

PROTECTION AND CONTROL FUNCTIONS FOR 'Z' SUBSTATION

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TABLE OF CONTENTS

PURPOSE AND SCOPE.....	1
PART 1 – PROCEDURAL	3
1 'Z' SUBSTATION FEEDER PROTECTION REQUIREMENTS	3
2 BUS COUPLER FUNCTIONAL REQUIREMENTS.....	3
3 TRANSFORMER HV FUNCTIONAL REQUIREMENTS.....	4
4 BUSBAR PROTECTION	6
5 GENERAL FUNCTIONAL REQUIREMENTS	7
6 FORMS AND RECORDS	12
PART 2 - DEFINITIONS AND DOCUMENT HISTORY	12
7 DEFINITIONS	12
8 AMENDMENTS RECORD	13
9 IMPLEMENTATION.....	13
PART 3 - GUIDANCE NOTES AND APPENDICES	14
10 REFERENCES – NATIONAL GRID TRANSMISSION DOCUMENTS	14

PURPOSE AND SCOPE

This specification, in conjunction with related functional specifications, details the protection, control and measurements functions and the associated interconnectivity which are required within light current systems at 'Z' substations on National Grid's 400, 275 and 132kV transmission system, including feeder and transformer bays specific to 'Z' substations. It also describes interfaces with other substation functions.

Informative: The 'Z' Substation Bay Specification is based on a standard application of, one feeder and one transformer connected to one Busbar, with another feeder and one transformer connected to another Busbar and the Busbars separated by a Bus Coupler to form a 'Z' configuration with provision for future extension to a Double Busbar Substation.

This is a level 3 technical specification, developed based on the Standard Bay Solutions (SBS) of protection and control functions for the Double Busbar Substation. This specification shall be read in conjunction with other relevant National Grid Technical Specifications (NGTSs) and policy documents, particularly NGTS 2.24 and associated Level 3 Technical Specifications TS 3.24.xx.

