

## **SYSTEM MONITORING – FAULT RECORDING**

### **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."*

### **TABLE OF CONTENTS**

PURPOSE AND SCOPE.....	1
<b>PART 1 – FUNCTIONAL AND PERFORMANCE REQUIREMENTS.....</b>	<b>1</b>
1 FUNCTIONAL REQUIREMENTS.....	1
2 PERFORMANCE REQUIREMENTS.....	4
3 FORMS AND RECORDS.....	5
<b>PART 2 - DEFINITIONS AND DOCUMENT HISTORY.....</b>	<b>5</b>
4 DEFINITIONS AND ABBREVIATIONS.....	5
5 AMENDMENTS RECORD.....	5
<b>PART 3 - GUIDANCE NOTES AND APPENDICES.....</b>	<b>5</b>
6 REFERENCES.....	5

### **PURPOSE AND SCOPE**

This document describes the functional and performance requirements for Users' equipment directly or indirectly connected to the National Electricity Transmission System. It applies to Users who are required to provide Fault Recording pursuant to the terms of the Bilateral Connection Agreement.

It is noted that such equipment is expected to be of benefit to both the Generator and TSO in helping to analyse system events and diagnose the root cause of transients that could otherwise affect the performance and safe operation of the grid or generator's facility.

Equipment topologies other than those proposed in this specification are acceptable where such solutions can be demonstrated by the User to meet the overall functional and performance requirements specified herein. In particular, different monitoring and fault recording functions can be integrated into the same hardware, provided that the required data can be recorded and retained in line with the requirements specified for each data type.

Whilst some requirements are essential to meet minimum legal standards others can be deviated from with mutual consent by all stakeholders and subject to the comments above.

The requirements are applicable for each individual connection between the User and the System. Where the fault recording function is integrated within another item of equipment, then this Specification shall form part of the overall specification for the equipment hosting the fault recording function.

### **PART 1 – FUNCTIONAL AND PERFORMANCE REQUIREMENTS**

#### **1 FUNCTIONAL REQUIREMENTS**

##### **1.1 Fault Recording Provision and Location**

Where applicable, fault recording facilities shall be supplied on every feeder/interconnector/connection unless otherwise agreed with NGET.

Note: Users are required to provide a fault recording facility at each connection point to the transmission system only. The exact location shall be agreed in the Bilateral Connection Agreement (BCA). Fault recording is provided by the relevant asset owners.

## 1.2 General

The fault recording system shall, when triggered, record at least the following signals in analogue form:

- Three-phase currents
- Three-phase voltages
- Active power
- Reactive power
- Frequency
- In addition, where applicable (i.e. HVDC connections), DC current and voltage is to be recorded.

Optionally, the fault recording system may also record the following signals (event information) in digital form:

- Main protection equipment outputs.
- Associated intertripping and signalling equipment outputs.
- Switchgear operation before, during and after system fault incidents.

*Informative: Specific analogue and event channels are shown in Figure 2 as guidance.*

The fault recorder shall record all the analogue and optional event data simultaneously with all channels relating to the same time reference.

The fault record shall be stored in a non-volatile memory storage medium, for subsequent retrieval by means of a Personal Computer (PC).

The equipment shall be capable of retaining its selected parameterisation and settings when its auxiliary energising supply is removed and subsequently reinstated.

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

Fault recording devices need to be powered via a UPS or other supply that would not be disrupted in the event of a de-energisation of the User's connection.

## 1.3 Analogue Channels

The sampling frequency of analogue channels for fault recording purposes shall be at least 1 kHz.

The measurements of the analogue channels shall have an accuracy of 1% or better.

The amplitude resolution shall be as a minimum in line with the performance of a 12 bit analogue-to-digital converter.

The RMS current measurement range should be user selectable offering typically selections for 10, 20, 40, 50 In. The range to be used shall be agreed with NGET but should at least offer ranges up to 30 In.

#### **1.4 Event Channels (Optional)**

The sampling frequency for the event channels shall preferably be the same as the analogue channels. The event channels shall be capable of accepting either Normally Open (NO) or Normally Closed (NC) contacts.

