity of controlled plant involved.

Informative: A mesh type substation can be broken down into a number of plant based building blocks: mesh corner, feeder, transformer, HV circuit breakers and transformer LV circuit breakers. This specification is organised around these building blocks and the plant isolation and DAR requirements are specific to these building blocks. To illustrate the application of these building blocks, Figure 9 and Figure 10 demonstrate the application of these blocks to representative single-switch and four-switch substation configurations.

- 4.2** All mesh corners, HV circuit breakers, transformer LV circuit breakers, feeders and transformers shall be provided with the facilities appropriate to the plant type and defined by this specification.
- 4.3** In addition to specific plant type requirements, all mesh corner plant isolation and DAR facilities shall comply with the following general DAR and Plant Isolation Requirements.

Automatic Switching Requirements

Informative: Plant specific Automatic Switching requirements (DAR and plant isolation) for mesh corners, feeders and transformers are defined within the plant related sections of this specification. Each plant item's switching requirements are defined in "Automatic Switching Tables for plant xxx". These tables define the plant isolation and DAR requirements for the appropriate range of initial plant conditions and protection signal initiating events. Where multiple actions are indicated, by virtue of multiple protections operations on one or more plant items, then all actions shall be executed and where differing control actions are indicated on a given plant item then the following priorities shall apply: If "DAR" and "Lockout DAR" are indicated then "Lockout DAR" shall take precedence; if "Open" disconnector and "no disconnector action" are indicated then "Open" disconnector shall take precedence. The following example illustrates this process for the situation where Mesh Corner Fault - No DAR and Feeder Fault - DAR Required events occur together:

Automatic Switching Requirements Table for: Mesh Corner Function (Reclaim Timer Not Running on X120 AND X420)						
Input/ Event	Line Disconnector (X103)		Transformer HV Disconnector (X113)		Mesh HV CB (X120+X420)	Transformer LV SGT 1 LV CB
	Position	Action	Position	Action	Action	Action
Mesh Corner Fault - No DAR Req'd.	Closed	Open	Closed	Open	Lockout DAR	Lockout DAR

Automatic Switching Requirements for Feeder Function (Reclaim Timer Not Running on X120 AND X420)						
Input/ Event	Line Disconnector (X103)		Transformer HV Disconnector (X113)		Mesh HV CB (X120+X420)	Transformer LV SGT 1 LV CB
	Position	Action	Position	Action	Action	Action
Feeder Fault - DAR Req'd.	Closed	None-			DAR	DAR

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Resultant Automatic Switching Requirements (Reclaim Timer Not Running on X120 AND X420)						
Input(s)/ Event(s)	Line Disconnector (X103)		Transformer HV Disconnector (X113)		Mesh HV CB (X120+X420)	Transformer LV SGT 1 LV CB
	Position	Action	Position	Action	Action	Action
Mesh Corner Fault - No DAR Req'd plus Feeder Fault - DAR Req'd.	Closed	Open	Closed	Open	Lockout DAR	Lockout DAR

- 4.4 The automatic switching requirements for mesh corner, feeder and transformer plant shall comply with the requirements detailed in the "Automatic Switching Tables for plant xxx" to be found in the appropriate sections of this specification.
- 4.5 Where multiple control actions are indicated, by virtue of multiple protections operations occurring on one or more plant items then all required automatic switching actions shall be executed and where differing control actions are indicated on a given plant item then the following priorities shall apply:
- (a) If "DAR" and "Lockout DAR" are indicated then "Lockout DAR" shall take precedence.
 - (b) If "Open disconnector xxx" and "No disconnector xxx" switching actions are indicated then "Open disconnector xxx" shall take precedence.

DAR

- 4.6 DAR shall be provided for all mesh corner circuit breakers and any associated transformer plant LV circuit breakers.
- 4.7 Where isolation of feeders/transformers/other plant is required then this plant isolation shall be completed before any associated circuit breaker DAR initiated reclosure to re-energise non-faulted plant can be take place.
- 4.8 All Mesh HV circuit breaker reclosures shall be separated by a minimum inter-switch delay time of 5 s.
- 4.9 If a mesh HV DAR sequence that is ready to reclose cannot proceed because of an inhibit condition then reclosure of any other ready HV CB shall be attempted.

