

REQUIREMENTS FOR SITE COMMISSIONING TESTS ON PROTECTION & CONTROL EQUIPMENT

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PURPOSE AND SCOPE

This document specifies a framework of requirements for the commissioning tests to be carried out on protection and control equipment, including secondary wiring and ancillary equipment associated with main plant.

PART 1 – PROCEDURAL

1 COMMISSIONING STAGES AND DOCUMENTATION

The following table identifies the stages of commissioning. Factory Acceptance Tests are excluded – although they form part of the wider equipment verification and test audit trail they do not comprise site commissioning. The right hand column identifies the test documentation.

Commissioning Stage	Test Documentation
Stage 1	SCT procedures Drawings Simulation schedules
Stage 2	SCT procedures Simulation schedules

NB: The term Site Acceptance Tests (SAT) is not used in this procedure (and is not a preferred term) since it is encompassed by Stage 1 commissioning.

All test documentation must be identified in the commissioning programme – see Commissioning Handbook N°1.

2 SITE COMMISSIONING TEST PROCEDURES (SCT)

SCT procedures are mostly concerned with proving the functionality of a protection and/or control system. In principle tests on each and every item of equipment could be contained in a SCT procedure, however, when conventional circuitry is utilised and depicted on a drawings, it is acceptable practice to utilise the drawing as the test document, see section 3.

SCT procedures fall into two categories of document as follows:-

- | | | |
|----|-------------------|---|
| a) | Prescriptive | These documents define the step by step test requirements for a specific item of equipment, eg. a type of distance protection. They must always be utilised for this type of equipment and rigorously adhered to. |
| b) | Template/Guidance | These documents are originated by National Grid and provide either a template or general guidelines. Suppliers may utilise alternative SCT procedures which encompass the requirements of the template. Appendix A lists the currently available documents. |

Both prescriptive and Suppliers' alternatives to Templates/ Guidance SCT procedures are a requirement of the Type Registration process.

SCT procedures must be formatted to a common structure/framework. This equally applies to SCT procedures for main plant. The required format is provided in form SCT01.A.

3 DRAWINGS

Circuit diagrams (formerly termed schematic diagrams) may be utilised as the test document. These must be retained as part of the commissioning documentation audit trail. Specific requirements are as follows.

3.1 DC Circuit Diagrams

DC circuit diagrams define the sequence logic for applications such as protection schemes, circuit breaker trip and control, disconnector control, interlocking schemes, operational tripping schemes etc.

Verification of the circuitry sequence logic may be undertaken by operation of each item (or items) of equipment in turn. Confirmation of the correct functionality of each item must be indicated by clearly ticking or highlighting the item on the drawing. Confirmation that a diagram has been fully proven shall be indicated by both the Commissioning Engineer (Supplier) and Commissioning Engineer (National Grid) signing and dating the drawing. The latter will also sign the commissioning programme.

Where circuitry is assembled onsite, negative tests shall be undertaken to confirm the correct interconnection of the circuitry (this does not apply to equipment which has been subject to FAT). The negative tests shall verify

- a) the power supply, ie. correct connection of the circuitry to the appropriate fuse/link/MCB

- b) that operation may only occur when each and every item of equipment is in the correct open/close or trip/reset state

DC circuit diagrams will invariably define the input/output terminations of relays and will therefore be referenced by the relevant SCT procedures.

3.2 AC Circuit Diagrams

AC circuit diagrams define the interconnection circuitry of CTs, VTs and connected equipment.

The individual equipment boxes/relays will be verified by secondary injection and recorded in SCT procedures. The interconnection will be proved by primary injection for CT circuitry and secondary injection for VT circuitry and these tests should also be recorded on SCT procedures. The SCT procedures should be referenced to AC circuit diagrams. Confirmation that each item on the diagram has been verified should be by clearly ticking or highlighting the item. Confirmation that a diagram has been fully proven shall be indicated by both the Commissioning Engineer (Supplier) and Commissioning Engineer (National Grid) signing the drawing. The latter will also sign the commissioning programme.

AC circuit diagrams will invariably define the input/output terminations of relays and will therefore be referenced by relevant SCT procedures. Where AC schematic diagrams show CT connections the CT tapping ratios shall be shown, with the tap in use clearly & correctly underlined.

4 STAGE 1 SIMULATION TESTS

Occasions will arise where it is necessary to verify circuitry and connected equipment on site by operating the installed protection/control and HV equipment. This may arise for example on auto-switching schemes or operational tripping schemes, although it is expected that Factory Acceptance Tests will reduce the need for, and range of, the verification tests to be undertaken.

In such instances the Supplier shall prepare a test schedule based, as far as possible, on the SCT Procedure Framework (Form SCT01.A). The test schedule shall comprise a comprehensive listing of events and observations as detailed in Appendix B, ie. of a similar format to that required of the FAT.

5 STAGE 2 SIMULATION TESTS

Simulation tests using the actual in-service equipment will need to be undertaken for autoswitching schemes.

A test schedules with a format similar to that in Appendix B of this document shall be utilised. This may be an integral part of a commissioning switching programme.

6 MULTI-FUNCTION RELAY CONSIDERATIONS

SCT procedures for multi-function relays may comprise either an individual SCT for each function (preferred option) or a single SCT covering all functions. If the latter is utilised the requirements of Form SCT01.A shall be applied to all functions within the relay.

7 STANDARD BAY SOLUTIONS

A SCT procedure may cover a complete standard bay solution. Such a procedure must contain a comprehensive contents listing and accord with the requirements of Form SCT01.A.

8 TEST EQUIPMENT

All test equipment shall be provided by the Supplier. It shall be both adequately rated for the intended purpose and subject to calibration inspection/verification. National Grid shall provide single phase and three-phase ac supplies from existing substation facilities as required.

9 AUTO-TEST EQUIPMENT

The Supplier may utilise auto-test equipment. The type, serial number, software version etc must be referenced in the appropriate SCT procedures. The SCT procedure must also list the tests that the auto-test equipment shall undertake – and the test results documentation must be to a standard that allows ease of interpretation by the Commissioning Engineer (National Grid) and must be appended to the SCT procedure.

10 DETAILED CONSIDERATIONS

10.1 Current Transformer Magnetisation Curve

The magnetisation curve of all CTs must be confirmed. Sufficient measurements shall be taken to enable the identification of the CT with reference to the manufacturer's design curve, and to determine the suitability of the CT for its intended duty. It is not normally necessary to check the characteristic up to the knee-point for this purpose. The core must be confirmed as being fully demagnetised before the test commences.

10.2 Secondary Injection

Secondary injection requirements shall be detailed in the relevant SCT procedure.

10.3 Primary Injection

The standard of primary injection to be undertaken is detailed in National Grid's Commissioning Handbook procedures.

10.4 Tripping Tests at Reduced Voltage

Protection and control equipment including HV circuit breaker trip and close coils shall be capable of operating down to 87.5 volts. This shall be demonstrated by employing a 'Trip Coil Tester', the output contacts of which should be connected across a trip relay.

10.5 CT Ratio Checks

All relevant CT ratios shall be checked and confirmed as correct. The AC schematic diagram showing the relevant CTs shall include the CT tapping ratios, with the tap in use clearly & correctly underlined. The SCT shall include a check on all measured relay currents against primary load, the reference for which shall be from a proven or undisturbed source.

11 FORMS AND RECORDS

Not applicable.

PART 2 - DEFINITIONS AND DOCUMENT HISTORY

12 DEFINITIONS

Not applicable.