PR-NET-OSM-070

MANAGEMENT OF FAULTS ON THE LOW VOLTAGE SYSTEM

OPERATIONAL SAFETY MANUAL - SECTION 10.5

Scottish & Southern Electricity Networks

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1 Introduction

1.1 This document defines the requirements and responsibilities for management of faults on the **SSEN-D Low Voltage** Distribution **System**.

1.2 Following this **Approved** procedure **Shall** ensure a safe, effective and customer focussed response to **Low Voltage** faults and restoration of affected supplies.

2 Scope

2.1 This document relates to operational requirements for management of faults on **SSEN-D**'s **Low Voltage** Distribution **System** including underground cable and overhead line **Systems**.

2.2 It applies to all persons employed by or working on behalf of **SSEN-D**, who are involved in the management activity associated with the identification, response, restoration, monitoring, customer liaison and repair of faults on the **Low Voltage System**.

2.3 This document details the specific process for management of **Transient Faults** on **SSEN-D**'s **Low Voltage System**.

2.4 The scope of this document does not apply to:

- Neutral faults (see PR-NET-OSM-071 Management of Neutral Faults - Operational Safety Manual – Section 10.6)
- Procedures for repair of **Low Voltage** faults

3 References

The documents detailed in Table 3.1 - Scottish and Southern Electricity Networks Documents, should be used in conjunction with this document.

Table 3.1 - Scottish and Southern Electricity Networks Documents

Reference	Title
PR-NET-OSM-006	SSEN Distribution Operational Safety Rules – Operational Safety Manual – Section 1.1
PR-NET-OSM-028	Switching Terminology and Approved Abbreviations - Operational Safety Manual - Section 4.4
PR-NET-OSM-071	Management of Neutral Faults - Operational Safety Manual – Section 10.6
PR-NET-OSM-072	Use of Low Voltage Mobile Generators - Operational Safety Manual – Section 11.1
FO-PS-030	LV Rogue Circuit Control Sheet
BN-PS-341	Briefing Note: Transient Fault Management and Fuse Replacement
PR-PS-795	Rogue Circuit / Customer Relations Process
WI-PS-1141	Fault Location: SNIFFING
WI-PS-1142	Kelvatek Bidoyng – Installation Operation & Retrieval
BN-PS-342	BIDOYNG Quick Reference Guide
PR-NET-ENG-032	Fuse and Earth Fault Loop Impedance Requirements for Secondary Plant, Networks and Low Voltage Cut-outs – Design Standard
WI-PS-842	Low Voltage Fault Re-Closers (REZAP and FUSEMATE)
BN-PS-343	FUSEMATE Quick Reference Guide
WI-NET-CAB-123	Removing and Replacement of Low Voltage Fuses
WI-PS-703	Work Instruction for Drilling and Sealing Holes for Cable Fault Sniffer Instrument
WI-NET-OSM-002	Personal Protective Equipment and Workwear for Live Environments

4 Definitions

4.1 The words printed in bold text within this document are either headings or definitions. Definitions used within this **Approved** Procedure are defined within the list presented immediately below, or within section 2 of the **Operational Safety Rules**.

4.2 **Automation**

Device connected or installed on the **System** that can be operated automatically and, if necessary, without manual intervention.

4.3 **Circuit Reclosing Device**

Device for safely re-energising a circuit following a fuse operation or outage.

4.4 **Dormant Circuit**

Low Voltage circuit where there has been no fault activity on the circuit within a 6-month period from the last fuse operation.

4.5 **Operational Safety Rules (OSR)**

The **SSEN-D** Distribution set of rules, as read with related documents and procedures, that provide generic safe systems of work on the **System** therefore ensuring the health and safety of all who are liable to be affected by any **Danger** that might arise from the **System**.

4.6 **PME**

Protective Multiple **Earthing** or TN-C-S **Earthing** system.

4.7 **Redhead Cut-out**.

100A single pole cut-out with solid link (Flat meter service isolator).

4.8 **Rogue Circuit**

Low Voltage circuit where a specified number of fuse operations occur within a specified time period because of a **Transient Fault**.

NOTE: Refer to Section 8.2 for the criteria used to classify a **Low Voltage** circuit as a **Rogue Circuit**.

4.9 **SIMS**

Supply Incident Management System.

4.10 **SNE**

Separate Neutral Earth or TN-S **Earthing** system.

4.11 **Transient Fault**

intermittent type fault that can cause fuse operation(s) but has not resulted in sufficient damage to prohibit restoration of supplies.

5 General Responsibilities

5.1 Persons who are required to operate and undertake work on the **System Shall** have a thorough understanding of the work and ensure on site risks are suitably assessed and appropriate control measures put in place before, during and after all activities.

5.2 Persons **Shall** ensure that at all times during the work (or associated testing) **General Safety** arrangements are maintained and that other work areas are not adversely affected by the activities for which they are responsible.

5.3 All operational activities **Shall** be in compliance with **SSEN-D** Safety, Health and Environmental policy and procedures, including **OSR**.

5.4 Other specific responsibilities in this **Approved** procedure **Shall** be followed.

6 Authorisation

6.1 Persons who are required to undertake **Low Voltage Switching** duties on a **System Shall** hold the appropriate competence and authorisation to carry out specified duties. It **Shall** be the responsibility of the individual to ensure that any actions performed are within the bounds of their Competency and authorisation level.

6.2 Persons who are required to install, operate and remove **Low Voltage** fuses and restoration equipment (see Section 9) **Shall** be **Authorised Persons** for **Low Voltage Switching**.

6.3 All persons carrying out work on **Low Voltage** cables **Shall** be Authorised in writing for the tasks.

6.4 Competence and Authorisation certificates **Shall** be retained personally and be made available upon request.

7 Personal Protective Equipment

7.1 Persons who are required to work or carry out **Switching** on or near the **System Shall** wear suitably **Approved** Personal Protective Equipment (PPE). Furthermore, where warning labels or signs identify the existence of a particular hazard, additional and appropriate PPE **Shall** be worn.

7.2 As a minimum, PPE **Shall** meet the requirements of WI-NET-OSM-002.

7.3 When carrying out any work or **Switching** operations (as per 6.2) on the **Live Low Voltage System,** Approved PPE **Shall** include arc protective workwear (which **Shall** be buttoned up to neck with sleeves fully rolled down), helmet, visor, **Low Voltage** insulated gloves with leather overgloves, high visibility jacket and safety footwear.

8 Process for Transient Fault Management

8.1 Overview

8.1.1 **Low Voltage Transient Faults** can result in fuse operations and account for a significant number of supply interruptions. Sometimes a sustained fault will develop after one or two fuse operations. In other cases, customers could have to suffer a much higher number of supply interruptions before the fault is finally located and repaired.

8.1.2 **Transient Faults** of this type give rise to situations which will count towards the Guaranteed and Overall Multiple Interruptions Standards. **Transient Faults** require management to ensure good standards of performance are maintained.

8.1.3 Customers' expectations continue to increase and they require a reliable supply of electricity but will usually accept the occasional supply interruption, provided **SSEN-D** deal with their situation quickly and, very importantly keep them informed about the problem. Many customer complaints are generated by **Transient Faults**. The number of complaints could be significantly reduced by proactive management of the fault and by giving customers an apology with some information about the problem at an early stage.

8.1.4 It is intended to reduce the risk of exposure to failures under the Multiple Interruption Standards by setting targets for attendance and by detailing methods by which recurring **Low Voltage** interruptions should be managed. Examples of these methods include use of **Low Voltage Circuit Reclosing Devices** (see Section 9).