Plant Isolation

- 4.10 Plant isolation facilities shall be provided for all plant connected to a mesh corner.
- 4.11 Where plant isolation is indicated, then the isolation sequence shall start after a user defined time delay after the initiating protection operation.
- 4.12 Plant isolation shall not take place unless all associated local and remote circuit breaker auto-reclose are inhibited and any other required interlock conditions have been met.
- 4.13 Plant isolation sequences shall be cancelled once the required plant isolation operation has been completed or the plant isolation sequence has been reset.
- 4.14 Where plant isolation is required before any DAR sequences can be completed and isolation is not possible or has failed then all related DAR sequences shall be locked out.



Sizing Requirement

- 4.15** The maximum sizing requirements will be specified as contract requirement.
- 4.16** It shall be possible for a given equipment installation to be extended, using additional hardware if necessary, in order to cope with additional plant/station extensions.

Informative: Typical extensions include: extension from single-switch station to "n" switch mesh; additional plant (Transformer, feeder, other banked plant or circuit breaker on a mesh corner).

Plant Layout/Topology

- 4.17** The scheme shall be capable of coping with variations in plant layout/topology.

Informative: For the purposes of meeting this requirement it can be assumed that voltage selection for determining circuit breaker voltage conditions will be performed by external systems that are outside the scope of this specification.

5 MESH CORNER FUNCTIONAL AND INTERFACE REQUIREMENTS

Informative: The scope of the mesh corner feeder unit is depicted in Figure 2.

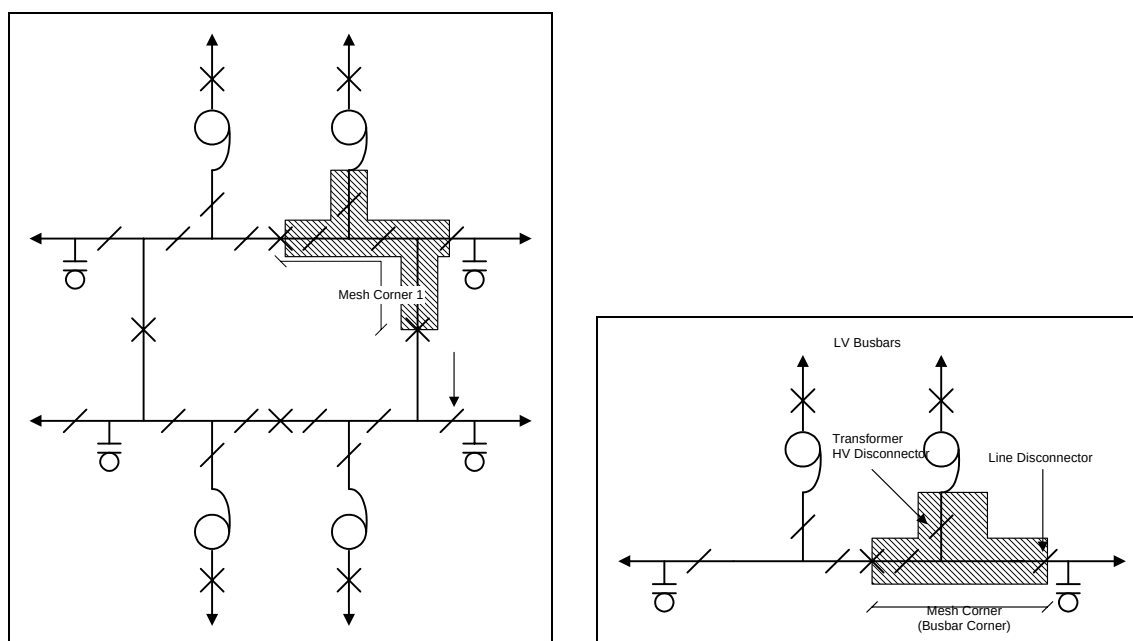


Figure 2: Scope of Mesh Corner Function

Functional Requirements

- 5.1** The Mesh Corner function shall provide the switching functionality detailed in Table 1 and Table 2.

