Science and Technology Facilities Council

ELECTRICAL SAFETY

Safety Code No 34

March 2026

Document Revisions

Date	Section/Sheet	Comment
November 14	First Issue	
September 17	B2.4 Working On and Testing LV equipment	NP exemption to work on and test equipment and cables rated above 100A
September 17	Table LV1 and B8.2 Safety Programme	Safety programme exemption
September 17	Appendix C.1 Training requirements	NP Training – courses available
September 17	Appendix C.1 Training requirements	AP Training – courses available
September 17	Appendix C.1 Training requirements	Asbestos Awareness training
September 17	Tables LV1, LV2 and LV3	Equipment with two sources of supply
September 17	Appendix G Personnel Protective Equipment	Arc flash protective clothing
September 17	B9.1 Permit To Work, Tables LV1 & 2	Street lighting circuits
March 18	Appendix G Personnel Protective Equipment	Insulating gloves
September 20	B7 Locking of switch rooms & B17 Operating records	Update wording.
August 21	4. Responsibilities	Added CAE, CAP and SAP definitions
January 23	Major revision of code	Updates agreed with STFC Electrical Safety Committee members
May 23	Continued major revision	Updates agreed with STFC Electrical Safety Committee members
Nov 24	Finalise major revision	Updates agreed with STFC Electrical Safety Committee members
March 26	Various additions and major rewrite of Appendix A	Updates agreed with STFC Electrical Safety Committee members

Electrical Safety

Contents

Electrical Safety

1. PURPOSE

The nature of STFC operations involves the widespread and pervasive use of electricity from low voltage electrical systems found in offices and workshops through to high voltage distribution systems and high voltage scientific equipment.

Electricity (and stored electrical energy) is taken for granted in almost every aspect of our daily lives, but nevertheless has the potential to cause death through electric shock, serious injury through electrical burns; electrical fires (the most common source of fire in the STFC); and damage to equipment and property resulting in lost time and delays to scientific and technical programmes.

Electrical safety is the subject of extensive and detailed legislation and guidance:

- Electricity at Work Regulations, 1989;
- IET Wiring Regulation, latest edition.
- Electricity Safety, Quality and Continuity Regulations, 2002;
- Provision and User of Work Equipment Regulation (PUWER), 1998;
- Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations, 1996;

Supply of Machinery (Safety) Regulations, 1992; and

- Electrical Equipment (Safety) Regulations, 1994.

This code outlines STFC policy with respect to the management of electrical safety hazards and the arrangements for complying with the legislation listed above. It sets out the electrical safety rules and procedures throughout STFC Practical implementation of this code may also result in detailed local rules or procedures.

2. SCOPE

The primary purpose of this code is to define the safety management and practices for those engaged in activities with electrical experimental and/or distribution equipment.

This code applies to all staff, tenants, visitors, facility users and contractors at all STFC sites.

Compliance with this code is mandatory when performing the following functions: specification, design, fabrication, procurement, installation, testing, working on or near, commissioning, operation, modification, maintenance / repair, inspection, and decommissioning of Electrical and Electronic Equipment at all STFC sites.

This code applies where STFC staff undertake electrical work at other sites unless the host site's arrangements provide equivalent or improved electrical safety control.

This code specifically excludes:

- Electrical installations on STFC sites not under the direct control of the STFC for example incoming substations.

- The safety management within STFC workshops and support laboratories for the fabrication, assembly and testing of electrical equipment.

Due to the pervasive nature of electrical safety hazards there are a large number of related STFC SHE codes and policies, including but not limited to:

- SHE Code 4 Safety and safe use of work equipment (PUWER);
- SHE Code 6 Risk Management;
- SHE Code 13 Construction, Design and Management;
- SHE Code 15 Management of Contractors;
- SHE Code 17 Portable Electrical Equipment;
- SHE Code 19 Work on buildings, premises, services and infrastructure;
- SHE Code 20 Controlling Explosive and Flammable Gases and Dusts;
- SHE Code 26 Safe use of lifting equipment;
- SHE Code 30 SHE Auditing and Inspection;
- SHE Code 32 Fire and Emergency Management;
- SHE Code 35 Asbestos Management;
- SHE Code 36 Management and Provision of first aid; and
- SHE Code 37 COSHH: safe use of chemicals / hazardous substances.

3. DEFINITIONS

See section 5 for definitions of other items.

3.1 **Distribution Electrical Equipment** - the Site Distribution System from point of entry to the Site to the agreed single points of demarcation for experimental electrical equipment. Including all high voltage switchgear, step down transformers, ring main units, conductors and all other related electrical equipment used to receive high voltage electricity and to re-distribute it at lower voltages.

3.2 **Experimental Electrical Equipment** - electrical systems directly associated with experimental rigs and facilities requiring additional specialist safety procedures. These systems must have an agreed single point of isolation from the Site Distribution Electrical System.

3.3 **Portable Electrical Equipment -** Portable equipment is not part of a permanent (fixed) installation but when used is connected to a fixed installation (or a generator), by means of a flexible cable, plug and socket. It includes equipment that is hand held or hand operated while connected to the supply. It also includes extension leads that supply portable equipment and are not part of the fixed installation. See SHE Code 17 Portable Electrical Equipment.

3.4 **Point of Demarcation** – this is normally a switch, circuit breaker or cable termination on an Electrical Distribution System that has been agreed by the relevant Authorising Engineers as the point of demarcation between the two areas of responsibility. This would normally be identified on a single line diagram as the single point of demarcation.

3.5 **Voltage**

The following ranges of voltage are defined for non-conductive environments:

- High Voltage: A potential normally exceeding Low Voltage;

- Low Voltage: A potential normally exceeding Extra-Low Voltage but not exceeding 1000 volts ac or 1500 volts dc between conductors, or 600 volts ac or 900 volts dc between a conductor and earth; and
- Extra-Low Voltage**:** A potential normally not exceeding 50 volts ac, or 120 volts dc, between conductors or between conductor and earth.

The RMS ripple on the DC supply is not to exceed 10% of the nominal DC.

High voltage is regarded internationally as being in excess of 1000 volts ac. However, in some UK systems the term `high voltage` is used where the voltage exceeds 650 volts ac.

Voltages in the Extra-Low Voltage range may still present a considerable hazard and when work is carried out on equipment operating in this voltage range a risk assessment should be carried out.

Particular precautions should be employed on equipment, which exceeds **5 Joules of stored energy and is able to exceed 5mA** output current on short circuit or **1.2cal/cm^2 Incident Energy**.

3.6 **Electrical Live Working**

An activity in which a person makes contact with energized parts or encroaches inside the live working zone (BS EN 50110-1) with either parts of their body or with tools, devices or equipment. Electrical Live Working is to be avoided whenever possible. Exceptionally, live working is permitted by an Authorised Person or Nominated Person where a Sanction to Work on or near Live Equipment (see section B11) or Local Rules specific to the equipment to be worked on, have been approved by the Authorising Engineer. All live work must have a risk assessment and method statement specifically written for the activity.

3.7 **Electrical and Electronic Equipment (*abbr. Equipment*)**

Anything used, intended to be used or installed for use, to generate, provide, transmit, transform, absorb, rectify, convert, conduct, distribute, control, store, measure or use electrical energy.

3.8 **Electrical system**

All electrical equipment and connected test equipment that is or may readily be connected electrically to a common source of electrical energy. A system encompasses all the constituent parts e.g. conductors, insulation, protective conductors, insulators and electrical equipment in it, and not simply the functional circuit.

Notes:

- Equipment which may readily be made live by a system is considered part of that system. For example, a lighting circuit disconnected from its source of electrical energy by means of removable links or fuses is still part of that system and so is a circuit which has been switched off even though the switch might be a double pole switch.

- A common source of electrical energy includes systems fed by several generators or transformers.
- In the case of transformers where energy is transmitted over galvanic separation between transformer windings, even though they are not connected electrically, the transformer and all its windings are part of the same system.
- Electrical circuits or equipment whose singular source of supply is batteries are not part of the system (such as test equipment, unless it is connected to the system).

3.9 Authorising Engineer

An engineer whose appointment has been approved by the Director to be responsible for implementing and monitoring this SHE Code.

3.9.1. Coordinating Authorising Engineer (CAE - Electrical) – Where there are more than one Authorising Engineer working within a specific site or campus, one will be formally appointed to coordinate the dialogue between the AEs and the SHE Group. The CAE is responsible for ensuring that there are suitable arrangements in place for the implementation of SHE Codes within their areas of responsibility. The CAE co-ordinate AP functions where required.

3.10 Authorised Person (AP - Electrical)

A person who has been appointed in writing by the Authorising Engineer on behalf of the Director to be responsible for the implementation and operation of this SHE Code.

3.10.1. **Coordinating Authorised Person (CAP - Electrical)** – Where there is more than one Authorised Person appointed for a system or installation, the Authorising Engineer should formally appoint one as a focal point for communication and cascading to other APs. Including activities as an AP, any Authorised Person who is nominated as CAP is in overall charge with responsibility for control of records etc.

3.10.2. **Senior Authorised Person (SAP - Electrical) –** A specialist or third party appointed person responsible for the planning, design, organisation, control and monitoring all types of construction and maintenance work on LV/HV networks up to 11kV and associated plant and equipment, including complex design, commissioning and fault diagnosis in accordance with safety and customer requirements, ensuring that all works are completed to time and budget. An individual having experience an SAP on utility HV systems, with DNO Operational Authorisation to 11kV OHL & UG with Sanction for Test and have a good knowledge of a wide range of High Voltage plant and equipment.

3.10.3. **Duty Authorised Person:** an AP who has current responsibility for a system or installation. The AE to define the local working practices of the Duty AP, such as record acceptance of keys and responsibilities as Duty AP in the site Electrical Distribution Operating Record and displayed at the mimic diagram. They will personally hold or carry an Authorised Person's key(s), normally stored in the system key press. The Duty AP shall relinquish duties in the EDOR as required or on completion of the works.

3.11 Nominated Person

A person certified by an Authorised Person or Authorising Engineer for defined work and with suitable and sufficient technical knowledge and experience to prevent injury, and who has:

- an adequate knowledge of electricity to undertake the defined work activity;
- an adequate experience of electrical work to undertake the defined work activity;
- an understanding of the system to be worked on and practical experience of that class of system;
- an understanding of the hazards which may arise during the work and the precautions which need to be taken;
- the ability to recognise at all times whether it is safe for work to continue; and
- the ability to recognise their own limitations.

A Nominated Person, whether STFC employed or a contractor, can be electrical qualified or non-electrical qualified, the Authorised Person or Authorising Engineer shall assess qualifications, competency and experience before issuing a letter of Appointment.

An Electrical Authorised Person can be assessed and appointed as a Nominated Person to receive safety documents or to work under Tables HV1, HV2, LV1, LV2 or LV3.

Operatives working in Hazardous areas (DSEAR/ATEX) shall be able to demonstrate their competence and provide evidence of attaining the knowledge and skill required in BSEN 60079-14 for selection, erection, testing and inspection for the specific area hazards.

3.12 Person in Charge

- A Nominated Person who has accepted a Permit to Work, a Sanction to Test, a Sanction for Work on or near Live Electrical Equipment, a Specific Written Instruction or an Authority for Access, for a particular task from another Authorised Person , **or**
- A Nominated Person who has accepted Standing Instruction from an Authorised Person , **or**
- A Nominated Person who is responsible for working on or testing low voltage equipment in accordance with Table LV3, **or**
- A suitably qualified person deemed competent to lead non-electrical work and has accepted a Permit to Work.

