

Disclaimer

Copyright © National Grid plc 2011, all rights reserved

This information should not be forwarded to third parties.

SHUNT REACTOR BAY

TABLE OF CONTENTS

PURPOSE AND SCOPE.....	1
PART 1 - PROCEDURAL	2
1 FUNCTIONAL REQUIREMENTS.....	2
2 INTERFACE REQUIREMENTS	7
3 IMPLEMENTATION REQUIREMENTS.....	8
4 CONTRACT SPECIFIC REQUIREMENTS.....	8
PART 2 - DEFINITIONS AND DOCUMENT HISTORY	9
5 DEFINITIONS	9
6 AMENDMENTS RECORD.....	9
PART 3 - GUIDANCE NOTES AND APPENDICES.....	10
7 SUBSTATION INFORMATION, CONTROL, PROTECTION AND METERING FUNCTIONAL RELATIONSHIPS.....	10
APPENDIX A TYPICAL PRIMARY CIRCUIT CONFIGURATIONS.....	11
A1 SHUNT REACTOR BAY CONNECTED TO DOUBLE BUSBAR.....	11
A2 SHUNT REACTOR BAY CONNECTED TO MESH CORNER.....	12
A3 SHUNT REACTOR BAY CONNECTED TO SGT TERTIARY.....	13
APPENDIX B.....	14
B1 ACCEPTABLE INTEGRATION OPTIONS	14

PURPOSE AND SCOPE

This is a bay level specification which is part of the Substation Information, Control and Protection suite of technical specifications and deals with the requirements for shunt reactor bays connected at 400kV, 275kV, 132kV and 13kV on National Grid's transmission system.

This specification, in conjunction with related functional specifications describes the functional and performance requirements for protection, control and measurements and the associated interconnectivity of separately switched 400kV, 275 kV, 132kV and 13 kV oil-immersed shunt reactors at National Grid substations. It also describes interfaces with other substation functions.

This Specification makes reference to, or should be read in conjunction with the following documents:

NGTS 2.3	Transformers and Reactors
NGTS 3.1.1	Substation Interlocking Schemes
NGTS 3.2.1	Switchgear Control
NGTS 3.15.2	Ferroresonance Switching
NGTS 3.24.3	Substation Facilities and Functions Common to all Bays
NGTS 3.24.4	Hardware Platform
NGTS 3.24.34	Busbar Protection
NGTS 3.24.38	Overcurrent Protection
NGTS 3.24.39	CB Fail Protection
NGTS 3.24.43	Interlocking

NGTS 3.24.65 Overall Protection

IEC 255 –13 Biased Differential Relays

PART 1 - PROCEDURAL

1 FUNCTIONAL REQUIREMENTS

Informative: This section describes all of the functions that might be needed on a shunt reactor bay, and also gives circumstances where functions may not be required.

1.1 General Requirements

- 1.1.1 All the protection, control and measurement equipment for the shunt reactor bay shall comply with hardware platform and EMC requirements specified in NGTS3.24.4 and NGTS3.24.15 respectively.
- 1.1.2 Each type of protection, control and measurement functions specified in this document for shunt reactor bays shall comply with relevant National Grid Technical Specifications.

1.2 Main Protection

- 1.2.1 Duplicate overall unit protection driven from a common set of current transformers shall be provided if non-numerical relays are offered.

Informative: An example of an acceptable scheme is two high impedance circulating current relays providing the first and second overall unit protection.

- 1.2.2 Each protection shall be responsive to both phase faults and earth faults on the shunt reactor and associated connections.
- 1.2.3 A single numerical relay is acceptable for providing the main protection. The relay shall provide an overall unit protection function which is responsive to both phase faults and earth faults on the shunt reactor and associated connections, and a unit protection function, as a minimum, responsive to earth faults on the shunt reactor and associated connections.

Informative: An example of an acceptable scheme is a single overall biased differential relay providing the first overall unit protection with a restricted earth fault protection function providing the second unit protection.