8.1.5 The following requirements detail the **SSEN-D** process for management of **Low Voltage Transient Faults** and are intended to:

- Ensure a consistent, proactive and customer focused approach is taken to resolve **Transient Faults** as quickly and efficiently as possible
- Maximise the use of **Low Voltage Automation** to minimise the impact of **Rogue Circuits**
- Ensure a customer focused, proactive, effective and sustainable process for the management of **Rogue Circuits**

8.2 Rogue Circuits

8.2.1 A **Low Voltage** circuit **Shall** be classified as a **Rogue Circuit** if ANY of the following criteria are met:

- If fuses have been replaced on the same feeder on 3 separate occasions within a 30-day period

NOTE: This will apply whether there have been 3 fuse replacements on the same feeder, either 1 operation on each phase or on a combination of phases.

- If fuses have been replaced on the same feeder on 6 separate occasions within a 6-month period

8.2.2 A fuse replacement is categorised as needing to return to site or notification of **Low Voltage Automation** operation. Outages caused by fuse replacements, open-circuits and pulled fuses should be counted, like fuse operations, for the purpose of classifying a **Rogue Circuit**.

8.3 Dormant Circuits

8.3.1 A **Low Voltage Rogue Circuit** / **Transient Fault Shall** be classified as **Dormant Circuit** if there is no fault activity on the circuit within a 6-month period from the last fuse operation.

8.3.2 A **Low Voltage Rogue Circuit** / **Transient Fault** needs to be classified as **Dormant Circuit** before it can be closed by Customer Relations. No further action needs to be taken unless the **Low Voltage** circuit experiences subsequent fuse operation(s) and it becomes a **Rogue Circuit** again.

8.4 Transient Fault Management – Stage 1 – Identify

8.4.1 Responsibility for carrying out requirements under this stage rests primarily with the Customer Contact Centre (CCC). This intention of activities in this stage is to identify and classify **Rogue Circuits**.

8.4.2 The **Rogue Circuit** procedure **Shall** be triggered when a **Low Voltage** circuit becomes classified as a **Rogue Circuit** (see Section 8.2).

8.4.3 **Transient Faults** should be identified from reports of no supplies or from a Kelvatek email notification.

8.4.4 When a **Low Voltage** circuit becomes classified as a **Rogue Circuit**, a **Rogue Circuit** Job **Shall** be raised in **SIMS** to capture the history of the **Transient Fault** and to provide instructions to Dispatch in the event of the next fuse operation/outage.

8.4.5 A **Rogue Circuit** Job **Shall** be kept "live" on **SIMS** until the criteria for a **Dormant Circuit** are met. A **Rogue Circuit** Job **Shall** not be closed at any point during this process. The **Rogue Circuit Shall** be assigned the status: LIVE – NEW, ONGOING, REPAIRED or DORMANT.

8.5 Transient Fault Management Stage 2 – React

8.5.1 Responsibility for carrying out requirements under this stage rests primarily with the relevant Depot.

8.5.2 The Network Integrity Manager is responsible for ensuring the regional Co-ordination Centres **Shall** check **SIMS** for **Rogue Circuit** Jobs on a daily basis.

8.5.3 Information required to complete FO-PS-030 **Shall** be collected and loaded to the "live" **SIMS** screen **Rogue Circuit** file. The Depot transient folder **Shall** be used whilst the **Rogue Circuit** file is being created.

8.5.4 As part of the completion of FO-PS-030, the Depot Manager **Shall** ensure that relevant **Low Voltage Automation** is fitted to the **Rogue Circuit** (see preferred options within BN-PS-341), where required.

8.5.5 Repairs to the **Rogue Circuit Shall** be progressed, if possible.

8.5.6 If the **Transient Fault** is fully repaired at this stage the relevant customer letter **Shall** be sent and the fault management process **Shall** be progressed to Stage 9 of this process.

8.5.7 The Customer and Community Advisors (CCA) **Shall** send a proactive and appropriate customer letter.

8.6 Transient Fault Management – Stage 3 – Inform

8.6.1 Responsibility for carrying out requirements under this stage rests primarily with Customer Relations.

8.6.2 Customer Relations **Shall** check **SIMS** for **Rogue Circuits** on a daily basis. Clear instructions for Dispatch in the event of the next outage **Shall** be added to the **Rogue Circuit** Job on **SIMS**.

8.6.3 Customer Relations **Shall** confirm which letter has been sent to the customer in accordance with PR-PS-795.

8.6.4 A confirmation report **Shall** be sent to the relevant Regional / Depot Manager.

8.6.5 The status of **Rogue Circuits Shall** be recorded and updated in the Rogue Report spreadsheet in accordance with Section 4 of PR-PS-795.

8.6.6 Customer Relations Shall identify Dormant Circuits from **SIMS** and Shall update the Rogue Circuit Job in **SIMS** and the Rogue Report in accordance with Section 8 of PR-PS-795.

8.7 Transient Fault Management –Stage 4 – Monitor

8.7.1 Responsibility for carrying out requirements under this stage rests primarily with the Network Integrity Manager.

8.7.2 The Network Integrity Manager **Shall** check for possible fault location information. Where possible, a Cable Sniffer location **Shall** be initiated.

8.7.3 The Network Integrity Delivery Manager **Shall** check the Kelvatek website daily to monitor the status of **Rogue Circuits**, in particular for possible fault location information and whether any can be classified as **Dormant Circuits**.

8.7.4 The Network Integrity Manager **Shall** monitor progress with respect to repairing **Transient Faults** and resolving any problems arising from **Rogue Circuits**.

8.7.5 The Network Integrity Delivery Manager **Shall** liaise with the Network Integrity Manager to review progress with resolving **Transient Faults** on a daily basis.

8.8 Transient Fault Management – Stage 5 – Re-interruption Identified

8.8.1 Responsibility for carrying out requirements under this stage rests primarily with the CCC.

8.8.2 In the event of a subsequent fuse operation/outage on a **Rogue Circuit,** generated from reports of no supplies or from a Kelvatek email notification, then a new Job in **SIMS Shall** be raised for that fuse operation/outage and the existing "live" **Rogue Circuit** Job **Shall** be updated. A notification from **SIMS** is emailed to the **Rogue Circuits** inbox (rogue.faults@SSE.com) when a fuse has operated.

8.8.3 Restoration of supplies **Shall** be initiated, if required.

8.8.4 The Kelvatek website **Shall** be checked for possible fault location information. Where possible, a Cable Sniffer location **Shall** be initiated.

8.8.5 Where the fault location is identified and repaired, the "live" Job on **SIMS Shall** be closed (see Stage 9).

NOTE: Customer Relations are automatically informed upon re-interruption, so additional notification at this stage is not required (see PR-PS-795).

8.9 Transient Fault Management – Stage 6 – React

8.9.1 Responsibility for carrying out requirements under this stage rests primarily with the relevant Depot.

8.9.2 The Supply Restoration Team Manager **Shall** check for any notification from the CCC or **SIMS** of re-interruption.

8.9.3 The Kelvatek website **Shall** be checked for additional fault location information.

8.9.4 The SNIFF procedure (see WI-PS-1141) **Shall** be followed to locate the **Transient Fault**.

8.9.5 A full repair **Shall** be initiated. If a repair is <u>not</u> possible, a full explanation **Shall** be recorded within the **SIMS** screen.

8.9.6 Customer Relations **Shall** be informed and an update **Shall** be provided to the Operations Manager/Performance Manager.

8.9.7 The CCA **Shall** ensure the appropriate letter is sent to the customer.

8.9.8 If the **Transient Fault** is fully repaired at this stage the relevant customer letter **Shall** be sent and the fault management process **Shall** be progressed to Stage 9 of this process.

8.10 Transient Fault Management – Stage 7 – Informed

8.10.1 Responsibility for carrying out requirements under this stage rests primarily with Customer Relations.

8.10.2 Customer Relations **Shall** identify, on a daily basis, which stage letter has been sent to the customer by the CCA within the depot (see PR-PS-795).

8.10.3 A confirmation report **Shall** be sent to the relevant Depot/Regional Manager.

8.11 Transient Fault Management – Stage 8 – Monitor

8.11.1 Responsibility for carrying out requirements under this stage rests primarily with the CCC/Depot/Customer Relations.