#### **1.5 Clock System**

The fault recorder shall be provided with an internal clock to time tag each fault record.

The clock shall be provided with facilities for external time synchronisation at periodic intervals.

#### **1.6 Triggering**

##### **1.6.1 Triggering - General**

Only one fault record shall be generated for a persistent trigger condition.

Once the fault recorder has been triggered, it should not be primed to trigger a further recording until at least 80% of the recording time has elapsed.

##### **1.6.2 Triggering from Analogue Channels**

The quantities of the triggering voltage or current shall be proportional to the RMS value of the inputs and shall be agreed with NGET (refer to PST010 (RES)).

Each analogue channel shall be provided with suitable selectable triggering facilities, as agreed with NGET:

- 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.

- 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.

#### **1.7 Fault Record Analysis**

Data import and export facilities shall be provided to COMTRADE format in accordance with IEC 60255-24 (BS EN 60255-24), allowing comparison and analysis on a common platform and in particular import into a fault record analysis software package implementing this standard.

#### **1.8 Settings**

- 1.8.1 Trigger settings for analogue and digital quantities shall be agreed between the User and NGET (refer to PST010 (RES)). It is essential to coordinate these settings to ensure that for

any event data from all Users is available. Settings are to be agreed with NGET for each application.

- 1.8.2 The settings shall ensure that the Fault Recorder does not trigger under normal credible running and loading arrangements.
- 1.8.3 Optionally, the Fault Recorder will trigger from a digital event for a fault condition (i.e. trip relay operation). Any relevant plant change of state indication will be captured as a digital input, but the Fault Recorder will not be triggered by this change of state.

## 2 PERFORMANCE REQUIREMENTS

### 2.1 General

The fault recorder and its interrogation equipment shall perform correctly in accordance with the requirements detailed in this TS, for the range of power system conditions and variations specified in TS 1 (RES) and the range of environmental conditions specified in TS 3.24.15 (RES).

### 2.2 Analogue Inputs

For CT inputs, where required, full d.c.DC offset shall be accurately reproduced when the X/R ratio of the system fault in-feed is a minimum of 16 and the design maximum symmetrical RMS fault current component is offset by an additional factor of 0.6.

*Informative: The system X/R ratio determines the time constant of the d.c. component's decay.*

Unless otherwise agreed, the voltage channels should accurately reproduce 150% of nominal.

Unless otherwise agreed, analogue channels, including any interposing transformers or shunts, should have a composite error of 1.0% or less.

Unless otherwise agreed, the bandwidth (-3 dB) of the analogue channels should cover, as a minimum requirement, a frequency range of 20 Hz to 400 Hz.

The response time of an analogue trigger shall not be greater than 40 ms.

### 2.3 Event Channels (Optional)

Unless otherwise agreed and where provided the event channels should be capable of the following:

- The response time of an event trigger shall be sufficiently short to trigger for event durations of 2 ms and above.
- Triggering shall not take place, however, for events lasting less than 0.5 ms or as a result of electrical noise.
- The event channels shall not trigger the fault recorder when the voltage of the input signal is less than 50% of nominal input voltage rating.
- The response time for storing the data relating to change of state of event signals shall not exceed 0.5 ms for every acceptable sampling rate.
- A minimum pulse width of 1 ms with an accuracy of 0.5 ms shall be capable of being captured. This requirement shall be met when multiple changes of state occur on any channel or group of channels.

**3 FORMS AND RECORDS**

N/A

**PART 2 - DEFINITIONS AND DOCUMENT HISTORY**

**4 DEFINITIONS AND ABBREVIATIONS**

COMTRADE	Common Format for Transient Data Exchange
CT	Current Transformer
DC	Direct Current
IED	Intelligent Electronic Device
LAN	Local Area Network
RMS	Root Mean Square
VT	Voltage Transformer
WAN	Wide Area Network

**5 AMENDMENTS RECORD**

Issue	Date	Summary of Changes / Reasons	Author(s)	Approved By (Inc. Job Title)
1	February 2018	First issue	Thomas Charton Asset Policy	Daniel Penny Asset Policy Manager