- 1.2.4 At 132 kV and below only a single overall unit protection (either high impedance or low impedance type) is required. The protection shall be responsive to both phase faults and earth faults on the shunt reactor and associated connections.
- 1.2.5 If a biased differential principle is used, the protection shall comply with the requirements of IEC 255-13.
- 1.2.6 The primary operating current of the protection shall be capable of achieving a setting between 10% and 30% of minimum fault current available for a fault at the reactor terminals if a high impedance scheme is offered.
- 1.2.7 The protection shall only operate for the fault within defined protective zone.

1.2.8 Operation of a main protection function shall:

- a) Trip shunt reactor circuit breaker
- b) Initiate CB fail protection where appropriate
- c) Initiate disconnector sequential isolation where required
- d) Initiate trip relay reset where required

1.2.9 Where the shunt reactor is connected onto a mesh corner without its own circuit breaker, operation of the main protection shall initiate tripping of the mesh corner circuit breakers, and DTTs to the associated SGT protection and to the remote end of the associated feeder. This shall be conditioned by the position of disconnector for the shunt reactor.

1.3 Back Up Protection

1.3.1 Back-up protection shall be provided in accordance with NGTS 3.24.38 and shall consist of the following:

- (i) 2-Phase definite time overcurrent and earth-fault protection.
- (ii) 3-Phase instantaneous high set overcurrent protection. (Not required at 13 kV)

1.3.2 Operation of either backup protection shall

- a) Trip the shunt reactor circuit breaker
- b) CB fail protection where appropriate
- c) Initiate disconnector sequential isolation where required
- d) Initiate trip relay reset where required

1.3.3 Where the shunt reactor is connected onto a mesh corner without its own circuit breaker, operation of the back up protection shall initiate tripping of the mesh corner circuit breakers, and DTTs to the associated SGT protection and to the remote end of the associated feeder. This shall be conditioned by the position of disconnector for the shunt reactor.

1.4 Mechanical Protection

1.4.1 Gas and oil actuated relays specified in NGTS 2.3 shall be provided to protect each separate oil filled tank associated with the shunt reactor.

1.4.2 The gas and oil actuated relay surge contact shall be connected to trip. The supplier shall demonstrate that the gas & oil actuated surge relay is immune to the start of pumps and through faults.

1.4.3 Winding temperature instruments specified in NGTS 2.3 shall be provided to protect the shunt reactor from winding over temperature.

1.4.4 Operation of the mechanical protection shall:

- a) Trip the shunt reactor circuit breaker
- b) Initiate CB fail protection where appropriate
- c) Initiate disconnector sequential isolation where required
- d) Initiate trip relay reset where required

1.4.5 Where the shunt reactor is connected onto a mesh corner without its own circuit breaker, operation of the mechanical protection shall initiate tripping of the mesh corner circuit breakers, and DTTs to the associated SGT protection and to the remote end of the associated feeder. This shall be conditioned by the position of disconnector for the shunt reactor.

1.5 Tripping Arrangements

1.5.1 At 400 and 275 kV, the tripping system shall be arranged as follows if two high impedance circulating current relays are offered for the main 1 and main 2 protection:

Tripping system 1:

- a) First overall unit protection
- b) 3-Phase instantaneous high set overcurrent protection. (Not required at 13 kV)
- c) Gas and oil actuated protection
- d) Pole discrepancy tripping

Tripping system 2:

- a) Second overall protection
- b) 2-Phase definite time overcurrent and earth-fault protection
- c) Winding temperature protection

1.5.2 At 400 and 275 kV, the tripping system shall be arranged as follows if a single numerical relay is offered for the overall biased differential protection and REF protection:

Tripping system 1:

- a) Overall biased differential protection and REF protection
- b) 3-Phase instantaneous high set overcurrent protection. (Not required at 13 kV)
- c) Pole discrepancy tripping