8.11.2 If a repair has still not been progressed then Stages 5 – 7 **Shall** be repeated.

8.12 Transient Fault Management – Stage 9 – Complete & Close

8.12.1 Responsibility for carrying out requirements under this stage rests primarily with the relevant Depot.

8.12.2 The “live” Job on **SIMS Shall** be closed, or converted to information on **SIMS** with full explanatory note(s), where the fault location is identified and repaired or the circuit is classified as a **Dormant Circuit**.

8.12.3 Customer Relations **Shall** be informed and **Shall** ensure the appropriate letter is sent to the customer.

8.12.4 The Depot **Shall** confirm the completed action to Customer Relations, and the relevant Depot/Regional Manager.

8.13 Transient Fault Management – Stage 10 – Administration

8.13.1 Responsibility for carrying out requirements under this stage rests primarily with Customer Relations.

8.13.2 The final close down administration **Shall** be completed as PR-PS-795.

8.13.3 The Customer Relations team **Shall** arrange for the **Rogue Circuit** to be closed on their systems with detailed reasoning for closure.

8.13.4 The Customer Relations team **Shall** ensure PR-PS-795 has been followed.

8.14 Rogue Circuit Reports

8.14.1 Customer Relations **Shall** update the Rogue Report with the information from “live” **Rogue Circuit** Jobs and **Dormant Circuits** on **SIMS** on a weekly basis in accordance with Section 10 of PR-PS-795.

8.14.2 A Weekly Update Report capturing the status of all **Rogue Circuits Shall** be compiled from **SIMS** and sent with the Rogue Report to the Supply Restoration Managers, Depot Operational Managers, Depot Performance Managers and the Performance Manager for Community, Welfare and Training.

8.14.3 The Supply Restoration Managers **Shall** complete the information requested in the Weekly Update Report and return to Customer Relations.

9 Application of Automation Equipment

9.1 The following **Automation** equipment should be used to respond to **Low Voltage** fuse operations and to the management of **Transient Faults**. The equipment is presented in the order it should be normally applied during management of **Transient Faults**.

Table 9.1 - Low Voltage Supply Restoration Equipment

1	BIDOYNG	BIDOYNG is a **Circuit Reclosing Device**. It fits into existing **Low Voltage** fuse ways. It uses two **Low Voltage** fuses in parallel, creating a single-shot auto-recloser. The primary fuse carries the load current until a fault causes it to operate. Then, after a delay, the secondary fuse is switched in and the network re-energised. The GATEWAY provides **Low Voltage** substation communications. It is a wireless interface between BIDOYNG and remote users, and gives visual representation of local BIDOYNG units. This allows up to 15 BIDOYNG units to give live status updates remotely	
2	REZAP MODULAR	REZAP MODULAR is a **Circuit Reclosing Device** / auto-recloser that incorporates vacuum circuit-breaker technology, fault location and communications. It fits within fuse panels with severe space restrictions (unit size 300 mm x 160 mm x 94 mm). It has fault location capabilities with 1 or 2 units installed, three-phase location when 3 units are installed and full fault location online and on-site via GATEWAY.	
3	REZAP FAULTMASTER	REZAP FAULTMASTER is **Circuit Reclosing Device** / auto-recloser that incorporates circuit-breaker vacuum technology (allows high energy throughout, enabling fault conditioning and 'thumping' for acoustic fault location), fault location and communications. Mobile phone controller enables remote trip and close operations.	
4	REZAP FAULTMASTER and REZAP MODULAR	Combined use of REZAP FAULTMASTER and REZAP MODULAR.	

5	RESTORE	RESTORE provides a safe, temporary connection to a faulted **Low Voltage** single-phase customer. It will disconnect the temporary supply in the event of overcurrent, earth leakage, or any break in the continuity of the connection cable. The supply is provided via connection to a neighbouring customer or other source via a double insulated cable along or above the ground and into the faulted premises	
6	FUSEMATE	FUSEMATE is designed to carry maximum load current for only a short period of time in order to allow a circuit to be tested. When closed under 'normal load' current conditions it will complete the circuit with its internal vacuum switch and display the current level on the LED bar graph display. If a fault exists, the fuse in FUSEMATE blows to provide automatic protection for the operator.	

9.2 In the event of a fuse operation on a **Low Voltage Dormant Circuit**, a suitably **Authorised Person** for **Low Voltage Switching** should remove any operated fuse(s) and replace the fuse carrier with a BIDOYNG unit(s). The BIDOYNG unit(s) should be replaced by the permanent fuse if there are no further fuse operations on the affected circuit within 30 days.

9.3 In the event of subsequent fuse operations, within 30 days of the first, on the affected **Low Voltage** circuit, a suitably **Authorised Person** for **Low Voltage Switching** should remove any operated BIDOYNG unit and fit the REZAP MODULAR or REZAP FAULTMASTER equipment. The intention is to capture information about the fault location during the next fuse operation.

9.4 In the event of subsequent operations with the REZAP equipment fitted and some fault location information, a suitably **Authorised Person** for **Low Voltage Switching** may use REZAP FAULTMASTER equipment to locate the fault using acoustic fault location techniques by 'thumping'.

NOTE: **Low Voltage** 'thumping' **Shall** <u>not</u> be carried out with customers connected due to the increased risk of equipment damage.

9.5 In the event supply is lost to one single-phase customer and supply restoration is expected to be protracted, a suitably **Authorised Person** should use the RESTORE equipment to provide a temporary supply to the affected customer, where there is a neighbouring source of **Low Voltage** supply. See Section 14 for further requirements about provision of temporary **Low Voltage** single-phase supplies.

10 Requirements for BIDOYNG

10.1 BIDOYNG and GATEWAY units **Shall** only be installed, operated and removed by suitably trained and **Authorised Persons** in accordance with WI-PS-1142.

10.2 Generally, a BIDOYNG unit **Shall** be fitted to each phase of the affected **Low Voltage** circuit(s).

NOTE: The system will only calculate the 'distance to the fault' if BIDOYNG units have been fitted to all three phases.

10.3 The GATEWAY **Shall** be connected at the substation with the BIDOYNG unit(s) ensuring the antenna is attached. It is important to check that the GATEWAY is correctly setup and communicating with the Kelvatek server/website before leaving site (see WI-PS-1142).

10.4 The **Authorised Person** that has fitted the BIDOYNG unit(s) **Shall** be responsible for:

- Checking up-to-date mains records and inputting correct details of the mains cables connected to the **Low Voltage** circuit via the Kelvatek website
- Informing the CCC that the BIDOYNG unit(s) are fitted and are in operation
- Ensuring a copy of BN-PS-342 is left on site with the BIDOYNG unit(s)

NOTE: Insufficient or inaccurate mains cable information will affect the accuracy of the 'distance to the fault' notified by the system.

10.5 Fault location information obtained from the BIDOYNG units and up to date mains records should be used to provide a search area for the fault (see Appendix A for the fault location procedure).

10.6 In the event that notification is received of a BIDOYNG fuse operation, the CCC **Shall** dispatch a suitably trained and **Authorised Person** to replace the fuse(s).

10.7 BIDOYNG units **Shall** be left in service until the affected circuit becomes a **Dormant Circuit.**

11 Requirements for REZAP

11.1 The REZAP MODULAR should be used in **Low Voltage** fuse panels with severe space restrictions, where the REZAP FAULTMASTER cannot be located.

11.2 REZAP units should be fitted on **Low Voltage** circuits with exceptional fuse operations over a short period. This can be categorised by one of the following:

- Any circuit to experience 4 fuse operations within 30 days
- Any circuit to have experienced more than 1 fuse operation in 15 days
- Any circuit which has been identified and approved by a Customer Operations Manager, irrespective of the number of fuse operations, in particular circuits with a high volume of Priority Service Registered (PSR) customers or which are experiencing a high volume of complaints
- On split phase networks in place of BIDOYNG units

NOTE: BIDOYNG units cannot provide a distance to fault functionality on spilt phase networks and the single ended fault location functionality of REZAP units makes them more appropriate.

