NPS/003/013 – Specification for Fault Passage Indicators and their associated Current and Voltage Sensing Instruments for use with Ground Mounted 11 & 20kV Switchgear

1. Purpose

The purpose of this document is to detail the technical requirements for Fault Passage Indication (FPI) module(s) and associated Current and Voltage sensing instruments for use with ground mounted switchgear on the Northern Powergrid distribution networks.

This document supersedes the following documents, all copies of which should be destroyed.

Document Reference	Document Title	Version	Published Date
NPS/003/013	Specification for Fault Passage Indicators and Current Transformers for use with Ground Mounted 11 & 20kV Switchgear	4.0	July 2014

2. Scope

This document applies to Fault Passage Indicators (FPIs) and their associated Current and Voltage sensing instruments for use with ground mounted switchgear on the Northern Powergrid 11kV and 20kV distribution networks.

Internal Code of practice documents IMP/010/011 and IMP/001/909 are indispensable sources of information for suppliers to be able to understand and appreciate the likely network parameters and conditions under which the FPI relays and associated sensing instruments will be expected to operate.

The following appendices form part of this technical specification: -

Appendix 1 – Addendum to Supplier

Appendix 2 – Addendum to Supplier Requirements

Appendix 3 – Logistical Requirements

Appendix 4 – Self Certification Conformance Declaration

2.1. Contents

3. Requirements

3.1. Overview

Northern Powergrid (the company) has requirement for FPI's with Fault detection capability classes:

- F2-A1-T2 – Non directional detection of only phase to earth faults
- F3-A1-T2 – Non-directional detection of both phase to earth faults and overcurrent
- F6-A1-T2 – Directional detection both of phase to earth faults and overcurrents.
- F6-A1-T3 - Directional detection both of phase to earth faults and overcurrents, with client/server communication

As defined in clause 8.4.2 of ENA TS 48-2 and IEC / BS EN 62689-1.

FPIs and connected sensing instruments are required to be used on the Northern Powergrid 11 & 20kV distribution networks.

On new installations, FPIs will as a minimum connect to integral CTs installed and wired by the switchgear manufacturer, and be capable of detecting and operating for phase-to-earth, phase to phase and three phase fault currents.

Whenever directional detection is necessary and wherever possible; it is desirable for FPI's to also connect to integral voltage sensing instruments installed and wired by the switchgear manufacturer.

On existing in-service installations, FPIs will be used to upgrade, repair or replace existing facilities, connecting to existing CTs, or to new sensing instruments. In situations where it is not possible to fit sensing instruments suitable for the detection of single phase, phase to phase and three phase fault currents the FPI and sensing instrument arrangement shall be capable of detecting earth fault currents.

FPIs may be required to interact with the switchgear remote control facilities on site (RTU), so shall have volt free contacts for such a connection. Further details of these are in Appendix 1(d).

The equipment shall comply with the latest version of all relevant and current: IEC International Standards, British Standard Specifications or equivalent Euro Norms, and Energy Networks Association Technical Specifications (ENATS), except where varied by this standard.

3.2. Technical Specification for the FPI

3.2.1. Overall

The FPI and associated sensing instruments shall meet the requirements of the latest version of ENATS 48 2 for FPIs, except where varied by this specification.

The FPI shall be designed and manufactured to provide reliable operation in accordance with the specification for the service life of an ENA TS 41-36 compliant switchgear unit.

Evidence shall be presented in the form of accelerated aging tests to demonstrate compliance with the declared lifetime of the FPI.

Consideration in the design shall be given to simple replacement of critical components, components that have the shortest lifetime expectancy, and components that have the lowest mean time between failures.

FPIs and associated equipment shall be capable of withstanding sensing equipment outputs resulting from passage of earth fault current up to 5kA for 3 seconds, or phase to phase fault current up to 20kA for 3 seconds without any detriment to their operation and without suffering damage or degradation.

The Earth Fault Current Transformer (CT) primary to secondary turns ratio shall be 60:1.

The Phase to Phase Fault CT primary to secondary turns ratio shall be 500:1.

3.2.2. Fault Detection

The unit shall detect and indicate the passage of earth fault current, and ideally can be configured for either:

- 40A or above trigger
- 80A or above trigger

The unit shall NOT operate for the passage of earth fault currents of less than 40A when configured for a 40A and above trigger or 80A when configured for 80A and above trigger

This is to avoid misleading indication resulting from the detection of stray current related to earth faults on other parts of the network.

The unit shall detect and indicate the passage of phase to phase and three phase fault currents and ideally can be configured for either;

- 500A or above trigger
- 1000A or above trigger

And shall be stable and not operate below these values.

Depending on type, the unit shall detect faults with both phase to phase and earth fault currents and, in these cases, shall provide indication of whether one, or both have occurred.

When specified, the unit shall also detect and indicate the direction of earth fault current and phase to phase faults within the parameters set above.

