PR-NET-OSM-056

MANAGEMENT OF FAULTS IN SUBSTATIONS AND SWITCHING SITES

OPERATIONAL SAFETY MANUAL - SECTION 6.14

Scottish & Southern Electricity Networks

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CONTENTS

1 Introduction

This **Approved** procedure provides guidance on the actions to be taken on site by **SSEN-D** employees and its contractors on the detection of a potential risk of failure or in response to a disruptive failure of any **SSEN-D Plant** and **Apparatus** in Substations and Switching sites connected to the Distribution **System**.

2 Scope

2.1 The scope of this document applies to:

- Requirements to safeguard operational staff when they respond to disruptive failures in Distribution and Transmission substations
- **Incidents** where a third-party might have caused the disruptive failure, e.g. trespassers
- Management of the Fire Service and firefighting
- SF6 procedures where SF6 might have been released from switchgear or where SF6 switchgear has caught fire
- Substation equipment that is suspected of having faulted or is in imminent risk of failure

2.2 This scope does not apply to:

- Restoration of supplies
- Management of faults or work on damaged or faulty overhead lines and underground cables
- Management of neutral faults
- Response to **System** faults
- Loss of partial earthing
- Investigation and reporting of asset failures

3 References

The documents detailed in Table 3.1 - Scottish and Southern Electricity Networks Documents, and Table 3.2 - Miscellaneous 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-043	Access to Substations and Switching Sites - Operational Safety Manual – Section 6.1
PR-NET-OSM-050	Access to and Operation of Plant and Apparatus containing SF6 - Operational Safety Manual – Section 6.8
PR-NET-OSM-080	Reporting and Investigation of Asset Failures - Operational Safety Manual – Section 12.9
PR-NET-OPS-008	Requirements for Management and Handling of Sulphur Hexafluoride (SF6) Related Activities

Reference	Title
WI-NET-OSM-002	Personal Protective Equipment and Workwear for Live Environments
N/A	SSEN SHE Handbook (Held in Safety, Health and Wellbeing SharePoint Site)

Table 3.2 - Miscellaneous Documents

Reference	Title
Occupational Safety Manual	This can be found in the Safety, Health and Environmental Sharepoint site

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 **Incident**

Event that has caused or is expected to cause damage to **Plant** or **Apparatus.**

4.3 **Operational Safety Rules (OSR)**

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**.

4.4 **Operator**

SSEN-D employee or any appropriately **Authorised Person** working on behalf of **SSEN-D**.

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 must 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.

6 Authorisation

6.1 It **Shall** be the responsibility of the individual to ensure that any actions performed are within the bounds of their competency and authorisation.

6.2 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.

8 Access Requirements

Access to all **SSEN-D** operational sites and the operation of any **Plant** and **Apparatus** connected to the **System**, **Shall** comply with the requirements of the **Operational Safety Rules** and PR-NET-OSM-043 Access to Substations and Switching Sites - Operational Safety Manual Section 6.1.

9 Risks following Disruptive Failure of Equipment in Substations

9.1 Following the disruptive failure of Substation equipment, a number of risks are liable to be present within the Substation environment. They **Shall** be fully assessed and understood by the **Operator** who first attends the scene and by subsequent support staff. This is to ensure that they can take the appropriate action to safeguard themselves and also provide suitable guidance to Emergency Services personnel when they arrive on site. Section 14 of this **Approved** procedure details the requirements when interacting with the Fire Service.

9.2 The predominant risks which should be assessed include, but are not limited to:

- Burning oil-filled equipment – There is a risk of extreme heat, explosion and escalation to adjacent oil-filled equipment. Noxious fumes and smoke may affect breathing and obscure vision
- Burning plastic/wiring – Toxic fumes may be present. Ventilation of the affected area could be required prior to access for those wearing appropriate PPE
- Exposed **Conductors** that may be **Live** – **Safety Distances Shall** be maintained from damaged equipment where covers have been compromised, or external busbar systems involved in a disruptive **Incident**. Immediate steps should be taken to make the equipment **Dead** remotely
- A **Control Engineer** or operation of an Auto-Reclose scheme may inadvertently make **Plant** and **Apparatus Live** - The **Control Engineer Shall** be informed immediately to prevent re-energisation
- General risk of debris that might have been scattered across the site
- Collateral damage to adjacent equipment from disruptive ballistic discharge
- Deluge or drenching systems including CO2, or a release of SF6, might leave residual materials which **Shall** require attention before entering the affected zone
- Substation security perimeter or internal compound fences breached – Temporary barriers or fencing **Shall** be installed as a priority together with appropriate notices to warn of **Danger** and to prevent unauthorised access.
- Structural damage to substation buildings – Access may need to be limited or prohibited until an appropriate survey has been undertaken.
- Environmental oil spills causing potential pollution to water courses etc. – Spill kits **Shall** be employed to provide temporary absorption and bunding. Notification the appropriate environment agency **Shall** be in accordance with the **SSEN-D** Environmental Safety Manual **Approved** procedure.