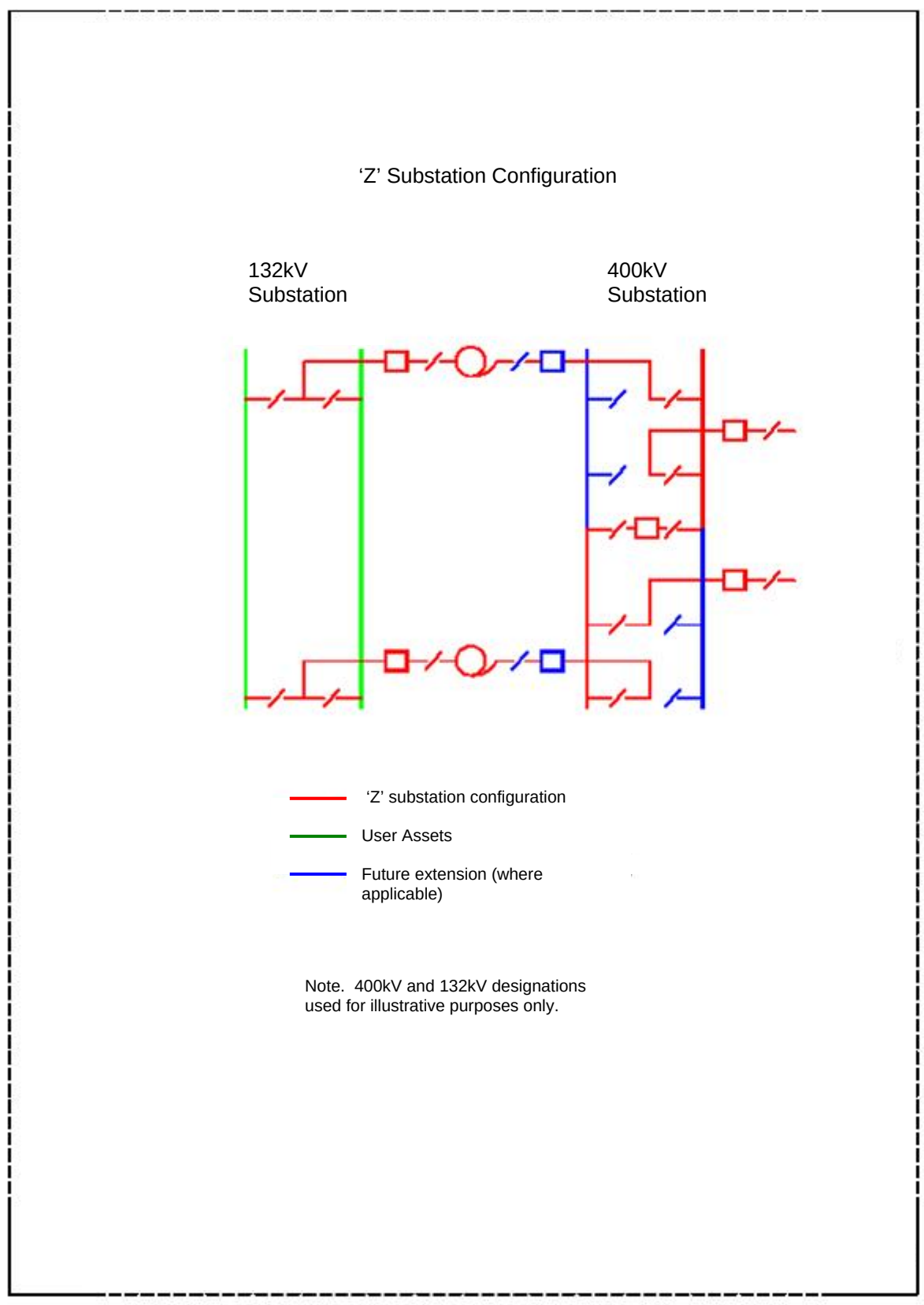


Figure 1 'Z' Substation Configuration

PART 1 – PROCEDURAL

1 'Z' SUBSTATION FEEDER PROTECTION REQUIREMENTS

Informative - This section describes the functions that are needed for a Feeder Circuit in a 'Z' configuration, and gives circumstances where functions may not be required.

Feeder Bay Protection

- 1.1 A Standard Feeder Protection and Control Bay Solution in accordance with TS 3.24.7 shall be utilised with the changes required in this specification.
- 1.2 When feeder protection operates, Direct Transfer Tripping (DTT) shall be sent to trip the Transformer LV Circuit Breaker. The DTT shall be conditioned to operate by the Bus Coupler Circuit Breaker and Disconnectors normally closed auxiliary contacts. The LV Circuit Breaker cross-tripping shall be carried out automatically by the Protection and Control equipment, and Maintenance override facilities shall be provided for the bus coupler Plant status inputs.
- 1.3 Should the Primary Plant at the Station be extended to a Double Busbar configuration then the following changes shall be made to the Protection scheme :- the Feeder protection tripping outputs have to be removed from both Transformer HV to LV DTT buswires.
- 1.4 The additional circuitry required to facilitate cross-tripping etc shall be made easily removable should the future extension to double busbar occur

Feeder Direct Transfer Tripping (DTT) Functions -

- 1.5 All feeders shall have dual Direct Transfer Tripping (DTT) functions (see NGTS 3.24.36) to each remote circuit end.
- 1.6 The feeder DTT function shall have the facility to enable initiation inputs to be individually selectable to be conditioned by the feeder disconnector and links should this be required. The contract will specify this.

2 BUS COUPLER FUNCTIONAL REQUIREMENTS

Informative - This section describes all of the functions that may be needed for a Bus Coupler when the Primary Plant is in a 'Z' configuration, and gives circumstances where functions may not be required.

Bus Coupler Protection

- 2.1 A Standard Bus Coupler Protection and Control Bay Solution as per NGTS 3.24.05 shall be used with the following function disabled: the Trip relay reset, as this will be performed by the Auto Switching Unit.
- 2.2 For the Auto Switching functionality for 'Z' configuration of the Primary Plant, a Standard Mesh Corner Single Switch Solution in accordance with NGTS 3.24.06 shall be used with the following functions disabled :- Feeder functions and Ferroresonance.

Informative - this function will no longer be required if a Circuit Breaker is installed on the HV side of the Transformers, and Both disabled functions will need to be restored if and when such a change is made.