Informative: Table 1 and Table 2 present the generic plant isolation and DAR requirements for a representative mesh corner when DAR reclaim timers are not running or are running. The table should be adapted to suit specific plant requirements.

Auto-Switching out of Service

Informative: Auto-Switching Out of Service is a function service status indication.

- 5.2** While in the operational state Auto-Switching Out of Service it shall not be possible to start or complete transformer, feeder or HV CB DAR sequences on plant directly associated with the mesh corner.

- 5.3 While in the state Auto-Switching Out of Service associated Mesh Corner DAR shall be set to DAR Out of Service
- 5.4 When the mesh corner function is reset or powered up it shall enter the state Auto-Switching Out of Service

Auto-Switching in Service

Informative: DAR in Service is a function service status indication.

- 5.5 While in the operational state Auto-Switching in Service all feeder and transformer functions shall be operational.

Mesh Corner Interface Requirements

- 5.6 Table 3 details required input/output facilities and associated input/output functionality.

Mesh Corner – Settings

- 5.7 The mesh corner function shall provide the setting options as detailed in Table 4.

**Table 1: Automatic Switching Requirements Table for: Mesh Corner Function
(Reclaim Timer Not Running on X120 AND X420)**

Input/ Event	Line Disconnect (X103)		Transformer HV Disconnect (X113)		Mesh HV CB (X120+X420)	Transformer LV SGT 1 LV CB
	Position	Action	Position	Action	Action	Action
Mesh Corner Fault - No DAR Req.	Closed	Open	Closed	Open	Lockout DAR	Lockout DAR
	Closed	Open	Open	None	Lockout DAR	Lockout DAR
	Open	None	Closed	Open	Lockout DAR	Lockout DAR
	Open	None	Open	None	Lockout DAR	Lockout DAR
Mesh Corner Fault - DAR Req.	Closed	None	Closed	Open	DAR	Lockout DAR
	Closed	Open	Open	None	Lockout DAR	Lockout DAR
	Open	None	Closed	Open	Lockout DAR	Lockout DAR
	Open	None	Open	None	Lockout DAR	Lockout DAR

Table 2: Automatic Switching Requirements for Mesh Corner Function (Reclaim Timer Running on X120 OR X420)

Input/ Event	Line Disconnecter (X103)		Transformer HV Disconnecter (X113)		Mesh HV CB (X120+X420)	Transformer LV SGT 1 LV CB
	Position	Action	Position	Action	Action	Action
Mesh Corner Fault - No DAR Reqd.	Closed	Open	Closed	Open	Lockout DAR	Lockout DAR
	Closed	Open	Open	None	Lockout DAR	Lockout DAR
	Open	None	Closed	Open	Lockout DAR	Lockout DAR
	Open	None	Open	None	Lockout DAR	Lockout DAR
Mesh Corner Fault – DAR Reqd.	Closed	Open	Closed	Open	Lockout DAR	Lockout DAR
	Closed	Open	Open	None	Lockout DAR	Lockout DAR
	Open	None	Closed	Open	Lockout DAR	Lockout DAR
	Open	None	Open	None	Lockout DAR	Lockout DAR

Table 3: Mesh Corner Automatic Switching – External Interfaces

Interface	Function	Type of Interface
5.8 Auto-Switching In	Control input to select Auto-Switching In service on associated mesh corner, feeder and transformer functions.	Control Input
5.9 Auto-Switching Out	Control input to de-select Auto-Switching In service on associated mesh corner, feeder and transformer functions.	Control Input
5.10 Auto-Switching In	This indication shall be active when the associated mesh corner, feeder and transformer functions are active.	Single Point Status Indication
5.11 Auto-Switching Out	This indication shall be active when the associated mesh corner, feeder and transformer functions are inactive.	Single Point Status Indication
5.12 Auto-Switching in Progress	This indication shall be set when a DAR and/or plant disconnecter switching sequence has been initiated and shall remain set until the switching sequence has been completed or cancelled.	Single Point Status Indication
5.13 DAR Required	This input shall accept signals from protections associated with a mesh corner to initiate mesh corner DAR (Start DAR) and opening of all associated HV Disconnecters.	Single Point Status Input