10 Procedure where a Potential Imminent Risk of Failure is Identified

10.1 Where an **Operator** identifies that there is a potential imminent risk of a catastrophic failure of any **Plant** or **Apparatus** connected to the **System**, the **Operator Shall**:

- Take the necessary actions to safeguard themselves and others from the imminent **Danger**
- Vacate the area immediately, which may include withdrawing to a safe location, forming a safety zone etc
- Prevent access to the area
- Prevent local operation of the **Plant** or **Apparatus** by themselves or other persons
- Inform the **Control Engineer** of the **Danger** without delay
- Where the site/Substation is of joint responsibility, e.g. a **High Voltage** customer substation, then the **Operator Shall** inform the owner or their nominated representative of the potential risk of failure
- If necessary, request the assistance of suitably experienced staff, e.g. **Senior Authorised Person**, at the relevant voltage level, to attend site
- Consider the quality and continuity of the customer's supply

10.2 The person in charge of the **Working Party Shall** liaise with the **Control Engineer** along with any other third-party organisations, e.g. members of the public, Emergency Services, other utilities etc.

10.3 The person in charge of the **Working Party Shall** carry out a full risk assessment and communicate their findings, along with any control measures to be implemented, to the **Working Party** and the **Control Engineer**.

10.4 Any access or operating restrictions **Shall** only be removed after the **Plant** or **Apparatus** has been made safe, the risk of catastrophic failure has been removed, or suitable control measures have been implemented.

10.5 Where there is an impact to the quality and continuity of the customers supply, consideration **Shall** be given to the provision of alternate means of supply.

11 Discovery of Abnormal Partial Discharge

11.1 Partial discharge occurs when a small crack, void or irregularity in an insulator causes an electric field to build up. The voltage levels, the shape of a void, ambient temperature etc, all influence how loud the discharge is and how quickly the insulation fails.

11.2 Discharge within an air chamber where water vapour is present, will give rise to the creation of acidic products that can attack the metal components causing corrosion or other undesirable effects. Other products can also be produced and once present, form surface deposits on insulation etc, leading to other potential discharge sites causing an ever increasing and more rapid deterioration within the unit.

11.3 Where an **Operator** identifies an audible electrical discharge emitting from the **Apparatus** or identifies partial discharge through routine surveying then the **Operator Shall** withdraw to a safe location and restrict access to the vicinity, e.g., Substation / Switching site and inform the **Control Engineer** without delay.

11.4 Where the Substation / Switching site is of joint responsibility, e.g., a **High Voltage** customer substation / site, then the **Operator Shall** inform the owner or their nominated representative of the potential risk of failure.

11.5 Where the **Operator** on site is not a **Senior Authorised Person** at the relevant voltage level, then the **Control Engineer Shall** arrange for a **Senior Authorised Person** at the relevant voltage to attend to take control of the site.

11.6 The **Senior Authorised Person** on site **Shall** carry out a risk assessment and discuss the findings with the **Control Engineer**. A course of action **Shall** then be agreed and implemented; which may include:

- Carrying out remote **Switching** to reduce the impact on the **System**, should it become necessary to isolate the **Apparatus** or if the **Apparatus** catastrophically fails whilst in service
- Remotely isolating the **Apparatus**
- Where necessary seeking advice from the **SSEN-D** Switchgear Specialist
- Installing monitoring equipment.
- Implementing an access restriction or installing safety barriers etc

11.7 Where the source of the discharge can be identified to a single unit or compartment, e.g. CT chamber, then the supply to the relevant switch / compartment **Shall,** where reasonably practicable, be **Isolated** to remove the risk of catastrophic failure.

11.8 Where it is not reasonably practicable for the supply to the **Apparatus** to be **Isolated**, then adequate control measures **Shall** be implemented. These may include access restrictions, safety barriers, operational restrictions, the installation of monitoring equipment etc.

11.9 Where it is previously known that discharge is present at the location, or the equipment in question has a history of electrical discharge at other locations, then this knowledge **Shall** be applied in the decision-making process.

12 Escape of SF6 Gas or Toxic Gases

In the event of a failure of a SF6 circuit breaker / switch, it is possible that SF6 solid and gaseous by-products could be released. The requirements of PR-NET-OSM-050 Access to and Operation of Plant and Apparatus containing SF6 Gas - Operational Safety Manual Section 6.8, and PR-NET-OPS-008 **Shall** be complied with, in particular:

- All staff who are required to work with SF6 **Shall** be trained and certified
- When working in or near open SF6 chambers, **Approved** PPE **Shall** be worn which **Shall** include disposable overalls, disposable gloves, respiratory and eye protection
- Any indoor area **Shall** be vented to remove any possible gaseous by–products
- Any white or grey dust **Shall** be treated as toxic. An **Approved** procedure **Shall** be followed to remove the dust and wash down the area with a neutralising solution.