3.13 Accompanying Safety Person

A competent person who has received suitable training and has adequate knowledge, experience and the ability to recognise hazards. They are required to keep watch, prevent interruption, summon help and apply first-aid. The person is to have sufficient familiarity with electrical systems being worked on and have received instructions on how to disconnect the equipment from all supplies of electricity, and how to switch off or disconnect any test equipment. They will not be directly involved in the work, or involved in anything to distract them from their duties.

4. RESPONSIBILITIES

4.1 Directors shall:

4.1.1 Have overall authority and responsibility for clearly defined electrical systems and electrical network(s).

4.1.2 Ensure that the specification, design, fabrication, procurement, installation, testing, commissioning, operation, modification, maintenance / repair, inspection and decommissioning of electrical systems are carried out by a sufficient number of competent people and that sufficient resource, and facilities are available to implement the requirements of this code.

4.1.3 Appoint in writing sufficient and suitably qualified and/or experienced Authorising Engineers for their Department who have successfully completed training and ensure that their appointment and scope of responsibility are recorded in the STFC SHE Directory (See Appendix C for training and experience requirements). Where necessary, collaborate with or share such appointments with other Departments.

4.1.4 Ensure that the Department hold sufficient electrical safety meetings to justify compliance with this code and report findings to the STFC Electrical Safety Committee and Departmental Safety Committee.

4.1.5 Discuss with the Authorising Engineer, as a minimum annually, the implementation and performance of the safety rules and review any matters of concerns.

4.2 **Authorising Engineers shall:**

4.2.1 Implement, administer, monitor and audit (see Appendix D) the application of this SHE code.

4.2.2 Ensure their out of hours contact details are available to those responsible for managing site emergencies.

4.2.3 An Authorising Engineer can undertake the duties of an Authorised Person within their area of appointment and may undertake duties as an Authorised Person in an area under the responsibility of another Authorising Engineer, however their work as an Authorised Person should be audited by another Authorising Engineer.

4.2.4 Ensure STFC subscribes to a suitable industry forum where serious electrical incidents, equipment faults/failures and manufacturers advisory notices are published. Whenever the forum reports on matters that are relevant to STFC, cascade the information in a timely manner.

4.2.5 Ensure any electrical appointed person does not exceed a maximum total working day as defined in SC08 Travel on Council Business.

Appointment and management of Authorised Persons

4.2.6 Appoint in writing sufficient Authorised Persons to ensure cover at all times, for all electrical systems, installations, and equipment for which they are responsible. Record the scope of their responsibilities by saving a copy of their letter of appointment, in the STFC SHE Directory. Ensure that Authorised Persons have at the time of appointment the required training and competence and maintain their training and competence thereafter (see Appendix C).

4.2.7 Ensure absolute clarity of responsibility for Authorised Persons such that, while there may be more than one Authorised Person appointed for an electrical system, only one is responsible for any defined work or test on an electrical system at any one time.

4.2.8 Defining in writing, using drawings and diagrams as appropriate, the exact extent of the electrical systems and installations for which each Authorised Person is responsible, keeping appropriate records for each. Clear demarcation must be in place between areas covered by different Authorised Persons.

4.2.9 Report to their appointing Director any deficiency in the number of suitably trained and experienced Authorised Persons .

4.2.10 Review the competence of Authorised Persons at least every 5 years or more frequently depending on performance and if necessary, suspend their appointment and remove their names from the SHE Directory informing the Authorised Person in writing of the reasons why. The Director is to be advised of such action and the corrective action recommended ensuring the continued safe operation of the electrical systems and installations.

4.2.11 Ensure all Authorised Persons are made aware of any relevant safety information, defect report or operational restriction on the electrical systems or equipment for which they are responsible as soon as is reasonably practicable, providing appropriate advice to prevent injury. (Example NEDeRS – Engineering Directorate)

Management of Electrical Systems

4.2.12 Ensure that the electrical systems under their responsibility have accurate documentation, including drawings / schematics available, so that the electrical system can be operated and maintained safely. All changes to the electrical system shall be recorded.

4.2.13 Ensure that all electrical incidents, near misses, hazardous conditions, dangerous occurrences or failures of electrical safe systems of work, under their responsibility are promptly reported by the relevant Authorised Persons and others undertaking electrical works, including contractors through Evotix Assure following SHE Code 5 - Incident Reporting and Investigation.

4.2.14 Investigate incidents involving electrical systems and installations within their area of appointment. Where learning points can be derived, work with SHE Group to ensure that the learning is cascaded to their Authorised and Nominated Persons and to the wider STFC electrical community.

4.2.15 Ensure that the correct signage identifying electrical hazards and contact telephone numbers are displayed outside all electrical substations and switch rooms.

4.2.16 Ensure that a list of significant hazards is displayed in or near all substation areas, switch rooms, switch cupboards, and adjacent to all distribution switchgear which is not confined to a specific room.

4.2.17 Under normal circumstances STFC does not permit live working on HV or LV systems, see section B11. However, in exceptional circumstances the Authorising Engineer may authorise such work for example, fault finding, testing and commissioning, near HV Experimental Equipment or on / near LV systems, and shall ensure the following criteria are met:

- it is unreasonable in all circumstances for the electrical equipment to be dead **and**
- it is reasonable in all circumstances for any person to be at work on or near conductors whilst they are live **and**
- suitable precautions (including where necessary the provision of suitable protective equipment) are taken to prevent injury, **and**
- the authorisation for live working is documented.

Where live working is considered necessary the Authorising Engineer shall ensure that a documented risk assessment is undertaken before giving written authority for work on or near live electrical equipment. The Authorising Engineer shall ensure that the people undertaking the work are thoroughly familiar with the risk assessment and that an accompanying safety person is specified.

4.2.18 Ensure that all amendments to this SHE Code are brought to the attention of all staff and others engaged in work on electrical systems at STFC sites for example Authorised Persons, Nominated Persons, electrical contractors etc.

4.2.19 Acceptance or otherwise of new works see section B25.
4.2.20 Ensure that statutory fixed wiring testing of electrical distribution systems is undertaken 5 yearly by suitably qualified persons supported by annual routine monitoring. Records of tests should be retained.
4.2.21 Authorising Engineers do not have authority to deviate from this Code. Where, exceptionally, they consider that it is appropriate to deviate from the Code temporarily; they must first obtain the agreement of the appropriate Director and SHE Group and record the details and reasons in writing and complete a risk assessment.

4.3 **Authorised Persons shall:**

4.3.1 Be responsible for the practical implementation and operation of this SHE Code for the equipment for which they have been appointed to install, operate, test, work on or maintain etc.
4.3.2 Ensure that, where the hazards are significant, a suitable documented risk assessment is undertaken for the work planned, see SHE Code 6, Risk Management.
4.3.3 On matters related to this SHE Code the Authorised Person's instructions are mandatory. In the case of a dispute, the Authorised Person is to stop the work or test and refer the matter to the Authorising Engineer for adjudication.
4.3.4 Ensure all Nominated Persons working within their area of responsibility are made aware of this SHE Code.
4.3.5 Issue and cancel all documents as described in Appendix A and B relating to the electrical system under their control.
4.3.6 Withdraw any documents they have issued or that have been issued by another Authorised Person and transferred to them, if the Person in Charge fails to follow the Rules and Procedures set out in this SHE Code, or if an unexpected hazard arises.
4.3.7 Maintain specialist Personnel Protective Equipment [PPE] (for example face shields, rubber matting, rubber gloves, arc flash protective clothing etc.), Test Equipment and Portable Earthing Equipment for which they are responsible, and ensure the equipment is regularly inspected, calibrated and maintained in good condition, see STFC recommended PPE standards.
4.3.8 Before any specialist Personal Protective Equipment is used it is inspected prior to use.
4.3.9 Inform the Authorising Engineer, in writing, of any defects that may compromise safety in an electrical system or equipment.
4.3.10 Ensure that all electrical incidents, near misses, hazardous conditions, dangerous occurrences or failures of electrical safe systems of work, under their responsibility are reported as soon as is reasonably practicable through Evotix Assure following SHE Code 5 - Incident Reporting and Investigation by those undertaking electrical works, including contractors.
4.3.11 Instruct persons required to operate Electrical Equipment under their control in the safe use of that Electrical Equipment and advise on the hazards arising from improper operation.
4.3.12 Ensure that cable detection, identification or location work is undertaken prior to excavation or other works on their electrical systems within the geographic area of their responsibility.
4.3.13 Where an Authorised Person is unsure of the meaning of any part of this Code they should refer the matter to their Authorising Engineer for guidance.
4.3.14 Perform the duties of a Nominated Person if approved by Authorising Engineer and shall be recorded on their letter of appointment.
4.3.15 If there is more than one Authorised Person working on or testing within an area of responsibility, one shall be nominated Duty Authorised Person and be responsible for overseeing activities.

4.3.16 Appoint in writing sufficient Nominated Persons and at the discretion of the AE appoint Accompanying Safety Persons to undertake electrical work within their area of responsibility for a period not exceeding 5 years, ensuring they are suitably trained and experienced prior to appointment, see Appendix C.

4.3.17 Ensure that the record of appointments of Nominated Persons is recorded in the STFC SHE Directory and maintained.

4.3.18 Review the competence of Nominated Persons at least every 5 years or more frequently depending on performance and if necessary, suspend their appointment and remove their names from the SHE Directory, informing the Authorised Engineer in writing of the reasons why. The Authorised Engineer is to be advised of the corrective action recommended to ensure the continued safe operation of the electrical systems and installations.

4.3.19 As appropriate approve a Nominated Person (STFC staff, contractors or others) for specific tasks by the issue of a Standing Instruction or Specific Written Instruction (see Appendix C for training requirements).

4.3.20 Work with any Nominated Person carrying out activities on the system or equipment within their area of responsibility to develop a written Method Statement where the Nominated Person has produced a Risk Assessment for a task which highlights a cause for concern.

4.3.21 Stop all electrical works where they consider the activities are not in accordance with this or other SHE Codes.

4.3.22 When electrical work is being undertaken that requires the presence of an Accompanying Safety Person, see section 4.6 and B6, prior to work commencing instruct them how to disconnect the equipment being worked on from all supplies of electricity, and how to switch off any test equipment or disconnect it from the supply.

4.4 Nominated Persons shall:

4.4.1 Sign to accept the responsibility to undertake defined electrical work, identified on the letter of appointment, issued by the Authorised Person for a period not exceeding 5 years.

4.4.2 Work in accordance with this SHE Code and take all measures necessary to prevent injury to themselves or others, and to prevent damage to Equipment.

4.4.3 Be aware of the extent and limits of the work to be undertaken, their competence, and of any constraints on the sequence or method of working.

4.4.4 As appropriate undertake a documented risk assessment of work planned, where the hazards are significant see SHE Code 6, Risk Management, excluding live working - see 4.2.17.

4.4.5 Only work on or test equipment which is listed on their letter of appointment unless covered by Standing Instructions or other Specific Written Instructions.

4.4.6 Issue a Permit to Work for equipment which is listed on their letter of appointment to a suitably qualified person to lead non-electrical work.

4.5 Persons In Charge shall:

4.5.1 Prior to commencing work ensure a suitable risk assessment and method statement is in place for the work planned, and the controls detailed implemented.

4.5.2 Be a Nominated Person, Contractor or Authorised Person who is working on or testing equipment in accordance with Table LV3 see appendix A and B, or has accepted a Permit to Work, Sanction to Test, Sanction for Work on or near Live Electrical

Equipment, a Specific Written Instruction, a Standing Instruction or Authority for Access from the Authorised Person.

4.5.3 Be a suitably qualified person deemed competent to lead the non-electrical work defined on the Permit to Work they have accepted.