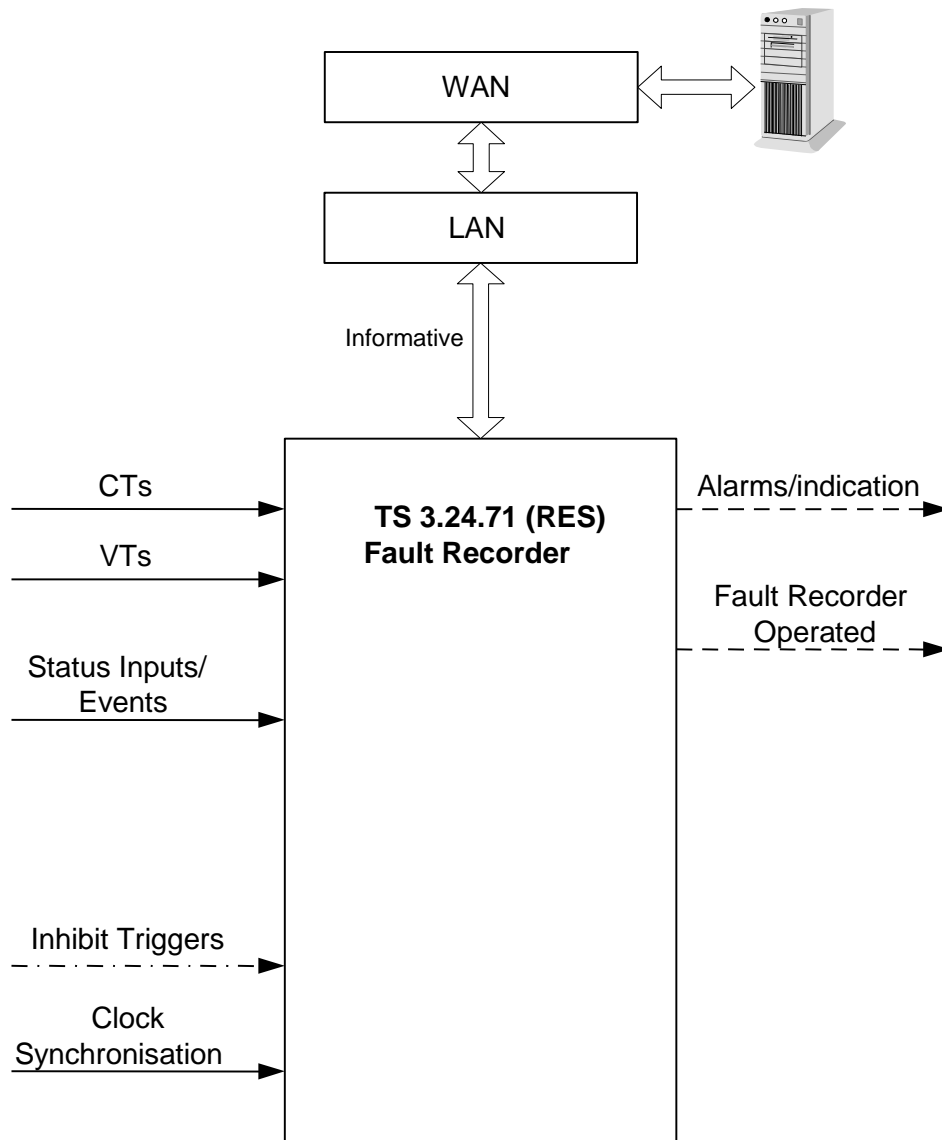
**5.1 Procedure Review Date**

5 years from publication date.