11.3 The ultimate decision to install a REZAP unit **Shall** be made by the Network Integrity Manager.

11.4 Customer Relations and CCAs should be consulted during the process of installing and utilising REZAPs on **Low Voltage** circuits in order for them to provide correct information in **SIMS** and to affected customers.

11.5 The REZAP MODULAR auto-reclose function can operate up to 5 times. Further auto-recloses should not be attempted.

11.6 The REZAP MODULAR **Shall** only be used on **Low Voltage** circuits with a current rating not exceeding 400 A. The **Authorised Person Shall** ensure the maximum fuse rating set on the REZAP unit does not exceed the **Low Voltage** circuit rating.

NOTE: Fusing information can be found in PR-NET-ENG-032.

11.7 REZAP units **Shall** only be installed, operated and removed by a suitably trained and **Authorised Persons** (Category 5) in accordance with WI-PS-842 and the manufacturer's operating instructions.

11.8 Before any connection of the REZAP unit to the **Low Voltage** circuit, the **Authorised Person Shall** carry out a full visual inspection and risk assessment taking into consideration the following:

- The unit may be being connected to Live fuse gear connections
- The connection ends of the unit (bolted parts that connect to the fuse way) are uninsulated and precautions **Shall** be taken to ensure these ends do not come in contact with **Earthed** metalwork, e.g. application of **Approved** shrouding
- The unit **Shall** be in a serviceable condition and **Shall** be within its certified test date
- All connection leads **Shall** be in good condition with no visible damage
- All procedures and tests in accordance with the installation guide **Shall** be completed before connection

11.9 Before connecting the REZAP unit to the **Low Voltage** circuit, the **Authorised Person Shall** ensure:

- The **Low Voltage** fuse gear is in good condition with no signs of misalignment, overheating, arcing or discharge
- All phase barriers and shrouds are in place and in good condition
- The busbar side and feeder side of the fuseway are correctly identified
- Any doors are secured to prevent movement in the wind
- There are no signs of water or water damage
- Earthing connections are present and in good condition
- Asbestos is not present, or if present, must not be disturbed
- The fuse board is suitably barriered off to prevent **Danger** to others in the vicinity of the equipment, including the general public

11.10 If any **Low Voltage** network equipment is found to be damaged or faulty, and could present a **Danger** to the operator, then the equipment **Shall** be made **Dead** before connection or removal of the REZAP unit.

11.11 REZAP units **Shall** only be connected to **Low Voltage** fuseways that take the J-type "U" slot fuse and **Shall** <u>not</u> be connected to fuseways without a slot. Only the **Approved** insulated tools provided with the REZAP unit **Shall** be used for connection or removal of the REZAP unit.

11.12 The REZAP unit **Shall** be suitably protected from weather and third-party interference.

12 Requirements for FUSEMATE

12.1 FUSEMATE units may be used to prove that a **Low Voltage** circuit is fault free <u>prior</u> to inserting the permanent fuse.

12.2 FUSEMATE units **Shall** only be installed, operated and removed by suitably trained and **Authorised Persons** in accordance with BN-PS-343.

12.3 FUSEMATE units **Shall** be tested before use with the supplied tester to ensure the FUSEMATE is functioning correctly and the switch position indications are correct.

12.4 FUSEMATE units **Shall** be inserted and removed as for fuses described in WI-NET-CAB-123.

12.5 FUSEMATE units should be operated from a safe position using the key fob device.

12.6 Permanent fuses should not be inserted where the FUSEMATE fuse has blown indicating a fault is present on the **Low Voltage** circuit. The **Authorised Person** should report the fault and take steps to initiate fault location and, where appropriate, repairs.

13 Requirements for Cable Sniffer

13.1 The Cable Sniffer is an **Approved** underground cable fault location device, which is supplied as a kit. It detects the location of the fault by sensing the gases given off by cable insulations when they start to break down.

13.2 The Cable Sniffer should be used to pinpoint the location of the cable fault based on fault location information obtained from fault reports, from **Automation** devices fitted, e.g. BIDOYNG and REZAP and from other fault location devices (see Section 8.7).

NOTE: Kelvatek reports can be used.

13.3 Where there are no **Low Voltage Automation** devices fitted to the affected circuit and/or there is no fault location information, the Cable Sniffer may be used to sniff for the fault at each joint position and surface damage location along the cable route. Where there is an open-circuit fault, and not all customers have lost supply, then the Cable Sniffer should be used to sniff for the fault at those joint or surface damage positions that are suspected of being open circuit.

13.4 The Cable Sniffer **Shall** be checked before use to ensure it is within its recalibration date and is functioning correctly.

13.5 The Cable Sniffer **Shall** only be operated by a suitably trained and competent persons. The Cable Sniffer **Shall** be operated in accordance with WI-PS-1141.

13.6 Prior to drilling any hole(s) in the ground, the operator **Shall** search for and positively/accurately identify the faulted **Low Voltage** cable and any buried services in the immediate area of the proposed hole using **Approved** equipment such as the Cable Avoidance Tool (CAT). No hole **Shall** be drilled above or in the immediate vicinity of a buried cable or service.

13.7 Under no circumstances **Shall** any hole be drilled which is greater in depth than 200 mm. A hole **shall** be drilled as per document WI-PS-703.

13.8 Where a positive result is obtained from the Cable Sniffer, the area of highest gas concentration **Shall** be located by drilling further holes in the search area and sniffing at those locations. The area of highest gas concentration **Shall** be marked at the site and on the GIS plan (see Figure 13.1).

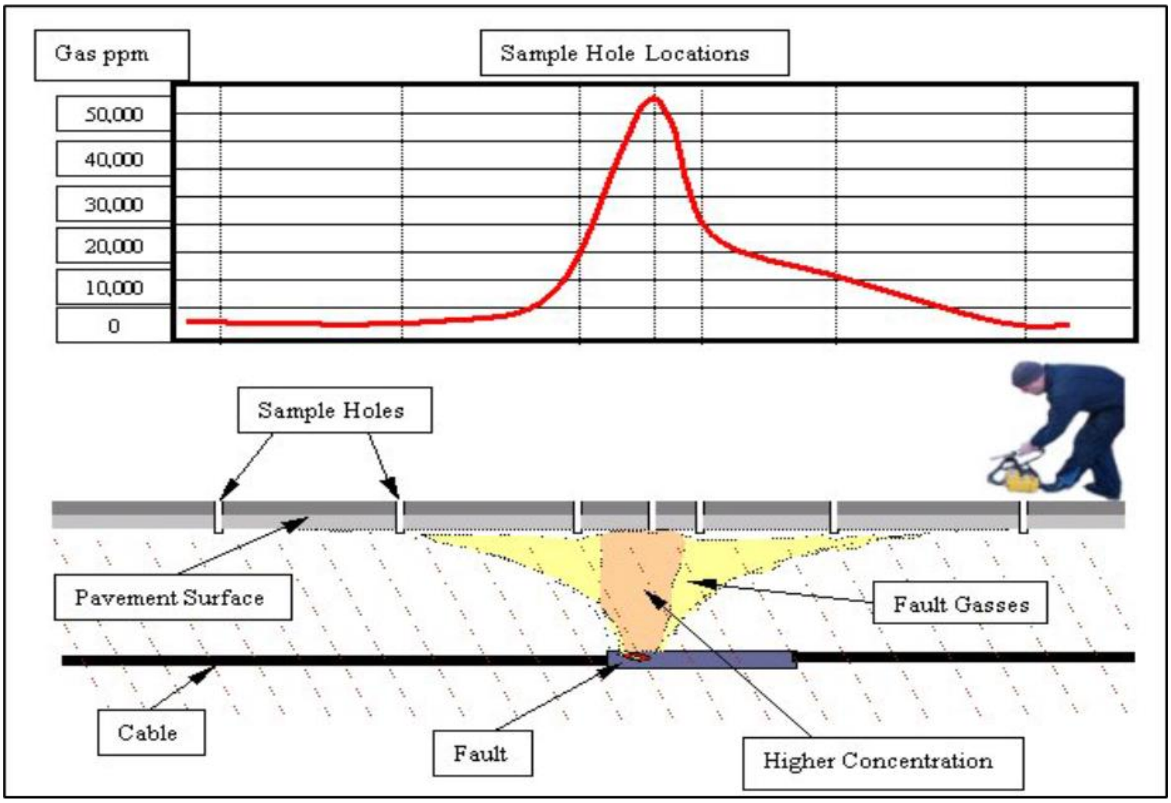

Figure 13.1 - Locating the Highest Gas Concentration

13.9 The operator **Shall** inform the Supply Restoration Team Manager and the CCC of the fault location. The CCC **Shall** update **SIMS** with the sniff fault location. The Supply Restoration Team Manager **Shall** decide the plan for excavating the cable and repairing the fault.