4.5.4 Follow the Authorised Person's instructions and work in accordance with this SHE Code, taking all safety measures necessary to prevent injury to themselves or others and to prevent damage to equipment. Instruct the Accompanying Safety Person, if present, in how to disconnect the Equipment being worked on from all supplies of electricity, and how to switch off any test Equipment or disconnect it from the supply.

4.5.5 Having accepted a Permit or Sanction, undertake / supervise only the specified work or test. Upon completion of this work or test, the Person in Charge then signs off the Clearance section of a Permit or Sanction.

4.5.6 If the Person in Charge must temporarily leave the place of work, the work or test is to be suspended, unless local rules apply, and adequate safe systems of work established.

4.5.7 Report all electrical safety incidents or near misses to the Authorised Person or Authorising Engineer as soon as is practicable, and in SHE website following SHE Code 5 - Incident Reporting and Investigation. Where reasonably practicable following an electrical incident, photographs should be taken before any items are disturbed.

4.6 **Accompanying Safety Persons shall:**

4.6.1 Undertake the following duties (see section B6):

- Maintain a watching brief for those undertaking electrical work for hazards, distractions and other sources of interruption; and
- In the event of an incident summon help, make the work area safe as appropriate disconnecting equipment worked on from all supplies of electricity, and switch off any test equipment or disconnect it from the supply, and apply first aid if it is safe to do so.

4.7 **Managers of electrical systems, including Contract Supervising Officers, shall:**

4.7.1 Prior to allowing electrical work on their equipment ensure that a risk assessment and method statement for the work planned has been established, see STFC SHE Code 6 Risk Management. As appropriate seeking the advice of STFC Authorising Engineer or Authorised Person.

4.7.2 Where such work is undertaken by STFC electrical staff or contractors working on their behalf, the competence of all individuals working on or near electrical systems must be approved by an Authorising Engineer or an Authorised Person before undertaking electrical work or tests.

4.8 **Staff, tenants, contractors, facility users or visitors shall:**

4.8.1 Report all electrical safety incidents or near misses to the Authorising Engineer or Authorised Person as soon as is practicable, and in Evotix Assure following SHE Code 5 - Incident Reporting and Investigation.

4.9 **SHE Group**

4.9.1 Ensure that electrical SHE incidents are reported to STFC Authorising Engineers to share learning and experience.

5. TECHNICAL DEFINITIONS

CAT Rating: Overvoltage installation categories have standards from I to IV. The division of a power distribution system into categories is based on the fact that a dangerous high-energy transient such as a lightning strike will be attenuated or dampened as it travels through the impedance of the system. A higher CAT number refers to an electrical environment with higher power available and higher energy transients. Thus, a multimeter designed to a CAT III standard is resistant to much higher energy transients than one designed to CAT II standards. Many test instruments such as oscilloscopes, multimeters, and component testers often have labels near or next to their inputs that indicate CAT rating.

Charged: A conductive part having an electrical potential through connection, capacitance, induction or static.

Competent Person: often referred to as a skilled person is a person judged by an Authorised Person as competent to receive a Permit or Sanction (usually a Nominated Person) or an Authority for Access for works in Switch Rooms and Substations for minor electrical work or work that involves other trades. Competent Persons shall have:

i. an understanding of the work they are to perform;
ii. an understanding of electricity and its potential to harm;
iii. an understanding of the electrical hazards which may arise during the work and the precautions which need to be taken;
iv. the ability to recognise at all times whether it is safe for work to continue;
v. the ability to recognise their own limitations.

Contractor: any external organisation or other body employed by STFC to carry out specific duties on or within STFC property.

Dead: Not electrically ‘live’ or ‘charged’.

Disconnection: Equipment (or a part of an electrical system) that is not connected to any source of electrical energy.

Earthed: Connected to the general mass of earth in such a manner as to ensure at all times an immediate discharge of electrical energy without risk or, as appropriate, injury.

Electrical Installation (abbr. Installation): An assembly of associated Electrical Equipment to fulfil a specific purpose, which forms part of a system.

Hazardous Area: Any location in which there is a risk to health, including areas identified under DSEAR, see SC20 – Hazardous Area Classification and Explosive Atmospheres. The risk may be due to any hazard, such as, combustible material, dangerous substances, explosive materials or atmospheres, poisonous substances, electromagnetic radiation, ionising radiation, or strong magnetic fields. Locations of work should also be considered such as confined space or working at height.

High Voltage Enclosure: A location within which a live High Voltage conductor is or may be exposed without the use of a tool or key.

Interlock: A means to prevent switching operations or access that might cause injury, such as paralleling of supplies, or entering enclosures without the supply being isolated.

International Protection (IP): A specification for degrees of protection provided by enclosures, for example IP2X defines an enclosure providing protection against ingress of foreign objects with a diameter of 12.5 mm, and from a finger being inserted and accessing hazardous parts: the X means there is no protection against ingress of water specified.

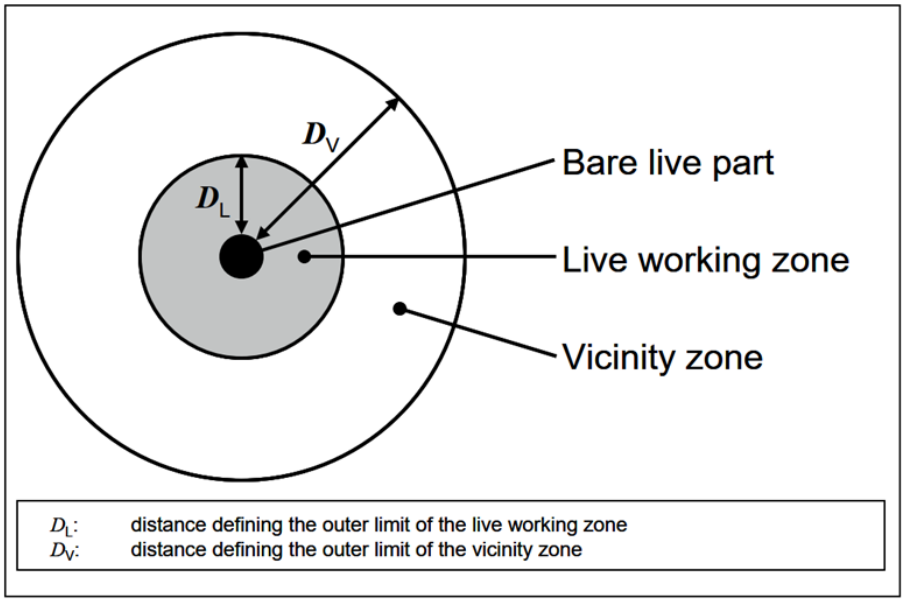
Isolate: Equipment (or part of an electrical system) which is disconnected and separated by a safe distance (the isolating gap) from all sources of electrical energy in such a way that the disconnection is secure, i.e. it cannot be re-energised accidentally or inadvertently.

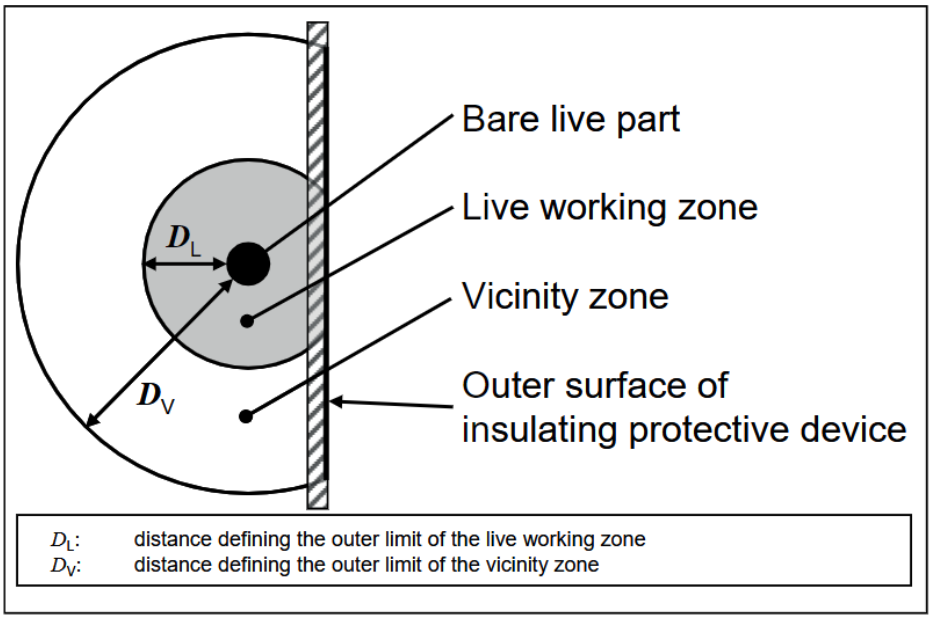
Live: Any apparatus or conductors that are at a voltage by being connected to a source of electricity.

Live working zone: *(danger zone BS EN 50110-1)* - a space around energized parts where reduction of electrical risk is managed by restricting access to skilled persons only, by maintaining the appropriate air distances to parts at a different electric potential and by using tools for live working: the distance from the energized parts to the outer boundary of a live working zone is greater or equal to the sum of the electrical distance appropriate for the maximum nominal voltage and of the selected ergonomic distance.

Vicinity zone: *(working near BS EN50110-1)* – a limited space outside the live working zone where specific precautions are taken to avoid encroaching into the live working zone: encroaching into the live working zone will create an electrical hazard from direct contact and electrical discharge.

Distances in air and zones for working procedures:





D_L: distance defining the outer limit of the live working zone
D_V: distance defining the outer limit of the vicinity zone

Nominal system voltage U_N kV r.m.s.	Minimum acceptable distance in air defining the outer limit of the live working zone D_L mm	Minimum acceptable distance in air defining the outer limit of the vicinity zone D_V mm
≤ 1	no contact	300
3	60	1 120
6	90	1 120
10	120	1 150
15	160	1 160
20	220	1 220
30	320	1 320
36	380	1 380
45	480	1 480
60	630	1 630
70	750	1 750
110	1 000	2 000
132	1 100	3 000
150	1 200	3 000
220	1 600	3 000
275	1 900	4 000
380	2 500	4 000
480	3 200	6 100
700	5 300	8 400

The figures of D_L and D_V have been set out to be a set of minimum administrative values, with respect to those existing in European countries.

Up to 70 kV: a wide range of values exists for D_L, because ergonomic considerations prevail on the calculation of the electrical component.

Consequently, the lowest value among the set of European figures is picked up.

Above 70 kV: the electrical component becomes predominant.

Accordingly, the minimum values of D_L given in Table A.1 are confirmed by computation method of EN 61472.

In the absence of computation methods for DC-systems, the values for distance D_L and D_V for AC-systems could also be used for DC-systems up to 70 kV.

NOTE 1 Intermediate values for D_L and D_V may be determined by linear interpolation.

NOTE 2 The values of Table A.1 intend to give guidance for future harmonisation between countries. Nevertheless, lower values can be accepted temporarily.

Safety key-box (lockout): A safety key-box as a minimum should have two locks, each of which should have only one key: one key should be issued to the Person in Charge receiving the safety document and the other key should be retained by the Duty Authorised Person. It should be so arranged that all locks must be released before access can be gained to the contents of the box.

Mimic Diagram: A single line diagram of an electrical distribution system so constructed that the symbol for each item of switchgear may be adjusted to indicate the ON, the OFF, or the EARTHED position. The symbol for each item of Equipment shall use the appropriate colour identification of voltages to BS EN 60617. These may be digital or physical however they shall be available at all times.