3.2.3. Fault Indication

The local indication of fault current passage and where applicable direction, shall be clear and unambiguous and shall distinguish between earth fault and overcurrent (phase to phase and three phase) faults in both the forward and reverse power flow conditions.

The indication will preferably use three separate indicators to represent each phase in order to indicate which phase or phases have passed the fault current.

Where applicable, the fault flow direction shall be indicated by a separate additional indicator and will preferably be configurable on-site.

Where a means of indication employs a flashing light, then the flash rate shall not be less than once every 3 seconds.

Earth fault and overcurrent faults can be distinguished by different colour indicators. Where earth fault and overcurrent faults are distinguished by a different flash rate of the same indicator in the same colour, the flash rate of overcurrent faults shall be the faster and differ from that of earth faults by a factor of two or more. In situations where both earth and overcurrent faults have been detected, the indication shall be at the highest flash rate.

The indication shall display until the unit is externally reset, for a time of no less than 3hours. If the unit is not externally reset within this time then the unit shall self-reset when the 3 hours has elapsed.

Following a reset, the unit shall be ready and capable to carry out a full detection and indication sequence again within a maximum of 30 seconds.

Normally open, volt free contacts that correspond to the state of the FPI shall be provided. It is a preferred option that these volt free contacts are separate and independent for each fault detection condition, rather than a single common set for Earth Fault and overcurrent (phase to phase and three phase). They shall remain latched until the unit is reset by either:

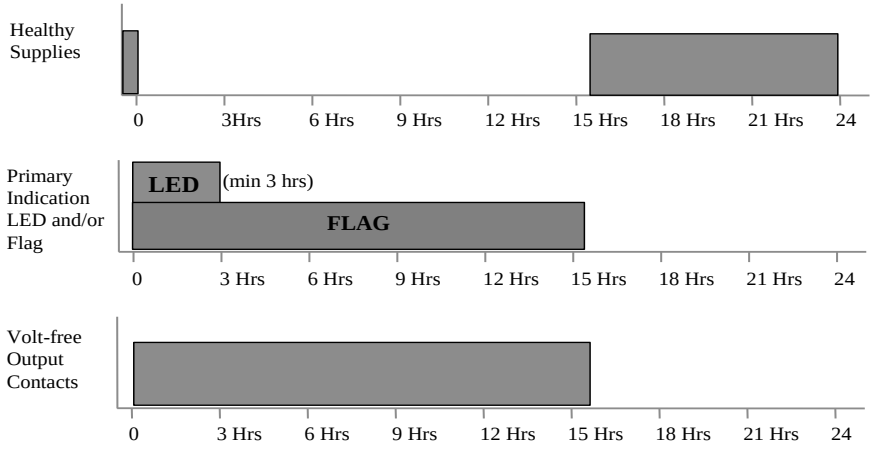
- restoration of supplies
- +24V DC nominal (18 – 30V DC range) pulsed remote reset command, or
- manual push button reset,

but in any case not by loss of internal energy.

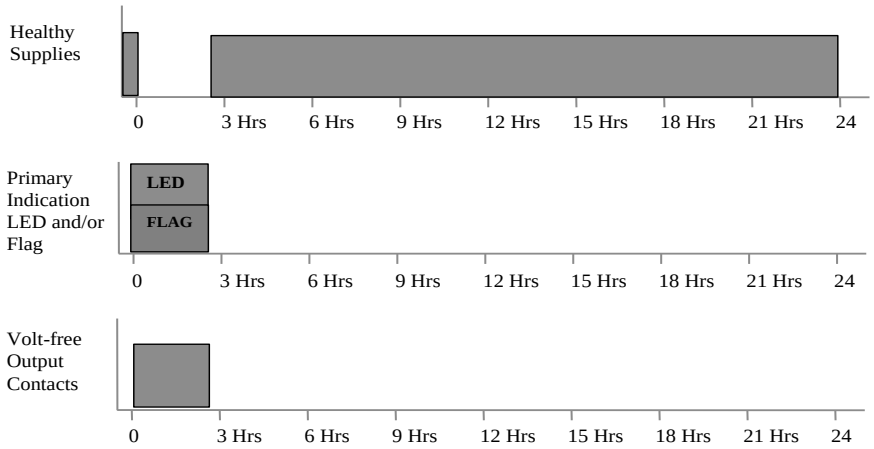
The latching of the volt free contacts shall have minimal (and preferably zero) drain on the FPI power supply.

The diagrams below indicate how the indication and volt free output contacts are required to operate.

Minimum requirements for the operation of indication and output contacts for supplies restored in excess of 3 hours



Minimum requirements for the operation of indication and output contacts for supplies restored within 3 hours



3.2.4. Resetting

Situation 1 – For use where a 230V or 110V AC reset supply is available

All four reset methods (a), (b), (c) and (d) below

Situation 2 – For use where a 230V or 110V AC reset supply is NOT available

Reset methods (b), (c) and (d) below

3.2.4.1. FPI relay reset methods:

a) Restoration of a 230V AC or a 110V AC supply or signal

A ten second delay is required to avoid false resets resulting from short term circuit re-energisation during fault switching.