13 Investigative Actions following the Disruptive Failure of Plant and Apparatus

13.1 Where an **Incident** occurs with no personal injury, then technical investigations **Shall** be undertaken by the Procedures and Investigations Team in accordance with PR-NET-OSM-080 Reporting and Investigation of Asset Failures - Operational Safety Manual Section 12.9.

13.2 Where a failure occurs and includes personal injury, the technical investigation **Shall** be managed by the Procedures and Investigations Team in parallel with the personal injury investigation conducted by the **SSEN-D** SHE Team.

13.3 Site safety **Shall** be maintained at all times, and it **Shall** be ensured that all assets are protected against further damage and/or the contamination of evidence where possible. The following **Shall** be considered:

- The presence of pressurised components
- Contamination (SF6, Polychlorinated Biphenyls (PCBs) and Oil etc.)
- Structural integrity of the building
- Whether the equipment should remain **Live**
- The continuity of Earthing systems

13.4 It is vital that once made safe, the failed **Apparatus** remains, where possible, undisturbed until photographic evidence is taken of the product and surrounding area.

13.5 Identification labels **Shall** be added to the photographs and once on-site investigations have been completed, the **Apparatus Shall** be carefully handled, transported and stored, in accordance with relevant **SSEN-D** Occupational Safety **Approved** procedures, to minimise any further damage and prevent contamination.

13.6 When switchgear fails to operate as designed during a **System** event, contributing factors may include a mechanical failure or protection system malfunction. It may be necessary to review protection system elements to determine the investigation conclusion and provide appropriate corrective/preventative actions. Any evidence **Shall** be collated, and a report produced.

13.7 When carrying out major catastrophic failure investigations, a number of contributing factors should be considered including lightning activity, **System** disturbance traces, local **Switching** and auto-recloser or testing activity.

13.8 Copies of inspection and maintenance records might also provide an insight into the reason for failure.

13.9 Information held within the ENA National Equipment Defect Reporting Scheme (NEDeRS) (Engineering Recommendation G28/4) **Shall** be reviewed and might provide guidance on similar failures previously recorded.

14 Management of the Fire Service and Fire Fighting

14.1 In an emergency involving threat to life or a serious fire, action **Shall** be taken at the earliest opportunity because:

- There may be injured persons in need of urgent medical attention
- The opportunity to start firefighting as soon as possible means less potential risk of injury to firefighting staff and the possibility of extinguishing the fire before serious damage occurs, as well as improving the chances of identifying the cause of the I**ncident**

14.2 In the event of such an **Incident** the following points **Shall** be considered by the **Control Engineer** and the **Operator**:

- It is important to balance the risks involved against creating undue delay before firefighting begins
- Apart from any other considerations, it is important to concentrate firefighting efforts in a major fire on protecting transformers and oil-filled cables since these items are extremely difficult to repair or replace
- While following this **Approved** procedure, the **Control Engineer Shall** make appropriate decisions based on the information available at the time

- Depending on the situation it may be necessary to request Police assistance to get **SSEN-D** staff to the site of an emergency quickly
- The Control Centre Manager **Shal**l be notified of the **Incident** at the earliest opportunity

14.3 In the event of an Incident at a Substation requiring urgent firefighting, the **Control Engineer** Shall:

- Ensure the Emergency Services have been informed of the Incident and made aware that they **Shall** not enter the site or approach **Apparatus** until clearance has been given by **SSEN-D**. If the site of the emergency is not local, 999 **Shall** be dialled and the Emergency Services **Shall** be advised of the **Incident** location together with the **SSEN-D** Emergency Contact Number
- Ensure, where the site **Apparatus** is jointly owned/operated with National Grid or a third-party, that the third-party is made aware of the **Incident** and **SSEN-D Shall** liaise with them as necessary during the Incident
- Ensure an **SSEN-D Authorised Person** is on site or has been sent to the site
- If necessary, make the appropriate part of the Substation / **Apparatus Dead**, where protection has not already operated to achieve this, and **Shall** check from the control system that there are no **Live** circuits feeding the site from other sources of supply. There is no requirement to provide full isolation at this time.

14.4 The **Control Engineer Shall** then give the **SSEN-D Authorised Person** permission to allow the Fire Service to start firefighting under their **Personal Supervision**, without entering switch rooms or buildings containing **Live High Voltage** / EHV **Apparatus**. The **Authorised Person Shall** ensure the Fire Service is warned of the potential hazards on site, including but not limited to:

- **Live Conductors** (if part of the site is still **Live**) including **Live** ancillary systems
- Oil and/or diesel fuel in **Plant** or storage (including oil-filled cables)
- SF6, Compressed Air and/or Gas Cable pressure systems
- Batteries and PVC insulated wiring
- Gas cylinders (if site is used as a reporting centre)
- Porcelain and/or glass insulators

14.5 Where necessary, **Switching** to provide full isolation **Shall** be commenced as soon as practicable, but without delaying firefighting.

15 Revision History

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