Protective Conductor (PE): (BS 7671) A conductor used for some measures of protection against electric shock and intended for connecting together any of the following parts:

i. exposed-conductive-parts;
ii. extraneous-conductive –parts;
iii. the main earthing terminal;
iv. earth electrode(s);
v. the earthed point of the source, or an artificial neutral.

Prove Dead: Demonstrate with an approved two pole voltage detector (GS38) that no electrical potential liable to cause injury is present. Multimeters must not be used for proving dead. Prove Unit or Test supply should meet or exceed the voltage source to be proven dead. Voltage detectors for hazardous areas must be Ex rated.

Proving Unit: see Test Supply**.**

Removable Temporary Earth: This is an earth, which may be removed for the duration of a test. The Authorised Person lists these on the Sanction to Test, when a Sanction to Test is required.

Substation: Any premises or part of premises in which electrical energy is transformed or converted to or from high voltage, or which contains high voltage switchgear.

Switchboard: High or low voltage switchgear assembled into a single panel or frame.

Switch Cupboard: A room containing distribution boards and other electrical apparatus, but not Distribution Switchgear. An Authority for Access would not normally be required. In exceptional instances where an area classed as a Switch Cupboard may be a shared area, such as those used by cleaners, it may be advantageous to change the reference to show the different level of access control.

Switchgear: An assembly of main and auxiliary electrical equipment for operation, regulation, protection, or other control of an electrical Installation.

Switch Room: A room other than a Substation containing distribution Switchgear. Unless authorised to do so, an Authority for Access would normally be required to enter.

Temporary Earth: A connection to earth made before working on or testing equipment to ensure as far as is practicable that the equipment does not become electrically charged, secured where practicable by a Safety Lock. On completion of a Permit to Work or Sanction to Test these earths are removed by the Authorised Person.

Test Equipment: Equipment to undertake particular tests that is suitable and sufficient for the use for which it is provided, that is maintained in a condition suitable for that use, and that is properly used (see CAT rating definition).

Test Indicator / Potential Indicator: Test Equipment for proving dead and confirming dead in connection with this SHE Code.
All test indicators should comply with BS EN 61243/IEC 61243 as appropriate. Low Voltage test indicators must comply with the recommendations of GS38 – Electrical Test Equipment for use by electrician, published by the Health and Safety Executive. Low voltage test Indicators should be suitably rated and operate down to 50 volts. (Voltage indicators with integral fuses are prohibited for future purchases)

Test Supply (or Proving Unit): Test Equipment for proving the function of a voltage Test Indicator or a Potential Indicator for live voltage and phasing Test Equipment or a current Test Indicator.

6. REFERENCES

- Electricity at Work Regulations, 1989.
- HSE guidance on Regulations HSR25. Memorandum of guidance on the Electricity at Work Regulations 1989.
- Electricity Safety, Quality and Continuity Regulations (ESQCR).
- Guidance on the Electricity Safety, Quality and Continuity Regulations (ESQCR), Department of Trade and Industry.
- BS 7671, Requirements for Electrical Installations, IET Wiring Regulation, latest edition.
- BS EN 61243-3:2010 Voltage indicators, Electrical test equipment for use by electricians, HSE guidance note GS38. (Integral Fuses are prohibited for future purchases of voltage indicators)
- Avoiding danger from underground services. HSE guidance note HSG47.
- Electricity at Work – Safe Working Practices. HSE guidance Information HSG85.
- Keeping electrical switchgear safe, HSG230.
- Electrical Switchgear Safety, General information sheet INDG372 (rev1).
- Safety in Electrical Testing: Switchgear and control gear, engineering information sheet EIS37.
- Safety in Electrical Testing at Work, general Information sheet INDG354.
- Guidance on Safe Isolation Procedures for Low Voltage Installations, HSE and Electrical Safety Council best practice guide no. 2.
- Specification for degrees of protection provided by enclosures (IP code) IEC 60529, as amended.
- Pocket Guide 16, IP codes, NICEIC Pocket Guides.
- Safety in Electrical Testing: Service and repair of audio, TV and computer equipment, engineering information sheet EIS36.
- Using electric storage batteries safely, general information sheet INDG139 (rev1).
- Electrical safety and you, general information sheet INDG231 (rev1).

- BSEN 50110-1 Operation of electrical installations
- BS 6423 Code of Practice - maintenance of low voltage switchgear
- BS 6626 Maintenance of switchgear 1kV to 36kV.
- BSEN 60079-14 Explosive atmospheres. Part 14: Electrical installations design, selection and erection.
- BSEN 60079-10-1 Explosive Atmospheres – Classification of areas.
- ENA Engineering Recommendations – Standards and guidance of all electrical network operators. (reference to best practice to include but not limited to UKPN G81 library***)***

APPENDIX A - EXPERIMENTAL EQUIPMENT - DESIGN AND OPERATION

A1 INTRODUCTION

A1.1 This appendix provides information and guidance regarding safe practice in the design, construction and operation of experimental scientific equipment, test facilities and their associated electrical and electronic experiment. This equipment by its nature covers a large array of electrical and electronic equipment. It varies in size from standalone units operating at high voltage and or high currents with or without stored energy. Through to electronic chassis' operating at Low Voltage or Extra-Low Voltage levels for purposes such as control and instrumentation. It includes equipment which:

- Is used as part of a scientific facility to directly operate, control or monitor the scientific facility.
- Is supplied by or brought to site by external users of the scientific facility for scientific purposes.
- Is designed by and or constructed by STFC.

This includes any experimental scientific equipment used in-house or on external user experiments carried out within STFC sites and or STFC experimental or Test facilities owned, controlled and operated by STFC.

A1.2 It describes the decision-making process for the requirement of engineering and administrative control measures including the appointment of electrical nominated and authorised persons.

A1.3 Working on or near live equipment is to be avoided whenever possible. Exceptionally live working is permitted, providing that it is undertaken in accordance with section B11.

A2 REQUIREMENTS FOR ELECTRICAL AUTHORISED AND NOMINATED PERSONS

A2.1 Electrical hazards present within the scientific equipment, associated experiments and test facilities such as high voltage, high current, stored energy, dual sources of supply etc. may require the appointment of electrical authorised and nominated persons. The electrical hazards should be risk assessed to identify mitigation measures that when realised may negate the need for the appointment of authorised and nominated persons.

This risk assessment shall be performed by the equipment owner or a departmental designated person, with the support of an appropriately qualified electrical engineer. It will be documented and stored in an accessible location during the operational life of the scientific equipment. The document shall be agreed and countersigned by the relevant electrical authorising engineer. The assessment will:

- Identify all electrical hazardous present whilst the equipment is both energised and de-energised. Particular attention should be given to equipment which exceeds 5 Joules of stored energy and is able to exceed 5mA output current on short circuit or 1.2cal/cm3 Incident Energy.
- Include the number of electrical sources supplying the scientific equipment, experiment or test.
- Identify the local environmental hazards both present and through operation of the equipment.
- Be reviewed on a 5 yearly basis or as and when the equipment is modified.

A2.2 The risk assessment may identify certain electrical conditions or environmental hazards that will automatically require the appointment of electrical authorised or nominated persons. Examples of these are:

- Any hazard as stated by the relevant electrical authorising engineer.

- Equipment that is located within, operates within or outputs into areas that may contain explosive atmospheres as defined by the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR).
- High power equipment, particularly connected to a three-phase electrical supply.
- Equipment that operates from more than one source of electrical supply.
- Equipment that generates high voltage or is connected to a high voltage supply and or located within a high voltage enclosure.
- Equipment that exceeds 5 Joules of stored energy and the associated risk assessment fails to identify mitigation measures utilising simple control measures.

A2.3 Electrical hazards associated with scientific equipment operating at LV or ELV can be mitigated during the design process and therefore not require electrically authorised or nominated persons. However, the person(s) responsible for the equipment, experiment or test must risk assess the activity and the competency of users operating the equipment, experiment or test.

A2.4 All personnel who design, operate or work on scientific equipment shall be assessed and deemed competent for their role and shall:

- be provided with suitable training to fulfil their role.
- be trained in the use of and have access to all appropriate test equipment and tools.
- be trained in the use of and allocated suitable personnel protective equipment.

A3 USER SUPPLIED EQUIPMENT

A3.1 All electrical scientific equipment supplied by or brought to site by external users of the STFC scientific facilities must comply with this safety code and all other applicable STFC safety codes.

A3.2 It is the responsibility of the relevant scientific facilities staff to ensure that any user supplied equipment complies with this safety code and all other applicable STFC safety codes.

A3.3 It is the responsibility of the relevant scientific facility staff to ensure all required hazard and risk assessments have been documented and the agreed mitigations including any engineering and administrative measures are in place before the user equipment is operated on any STFC site.

A4 SAFE DESIGN CONSIDERATIONS

A4.1 It is essential that all electrical equipment is safe and that safe operating conditions are established in the design stage. Due to the vast array of high and low voltage equipment only a guide to safe practice in design and operation can be given, based on past experience of similar work.

A4.2 Consideration needs to be given to electrical hazards present whilst the equipment is energised and those still present once de-energised. Particular attention should be given to equipment which exceeds 5 Joules of stored energy and is able to exceed 5mA output current on short circuit or 1.2cal/cm3 Incident Energy.

A4.3 The equipment design process must:

- Allow for the additional load on the Distribution Network.
- Allow for the environmental conditions in which it operates.
- Ensure that the equipment meets all required legislation, regulations such as PUWER, any applicable standards and STFC safety codes.
- Include a risk assessment to identify the hazards with associated risks and ensure suitable engineering and or administrative controls are in place.

- Ensure that the equipment is maintained in a satisfactory condition.
- Check It is suitable for the electrical supply to which it is connected.
- Ensure personnel operating and maintaining the equipment are appropriately trained.
- Provide suitable documentation to enable safe operation and maintenance.

A4.4 It is advisable in the design stage to consult with SHE Group, Estates and Fire Safety Advisors for consideration of the following:

- Fire Detection.
- Emergency Exits.
- Emergency Shut-Down Facilities.
- Lighting and Emergency Lighting.
- Audible Alarms.
- Waste Heat Extraction.

A4.5 The equipment should be physically capable of performing the activities in the environment for which it is designed and constructed. Mechanical and electrical stresses must not cause the equipment to become unsafe.

A4.6 If the equipment is located or operates into an explosive atmosphere, compliance with the DSEAR regulations is required and consideration given so that any works on the equipment can be carried out safely.

A4.7 Whenever high power, high frequency equipment is designed or used, the electro-magnetic field and ionising radiation hazards must be considered, see SHE Code 23, Working with time varying electro-magnetic fields and SHE Code 28 Radioactive open sources.

A4.8 All electrical connections and terminals above ELV shall be insulated or include physical protection to a minimum of IP2X.

A4.9 All designs shall eliminate inadvertent contact with high or low voltage conductors and connections during servicing or other works by physical protection to a minimum of IP2X or where this is not possible using interlocks.

A4.10 Earth and bonding requirements are to be part of the design and operational process.

A5 MARKING AND IDENTIFICATION

A5.1 Departmental design policies are to be followed to ensure consistency in marking and identification colours and text descriptors.

A5.2 All switches, control buttons, and indicator lamps must be clearly marked to indicate their function.

A5.3 Emergency controls and isolators shall be installed in prominent positions and must be marked to identify the equipment they control.

A5.4 The following information should be displayed near the entrance to all experimental High Voltage Enclosures and low voltage equipment:

- Clear operating instructions; and
- Clear shut-down instructions; and
- Location of isolator; and
- Emergency First Aid instructions; and
- A hazard warning poster indicating the major hazards; and
- Contact details for those responsible for the area in and out of normal working hours.