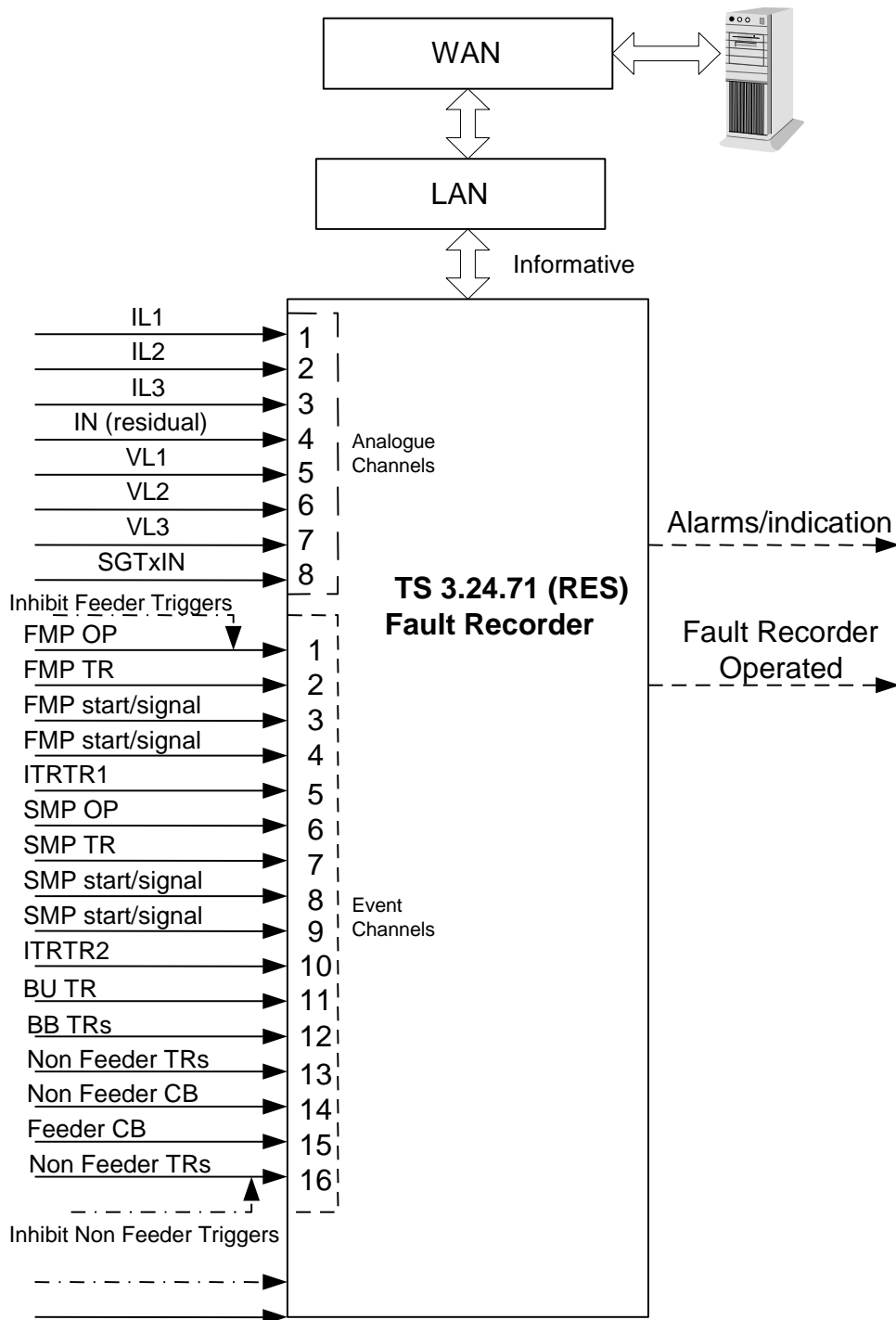
**PART 3 - GUIDANCE NOTES AND APPENDICES**

**6 REFERENCES**

TS 1 (RES)	Ratings and General Requirements for Plant, Equipment, Apparatus for the National Grid System.
TS 3.24.15 (RES)	Environmental and Test Requirements for Electronic Equipment.
IEC/BS EN 60255-24	Common Format for Transient Data Exchange (COMTRADE) for Power Systems.
PST010 (RES)	Backup Protection Grading across National Grid/Distribution Network Operator Interfaces and other Third Parties



**Figure 1: Typical Fault Recording Application within an Integrated Monitor (Analogue and Events (Optional) Input to System Monitoring Devices)**



**Figure 2: Example of a typical application showing Fault Recorder Generic Connections and Labels for TSO Feeders**  
**FMP – First Main Protection, SMP – Second Main Protection – For HVDC additional DC quantities are to be measured.**

**Copyright © National Grid plc 2017, 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*