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National Grid

National Grid
Technical
Specification

**Standalone
Quadrature Booster
Control Systems**

NGTS 3.24.57
Issue 1
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STANDALONE QUADRATURE BOOSTER CONTROL SYSTEMS

FOREWORD

This Specification is part of a hierarchical structure of documentation describing the requirements for Substation Control Systems which comprises three levels of functional specification. This Document is a Level Three Specification and contains specific functional requirements.

1 SCOPE

This Specification defines the functional and performance requirements for Standalone Quadrature Booster Control Systems used for the operation and management of 275 kV and 400 kV Quadrature Boosters.

2 REFERENCES

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

NGTS 2.7	Specification for Substation Control Systems
NGTS 2.13	Electronic Equipment
NGTS 3.7.2	Digital and Control Outputs
NGTS 3.7.4	Substation Control System Operator Interface
NGTS 3.7.5	Data Archiving
NGTS 3.7.19	Local Control Point Facilities
NGTS 3.7.21	Database Management
NGTS 3.7.22	Diagnostic Facilities
NGTS 3.7.33	Analogue and Digital Inputs
NGTS 3.12.1	48 Volt D.C. Supplies

3 DEFINITIONS

CP	Configuration Parameter (Appendix B)
DBI	Don't Believe It (An invalid switch gear status condition)
EXPORT	Power flowing from the Substation busbar through the QB to line
EMS	Energy Management System (Located at the National Grid Control Centre)
IMPORT	Power flowing towards the Substation busbar through the QB from line
I/O	Input / Output
MCB	Motor Circuit Breaker (Applies to the Tap Changer Motor)
METRO	Microprocessor Enhanced Telecontrol of Remote Outstations
MMI	Man Machine Interface
NGCC	National Grid Control Centre
NPAN	Normal Precision Analogue
OTPS	Over Temperature Protection System
SCS	Substation Control System
QB	Quadrature Booster
QBCS	Quadrature Booster Control System
TCIP	Tap Change In Progress (Signal generated by a QB Tap Changer)
TPI	Tap Position Indication

NB: all references to an SCS within this document shall be deemed to mean also a METRO installation at substations so equipped

4 GENERAL REQUIREMENTS

4.1 The QBCS shall be installed in National Grid substations to manage the operation of 275 kV and 400 kV Quadrature Boosters. The QBCS shall:

- (a) provide a local display of all pertinent QB operational information
- (b) provide a facility to manually tap a QB in the event of a telecommand system failure
- (c) ensure that a QB Tap Changer is only operated when safe to do so
- (d) provide appropriate alarms and indications to the Substation Control System
- (e) provide an “Envelope Management” facility for each QB

QB Operation

4.2 The QBCS shall be responsible for operation and management of between one and four QBs each operating at either 275 kV or 400 kV.

4.3 The QBCS shall conform to the definition of relationship between QB Tap Position and Power Flow as detailed in Appendix A unless advised otherwise in the contract documents.

Plant Information Displayed on the MMI

4.4 For each QB controlled the QBCS shall acquire and display at least the information listed below:

- (a) A diagram of the plant and the status of all associated switchgear
- (b) The Tap Position Indication (the number of taps to be specified in contract documentation)
- (c) An indication when a Tap Change is in Progress
- (d) An indication when the Tap changer MCB is tripped
- (e) The phase to phase voltage measured on the QB line side
- (f) The current measured in a single phase on the QB line side
- (g) The MWs measured on the QB line side labelled IMPORT or EXPORT
- (h) The **MVARs** measured on the QB line side labelled IMPORT or EXPORT
- (i) The temperature of the HV Shunt **winding**
- (j) The temperature of the HV Series **winding**
- (k) The temperature of the LV Shunt **winding**
- (l) The temperature of the LV Series **winding** (where required by the contract documentation)
- (m) QB and QBCS alarm information
- (n) All “Tap Raise Control Disallowed” indications currently active
- (o) All “Tap Lower Control Disallowed” indications currently active
- (p) All “Outside Operating Envelope” indications currently active
- (q) An indication of the Control Point
- (r) **The Shunt Tank Core Temperature using the average value from a three sensor array**
- (s) **The Series Tank Core Temperature using the average value from a three sensor array**
- (t) The System Frequency

Control Point Selection

4.5 The QBCS shall provide from the MMI a means of allowing control of each QB Tap Changer to be individually selectable between either telecommand from the Substation Control System or locally from the QBCS MMI. The MMI operation to allow selection of the Control Point for each QB shall be under key control.