A5.5 **Voltage Warning Labels**

A5.5.1 Every item of equipment or enclosure where a voltage exceeding ELV exists, and where the presence of such a voltage would not normally be expected, shall be so

arranged that before access is gained to live parts, a warning of the maximum voltage present is clearly visible. Specific consideration should be given to instances where multiple phases are present.

A6 ENCLOSURES AND BARRIERS

A6.1 All experimental equipment shall be housed within suitable enclosures to prevent access when the equipment is live or charged. An enclosure shall comprise of a container manufactured from insulated material or earthed metalwork.

A6.2 All covers, fascia's, or doors shall only be removable with the use of a tool.

A6.3 Larger enclosures shall be positioned in such a way so as not create additional hazards. Sufficient space and lighting shall be provided around such enclosures to allow work within the enclosure to be carried out safely.

A6.4 All panels and ventilating spaces shall be designed so as to prevent physical contact with live or charged conductors, with a minimum of IP2X rating.

A6.5 Good housekeeping, tidiness, and neatness of layout are important factors in maintaining safety with all types of equipment.

A7 Temporary Supplies

A7.1 Where experimental equipment is to be installed for a temporary period, the use of Temporary Supplies may be considered. (See section B21)

A8 APPARATUS LEFT WORKING UNATTENDED - Emergency Procedures

A8.1 If it is necessary for apparatus to be left working unattended, emergency contact details, of those responsible for the equipment in and out of normal working hours, must be recorded on hazard warning posters, located outside the area where the equipment operates.

A8.2 If there is any doubt about the advisability of leaving apparatus working un-attended the Authorising Engineer or SHE Group should be consulted.

A8.3 Where emergency instructions for the safe shut down of unattended equipment are necessary these should be in a prominent position adjacent to equipment left working. Such instructions should be readily operated by personnel unfamiliar with it: a sketch of the layout and position of means of isolation and include any specific explosion, toxic, or other hazards which may arise.

A8.4 Means shall be provided as necessary to prevent injury, or damage to the apparatus (such as manual resets) in the event of an electrical power or other service failure, or upon restarting following restoration of supply.

A9 EMERGENCY SHUTDOWN FACILITIES

A9.1 Where there is an increased likelihood that an electrical incident or fire may occur, such as in experimental areas, HV enclosures and laboratories, the inclusion of emergency shutdown buttons or break-glass units to interrupt all electrical supplies should be considered.

A9.2 Emergency shutdown control points shall be situated in prominent positions and shall be clearly labelled to indicate what they control. Circuit reference numbers shall also be included.

A9.3 All personnel working in these areas shall be shown where these control points are located and instructed in their operation.

A9.4 The design and positioning of such control points shall include consideration to avoid accidental tripping of the equipment or system.

A9.5 Consideration should also be given in the design to the way tripped circuits are reset. Whilst for most applications an automatic reset occurs when the button is released or the glass replaced, other applications may require a more controlled method of reset.

A9.6 Shutdown circuits shall be fully tested every 5 years unless an Authorising Engineer has performed a risk assessment and specified an alternative period. However, for main high voltage and low voltage distribution panels, local procedures, agreed with the Authorising Engineer, may be used to prevent a full trip of the breakers. As reliable operation of a shunt trips is dependent on a functional power supply, monitoring of the supply should be considered.

A10 ISOLATION AND EARTHING

A10.1 A means of positively isolating low and high voltage equipment shall be provided and shall be clearly marked.

A10.2 IEC and or miniature circuit breaker lockout and tag off systems shall be used where appropriate.

A10.3 Contactors used for operational purposes must not be regarded as points of isolation.

A10.4 Wherever practicable, locate the isolating switches adjacent to the equipment.

A10.5 If the equipment is low voltage and has a single point of isolation, then a suitable risk assessment and / or the procedures set out in Table LV3 shall be followed.

A10.6 Where a Permit to Work or Sanction to Test is required the isolation procedures are set out in Tables EXPHV1, EXPHV2, LV1 and LV2 and shall be followed.

A10.7 EARTH BONDING

A10.7.1 Each large enclosure shall be provided with a suitable earth point within the enclosure.

A10.7.2 Metal enclosures, cases of all equipment, doors, cable armouring, conduits, and metal trunking shall be suitably bonded and earthed. All bonding and earth connections shall be capable of carrying the maximum possible fault current.

A10.7.3 Equi-potential bonding will be required where other services (e.g. gas, water, etc.) form part of the experimental Equipment.

A10.8 Earthing of Portable Electronic Test Equipment

A10.8.1 All class I insulated portable electronic test equipment connected to the main electrical distribution system must be properly earthed. (See SHE Code 17 Portable Electrical Equipment)

A10.8.2 Personnel using portable electrical test equipment (such as oscilloscopes and multi-meters) on electrical equipment must be competent and familiar with the equipment to be tested; particular attention shall be given to floating signal references and isolated earths. If Live Working is required, then it must conform to section B11.

A11 INTERLOCKS

A11.1 As identified as a mitigation measure following a risk assessment, safety interlocks shall be fitted to enclosures to prevent access to any exposed live or charged conductors. They are required on all panels or doors that can easily be removed without the use of a tool. Mechanical and electro-mechanical interlocks should be used for permanent enclosures.

A11.2 Permanent interlock systems shall be positively operated, should fail safe, and have their wiring segregated from other wiring (where applicable). Standard micro-switches shall not be used as a sole point of isolation for interlock systems.

A11.3 For non-permanent experiments simple electrical interlocks may be adequate.

A11.4 Interlock circuits using positively operated switches are vital for the protection of equipment and personnel against faults and mal operation. It is essential that they are

thoroughly tested during commissioning and thereafter are checked periodically throughout the life of the Equipment.

A11.5 Consult SC40 Interlocks for Personnel and Environmental Protection for guidance on trapped key interlocks, such as Fortress and Castell keys.

A11.6 HV INTERLOCKS BYPASS

A11.6.1 Occasionally with high voltage equipment it may be necessary to obtain access to enclosures with the interlocks bypassed. Bypasses provided for this purpose should be carefully assessed with a risk assessment and method statement and approved by an Authorising Engineer. Refer to table EXPHV3.

A11.6.2 Where, in the judgement of the Authorising Engineer, or an Authorised Person approved in the Local Rules; after examining all possible alternatives, it is essential to gain access with conductors live or charged, then the following conditions must also be adhered to:

- There must be adequate working space, adequate means of access and adequate lighting;
- A Nominated Person or Authorised Person responsible for the work or acting as an accompanying safety person must have intimate knowledge of the equipment.
- Personnel must not work alone, at least two people must be present and must be in sight of each other.
- Entry must be limited to:
    - Authorised Person(s) and Nominated Person(s), with one of them acting as the Accompanying Safety Person; or
    - as detailed in local operating instructions or rules.
- A Sanction for Work on or near Live Electrical Equipment (Section B11) must be issued to the Authorised Person or a Nominated Person before access is permitted. This Sanction must specify in detail the limits of the safe area, the conductors which are live or charged, any special precautions taken, and exactly what work is to be done.
- The area within which the work is to be done must be clearly defined by the use of ropes, barriers, or by height, and with notices. These must be arranged to maintain certain minimum clearances. For guidance on recommended distances in air and zones for working on or near live conductors refer to BS EN 50110, see section 5. Technical Definitions. Where these distances cannot be achieved, or are inadequate to avoid injury, then the Authorised Person can amend these distances if suitable risk assessments and method statements are followed.
- Where Interlocks are bypassed, the Authorised Person must ensure that all changes made to the system are formally recorded. Once work or tests are completed, they must formally record that the bypassed interlocks have been reinstated and tested.
- When the work involves the use of portable ladders, then it must be supervised and directed by the Authorised Person. The Authorised Person must satisfy themselves that the ladders are of a suitable type, are no longer in use than is necessary for the job, and are not erected, moved, or used in a manner inconsistent with other requirements.
- When working or testing in a HV Enclosure ensure that tools, equipment, protective clothing, barriers, and/or screens are safe, in good condition, appropriately rated and fit for purpose.

A12 EXPERIMENTAL HIGH VOLTAGE EQUIPMENT

A12.1 Enclosures and Barriers

A12.1.2 All high voltage equipment shall be housed within suitable rated IP enclosures and means provided to prevent access when the equipment is live or charged. An enclosure may be a room, a barricaded area, or / and equipment rack.

A12.1.3 For large equipment where it is possible to enter the enclosure, there should be a safe means of access and a clear and unobstructed passage around the equipment. Overhead clearance should be considered, particularly where cranes are installed.

A12.1.4 On small equipment where entry is not possible, the panels and ventilating spaces shall be designed to prevent physical contact with exposed live or charged conductors with a minimum rating of IP2X, taking into consideration HV minimum clearance distances.

A12.1.5 An enclosure may be:

- Permanent;
- Temporary (lifetime less than 3 months);
- Very Short Term (lifetime less than 1 week);

A12.1.6 Permanent enclosures should be soundly constructed and any requiring physical entry shall be at least 2m high. Use may be made of close mesh perforated metal, and safety glass or plastic for windows. Adequate interlocks and labels must be fitted to doors and on panels which are easily removable, without the use of tools. Removable panels shall be marked with labels stating that live or charged parts will be exposed if those panels are removed.

A12.1.7 Temporary enclosures shall be designed to suit the scale of the experiment but should be of a rigid construction and suitably interlocked.

A12.1.8 Very short-term experiments shall be enclosed to bar access. Where reliance is placed on rope or tape barriers and prominent Safety Notices, the equipment should not be unattended when energised.

A12.1.9 All Low Voltage conductors which may remain live or charged even when the high voltage is de-energised should be completely enclosed and conform to IP2X.

A12.1.10 Good housekeeping, tidiness, and neatness of layout are important factors in maintaining safety with all types of enclosure.

A12.2 Isolation and Earthing

A12.2.1 For large permanent installations it is advisable to mechanically interlock the door of the enclosure with the isolation and earthing switches, thus ensuring the system is earthed before the enclosure door can be opened.

A12.2.2 Where interlocks are not practicable, the isolator shall be a manually operated switch or fuse-switch located near the door and conspicuously marked. This type of switch must have the facility for safety locks to be fitted.

A12.2.3 Contactors used for operational purposes must not be regarded as points of isolation.

A12.2.4 Where the isolator does not interrupt the low voltage circuits to facilitate rescue or firefighting operations, an emergency isolator is to interrupt all supplies and render the enclosure completely dead.

A12.2.5 Temporary installations may employ an isolator interlocked with the door and with a gravity operated earthing switch.

A12.2.6 Wherever practicable, locate the isolating and earthing switches so that they are visible from the entrance to the enclosure.

A12.2.7 The use of approved Earthing Sticks should be considered wherever practicable but should only be applied after the usual methods of making safe have been performed.

A12.2.8 The person responsible for the area, in consultation with the Authorising Engineer or Authorised Person, must ensure that equipment used within the area is suitably rated (e.g. Earth sticks and test equipment). The user must inspect the equipment before use and ensure that the rating is not exceeded.

A12.3 Warning Devices

A12.3.1 Suitably positioned illuminated lamps shall be used to indicate that high voltage circuits are live or charged, to indicate whether it is safe to enter.

A12.3.2 Each indicator shall contain two sources of illumination.

A12.3.3 On large installations lamps should be placed prominently within the high voltage enclosure; the use of an audible evacuation signal are also advisable.

A12.3.4 Warning notices of a type conforming to the requirements of the Electricity Safety, Quality and Continuity Regulations shall be installed in such a way as to be visible on all approachable sides of the enclosure.

