

This document is for internal and contract specific use only.

Disclaimer

NGG and NGET or their agents, servants or contractors do not accept any liability for any losses arising under or in connection with this information. This limit on liability applies to all and any claims in contract, tort (including negligence), misrepresentation (excluding fraudulent misrepresentation), breach of statutory duty or otherwise. This limit on liability does not exclude or restrict liability where prohibited by the law nor does it supersede the express terms of any related agreements."

Copyright © National Grid plc 2011, all rights reserved

All copyright and other intellectual property rights arising in any information contained within this document are, unless otherwise stated, owned by National Grid plc or other companies in the National Grid group of companies. No part of this publication may be reproduced in any material form (including photocopying and restoring in any medium or electronic means and whether or not transiently or incidentally) without the written permission of National Grid plc

This information should not be forwarded to third parties.

QUADRATURE BOOSTER BAY

TABLE OF CONTENTS

PURPOSE AND SCOPE	1
PART 1 – GENERAL REQUIREMENTS	1
1 FUNCTIONAL REQUIREMENTS.....	1
2 INTERFACE REQUIREMENTS	6
3 PERFORMANCE REQUIREMENTS.....	8
4 TEST REQUIREMENTS	8
5 TYPE REGISTRATION.....	8
6 CONTRACT SPECIFIED OPTIONS	8
7 FORMS AND RECORDS.....	8
PART 2 - DEFINITIONS AND DOCUMENT HISTORY	9
8 DEFINITIONS	9
9 AMENDMENTS RECORD	9
PART 3 - GUIDANCE NOTES AND APPENDICES.....	10
10 SUBSTATION INFORMATION, CONTROL, PROTECTION AND METERING FUNCTIONAL RELATIONSHIPS FOR A QUADRATURE BOOSTER BAY	10
11 REFERENCES	11

PURPOSE AND SCOPE

This specification defines the functional and performance requirements for the protection of 400kV and 275kV oil immersed Quadrature Boosters (QB) constructed in accordance with IEC 76 or equivalent.

PART 1 – GENERAL REQUIREMENTS

1 FUNCTIONAL REQUIREMENTS

The QB protection system shall comprise main protection, backup protection and mechanical protection. The protection devices shall operate in to two independent tripping systems. The Acceptable Integration options are given in Table 1 in Appendix A.

1.1 Main Protection

- 1.1.1 A single overall unit protection shall be provided in accordance with TS 3.24.65.

Informative: The overall unit protection shall normally be fed from the second DC supply system.

- 1.1.2 The protection shall be responsive to both phase and earth faults on the QB series and shunt windings and associated connections.

- 1.1.3 When specified, the protection shall be provided with dual settings to cater for the following operating conditions;

- a) Quadrature Booster In-Service.
- b) Quadrature Booster Out-of-Service.

- 1.1.4 Switching of the protection settings for the different operations shall be controlled by the position of the primary (bypass) disconnector.

Informative: Only the overall unit protection is required to have dual settings. All other settings shall remain unchanged.

1.1.5 CT Supervision (CTS) shall be provided in accordance with the requirements of TS 3.24.65.

1.2 Backup Protection

1.2.1 Backup protection shall be provided in accordance with TS 3.24.38 and shall consist of;

a) HV Differential Overcurrent Protection

Three-phase differentially connected overcurrent protection shall be provided with IDMT and OC functions to protect the QB series and shunt windings and associated connections. The protection shall be stable for any inrush or outrush transient.

b) LV Instantaneous Earth Fault Protection

LV Instantaneous earth fault protection shall be provided by an OC function to protect the QB LV shunt winding and associated connections.

c) LV Earth Fault Protection

LV earth fault protection shall be provided with an EIDMT function to protect the QB LV shunt winding and associated connections.

1.3 Mechanical Protection

Informative: Mechanical protection trip outputs shall initiate in to the No. 1 Tripping System. This is normally achieved by the use of 'diode'd connections.

1.3.1 Gas and Oil Actuated Protection

Gas and Oil relays as specified in TS 2.3 shall be provided to protect each separate oil-filled main tank associated with the QB, against loss of oil and oil surge.

An oil surge relay shall be provided to protect the tap-changer diverter, and a gas and oil actuated relay shall be provided to protect the tap-changer selector against gas accumulation and oil surge. These shall meet the requirements set out in TS 3.3.4

The Gas and Oil relay trip signals shall be selectable to initiate tripping of the local circuit breaker(s), there shall be no initiation to remote end circuit breaker(s).

1.3.2 Winding Temperature Protection

Winding temperature instruments specified in TS 2.3 shall be provided to protect the QB HV series winding, HV shunt winding, LV series winding and LV shunt winding from over-temperature.

The WTI trip signals shall be selectable to initiate tripping of the local circuit breaker(s), there shall be no initiation to remote end circuit breaker(s).

1.3.3 Core Temperature Protection

A minimum of three core temperature indicators are required for each shunt and series unit, each with alarm and trip contacts and a 4-20 mA analogue indication output.

The temperature of the core of each unit shall be measured at a minimum of three places where overheating might be expected to occur if flux levels are exceeded.

A single trip contact shall be provided for each of the shunt and series units. The contact will close if two or more of the core temperatures on that unit exceed an acceptable limit. The trip contacts shall be settable in the range of 30 deg C to 150 deg C.

1.6 Mesh Corner Protection

1.6.1 For QB's connected to 400kV and 275kV mesh substations, the QB bay shall interface with;

- a) Mesh corner protection in accordance with TS 3.24.6
- b) Protection functions associated with transformers connected to the same mesh corner in accordance with TS 3.24.8
- c) Protection and DTT functions associated with feeder circuits connected to the same mesh corner in accordance with TS 3.24.6

1.6.2 On operation, mesh corner protection shall;

- a) Trip the bay CB
- b) Initiate CBF protection where appropriate
- c) Lockout QBCS and tap-change control where appropriate
- d) Initiate DTT to the remote end(s) of the circuit

1.7 Direct Transfer Trip

1.7.1 Receipt of a QB Direct Transfer Trip (QB DTT) shall;

- a) Trip the bay CB
- b) Initiate CBF protection where appropriate
- c) Lockout QBCS and tap-change control where appropriate

1.8 Ferroresonance Detection and Quenching

1.8.1 Ferroresonance detection and quenching facilities shall be provided in accordance with TS 3.24.17 and TS 3.24.80.

1.8.2 An F4 ferroresonance scheme shall be provided unless otherwise specified.

1.9 Routine Protection Operation Tests

1.9.1 A secure test facility shall be provided to initiate the tripping of the QB circuit from the QB main protection by simulating a QB fault. The facility shall initiate tripping, I/T, DAR, Auto-Switching, CBF, fault recorders etc.

1.9.2 The circuit shall be in service and energised, with all protection systems, Auto-Switching and DAR in service. Correct operation of primary equipment at all circuit ends shall be verified and the correct operation of intertripping, (remote) alarms, indications and auto switching shall be verified. The circuit shall be returned to service after the trip, preferably as the result of DAR operation taking in to account the 'IN' or 'OUT' status of the bypass disconnector Auto-Switching scheme.