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SYSTEM MONITORING – FAULT RECORDING

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PURPOSE AND SCOPE

This Specification defines National Grid's technical requirements for fault recording.

Fault recording equipment is required to provide monitoring of system faults. This Specification describes the functional and performance requirements for fault recording on National Grid's 400 kV, 275 kV and 132 kV systems.

The requirements are applicable for each feeder end as specified within the Bay Specifications.

Common requirements for all System Monitoring are given in NGTS 3.24.68. Fault Recording is one of three functions specified.

Where the fault recording function is integrated within another item of equipment, then this Specification shall form a part of the overall Specification for the equipment hosting the fault recording function ie NGTS 3.24.68, System Monitor Common Requirements.

See Appendix A at the end of this TS for fault recording integrated within protection.

PART 1 – PROCEDURAL

1 FUNCTIONAL REQUIREMENTS

1.1 Fault Recording Provision and Location

- 1.1.1 Fault recording facilities shall be supplied on every feeder end at 400 kV, 275 kV and 132 kV substations.
- 1.1.2 Where integrated within protection, fault recording location shall be as per NGTS 3.24.7, in line with acceptable integration options provided.
- 1.1.3 The following shall apply:
 - a) Limited fault recording facilities for a non-feeder circuit (ie supergrid transformer, bus section, bus coupler etc), shall be met by utilising the spare analogue and event channels provided within an adjacent feeder fault recording facility.

- b) Up to a maximum of two non-feeder circuits may be paralleled onto the spare channels associated with one feeder circuit.
- c) Where the number of non-feeder circuits at a substation exceeds the available spare channel capacity provided by the feeder fault recording facility, then a separate common fault recorder shall be supplied to provide the necessary analogue and event channels for the additional non-feeder circuits.
- d) The equipment shall be provided with and set to the channel allocation and labelling guidance given in Figure 2 of this Specification (channel order may vary). Detailed setting and labelling guidance can be found in TGN(E) 156.

1.2 General

- 1.2.1 The fault recording system shall, when triggered, record in analogue form, three phase currents, residual current, three phase voltages and in digital form, event information, including: first and second main protection equipment outputs, associated intertripping and signalling equipment outputs and switchgear operation before, during and after system fault incidents. Specific analogue and event channels required are shown in TGN(E) 156 and Figure 2 as appropriate.
- 1.2.2 A minimum of 8 analogue channels and 16 event channels per feeder circuit end is required.
- 1.2.3 The fault recorder shall record all the analogue and event data simultaneously with all channels relating to the same time reference.
- 1.2.4 The fault record shall be stored in a non-volatile memory storage medium, for subsequent retrieval by means of a personal computer (PC).
- 1.2.5 The equipment shall be capable of retaining its selected parameterisation and settings when its auxiliary energising supply is removed and subsequently reinstated up to a year later.

Informative: It would be preferable not to have batteries as the provider of this memory retention.

- 1.2.6 Recorders shall be designed such that each primary circuit's records are easy to individually access, display on a PC screen, analyse and print.

1.3 Analogue Channels

- 1.3.1 The sampling frequency of analogue channels shall be at least 2 kHz and preferably 6 kHz or greater.
- 1.3.2 The analogue information shall have an amplitude resolution of at least 1 in 64 million.

Informative: This could, for example, be achieved by a 16 bit analogue-to-digital converter.

- 1.3.3 The RMS current measurement range shall be user selectable offering at least selections for 10, 20, 40, 50, In.

1.4 Event Channels

- 1.4.1 The sampling frequency for the event channels shall preferably be the same as the analogue channels, however, where the sampling frequency is different, it shall not be less than 1kHz.
- 1.4.2 The event channels shall be capable of accepting either normally open (NO) or normally closed (NC) contacts.

1.5 Recording Time

- 1.5.1 The fault recorder shall have a pre-trigger recording time selectable within the range of 100 ms to 200 ms in steps of not greater than 50 ms and a separate total recording time setting of 300 ms to 1 s in steps of not greater than 50 ms.