A13 HIGH ENERGY CAPACITOR BANKS

A13.1 Discharging of Capacitor Banks

A13.1.2 The safety of persons working on capacitor banks must be ensured by discharging, shorting, and earthing the capacitors so that no hazardous voltages remain or will arise due to dielectric recovery.

A13.1.3 Two electrically independent systems shall be incorporated for these purposes, without the need to enter the high voltage enclosure. In large installations they will take the form of “Slow Dump” and Shorting Switches, and separate Earthing Switches.

A13.2 Slow Dumping of Capacitor Banks

A14.2.1 All capacitor banks shall be provided with a means for safe slow dissipation of their stored energy into a resistive load. The resistance value and rating shall have an adequate margin of safety and be arranged to restrict currents and discharge times to reasonable values.

A14.2.2 For small installations a bleeder chain across the capacitor(s) may be sufficient, on large installations a “slow dump switch” and “dump resistor” must be fitted.

A14.2.3 The “slow dump switch” circuit shall be an independent means of dissipating the energy stored in capacitors.

A14.2.4 Any “fast dump or crowbar” circuits provided as a plant protection measure shall be regarded as an additional facility.

A13.3 Shorting Switches for Capacitor Banks and Connections to Earth

A13.3.1 All capacitor banks shall be provided with sufficient permanently installed shorting switches to remove all hazardous voltages. The connections to the individual capacitors shall be direct, visible, and of robust construction.

A13.3.2 In cases where capacitor banks are connected in series-parallel, or are sub-divided by fuses or protective resistors, each parallel-connected group shall be independently discharged and short-circuited before access to the bank can be considered safe.

A13.3.3 Facilities for local operation of shorting switches shall be provided.

A13.3.4 In some cases, it may be permissible to combine dumping and earthing in a switch that first connects a resistor in circuit for sufficient time to reduce any capacitor charge to a value at which the application of a short circuit can be shown to be a safe operation.

A13.3.5 It is recommended that shorting switches should incorporate a solid connection to the installation earth independent of the load circuit.

A13.3.6 Except for very simple low energy experiments, Earthing Sticks shall be used only after the standard procedures of making safe as described in Table CAP1.

A13.3.7 Care shall be taken to ensure Earthing Sticks are:

- suitably rated for the operating voltage of the system; **and**

- capable of dissipating safely all the stored energy to which they may be subjected;
- the earth connection is sound and substantial; **and**
- they have been suitably tested on a 5 yearly basis and records maintained

A13.4 Capacitor Fault Conditions

A13.4.1 Fault conditions on capacitor banks require special precautions which may be peculiar to each installation. Consideration should be given to the means of making safe under such conditions. This may include emergency equipment such as voltage indication, and the discharge and earthing of damaged or faulty Capacitor Banks.

A13.4.2 The design must be such that in the event of a capacitor failure within one bank, the energy flowing into the fault can be absorbed safely.

A13.4.3 Considerable forces can be generated under fault conditions; the mechanical support systems of conductors must be sized to withstand these forces.

A13.5 Spare Capacitors

A13.5.1 All spare or disconnected storage capacitors in working areas or storage facilities must be kept short-circuited to prevent the build-up of dangerous voltages through dielectric recovery.

A13.5.2 Procedures and monitoring must be in place to ensure capacitors are not left open circuit for longer than the minimum practicable period during the building or modification of Capacitor Banks.

A14 BATTERIES

A14.1 *Battery systems used in Experimental equipment present hazards including stored energy and maintenance. It is important that all hazards are suitably risk assessed and mitigation measures documented.*

A14.6 Appendix E contains recommendations for the safe use, handling, storage, and maintenance of batteries.

Table EXPHV1 For Working on High Voltage Experimental Equipment in an Enclosure

All High Voltage Equipment in experimental areas having a steady short circuit current greater than 5mA and a maximum stored energy of greater than 5 joules.

The Authorised Person is responsible for ALL steps except step 6, which is undertaken by the Person in Charge.

Step	Action
1: PREPARATION	COMPLY WITH ANY PARTICULAR SAFETY PROCEDURES APPLICABLE TO THE LOCATION. Risk Assessments must be in place for the work to be carried out before proceeding to Step 2.
2: ISOLATE AND FIX SIGNS	ISOLATE FROM ALL SOURCES OF SUPPLY. Where practicable, prevent unauthorised connection or unauthorised operation by fixing Safety Locks and/or Caution Notices at all the points of isolation. Fix Electrical Equipment Warning Signs on adjacent live Equipment at the places of work.
3: PROVE DEAD AND EARTH	ENSURE THAT THE EQUIPMENT TO BE WORKED ON IS THE EQUIPMENT THAT HAS BEEN ISOLATED. Where fitted, earth Equipment using the earthing switch and fix Safety Locks. Ensure that all Red lights (where fitted) have been extinguished, and replaced by illuminated Green (earthed) lights. Where practicable prove dead, with a High Voltage potential indicator, at all accessible points of isolation and at the places of work. Where possible, earth down exposed electrical conductors using Earthing Sticks.
4: ISSUE PERMIT TO WORK	The prospective Person in Charge is to be aware of the Risk Assessment, Safety Programme, and the safety arrangements at all the points of isolation and at the places of the work. The Person in Charge is to fit their Safety Locks to all points of isolation. The Permit to Work, issued by the Authorised Person, must be displayed at the point of work.
5: CONFIRM DEAD	Where it is not practicable in Step 3 to prove the Equipment dead until conductors have been made accessible to a High Voltage Test Indicator, the Authorised Person is to remain with and supervise the prospective Person in Charge to ensure covers or shrouds are removed safely. The Authorised Person shall then prove dead using an appropriate High Voltage Test Indicator.
6: UNDERTAKE WORK	The Person in Charge undertakes or directly supervises the work and, on completion or when the work is stopped and made safe, checks that all persons under their charge are made aware of the completion/suspension of work, returns the Permit to Work to the Authorised Person , and completes and signs Part 3.
7: CHECK WORK	If the work has been completed, check that the work is satisfactory, that the Equipment has been restored to working order and that it may be safely energised. If the work was stopped in Step 6, check that the Equipment has been made safe.
8: CANCEL PERMIT TO WORK	Cancel the Permit to Work completing and signing Part 4. The Person in Charge shall remove their Safety Lock applied in Step 4. Where a test is required before the Equipment is energised, Steps 9 and 10 are omitted, and the procedures of Table EXPHV2 are to be followed. Where other Permits relate to the Equipment and have not been cancelled, Steps 9 and 10 are omitted.
9: REMOVE EARTHS	Remove the Safety Locks and Earths applied in Step 3.

10: MAKE EQUIPMENT OPERATIONAL	Remove the Safety Locks and signs fitted in Step 2 and restore the Equipment to an operational state.
11: RECORDS	The completed Permit to Work shall be placed in the operational file and held for 2 years.

Table EXPHV2 For Testing High Voltage Experimental Equipment in an Enclosure

All High Voltage Equipment in experimental areas having a steady short circuit current greater than 5mA and a maximum stored energy of greater than 5 joules.

The Authorised Person is responsible for ALL steps except step 6 undertaken by the Person in Charge.

Step	Action
1: PREPARATION	COMPLY WITH ANY PARTICULAR SAFETY PROCEDURES APPLICABLE TO THE LOCATION. Risk Assessments must be in place for the test to be carried out before proceeding to Step 2.
2: ISOLATE AND FIX SIGNS	ISOLATE FROM ALL SOURCES OF SUPPLY. Where practicable, prevent unauthorised connection or unauthorised operation by fixing Safety Locks and/or Caution Notices at all the points of isolation. Fix Electrical Equipment Warning Signs on adjacent live Equipment at the places of work.
3: PROVE DEAD AND EARTH	ENSURE THAT THE EQUIPMENT TO BE TESTED IS THE EQUIPMENT THAT HAS BEEN ISOLATED. Where fitted, earth Equipment using the earthing switch and fix Safety Locks. Ensure that all Red lights (where fitted) have been extinguished, and replaced by illuminated Green (earthed) lights. Where practicable prove dead, with a High Voltage potential indicator, at all accessible points of isolation and at the places of test. Where possible, earth down exposed electrical conductors using Earthing Sticks.
4: ISSUE SANCTION TO TEST	The prospective Person in Charge is to be aware of the Risk Assessment, Safety Programme, and the safety arrangements at all the points of isolation and at the places of the test. The Person in Charge is to fit their Safety Locks to all points of isolation. Where the test may extend the boundaries of the HV enclosure, barriers are to be set up at safe distances and High Voltage Enclosure Signs fitted.
5: CONFIRM DEAD	Where it is not practicable in Step 3 to prove the Equipment dead until conductors have been made accessible to a High Voltage Test Indicator, the Authorised Person is to remain with and supervise the prospective Person in Charge to ensure covers or shrouds are removed safely. The Authorised Person shall then prove the Equipment dead using an appropriate High Voltage Test Indicator. The Authorised Person shall then prove the Equipment dead at the places of work before allowing the Person in Charge to assume control of the test.
6: UNDERTAKE WORK	The Person in Charge undertakes or directly supervises the test including the disconnection of any Removable Earths. On completion of the test, or when the test is stopped and made safe, the conductors are to be discharged and any Removable Earths restored. After ensuring that all persons under their charge are made aware of the completion/suspension of work, the Person in Charge returns the Sanction to Test to the Authorised Person , and completes and signs Part 3.
7: CHECK WORK	If the test has been completed, check that the work is satisfactory, that the Equipment has been restored to working order and that it may be safely energised. If the work was stopped in Step 6, check that the Equipment has been made safe.
8: CANCEL SANCTION TO TEST	Cancel the Sanction to Test completing and signing Part 4. The Person in Charge shall remove their Safety Lock applied in Step 4. Where the test has been stopped in Step 6 and work is required before the Equipment is re-tested, Steps 9 and 10 are omitted, and the procedures of Table EXPHV1 are to be followed.
9: REMOVE EARTHS	Remove the Safety Locks and Earths applied in Step 3.
10: MAKE EQUIPMENT OPERATIONAL	Remove the Safety Locks and signs fitted in Step 2 and restore the Equipment to an operational state.
11: RECORDS	The completed Permit to Work shall be placed in the operational file and held for 2 years.

Table EXPHV3 For Working on or Live Testing of High Voltage Experimental Equipment with Interlock Bypasses Applied

All High Voltage Equipment in experimental areas with Interlock Bypasses and having a steady short circuit current greater than 5mA and a maximum stored energy of greater than 5 joules.

The Authorised Person responsible for ALL steps except step 4 undertaken by a Nominated Person.