If the FPI receives a 230V or 110V AC supply or signal for a continuous period of 10 seconds the FPI shall automatically reset the local indication and the volt free contacts.

b) Manual Reset

Facilities for manually resetting the FPI shall be on the front panel of the relay.

Manual reset shall preferably be by means of an integral push button and shall not require any tools; e.g. magnets etc.

c) Remote SCADA Reset

Remote SCADA command signal of between 18 and 30V DC (+24V DC nominal) for 0.25 to 1.0 second duration.

d) Self-Reset

The FPI shall self-reset after 3 hours; the volt free output contacts shall remain closed until the unit is reset externally.

Following a reset, the unit shall be ready and capable to carry out a full detection and indication sequence again within 30 seconds of receipt of the reset command or signal.

3.2.5. Power Source

The FPI shall not be powered by an LV AC supply. Any LV AC connected to the FPI shall be for either reset purposes OR fault flow direction determination purposes.

The FPI relay shall contain a power source to provide energy to the FPI, at least, during the fault detection and indication (local indication and closure of the no-volt SCADA interface contacts) periods.

The internal power source and the components that make up the power source shall have a MTBF of at least 15 years.

The internal power source shall be designed, rated and manufactured to provide an estimated lifetime of at least 15 years in service in the FPI Relay.

It shall be assumed that this is the sole power supply to the FPI relay and that the FPI is required to detect and indicate three occasions per year for these 15 years and indicate locally for at least three hours and hold the No-Volt relay closed for 12 hours on each of these occasions.

The internal power source shall be easily accessible and shall be connected to the FPI relay by a commonly available plug-in interface to allow testing and replacement.

The relay shall also be supplied equipped to accept a range taking input (12V DC to 36V DC) to allow the option for a power supply to also be provided from a nominal 24V DC local RTU battery supply.

Where the internal power source is a battery, the manufactured date of the battery shall be printed on a label attached to the outside of the FPI housing making it clear and unambiguous that the date is the manufactured date which shall be displayed in the format “MM YYYY”.

3.2.6. Testing facilities

The relay shall provide means to allow testing of the power supply/supplies and indication(s) without the need for tools, equipment or instruments.

The relay shall provide facilities to allow testing of: the detection levels, the indication, operation of volt free contact(s) and the manual reset.

The FPI shall allow in situ testing of the installed arrangement by primary injection through the Current Sensing circuit(s).

The FPI shall allow in situ testing of the installed arrangement by secondary injection of the FPI, without the need to disconnect the Sensing instruments and without the need to isolate any connected LV AC supply.

3.3. Technical Specification for the sensing instruments.

The physical dimensions of HV cables are given in Appendix 1.

For all the variants below; allowance shall be made for the 'doubling back' of the earth screen through the CT.

All "solid core" CT's shall be supplied with the turns ratio wires terminated using fork crimps and shall include a moveable shorting link provided within the termination box.

3.3.1. Single Phase Current Transformers (CTs)

a) Internal, Split Core CTs

Each CT shall be suitable for retrofitting around the single phase cables inside the cable box of an item of plant or switchgear. The CT ratio shall be 500:1.

b) External, Split Core CTs

Each CT shall be suitable for retrofitting to existing single core cables external to the cable box. The CT ratio shall be 500:1.

3.3.2. Three Phase Current Transformers (CTs)

a) External, Split Core CTs

Shall be suitable for retrofitting to an existing three core HV cable or existing single core cables in trefoil (triplex) formation, external to the cable box. The CT ratio shall be 60:1.

b) External, Solid, 'wedding ring' CTs

Shall be suitable for fitting around a three core HV cable or single cores cables in trefoil (triplex) formation, external to the cable box. The CT ratio shall be 60:1.

3.3.3. Other Current (I) Sensors / sources of measurement

Alternative types of sensor instrument and sources of measurement of Primary AC current will be considered and assessed based on their merits in comparison to the long-established use of Current Transformers. It shall be incumbent on the supplier to provide full details including associated risks, benefits, limitations and evidence of testing for suitability, reliability and safety.

3.3.4. Voltage Reference for directional capability

The Voltage reference source for directional element determination may be taken from:

- Switchgear on-board Voltage Indicators -
  - Voltage Potential Indicating System (VPIS)
  - Voltage Detection System (VDS)
- Local LV PENDA's controlled by the HV Switchgear that the FPI is monitoring
- Local Metering unit Voltage Transformer secondary supplies controlled by the HV Switchgear that the FPI is monitoring

3.4. Housing, Finish and Environmental Withstand and Type Testing for FPI and for CTs

3.4.1. General

The material and finish of the FPI housing and the CT body/housing shall be a neutral colour and shall be resistant to the degrading effects of ultraviolet radiation.

The FPI and sensing equipment shall be designed and manufactured to withstand and not degrade when used in the same environment as specified for outdoor and indoor switchgear in accordance with ENA TS 41 36 and shall be designed for a minimum lifetime of 20 years.