13.10 Where a negative result is obtained from the Cable Sniffer, the sniffed locations **Shall** be marked on the GIS plan and a copy of the plan **Shall** be left on site (within the associated **Low Voltage** fuseboard or pillar). The operator **Shall** inform the Supply Restoration Team Manager of the result and the sniffed locations. The Supply Restoration Team Manager **Shall** decide the plan for further investigation of the fault location.

14 Temporary Low Voltage Single-Phase Supplies

14.1 General

14.1.1 The single-phase supply to a customer can be lost as a result of a failure of the **Low Voltage** service cable or mains cable. In this case the customer's supply can be promptly restored by:

- Provision of a supply from a portable generator (see Use of PR-NET-OSM-072 **Low Voltage** Mobile Generators - Operational Safety Manual – Section 11.1)
- Installing a temporary supply from a from a nearby **Low Voltage** supply such as a Live 100A cut-out in an adjacent property

14.1.2 A temporary single-phase supply may be provided to a customer from a nearby **Low Voltage** supply using **Approved** equipment providing that:

- The type of earthing at the source and destination cut-out are the same; the connection of **PME** and **SNE Earthed Systems Shall** not be permitted
- The source of supply and / or destination of supply does not have electric storage heating, or other substantial loads, that could be in operation during the time the temporary supply is connected
- The connecting cable is double insulated and in good condition; twin core and earth cables of any size and concentric cables with a cross-sectional area less than 25mm^2 **Shall** not be used
- The connecting cable is electrically protected at the source of supply so that the connecting cable is made **Dead** in case of damage to the cable, overloading of the cable or occurrence of an **Earth** fault at the destination customer installation being backfed
- The connecting cable is mechanically protected and is suitably noticed to prevent third-party damage
- The connecting cable is 25m or less in length
- Any specific instructions from the equipment manufacturer/supplier are followed

NOTE: The Kelvatek RESTORE is **Approved** equipment and is preferred for this purpose.

14.1.3 Where the source of supply is a **Low Voltage** cut-out it **Shall**:

- Be a plastic type with a current rating not less than 100A
- Be in a serviceable condition with no visible defects, damage, compound leaks or signs of overheating
- Not provide a loop connection to an adjacent property

14.1.4 Obsolete cut-outs, including metal-clad, rewireable or fused neutral unit types, **Shall** not be used for providing a temporary supply.

14.1.5 Only **Authorised Persons** (Category 4 and Category 5) **Shall** be permitted to connect and disconnect temporary single-phase supplies.

14.1.6 **Authorised Persons Shall** wear PPE as detailed in Section 7 of this procedure whilst connecting/disconnecting temporary supplies.

14.1.7 The connecting cable **Shall** be suitably routed, mechanically protected and warning notices posted to prevent any **Danger** to the public. Warning tape ‘DANGER KEEP CLEAR’ **Shall** be wrapped around the connecting cable.

NOTE 1: The warning tape stock number is 118765.

NOTE 2: Installation of the connecting cable in a standard 38mm^2 diameter service tube is an **Approved** means of mechanical protection.

14.1.8 Before connecting any **Low Voltage** temporary single-phase supply:

- The **Authorised Person** should inform the customer at the source of supply and destination of supply about the intention to connect the temporary single-phase supply, the precautions to be taken to prevent any **Danger** and the 24-hour customer contact telephone number to be used for reporting any problem. The agreement of both customers **Shall** be obtained

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- The destination of supply **Shall** be proved **Dead** using an **Approved** voltage testing device, the destination cut-out fuse **Shall** be removed and the destination customer's main switch **Shall** be opened.
- The source of supply **Shall** be tested using an **Approved** voltage testing device for correct voltage and polarity.

14.1.9 The connection to the source of supply **Shall** be carried out **Dead**, where reasonably practicable.

14.1.10 Once the connecting cable has been made **Live**, the destination of supply **Shall** be tested using an **Approved** voltage testing device for correct voltage and polarity before the destination customer installation is made **Live**.

14.1.11 This type of temporary supply **Shall** not be installed for more than 24 hours.

14.2 Procedure for Temporary Supplies to a CNE Service

14.2.1 The following procedure **Shall** be followed for providing temporary supplies to a **CNE** service (see Figure 14.1).

1. Install a temporary 100A cut-out adjacent to the **Live** cut-out at the source of supply; ensure the service fuse is removed.
2. Install a temporary **Redhead cut-out** adjacent to the **Dead** cut-out at the destination of supply; ensure the isolator is open.
3. Install the temporary connecting cable and terminate one end directly into the temporary cut-out and the other into the **Redhead cut-out**. Test the insulation resistance of the connecting cable using an **Approved** test device.
4. Where reasonably practicable, remove the service fuse from the **Live** cut-out at the source of supply to make **Dead**.
5. Install a set of $25mm^2$ meter tails between the permanent cut-out and the temporary 100A cut-out at the source of supply.
6. Insert the service fuse in the permanent cut-out at the source of supply to make **Live**.
7. Check the voltage and polarity at the temporary 100A cut-out at the source of supply using an **Approved** test device.
8. Insert a 60A service fuse in the temporary 100A cut-out at the source of supply to energise the temporary connecting cable.
9. Check the voltage and polarity at the temporary 100A single pole cut-out with solid link (**Redhead**) switch.
10. Remove the service fuse from the permanent cut-out at the destination of supply and prove both the line and neutral **Conductors Dead** using **Approved** test lamps and check the polarity with an **Approved** test device.
11. Switch-off the main switch in the customer's installation at the destination of supply.
12. Disconnect the customer's **Earthing** connection from the permanent cut-out at the destination of supply and connect to the temporary **Redhead cut-out**. If necessary, install an **Earth** terminal block and additional $10mm^2$ pvc copper earth wire to make this **Earthing** connection.
13. Transfer the meter tails from the permanent cut-out to the temporary **Redhead cut-out** at the destination of supply.

14. Remove the meter terminal cover at the destination of supply and check all the connections are tight. Replace the cover and reseal.

15. Close temporary **Redhead cut-out**.

16. Switch on the destination customer's main switch and check voltage using an **Approved** voltage testing device at a convenient wall socket in the customer's installation.