Step	Action
1: PREPARATION	COMPLY WITH ANY PARTICULAR SAFETY PROCEDURES APPLICABLE TO THE LOCATION. Standing Instructions and Risk Assessments must be in place for the work or test to be carried out before proceeding to Step 2.
2: ISSUE SANCTION FOR WORK ON OR NEAR LIVE ELECTRICAL EQUIPMENT	ALL PERSONNEL INVOLVED WITH THE WORK OR TEST MUST BE FULLY AWARE OF THE HAZARDS CREATED BY THIS PROCEDURE. The prospective Person in Charge is to be aware of the Risk Assessment, Safety Programme, and the safety arrangements at the places of the work. The Sanction for Work on or near Live Electrical Equipment must be displayed at the point of work.
3: BYPASS	INTERLOCKS SHALL ONLY BE BYPASSED WHERE IT IS NOT PRACTICABLE TO CARRY OUT THE WORK IN OTHER WAYS. Operation of Interlock Bypasses shall only be carried out by the Authorised Person. Where a switch handle or button must be held in position throughout the work or Test to allow entry, an Accompanying Safety Person must be present at the entrance to the High Voltage enclosure whilst the work is in progress. Where a switch with an audible alarm is fitted to indicate operation of the Interlock Bypass, the Authorised Person is to act as Accompanying Safety Person. Where changes have been made to the Interlock to achieve bypass, these changes must be recorded.
4: UNDERTAKE WORK OR TEST	Work or testing is to be carried out as timely as possible. Appropriate PPE as defined by the Risk Assessment and/or Standing Instruction must be worn. On completion/suspension of work, the Person in Charge returns the Sanction for Work on or near Live Electrical Equipment to Work to the Authorised Person , and completes and signs Part 3.
5: CANCEL SANCTION FOR WORK ON OR NEAR LIVE ELECTRICAL EQUIPMENT	Cancel the Sanction for Work on or near Live Electrical Equipment by completing and signing Part 4 and placing the completed Sanction in the “Cancelled SFW File.”
6: REMOVE BYPASS	Once work is completed and the door interlock returned to normal, the handle or button of the bypass may be released, or the bypass switch and audible alarm returned to normal. Where changes have been made to the Interlock to achieve bypass, reinstatement of the interlocks must be made and recorded. Where the work is stopped in Step 4 for other work requiring an isolation, procedures of Table EXPHV1 and EXPHV2 as appropriate are to be followed.
7: RECORDS	The completed Sanction for Work on or near Live Electrical Equipment shall be held for 3 years.

Table CAP1 Procedure for working or testing on large high voltage capacitors banks

Capacitor banks having a steady short circuit current greater than 5mA and a maximum stored energy of greater than 5 joules.

The Authorised Person is responsible for ALL steps except step 8 undertaken by the Person in Charge.

Step	Action
1: PREPARATION	COMPLY WITH ANY PARTICULAR SAFETY PROCEDURES APPLICABLE TO THE LOCATION. Standing Instructions and Risk Assessments must be in place for the work or test to be carried out before proceeding to Step 2.
2: ISOLATE AND FIX SIGNS	ISOLATE FROM ALL SOURCES OF SUPPLY. Where practicable, prevent unauthorised connection or unauthorised operation by fixing Safety Locks and/or Caution Signs at all the points of isolation.
3: DISCHARGE	DISCHARGE ALL CAPACITORS IN A SAFE AND CONTROLLED MANNER. Controlled discharges shall be made using Slow Dump Switches and Dump Resistors to restrict currents.
4: SHORT	ENSURE CAPACITORS ARE DISCHARGED BEFORE SHORTING. Operate Shorting Switches to remove all hazardous voltages. Ensure no hazard to personnel is involved with the operation of Shorting Switches
5: EARTH	Where applicable, operate Earthing Switches.
6: PROVE DEAD	Prove dead using a suitable voltage Test Indicator at all places of work. Additional Earthing Sticks may be used around the places of work.
7: ISSUE PERMIT TO WORK	The prospective Person in Charge is to be aware of the Risk Assessment, Safety Programme, and the safety arrangements at all the points of isolation and at the places of the work. The Person in Charge is to fit their Safety Locks to all shorting points or earthing points. The Permit to Work, issued by the Authorised Person, must be displayed at the point of work.
8: UNDERTAKE WORK	The Person in Charge undertakes or directly supervises the work and, on completion or when the work is stopped and made safe, checks that all persons under their charge are made aware of the completion/suspension of work, returns the Permit to Work to the Authorised Person , and completes and signs Part 3.
9: CHECK WORK	If the work has been completed, check that the work is satisfactory, that the Equipment has been restored to working order and that it may be safely energised. If the work was stopped in Step 8, check that the Equipment has been made safe.
10: CANCEL PERMIT TO WORK	Cancel the Permit to Work completing and signing Part 4. The Person in Charge shall remove their Safety Lock(s) applied in Step 4.
11: REMOVE EARTHS	Remove Earths applied in Step 5.
12: REMOVE SHORTS	Remove shorts applied in Step 4. and return Capacitor Bank to an operational state.
13: MAKE EQUIPMENT OPERATIONAL	Remove all Safety Locks applied in Step 2 and return Capacitor Bank to an operational state. The completed Permit to Work shall be placed in the operational file and held for 2 years.

Appendix B ELECTRICAL DISTRIBUTION SYSTEM SAFETY RULES AND PROCEDURES

B1 ALLOCATION OF RESPONSIBILITIES BETWEEN THE STFC AND OTHERS

General

B1.1 Where there is a division of electrical responsibilities between the STFC and others working on STFC sites, such as contractors or electrical suppliers, the STFC Authorising Engineer or Authorised Person shall co-operate and co-ordinate with the other party (or parties) as necessary to prevent injury.

B1.2 The STFC Authorised Person shall not exceed their areas of responsibility as defined by their letter of appointment.

B1.3 In the clauses that follow, each demarcation of responsibility is to be recorded in writing and precisely described by a diagram. The Demarcation Line is to be at a cable termination and should normally be at the outgoing terminals of a switch or circuit breaker, which shall remain under the control of the controlling authority.

Where STFC has Control of the Electrical Hazards

B1.4 The STFC owns and is responsible for the safe installation, operation and maintenance of all electrical systems on its sites and those working on them. STFC personnel and others are to work in accordance with this SHE Code.

B1.5 During the design phase of any new installation, upgrade or modification to the distribution system the Authorising Engineer and/or Authorised Person must be consulted to ensure that safe operating conditions are maintained / established. These include adding a substantial load, upgrading fire detection, modifying emergency exits, etc.

Where STFC does not have Control of the Electrical Hazards

B1.6 STFC has the general duty of care that is imposed by the Health and Safety at Work etc. Act 1974. The organisation or person having control of the electrical hazard is responsible for ensuring the safety of all persons on site and is required to operate a safe system of work by the Electricity at Work Regulations, 1989. This means, that even where STFC transfers control to another body, such as under a Certificate of Transfer of Control (see section B14), there is still a responsibility upon STFC to ensure work is carried out to a standard, that as a minimum, complies with this SHE Code.

Where STFC Appoints an Electrical Contractor

B1.7 STFC is to specify in the conditions of contract that the contractor shall comply with all SHE Codes, with particular reference to SC15 – Contractor Management.

B1.8 Contractor must not isolate equipment unless they have been appointed as an Authorised or Nominated Person by the Authorising Engineering responsible for the electrical system or a Transfer of Control has been issued.

B1.9 The STFC Authorising Engineer may, where appropriate, appoint non-STFC Authorised Persons to work on STFC electrical systems.

B1.10 In certain cases, for example under a contract, the contractor may be allowed to adopt their own safe system of work subject to approval by the STFC Authorising Engineer responsible for the area of work. A copy of such rules shall be sent to the Authorising Engineer a minimum of 1 month prior to the start of the contract so that any anomalies

can be corrected prior to the commencement of work. Any subsequent changes to the Contractors' system of work must be approved by the STFC Authorising Engineer.

B1.11 Where the Contractor is to take responsibility for part of a system or installation connected to the STFC system, a Certificate of Transfer of Control shall be issued (see Section B14). The exact extent of the responsibilities of all parties shall be shown on the certificate and on associated drawings and shall show clearly all Demarcation Lines. This Certificate, including the conditions of issue, must be agreed by the project manager before issuing to the contractor.

B1.12 For acceptance of a new electrical system, see Section B25.

Where STFC Provides a Temporary Electricity Supply to another Consumer or Contractor

B1.13 The temporary supply is to include a means of isolation under the control of STFC. The supply terminals of the temporary supply are to be the outgoing terminals of a switch dis-connector, circuit breaker, or other clearly identified terminals. (See section B21)

B1.14 STFC is to be responsible for the control of the system up to and including the supply terminals. The consumer is to be responsible for the connections to the terminals and for the remainder of the downstream system.

B1.15 Where Temporary Supplies are under the control of contractors it shall be the responsibility of the contractor to provide monthly test certificates to a nominated person at STFC.

B1.16 Failure to comply with Clause B1.13 may result in a disconnection of supply by STFC.

B2 WORKING ON AND TESTING LOW VOLTAGE EQUIPMENT

General

B2.1 This SHE Code does not apply where low voltage equipment has been discharged, disconnected, removed from the system or installation and is not energised by other means.

B2.2 Low voltage equipment that is considered by the Authorised Person to be in a dangerous condition is to be isolated elsewhere and action taken by the Authorised Person to prevent it being re-connected to the supply of electricity. The Authorised Person is to report the matter as soon as reasonably practicable to the Authorising Engineer.

B2.3 If the equipment is low voltage and has a single point of isolation rated at less than 100A, then the procedures set out in Table LV3 shall be followed.

B2.4 Unless the provision of Section B11 apply, all working on or testing of low voltage equipment connected to a system is to follow the procedures set out in Tables LV1, LV2 or LV3 of this SHE Code as appropriate. A Nominated Person following the procedures set out in Table LV3 becomes the Person in Charge and is responsible for the Work or Test.

B2.5 All issued safety documentation must prevent unauthorised changes to content of documents by completing all sections and using word 'none' or striking through unused section.

B2.6 The Authorising Engineer can issue an exemption to a Nominated Person to switch, operate and make safe equipment on the load side of a main intake switch rated above 100A provided that a suitable risk assessment has been completed, and the specific exemption is detailed on the Nominated Person's letter of appointment.

B2.7 A means of positively isolating low voltage equipment shall be provided and shall be clearly marked.

B2.8 Contactors, inverters *and electronic controllers* used for operational purposes must not be regarded as points of isolation.

B2.9 Wherever practicable, locate the isolating switches adjacent to the equipment.

B2.10 Where a low voltage isolation is via a high voltage source, HV safety rules (B3) shall apply.

B2.11 Safety Locks and caution signs are to be applied wherever practicable at points of isolation to prevent unauthorised operation or re-connection. Voltage Test Indicators are to be tested immediately before and after use against a Test Supply (proving unit).

B2.12 *Test Indicators must comply with the recommendations of GS38 – Electrical Test Equipment for use by electrician. (see definitions - test indicators)*

B2.13 Multifunction instruments, single contact neon indicators, or non-contact indicators shall not be used to prove dead at Low Voltage.

B2.14 A suitably rated proving unit, appropriate for voltage under test, is the recommended method for verifying the functionality of a Voltage Test Indicator; they must be designed for use with two pole voltage testing devices, examples of compliant units are Martindale PD700, Megger MPU690 and Kewtech Kewprove3. A known live ac supply can be used for verification in extreme cases, voltages above ELV must be protected to a minimum of IP2X.

B2.15 Equipment and conductors are to be proved dead prior to the application of any temporary earth and removable temporary earth. Where it is not practicable to prove dead other means are to be used to make an assessment that the Equipment and conductors to which the earth is to be applied are not energised, then any temporary earth and removable temporary earth connections shall be made by means of a switch, or circuit breaker with integral earthing facilities, that form part of the permanently installed equipment. Other forms of temporary earth or removable temporary earth connection shall not be used until the conductor, where the earth is to be applied, has been proved dead.

B2.16 Where the procedures involve the application of Temporary Earths the unauthorised removal of such earth connections is to be prevented wherever practicable by the application of Safety Locks. These Safety Locks are, where practicable, to be in addition to those required by Clause B2.5.

B2.17 Where the procedures involve the application of Removable Temporary Earths the unauthorised removal of such earth connections is to be prevented, wherever practicable, by the application of an Earthing Lock. The key of the Earthing Lock is to be issued to the Person in Charge who will retain control of it for the duration of the tests (see Clauses B19.9 to B19.11).