The FPI housing shall be designed with sufficient internal volume when sealed as in-service such that all the required connecting wires can be accommodated without pinching or crushing cores together.

It is preferred that the FPI housing is compatible with the existing FPI back boxes used by Northern Powergrid, which measure 122 mm x 120 mm at the front

There shall be four (4) cable entry holes made available of a diameter of not less than 20mm. Blanking plugs and suitable sealing cable glands shall also be provided.

Any external screws that are used as fixings shall be suitable for the outside environment as further detailed below without corroding or degrading and shall be self-retaining. The method by which they secure to the housing should be designed so as to resist stripping the threads or damaging the housing through over tightening.

Any labels attached shall be weather and UV resistant and not fade for the lifetime of the product.

A single FPI relay unit and all associated sensing equipment shall be used for the environmental tests listed below.

The tests shall be carried out in the sequence of the sub-clauses below.

For the testing; the unit shall be:

Attached to the test equipment by using the bracket arrangement that will be used to mount the unit in a substation.
In the quiescent state during the test.
Recovered at standard atmospheric conditions.

3.4.2. Impact

The FPI shall meet the requirements of IEC 60068 2 62; Two Joules test with 3 impacts being applied to each side of the body, to the front of the unit and to the top of the unit.

3.4.3. Relative Humidity

The FPI shall operate satisfactorily with a relative humidity up to 100%.

The FPI shall meet the requirements of IEC 60068 2 30 with severity class 40°C 56 cycles.

In the case of vented designs care shall be taken to ensure that when external moisture is removed from the unit, any moisture that has condensed within the unit is not disturbed and caused to move, shaken/drained from the unit or provided with a wick allowing it to be withdrawn from the unit.

3.4.4. Salt Mist

The FPI shall meet the requirements of IEC 60068 2 52, Three day test

The unit shall be recovered and the exterior washed and dried before examination for material degradation or corrosion and functionality checks. The condition of the interior of the unit and internal components shall also be checked for evidence of corrosion or material degradation.

3.4.5. Temperature

The FPI shall meet the requirements of IEC /BS EN 62689-1 Temperature category -25/55 (Min -25°C, Max 55°C)

The FPI shall meet the requirements of IEC 60068 2 1 severity class 25°C 16 hours.

The FPI shall meet the requirements of IEC 60068 2 2 severity class +40°C 16 hours. The test shall take into account solar radiation, at 1000W/m2, in accordance with IEC 60068 2 5. This solar gain shall be applied for the last 8 hours of test.

3.4.6. Electromagnetic Emissions

The FPI shall meet the requirements of IEC 61000 6 3 for Radiated Electric Field Emissions.

3.4.7. Electromagnetic Immunity

The FPI shall meet the requirements of IEC 61000 6 2 for:

Power Frequency magnetic field
Immunity to Radio Frequency Electromagnetic Fields,
Immunity to Electrostatic Discharge.

The FPI shall meet the requirements of EN 60255 26 for Zone A, severe electrical environment.

3.4.8. IP Rating

FPI housings of a sealed design shall be protected to a minimum level of IP65 in accordance with IEC 60529.

FPI housings of a ventilated design shall be protected to a minimum level of IP54 in accordance with IEC 60529, any condensation within the housing shall drain free from the housing and the circuit board and components shall be coated with a moisture barrier.

CTs and other current sensing instruments for mounting internal to the switchgear and above 600mm above ground level shall be protected to a minimum level of IP34 in accordance with IEC 60529.

CTs and other current sensing instruments for mounting external to the switchgear, or internal to the switchgear and lower than 600mm above ground level shall be protected to a minimum level of IP67 (and preferably IP68) in accordance with IEC 60529.

3.4.9. Verification of Continued Operability - Following Environmental Testing

Following the above series of type tests the FPI and CT shall be tested for detection, correct response and operation under the conditions specified in 3.2.1 to 3.2.4 above.

4. References

4.1. External Documentation

Reference	Title
ENATS 48 2 Issue 2 2016	Fault Passage Indicators up to 36Kv for underground and overhead distribution systems
IEC / BS EN 60068 2	Environmental Testing – Multiple parts as referenced in body text
IEC / BS EN 60529:1992+A2:2013	Degrees of Protection Provided by Enclosures (IP code)
IEC / BS EN 61000-6-2:2005	Electromagnetic Compatibility (EMC). Generic standards. Immunity for Industrial environments
IEC / BS EN 60255 26:2013	Measuring Relays and protection equipment. Electromagnetic compatibility requirements.
IEC / BS EN 62689 1	Current and voltage sensors or detectors, to be used for fault passage indication purposes. General principles and requirements.
IEC / BS EN 62689 2	Current and voltage sensors or detectors, to be used for fault passage indication purposes. System aspects.