Tap Changer Control

4.6 The QBCS shall control the QB by means of “Tap Raise” and “Tap Lower” controls to the Tap Changer. “Tap Raise” shall cause the Tap Position to increment and “Tap Lower” shall cause the Tap Position to decrement.

4.7 When the Control Point Selection for a specific QB is “Remote” then telecommanded “Tap Raise” and “Tap Lower” controls for that QB shall be accepted from the SCS. “Local” control of the same QB from the QBCS MMI shall not be permitted.

- 4.8** When the Control Point Selection for a specific QB is “Local” then “Tap Raise” and “Tap Lower” controls for that QB may be initiated on the MMI. Telecommanded “Tap Raise” and “Tap Lower” controls from the SCS for the same QB shall not be accepted.
- 4.9** With a QB out of circuit (Switchgear Status = Circuit Open), a “Tap Raise” or “Tap Lower” control, irrespective of source, may be issued to plant at any time provided that:
- (a) The selected QBs MCB is not tripped
 - (b) A tap change on the selected QB is not already in progress
 - (c) At least five seconds have elapsed since the last tap change was completed. (Tap Change completion being defined as the termination of the TCIP signal with the expected new Tap Position Indication set).
- 4.10** With the QB in circuit (Switchgear Status = Circuit Closed), a “Tap Raise” or “Tap Lower” control, irrespective of source, shall only be issued to plant if all the following conditions pertain:
- (a) The selected QBs MCB is not tripped
 - (b) A tap change on the selected QB is not already in progress
 - (c) At least five seconds have elapsed since the last tap change was completed on the selected QB.
 - (d) No alarms **other than those specifically excepted in Clause 4.11** are standing for the selected QB
 - (e) The selected QB global MW Import or Export limits are not exceeded.
 - (f) For a “Tap Raise” control the “Tap Raise Control Disallowed Indication” is not standing.
 - (g) For a “Tap Lower” control the “Tap Lower Control Disallowed Indication” is not standing.
- 4.11** **In meeting the requirements of clause 4.10 the following alarms are specifically excepted:**
- (h) **The winding temperature alarm**
 - (i) **The core temperature alarm**
 - (j) **The core temperature sensor fault alarm**
 - (k) **The core temperature sensor discrepancy alarm**

Configuration Parameters

- 4.12** The QBCS shall maintain a database of configurable parameters needed to describe each QB and provide limits against which to test for alarm conditions. Each configurable parameter or limit required is set out in Appendix B.
- 4.13** In addition to the basic configuration, an “operating envelope” database for each QB managed by the QBCS shall also be maintained. The information to be maintained in this database shall be as set out in Appendix C.
- 4.14** A database setup and modification tool shall be provided for all configuration parameters
- 4.15** Where “Envelope Management” is provided in the QBCS, a utility to allow database import from a Microsoft Excel^(TM) Spreadsheet, Version 5.0 and later shall be provided. The database for each QB managed by the QBCS shall be imported separately.

Controls from the SCS

- 4.16** The QBCS shall provide a facility to accept a “Tap Raise” and “Tap Lower” control from the SCS for each QB managed.
- 4.17** Corresponding “Tap Raise” and “Tap Lower” controls shall only be issued by the QBCS to plant provided that the control point for the selected QB is remote and the conditions specified in Clause 4.9 or 4.10 as appropriate are satisfied.