17. Plug any exposed terminals in the permanent cut-out at the destination of supply.

18. Seal all cut-outs.

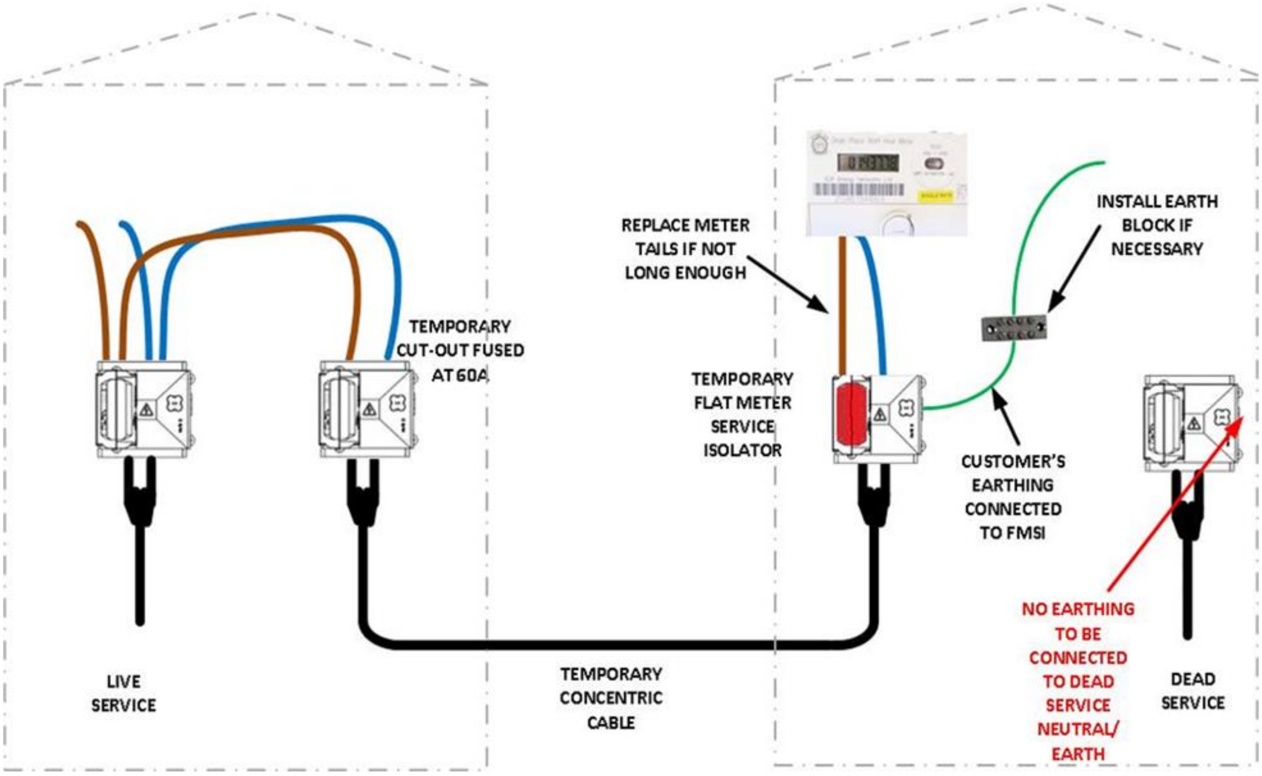


Figure 14.1 - CNE Service – Connection of Temporary Supplies to a CNE Service

14.2.2 No earthwires **Shall** be left connected to the **Dead** service. This is important to prevent fault current from returning via the temporary connecting cable.

14.2.3 Following reconnection of the normal supply at the destination cut out and removal of the temporary service any exposed **Live** connections in any cut-out **Shall** be plugged with insulated inserts.

14.3 Procedure for Temporary Supplies to a SNE Service

14.3.1 The following procedure **Shall** be followed for providing temporary supplies to a **SNE** service (see Figure 14.2).

1. Install a temporary 100A cut-out adjacent to the **Live** cut-out at the source of supply; ensure the service fuse is removed.

2. Install a temporary **Redhead cut-out** adjacent to the **Dead** cut-out at the destination of supply; ensure the isolator is open.

3. Install the temporary connecting cable and terminate each end directly into the temporary cut-out and **Redhead cut-out.** Test the insulation resistance of the connecting cable using an **Approved** test device.

4. Where reasonably practicable, remove the service fuse from the **Live** cut-out at the source of supply to make **Dead**.

5. Install a set of $25mm^2$ meter tails between the permanent cut-out and the temporary 100A cut-out at the source of supply.

6. Insert the service fuse in the permanent cut-out at the source of supply to make **Live**.

7. Check the voltage and polarity at the temporary 100A cut-out at the source of supply using an **Approved** test device.

8. Insert a 60A service fuse in the temporary 100 A cut-out at the source of supply to energise the temporary connecting cable.

9. Check the voltage and polarity at the temporary **Redhead cut-out**.

10. Remove the service fuse from the permanent cut-out at the destination of supply and prove both the line and neutral **Conductors Dead** using **Approved** test lamps and check the polarity with an **Approved** test device.

11. Switch-off the main switch in the customer's installation at the destination of supply.

12. Disconnect the customer's **Earthing** connection from the permanent cut-out at the destination of supply and connect to the temporary **Redhead cut-out**. If necessary, install an **Earth** terminal block and additional $10mm^2$ pvc copper **Earth** wire to make this **Earthing** connection.

13. Transfer the meter tails from the permanent cut-out to the temporary **Redhead cut-out** at the destination of supply.

14. Remove the meter terminal cover at the destination of supply and check all the connections are tight. Replace the cover and reseal.

15. Close temporary **Redhead cut-out**.

16. Switch on the destination customer's main switch and check voltage using an **Approved** voltage testing device at a convenient wall socket in the customer's installation.

17. Plug any exposed terminals in the permanent cut-out at the destination of supply.

18. Seal all cut-outs.

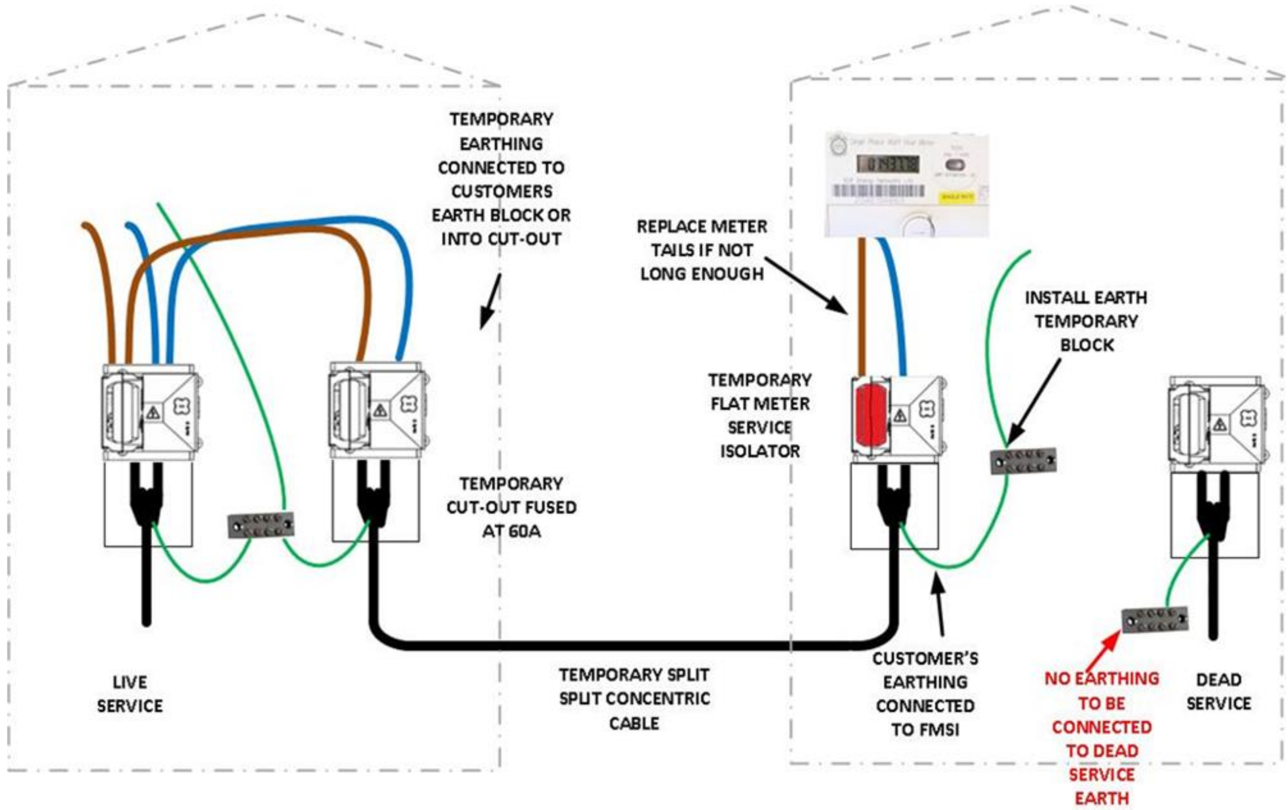


Figure 14.2 - SNE Service – Connection of Temporary Supplies to a SNE Service

14.3.2 No **Earth** wires **Shall** be left connected to the **Dead** service. This is important to prevent fault current from returning via the temporary connecting cable.