4.2. Internal Documentation

Reference	Title
IMP/010/011	Code of Practice for Earthing LV Networks and HV Distribution Substations
IMP/001/909	Code of Practice for Distribution System Parameters

4.3. Amendments from Previous Version

Reference	Description	
Header	Logo	Header updated to current format
Title		Updated to replace Current Transformers with associated current and voltage sensing instruments
2.0	Scope	Additional reference to internal Policy documents
Multiple		Inclusion of current and voltage sensing instruments
3. 1	Requirements	Additional information on FPI classes required and inclusion of directional fault detection
3.3		Expansion to include sensing instruments and sources
3.4		Additional specific requirements added regarding housing volume and fixings
4.1 & 4.2	References	Addition of BS EN 62689 parts 1 & 2 and internal documents IMP/010/011 & IMP/001/909
5.	Definitions	Additions to clarify terms
	Testing Facilities	
Appendix 1	Addendum to supplier	Alterations and inclusions due to the expansion in scope of product and addition of 1d Connections.
Appendix 4	Self-Certification Conformance Declaration	Amended to reflect changes listed above.

5. Definitions

Reference	Title
Directional Fault Detection	Where the line voltage is referenced in relation to the current flow to determine where the fault has occurred
Non-directional Fault Detection	Where only current flow is monitored on the line meaning that the fault source cannot be determined as being either one side or other of the sensing location.
MTBF	Mean time between failure
SCADA	Supervisory control and data acquisition
PENDA	Public Electricity Network Distribution Assembly

6. Authority for issue

6.1. CDS Assurance

I sign to confirm that I have completed and checked this document and I am satisfied with its content and submit it for approval and authorisation.

		Date
Dan Rodrigues	Governance Analyst	27/09/2019

6.2. Author

I sign to confirm that I have completed and checked this document and I am satisfied with its content and submit it for approval and authorisation.

Review Period - This document should be reviewed within the following time period.

Standard CDS review of 3 years?	Non Standard Review Period & Reason	
No	Period: 5 Years	Reason: Update will be dictated by contract renewal date or any significant changes in the specification or documents referenced
Should this document be displayed on the Northern Powergrid external website?		Yes

		Date
Alan MacDonald	Policy & Standards Engineer	02/10/2019

6.3. Technical Assurance

I sign to confirm that I am satisfied with all aspects of the content and preparation of this document and submit it for approval and authorisation.

		Date
Ged Hammel	Senior Policy & Standards Engineer	03/10/2019
David Miller	Senior Protection Engineer	02/10/2019
Graeme Melia	Technical Services Engineer	21/10/2019
Mark Marshall	Network Reliability Manager	08/11/2019

6.4. Authorisation

Authorisation is granted for publication of this document.

		Date
Greg Farrell	Head of System Strategy	15/10/2019

Appendix 1 – Addendum to Supplier

Appendix 1a – New Installations v. Existing Installations

The specification states that FPI arrangements:

"shall be capable of detecting single phase and /or phase to phase and / or three phase fault current".

It is accepted that existing FPI installations might have a single phase balance CT fitted around a three phase cable, for example where an existing site employs a three core cable entering into a compound filled cable box, in which case it is not practical to convert these to also detect phase fault currents and it is accepted that there are reduced fault detection capabilities.

Appendix 1b – Variants of FPIs and CTs

The specification states that:

"On new installations, FPIs will as a minimum connect to integral CTs installed and wired by the switchgear manufacturer, and be capable of detecting and operating for phase-to-earth, phase to phase and three phase fault currents.

Whenever directional detection is necessary and wherever possible; it is desirable for FPI's to also connect to integral voltage sensing instruments installed and wired by the switchgear manufacturer.

On existing in-service installations, FPIs will be used to upgrade, repair or replace existing facilities, connecting to existing CTs, or to new sensing instruments. In situations where it is not possible to fit sensing instruments suitable for the detection of single phase, phase to phase and three phase fault currents the FPI and sensing instrument arrangement shall be capable of detecting earth fault currents."

FPIs may be required to interact with the switchgear remote control facilities on site (RTU), so shall have volt free contacts for such a connection."

Where practicable; manufactures shall offer a single design of FPI that, whilst meeting all the requirements of the main specification, incorporates the facility to connect to a range of CT's and sensing instruments. The combined arrangement will cater for Non-directional applications and shall satisfy all the scenarios listed below.

Where this is not practicable Northern Powergrid will consider multiple FPI designs:

- In conjunction with existing CTs or current sensors, which may be integral to the switchgear
- In conjunction with CTs or current sensors in an arrangement that can distinguish between earth fault and phase to phase faults.
- In substations with, or without, a 230V supply (for reset purposes only)
- In substations with, or without, a SCADA 24VDC reset supply
- In substations with, or without, a RTU capable of providing a DC Power supply (+12-36VDC)

Where practicable manufactures shall offer a single design of CT or Current sensing instruments that meets all the requirements of the main specification and offers the facility to measure the current energy flowing through a range of different cable arrangements. Where this is not practicable Northern Powergrid will consider multiple CT and current sensor arrangements to cater for the broad range of scenarios. Typical scenarios are:

- Suitable for use with existing FPIs.
- Where no CTs are present.
- In situations that require the detection of, and distinguishing between, earth fault and phase to phase faults.