1.6 Memory

- 1.6.1 The fault recorder function shall have a non-volatile storage capacity of at least 100 consecutive fault triggered records per circuit.

Informative: The fault recorder equipment itself may only have a capacity of, say, 30 records, provided the recording system automatically passes its records to a non-volatile storage system which will retain at least 100 fault records per circuit and can be interrogated as required by this Specification.

Informative: The fault records shall consist of, as a minimum requirement, 100 ms of pre-trigger recording and 400 ms of post-trigger recording for both analogue and logic signals at a sampling frequency of 6 kHz for 8 analogue and 16 event channels.

- 1.6.2 When full, the oldest fault record in memory shall be overwritten by an incoming fault.

1.7 Clock System

- 1.7.1 The fault recorder shall be provided with an internal clock to time tag each fault record.
- 1.7.2 The clock shall be provided with facilities for external synchronisation to a substation clock.

1.8 Triggering - General

- 1.8.1 Means shall be provided to trigger the fault recorder manually, locally and remotely, through the remote interrogation software.
- 1.8.2 Only one fault record shall be generated for a persistent trigger condition.
- 1.8.3 Once the fault recorder has been triggered it shall not be primed to trigger a further recording until at least 80% of the recording time has elapsed.
- 1.8.4 Means shall be provided to select or de-select, as required, triggering from any analogue or event channel.
- 1.8.5 The inhibit facility shall provide clear indication that triggering has been inhibited and shall preferably automatically re-enable the triggering after a selectable period of time eg 2 hours, 2 days etc.

1.9 Triggering From Analogue Channels

- 1.9.1 Analogue trigger and amplitude settings shall be in steps of not greater than 5% of the nominal maximum amplitude over the full scale range.
- 1.9.2 The quantities of the triggering voltage or current shall be proportional to the RMS value of the inputs.

1.9.3 Each analogue channel shall be provided with the following independent selectable triggering facilities:

a) Voltage and Current Threshold Triggering

Fault recorder triggering when the voltage falls or rises to a pre-set threshold or when the current rises to a pre-set threshold.

b) Voltage and Current Variation Triggering

Fault recorder triggering when the voltage falls or the current rises by a pre-set percentage of nominal maximum amplitude of recording in 1 cycle. Steps shall be taken to ensure that spurious triggering will not occur on voltage inputs when the primary voltage is already at or near zero.

c) Current Negative Phase Sequence Triggering

Either over-threshold triggering or positive variation triggering is acceptable.

1.10 Distance to Fault Estimation

1.10.1 The fault recorder shall be provided with distance to fault (DTF) estimation facilities.

1.10.2 Where a single item of equipment serves both feeder circuits on a double circuit overhead line, the DTF estimation shall take into account the effects of mutual coupling between the two circuits.

1.10.3 Where the fault record is available from the remote end in COMTRADE or native format, the analysis package shall take into account the fault current infeed from the two ends and provide a compensated DTF estimation.

1.11 Interfaces

1.11.1 The equipment shall be connected to other equipment as described in the appropriate Bay Specification (ie Feeder Bay Specification NGTS 3.24.7, Mesh Corner Bay Specification, NGTS 3.24.6 etc) as appropriate, Figure 1 or Figure 2 of this document (depending on application) and as declared below.

1.12 Interrogation Facilities

1.12.1 Once a directory of fault records has been retrieved from the fault recorder, the operator shall be able to choose one or a selection of several fault records in a batch, to be up-loaded to the PC.

1.12.2 The user shall be able to easily identify, distinguish and select fault recorder records from those of quality of supply or dynamic records where the fault recorder function is integrated within an Integrated Monitor.

1.12.3 The interrogation software package shall be capable of displaying the retrieved records. Brief information such as fault reference number, site, circuit, date, time, etc about each record shall be displayed on a menu system.

1.12.4 The display interface shall be user friendly, displaying user defined parameters with automatic and manual scaling facilities, enabling manipulation of data for display and printing.