14.3.3 Following reconnection of the normal supply at the destination cut out and removal of the temporary service any exposed **Live** connections in any cut-out **Shall** be plugged with insulated inserts.

15 Revision History

No	Overview of Amendments	Previous Document	Revision	Authorisation
01	New document created	TBC	1.00	Richard Gough
02				

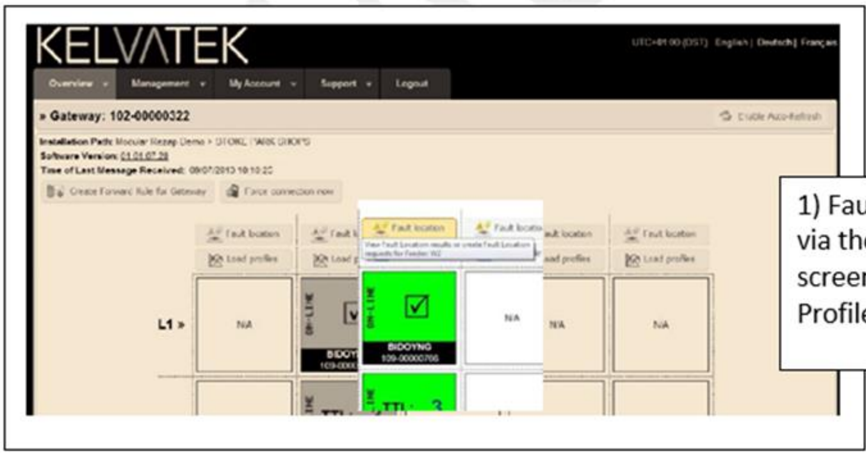
Appendix A BIDOYNG Fault Location

Introduction

1. BIDOYNG Fault Location uses an application of Impedance to fault. The system records fault current at the time of the fault along with voltage across all three phases.
2. Results are displayed as a distance in metres.
3. The network is constantly monitored so every fault event will be recorded and providing all three phases have devices fitted used to automatically calculate the distance.
4. The system will notify the user when enough data has been collected to estimate a distance to the fault.
5. In order for a distance to be calculated the user is required to input cable details via the website, this can be done as soon as devices are installed and will be automatically saved. Cable details should be inputted as soon as installation goes live.
6. Once enough data has been collected the system will provide a result based on the cable details supplied.

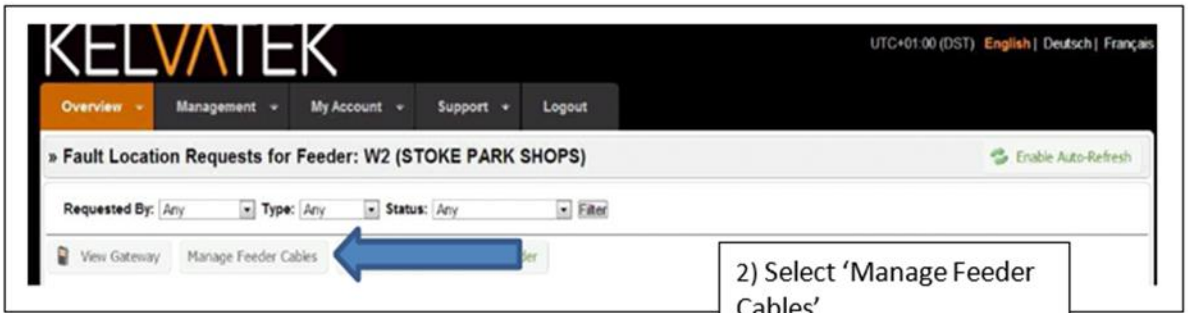
Fault Location Procedure

1. The following procedure applies to the location of **Transient Faults** provided by the BIDOYNG and GATEWAY system.



Log on to the Kelvatek website and follow the steps below

1) Fault location is found via the Gateway View screen above the Load Profile option.



2) Select 'Manage Feeder Cables'

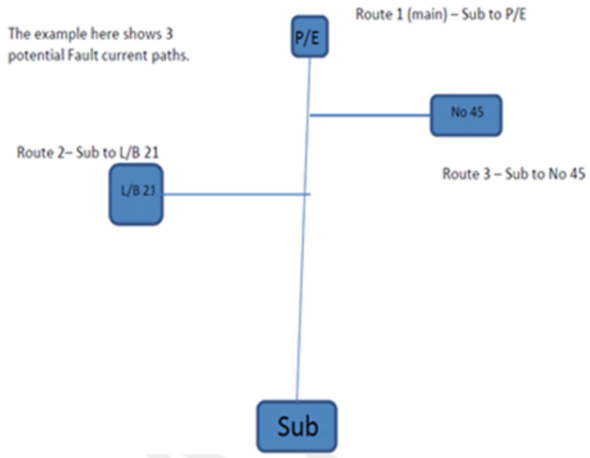
3) From here you have two options.

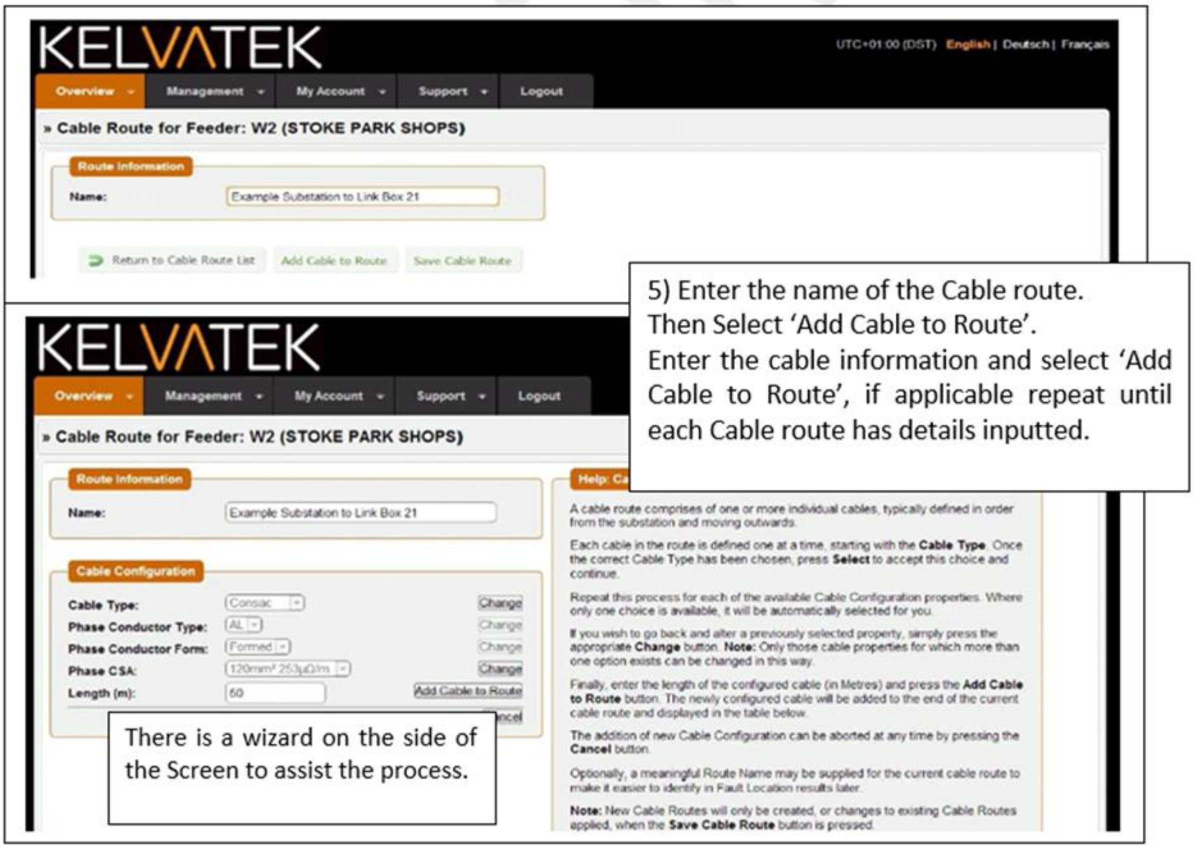
Option 1
You can select the heaviest type of cable giving you the maximum distance to the fault. This is good for a quick result and particularly if the fault is before the first branch. This can however be prone to a large tolerance if the network is sectioned with different types of cable and the fault is beyond the first branch.