Appendix 1c – Physical CT or current sensor Sizing

To assist with CT and current sensor instrument sizing, typical 11 & 20kV cables / configurations are as detailed below:

- Northern Powergrid three core cable has an outside diameter of between 35mm and 100mm
- Northern Powergrid single core cable has an outside diameter of between 61mm and 81mm when in trefoil formation
- Northern Powergrid single core cable has an outside diameter of between 28mm and 49mm when not in trefoil formation
- 3 Core cable enters the cable box before the cores are separated.
- Single core cable is usually laid in the ground in trefoil formation and the cores then either:
  - (a) Remain in trefoil until after they enter the cable box.
  - (b) Are separated before entering the cable box, in flat formation at approx. 105mm centres and the trefoil separation point is typically 500mm below the cable box. At this distance below the cable box it is likely that any CT fitted around the trefoil portion of the cable is likely to be in, or close to the bottom of the cable trench; this is an unacceptable arrangement.

Appendix 1d – Connections

The following connections to external sensors, instruments and equipment are expected as a minimum on Class F2 (Non-directional Earth Fault only) types of FPI:

- Current Input: 2 wires up to 2.5mm
- +12-36VDC Power: 2 wires up to 1.5mm
- +18-30VDC Reset: 2 wires up to 1.5mm
- +100-252VAC Reset: 2 wires up to 1.5mm
- Earth Fault Relay volt-free output (preferably N/O): 2 wires up to 1.5mm

The following connections to external sensors, instruments and equipment are expected as a minimum on Class F3 (Non-directional Earth Fault and overcurrent) types of FPI

- Current Input: 2 wires x 3 Phases ; 6 or 4 wires up to 2.5mm
- +12-36VDC Power: 2 wires up to 1.5mm
- +18-30VDC Reset: 2 wires up to 1.5mm
- +100-252VAC Reset: 2 wires up to 1.5mm
- Fault Relay volt-free output (preferably N/O): 2 wires up to 1.5mm

The following is a *preferred option*

- Overcurrent Relay volt free output (preferably N/O): 2 wires up to 1.5mm

The following connections to external sensors, instruments and equipment are expected as a minimum on Class F5/F6 (Directional Earth Fault / Directional Earth Fault and overcurrent) types of FPI

- Current Input: 2 wires x 3 Phases ; 6 or 4 wires up to 2.5mm
- System Voltage Reference input: 2 wires up to 2.5mm
- +12-36VDC Power: 2 wires up to 1.5mm
- +18-30VDC Reset: 2 wires up to 1.5mm
- +100-252VAC Reset: 2 wires up to 1.5mm
- Fault Relay volt-free output (preferably N/O): 2 wires up to 1.5mm
- Fault Direction volt free output (Forward/Reverse) : 2 wires up to 1.5mm

The following is a *preferred option*

- Overcurrent Relay volt-free output (preferably N/O): 2 wires up to 1.5mm

Appendix 2 – Addendum to Supplier Requirement

The supplier shall provide with the tender full technical details of the equipment offered and shall indicate any divergence from these standards or specifications.

Supporting evidence of compliance with type tests shall be submitted with the completed tender document.

Manufacturers may provide alternative tenders for items not complying with the above specification. This shall be clearly stated together with detailed descriptions of any variation from the specification, together with drawings and test results.

Appendix 3 – Logistical Requirements

To enable Northern Powergrid to store the product(s) in accordance with the manufacturer's recommendations the Tenderer shall provide details of the recommended storage environment with respect to each tendered product.

Details should be provided where relevant in respect to the minimum and maximum exposure levels, frequency of exposure and duration of exposure of the packaged item with respect to;

- Ambient temperature
- Atmospheric corrosion
- Humidity
- Impact
- Water
- Vibration
- Dust
- Solar radiation

Clearly legible, easily identifiable, durable and unambiguous labelling shall be applied to each individual and where relevant multiple package of like products. Where products packages tendered are made up of sub packages each sub packages shall be marked. As a minimum requirement the following shall be included;

- Manufacturer's trademark or name
- Supplier's trademark or name
- Description of item
- Date of packaging and/or batch number
- Northern Powergrid product code
- Weight

The Tenderer shall submit, at the time of tendering, a sample of the proposed labelling for each product package type.

Appendix 4 – Self-Certification Conformance Declaration

This self-declaration sheet identifies the clauses of the aforementioned standards relevant to Fault Passage Indicators for use with Ground Mounted 11 & 20kV Switchgear for use on the Northern Powergrid distribution networks.
The manufacturer shall declare conformance or otherwise, clause by clause, using the following levels of conformance declaration codes.