Although 'Mesh Corner' type specifications are called within this TS there shouldn't be any reference to Mesh corners anywhere in the design. It is essential that there is no use of the words 'mesh' and 'corner' in any part of the installed substation (diagrams, relay panels, databases, etc.).

- 2.3** If the Primary Plant at the Station is extended to a Double Busbar configuration then the following changes shall be made to the Protection and control scheme :- The Trip Relay Reset shall be re-instated as the Auto Switching function will be removed at this stage.

3 TRANSFORMER HV FUNCTIONAL REQUIREMENTS

Informative - This section describes all the functions that may be needed on 'Z' substation transformer HV functions, and gives circumstances where functions may not be required.

- 3.1** Details of the transformer LV and tertiary functions shall comply with the requirements in NGTS 3.24.8.

Transformer Main Protection

- 3.2** A Standard Protection and control Bay Solution for the relevant Transformer type as per NGTS 3.24.8 shall be utilised with the following functionality deactivated while the Primary Plant is in the 'Z' configuration :- Trip relay reset, Sequential Isolation, CB Fail, Phases Not Together, and Trip Circuit Supervision. Circuit Breaker Trip and Control shall not be utilised as there is no Transformer HV Circuit Breaker used in this scheme.
- 3.3** If the Primary Plant at the Station is extended to a Double Busbar configuration then the following changes shall be made to the Protection and Control scheme and the following functions are to be enabled: Trip Relay Reset, Sequential Isolation, Circuit Breaker Fail, Phases Not Together and Trip Circuit Supervision. Circuit Breaker Trip and Control shall also be re-instated as there will now be Circuit Breakers available on the HV and LV sides of the Transformers.
- 3.4** Transformer overall unit protection functions shall, on operation
- a) Trip the Transformer LV,
 - b) Trip the associated feeder CB (connected on the same bar)
 - c) Trip the Bus Coupler circuit breaker
 - d) Initiate CB Fail
 - e) Initiate auto switching

Transformer HV Back Up Protection

- 3.5** Back up protection functions having the following characteristics (see NGTS 3.24.38) shall be provided.
- a) Two stage HV 3-phase IDMT overcurrent protection
 - b) HV 3-phase instantaneous overcurrent protection with low transient overreach characteristics
- 3.6** The back up protection functions shall, on operation have the selectable option to
- a) Trip transformer LV CB
 - b) Trip the associated feeder CB (see sections 1.5 and 3.10 respectively)

- c) Trip the Bus Coupler CB
- d) Initiate CB Fail
- e) Initiate auto switching

Informative - The first stage of the two stage overcurrent (3.5(a)) will normally be selected to trip the transformer LV CB only and not initiate Automatic Switching and HV CB Fail.

Transformer HV Stub Bus Protection

- 3.7** Stub bus protection (see NGTS 3.24.38) shall be provided if the transformer is likely to be energised from the LV, for any length of time, with the transformer HV busbar disconnecter open. The contract will specify this function.

Informative - Stub bus protection caters for a fault between the transformer CT and the open HV busbar disconnecter, which would not be cleared by the transformer main protection.

- 3.8** Stub bus protection shall remain blocked while the transformer HV busbar disconnecter is closed.

- 3.9** The stub bus protection shall, on operation

- a) Initiate transformer HV DTT send functions (see section 3.10)

Transformer HV Direct Transfer Tripping (DTT) Functions

- 3.10** There shall be a Direct Transfer Tripping (DTT) function between the HV and each LV circuit end and a Direct Transfer Tripping (DTT) function between the HV and any tertiary connected plant.

- 3.11** Dual transformer DTT functions shall be provided, and each one should reside in a different hardware unit.

Informative - The DTT function can be via a direct wire connection, a cross-site fibre or via an Operational Telecommunications Service (TS). The contract will specify this.

- 3.12** Receipt of a DTT at the HV from an initiation at the LV shall, on operation

- a) Initiate Trip to Feeder and Bus Coupler Circuit Breakers. And Tertiary CB where fitted.
- b) Initiate CB Fail
- c) Initiate auto switching

- 3.13** Receipt of a DTT at the HV from an initiation at the Tertiary shall, on operation

- a) Initiate Trip to Feeder and bus Coupler CBs and send DTT to LVCB
- b) Initiate CB Fail
- c) Initiate auto switching