Option 2
Select 'Create New Cable Routes' and input the cable details considering every possible fault current path from that substation. The system will then save these details and once enough Fault data has been collected will display results relative to each cable route.

4) When monitoring the network from a single end it is not possible to tell which branch of a feeder the fault may be down.

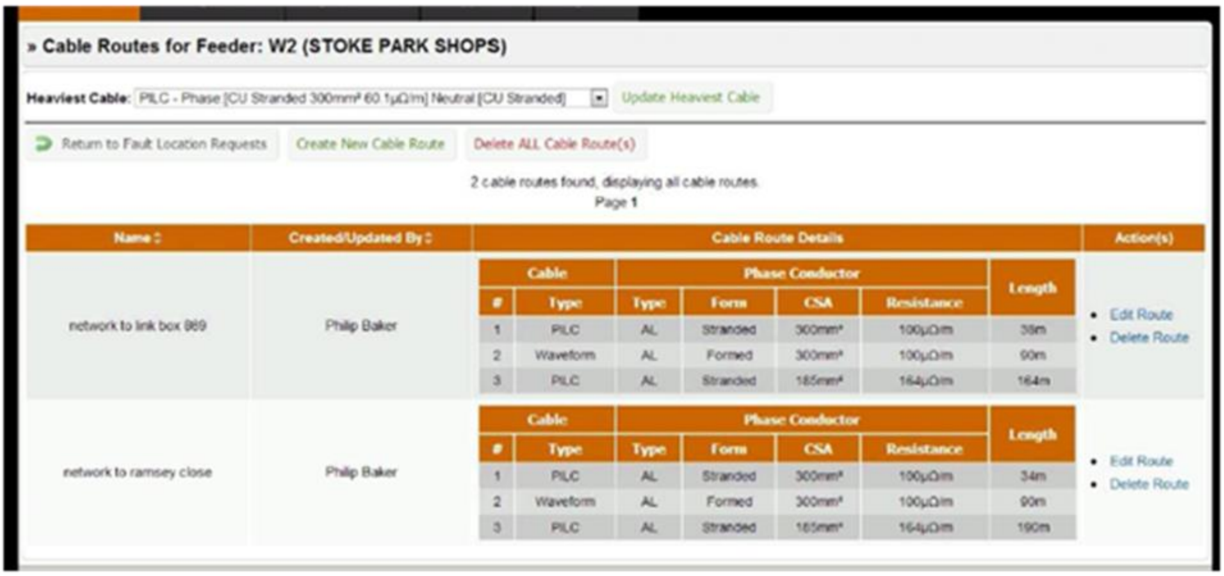
- When inputting cable details the system will ask you to give the route a Name, chose something simple and relevant i.e. Sub to L/B21.
- Next, add cable to that route using quick select drop down options.
- Each Route is a potential Fault Current Path from the substation and the cable details must be entered fully from substation with each additional route for a feeder.





2. This is an example of a live installation with Two Potential Current Paths.

NOTE: Although both routes share common cable details, each route must be considered separate when carrying out the Create Route process.

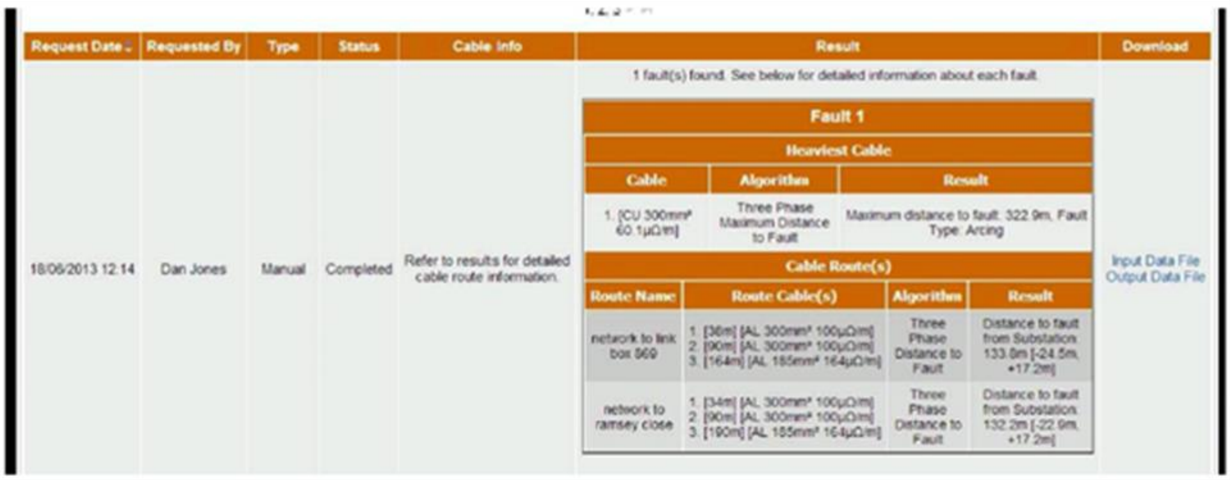


3. Where possible enter cable details as accurately as possible to ensure effective results are obtained.

4. The system accounts for the change in impedance between cable types. Trying to short cut by entering a cable type of ‘Average Impedance’ will produce an ‘Average Result’.

Fault Location Results

1. This is an example of a fault location result:



Request Date	Requested By	Type	Status	Cable Info	Result	Download
18/06/2013 12:14	Dan Jones	Manual	Completed	Refer to results for detailed cable route information.	1 fault(s) found. See below for detailed information about each fault.	Input Data File Output Data File

Fault 1

Heaviest Cable

Cable	Algorithm	Result
1. [CU 300mm² 60.1µΩ/m]	Three Phase Maximum Distance to Fault	Maximum distance to fault: 322.9m. Fault Type: Arcing

Cable Route(s)

Route Name	Route Cable(s)	Algorithm	Result
network to link box 869	1. [36m] [AL 300mm² 100µΩ/m] 2. [90m] [AL 300mm² 100µΩ/m] 3. [164m] [AL 185mm² 164µΩ/m]	Three Phase Distance to Fault	Distance to fault from Substation: 133.8m [-24.5m, +17.2m]
network to ramsey close	1. [34m] [AL 300mm² 100µΩ/m] 2. [90m] [AL 300mm² 100µΩ/m] 3. [190m] [AL 185mm² 164µΩ/m]	Three Phase Distance to Fault	Distance to fault from Substation: 132.2m [-22.9m, +17.2m]

2. Distance is provided for each Cable Route along with a tolerance.

3. Tolerance values will vary from fault to fault depending activity and type of fault.