Conformance declaration codes:
N/A = The clause is Not Applicable/Appropriate to the product
Cs1 = The product **conforms fully** with the requirements of this clause
Cs2 = The product **conforms partially** with the requirements of this clause
Cs3 = The product **does not conform** to the requirements of this clause
Cs4 = The product **does not currently conform** to the requirements of this clause, **but the manufacturer proposes to modify and test** the product in order to conform.

Manufacturer: ……

Product Reference: ……

Name and Position: ……

Signature and Date: ……

Instructions for completion

- **When Cs1 code is entered a remark IS still necessary** to confirm why/how it complies fully.
- **When any other code is entered** a detailed reason for and explanation of the non-conformance, or irrelevance shall be given. Prefix each remark with the relevant 'NPS', 'BS EN', 'IEC' or 'ENATS' reference to indicate to which standard(s) the remark applies.

One sheet shall be completed for each Item or variant submitted.

Appendix 4 Continued

Technical Specification for Fault Passage Indicators for use with Ground Mounted 11 & 20kV Switchgear

• **NPS/003/013 Specification for Fault Passage Indicators and their associated Current and Voltage Sensing Instruments for use with Ground Mounted 11 & 20kV Switchgear**			
	Requirement	**Conformance Code**	**Remarks**
3.1 Overview	Fault detection capability class – *State which classes apply*		
	Suitable for use on new installations including utilising switchgear manufactures integral CTs		
	Directional class device can utilise Switchgear integral Voltage sensing system (VPIS/VDS) – *State which*		
	Suitable for existing Installations		
	Is capable of interacting with a Remote Terminal Unit (RTU) via volt free contacts		
	Indicates Non-directional Earth faults and Phase-Phase faults		
	Indicates Directional Earth faults and Phase-Phase faults		
	ENA TS, BS & IEC compliance		
3.2 Tech Spec	ENA TS 48-2 compliance ***Provide details of ALL non-compliances with any clauses of ENA TS 48-2.***		
3.2.1 Overall	Service life of 30 years in accordance with service and environmental conditions specified in ENATS 41-36 (the specification for the HV switchgear associated with the FPI).		

- **NPS/003/013 Specification for Fault Passage Indicators and their associated Current and Voltage Sensing Instruments for use with Ground Mounted 11 & 20kV Switchgear**

	Requirement	Conformance Code	Remarks
3.2.1 Overall continued	Subject to successful accelerated ageing tests *(provide details of testing regime and relevant test standards)*		
	Declare internal power source (e.g. battery or capacitor) and provide details, including longevity and minimum guaranteed life of these components. Provide details of the method of replacement of this power source,		
	Design consideration to simple replacement of other critical components *(provide details)*		
	Fault current withstand: Phase-Earth = 5kA for 3 secs Phase - Phase = 20kA for 3 secs		
	Associated CT ratios: Earth fault = 60:1 Phase - Phase fault = 500:1		
3.2.2 Fault Detection	Earth Fault Current trigger value is configurable for • 40A or above • 80A or above		
	Shall NOT operate for Earth Fault below the trigger values • 40A where configured for 40A and above • 80A where configured for 80A and above		

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	Requirement	Conformance Code	Remarks
3.2.2 Fault Detection (continued)	Phase to Phase and Three Phase fault trigger value is configurable for • 500A or above • 1000A or above		
	Shall NOT operate for Phase to Phase and Three Phase fault below the trigger values • 500A where configured for 500A and above • 1000A where configured for 1000A and above		
	Will indicate both Earth Fault and Phase to Phase faults concurrently where these have occurred		
3.2.3 Fault Indication	Local clear and unambiguous indication *(provide details)*		
	Indication is distinguishable between EF and Ph-Ph / 3 Ph Faults *(provide details)*		
	Local indication flash rate ≥ 3 secs *(provide details)*		
	Flash rate of Ph-Ph/3-Ph fault ≥ 2 times the EF flash rate where combined indicator is used *(confirm details)*		
	Higher Flash rate takes priority where both EF & Ph-Ph/3-Ph faults are detected and a combined indicator is used		
	Local indication for at least 3 Hrs where not externally reset, then self-resets after this time. *(provide details)*		

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	Requirement	Conformance Code	Remarks
3.2.3 Fault Indication (continued)	Normally open volt free contact(s) provided on NON-DIRECTIONAL FPI either: • One combined fault output (N/O) • Two Separate fault output contacts (N/O) – preferred option *(please state which applies))*		
	Normally open volt free contacts provided on DIRECTIONAL FPI • One Directional (Fwd/Reverse) output contact (N/O) and either: • One combined fault output (N/O) • Two Separate fault output contacts (N/O) – preferred option *(please state which applies)*		
	Normally open volt free contacts remain latched until reset by either: • Restoration of supplies • +24VDC pulsed remote reset • Manual push button reset *(confirm all three conditions)*		
	Indication and volt free contacts compliance with illustrated characteristics in diagrams		
3.2.4 Resetting	Reset automatically (ac supply and 10sec delay) **Applies to Situation 1 only**		
3.2.4 Resetting	Reset manually locally (on front panel) *(provide details)*		

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	Requirement	Conformance Code	Remarks
(continued)	Reset remotely via SCADA +24V DC nominal pulsed for 0.25 to 1.0 sec		
	Does NOT reset contacts on loss of internal energy		
	Upon any reset - indication stops and volt free contacts reset		
	After reset; FPI is ready again ≤ 30 secs - please state recovery time and whether restoration of ac supply is required.		
	Upon any reset - indication stops and volt free contacts reset		
3.2.5 Power Sources	The FPI relay has an internal power source. (*provide details)*		
	Internal power source and its components MTBF of ≥ 15 years.		
	Internal power source and its components provide a service life of ≥ 15 years under stated conditions (*provide details of longevity)*		
	Internal power source is accessible and can be tested. (*provide details of testing)*		
	FPI relay can accept external range taking supply (12V – 36V DC) as external power source. (*provide details of connection arrangement, range accepted and current usage).*		

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	Requirement	Conformance Code	Remarks
	Power source (battery) manufactured date in format MM YYYY is provided on the external surface of the relay enclosure		
3.2.6 facilities for functional testing of the FPI relay	Testing does not require special tools, equipment or instruments (*provide details)*		
	Facilities for Testing • detection levels • indication • operation of volt free contacts and the manual reset are provided (*provide details)*		
	FPI & Sensing Instruments allows primary injection testing (*provide details)*		
	FPI allows **in-situ** secondary injection testing without requiring disconnection (*provide details)*		
3.3 CTs and Current Sensing Instruments	Solid core CT's supplied with turns wiring terminated to changeover block with fork crimps and includes a moveable shorting link inside the block.		
3.3.1 Single Phase CTs (a) Internal split core CTs	500:1 ratio, split and suitable for single core cables inside a switchgear cable box		

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	Requirement	Conformance Code	Remarks
3.3.1 Single Phase CTs (b) External split core CTs	500:1 ratio, split and suitable for single core cables external to and directly below a switchgear cable box		
3.3.2 Three Phase CTs (a) External split core CTs	60:1 ratio, split and suitable for a thee phase cable, or three single core cables in trefoil, external to and directly below a switchgear cable box		
3.3.2 Three Phase CTs (b) External solid core CTs	60:1 ratio, solid and suitable for a thee phase cable, or three single core cables in trefoil, external to and directly below a switchgear cable box		
3.3.3 Other Current Sensors	Options offered including benefits and limitations		
3.3.4 Directional Fault capability – Acceptable Sources of Voltage Reference	On board Switchgear Voltage detection systems : VPIS or VDS *-state and specify which can be used*		
	Local LV PENDA controlled by switchgear being monitored		
	Local VT secondary for Metering of switchgear being monitored		
	Local RTU LVAC where controlled by the switchgear being monitored.		
3.4 FPI and CT finish and environmental testing	FPI Housing a Neutral colour and UV resistant (*provide details of material, colour and UV stability type testing)*		

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	Requirement	Conformance Code	Remarks
3.41 General	Minimum 20 Year life in ENA TS 41 36 indoor and outdoor switchgear environment.		
	Sufficient internal volume to accommodate wiring without pinching, crushing or damage		
	Four cable entry holes available of a diameter ≥ 20mm. Blanking plugs and suitable sealing cable glands also provided.		
	External fixing screws suitable for the outside environment, self-retaining and should resist stripping the threads or damaging the housing through over tightening.		
	Type tested in accordance with criteria specified in NPS/003/013		
3.4.2 Impact	IEC60068 2 62 2J x 3 impacts to: each side, face and top		
3.4.3 Relative Humidity	Operate satisfactorily with a relative humidity up to 100%.		
	IEC60068-2-30 40°C 56 cycles		
3.4.4 Salt Mist	IEC 60068-2-52 three day test		
3.4.5 Temperature	IEC / BS EN 62689-1 -25/55		
	IEC 600368 2 1 25C for 16 Hrs		
	IEC 600368 2 2 +40°C for 16 Hrs (inc. solar gain 1000W/m^2 for, at least, last 8 hrs)		

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	Requirement	Conformance Code	Remarks
3.4.6 Electromagnetic Emissions	IEC 61000 6 3 – radiated electric field emissions		
3.4.7 Electromagnetic Immunity	IEC 61000 6 2 - power freq electromagnetic field		
	IEC 61000 6 2 - radio freq electromagnetic field		
	IEC 61000 6 2 - immunity to electrostatic discharge		
	BS EN 60255 26 Zone A - severe electrical environment		
3.4.8 IP rating FPI Relay	Sealed relay minimum IP65 to IEC 60529		
	Ventilated relay minimum IP54 to IEC 60529 with condensation drain and PCB moisture barrier coated		
3.4.8 IP rating CTs and other current sensing instruments	Internal CTs and instruments minimum IP34 to IEC 60529		
	External CTs and instruments minimum IP67 (preferably IP68) to IEC 60529 *(state rating)*		
3.4.9	Verification of operability and functionality following environmental testing. *(state compliance)*		