B2.18 Prior to the issue of a Permit to Work or Sanction to Test, the Authorised Person is to show the prospective Person in Charge the isolation and earthing diagram on the Safety Programme, the safety arrangements at the points of isolation and at the places of work or test and is to ensure that the person understands all the relevant safety procedures and precautions. After accepting the Permit to Work or Sanction to Test the Authorised or Nominated person becomes the Person in Charge and is responsible for the defined Work or Test until the Permit or Sanction is cancelled.

Table LV1 for Working on Low Voltage Equipment

Except where a Risk Assessment indicates that an explosion, electric shock or possibility of short circuit exists, equipment operating at Extra Low Voltage is exempt from these procedures.
Steps in column 1 are to be undertaken in numerical order.

Columns 2, 3 and 4 provide detail for the specified Equipment.

The Authorised Person is to be in possession of a current Authorised Person's letter of Appointment appropriate to the equipment being worked on, and is responsible for Steps 1, 2, 3, 4, 5, and 7, 8, 9, 10, 11.

The Person in Charge is to be in possession of a current Nominated Person's letter of Appointment appropriate to the equipment being worked on, and is responsible for Step 6.

COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4
EQUIPMENT	Main incomer switch, switchboards and Equipment having two or more sources of supply, cables and other Equipment on the supply side of a main incomer switch and all underground cables, street lighting circuits and supplies rated at 100A or more. (If equipment has two sources of supply and one is for controls / instrumentation only, see Column 2 of Table LV3)	Generating sets started by manual initiation from a remote location, or automatically on receipt of a signal.	Uninterruptible Power Supply Equipment / Electrical Energy Storage Systems. If a battery system has a series string voltage exceeding 120 volts dc or an arc flash incident energy >1.2cal/cm2 a Sanction to Work should be completed, unless isolators have been provided to allow the string voltage to be reduced to below 120 volts dc.
STEP 1: PREPARE SAFETY PROGRAMME	COMPLY WITH ANY PARTICULAR SAFETY PROCEDURES APPLICABLE TO THE LOCATION. Prepare a Safety Programme, obtain an AP countersignature and gain approval from equipment owner before proceeding to step 2. Unless B8.2 applies.		
STEP 2: ISOLATE AND FIX SIGNS	ISOLATE FROM ALL SOURCES OF SUPPLY. Prevent unauthorised connection or unauthorised operation by fixing Safety Locks and Caution Notices at all the points of isolation. Fix Caution Notices on motor starting Equipment. Fix Electrical Equipment Warning Signs on adjacent live Equipment at the places of the work.	INHIBIT ENGINE START, ISOLATE GENERATOR. Prevent unauthorised connection, or unauthorised operation or unauthorised starting by fixing Safety Locks. Fix Caution Notices at all the points of isolation and on the engine start panel. Fix Electrical Equipment Warning Signs on	ISOLATE FROM ALL SOURCES OF SUPPLY. Isolate mains supply, battery supply, output supply and any standby power supply. On parallel Uninterruptible Power Supply systems and those having an external bypass, ISOLATE the output supply terminal of the

	The need to isolate neutral conductors should be assessed on each job and should be stated on the permit whether or not the neutral link has been broken.	adjacent live Equipment.	units being worked on from all sources of supply. If a battery installation is to be worked on, follow the rules applicable to Work on or near Live Equipment, disconnect the battery from its charger and disconnect the battery earth. Prevent unauthorised connection or unauthorised operation by fixing Safety Locks and Caution Notices at points of isolation. Fix Electrical Equipment Warning Signs on adjacent live Equipment.
STEP 3: PROVE DEAD AND EARTH	ENSURE THAT THE EQUIPMENT TO BE WORKED ON IS THE EQUIPMENT THAT HAS BEEN ISOLATED.		
	Where practicable prove dead with a voltage Test Indicator at all the points of isolation and at the places of the work. Where practicable earth conductors at points of isolation and fix Safety Locks. Identify cables with certainty at the places of the work.	Where practicable prove dead with a voltage Test Indicator at all the points of isolation and at the places of the work. Earth the line and neutral generators output terminals or conductors and, where practicable, fix Safety Locks.	Except for the battery installation, where practicable, prove dead with a voltage Test Indicator at all the points of isolation and at the places of work. Except for the battery installation, where practicable, earth conductors at points of isolation and fix Safety Locks.
STEP 4: ISSUE PERMIT TO WORK	The prospective Person in Charge is to be shown the electrical diagram on the Safety Programme and the safety arrangements at all the points of isolation and at the places of the work. The Person in Charge is to fit their own safety locks to all points of isolation or is to be issued with a Lock-out Box Key by the Authorised Person. The Permit to Work must be displayed at the point of work. After issuing the Permit the Authorised Person shall adjust the Mimic Diagram, if installed, the Electrical Distribution Operating Record is to be completed and the Safety Programme shall be filed in the Electrical Safety Documents Register.		

STEP 5: CONFIRM DEAD	Where it is not practicable to prove Equipment dead until conductors have been made accessible to a Voltage Test Indicator, the Authorised Person is to remain with and supervise the Person in Charge to ensure covers and shrouds are removed safely. The Authorised Person shall then confirm dead before allowing the Person in Charge to assume control of the work.
STEP 6: UNDERTAKE WORK	The Person in Charge undertakes or directly supervises the work and on completion, or when the work is stopped and made safe, returns the Permit to Work to the Authorised Person and completes and signs Part 3. The Person in Charge must remove all their Safety Locks.
STEP 7: CHECK WORK	If the work has been completed, check that the work is satisfactory, that the Equipment has been restored to working order and that it may be safely energised. If the work was stopped in Step 6, check that the Equipment has been made safe.
STEP 8: CANCEL PERMIT TO WORK	Cancel the Permit to Work by placing the complete Permit to Work in the "Cancelled PTW File" and completing and signing Part 4. The Person in Charge removes their own Safety Locks or returns their Lock-out Box Key to the Authorised Person. Where a test is required before the Equipment is energised, Steps 9 and 10 shall be omitted, and the procedures of Table LV2 are to be followed. Where other Permits relate to the Equipment and have not been cancelled, Steps 9 and 10 are omitted.
STEP 9: REMOVE EARTHS	Remove the Safety Locks and earths applied in step 3.
STEP 10: MAKE EQUIPMENT OPERATIONAL	Remove the Safety Locks and Signs fixed in Step 2 and restore the Equipment to an operational state.
STEP 11: COMPLETE RECORDS	Adjust the Mimic Diagram if installed. Complete the Electrical Distribution Operating Record.

Table LV2 for Testing Low Voltage Equipment

Except where a Risk Assessment indicates that an explosion, electric shock or possibility of short circuit exists, Equipment operating at Extra Low Voltage is exempt from these procedures.
Steps in Column 1 are to be undertaken in numerical order.

Columns 2, 3 and 4 provide detail for the specified Equipment.

The Authorised Person is to be in possession of a current Authorised Person's letter of Appointment appropriate to the Equipment being tested, and is responsible for Steps 1, 2, 3, 4, 5, and 7, 8, 9, 10, 11.

The Person in Charge is to be in possession of a current Nominated Person's letter of Appointment appropriate to the Equipment being tested, and is responsible for Step 6.

COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4
EQUIPMENT	Main intake switches, switchboards and Equipment having two or more sources of supply, cables and other Equipment on the supply side of a main intake switch and all underground cables, street lighting circuits and supplies rated at 100A or more. (If equipment has two sources of supply and one is for controls / instrumentation only, see Column 2 of Table LV3)	Generating sets started by manual initiation from a remote location, or automatically on receipt of a signal.	Uninterruptible Power Supply Equipment / Electrical Energy Storage Systems
STEP 1: PREPARE SAFETY PROGRAMME	COMPLY WITH ANY PARTICULAR SAFETY PROCEDURES APPLICABLE TO THE LOCATION. Prepare a Safety Programme, obtain an AP countersignature and gain approval from equipment owner before proceeding to step 2. Unless B8.2 applies.		
STEP 2: ISOLATE AND FIX SIGNS	ISOLATE FROM ALL SOURCES OF SUPPLY. Prevent unauthorised connection or unauthorised operation by fixing Safety Locks and Caution Notices at all the points of isolation. Fix Caution Notices on motor starting Equipment. Fix Electrical Equipment	INHIBIT ENGINE START, ISOLATE GENERATOR. Prevent unauthorised connection, or unauthorised operation or unauthorised starting by fixing Safety Locks. Fix Caution Notices at all the points of isolation and on the engine start panel. Fix	ISOLATE FROM ALL SOURCES OF SUPPLY. Isolate mains supply, battery supply, output supply and any standby power supply. On parallel Uninterruptible Power Supply systems and those having an external bypass, ISOLATE the

	Warning Signs on adjacent live Equipment at the places of the test. The need to isolate neutral conductors should be assessed on each job and should be stated on the permit whether or not the neutral link has been broken.	Electrical Equipment Warning Signs on adjacent live Equipment at the places of the test.	output supply terminal of the units being worked on from all sources of supply. If battery installation is to be worked on, follow the rules applicable to Work on or near Live Equipment and disconnect the battery from its charger and disconnect the battery earth. Prevent unauthorised connection or unauthorised operation by fixing Safety Locks and Caution Notices at points of isolation. Fix Electrical Equipment Warning Signs on adjacent live Equipment.
STEP 3: PROVE DEAD AND EARTH	ENSURE THAT THE EQUIPMENT TO BE TESTED IS THE EQUIPMENT THAT HAS BEEN ISOLATED.		
	Where practicable prove dead with a voltage Test Indicator at all the points of isolation and at the places of the test. Where practicable earth conductors at points of isolation and fix Safety Locks to Temporary Earths and Earthing Locks to Removable Temporary Earths. Identify cables with certainty at the places of the test.	Where practicable prove dead with a voltage Test Indicator at all the points of isolation and at the places of the test. Earth the line and neutral generators output terminals or conductors and, where practicable, fix Safety Locks to Temporary Earths and Earthing Locks to Removable Temporary Earths.	Except for the battery installation, where practicable, prove dead with a voltage Test Indicator at all the points of isolation and at the places of the test. Except for the battery installation, where practicable, earth conductors at points of isolation and fix Safety Locks to Temporary Earths and Earthing Locks to Removable Temporary Earths.
STEP 4: ISSUE SANCTION TO TEST	The prospective Person in Charge is to be shown the electrical diagram on the Safety Programme and the safety arrangements at all the points of isolation and at the places of the test. The Person in Charge is to fit their own Safety Locks to all points of isolation or is to be issued with a Lock-out Box Key by the Authorised Person. The Person in Charge is to be issued with a key to the Earthing Lock on the Removable Temporary Earths. The Sanction to Test is issued to the Person in Charge.		

STEP 5: CONFIRM DEAD	Where it is not practicable to prove Equipment dead until conductors have been made accessible to a Voltage Test Indicator, the Authorised Person is to remain with and supervise the Person in Charge to ensure covers and shrouds are removed safely. The Authorised Person shall then confirm dead before allowing the Person in Charge to assume control of the work.
STEP 6: UNDERTAKE TEST	The Person in Charge undertakes or directly supervises the test, including the disconnection of any Removable Temporary Earths. On satisfactory completion of the test or when the test is stopped and made safe, the conductors are to be discharged and any Removable Temporary Earths restored. The Person in Charge is to remove their own Safety Locks or return their Lock-out Box Key to the Authorised Person. The Person in Charge is to return the key for the Earthing Lock to the Authorised Person. The Person in Charge then returns the original parts 1 and 2 of the Sanction to Test to the Authorised Person and completes and signs Part 3.
STEP 7: CHECK TEST	If the test was completed, check that the work is satisfactory, that the Equipment has been restored to working order and that it may be safely energised. If the work was stopped in Step 6, check that the Equipment has been made safe.
STEP 8: CANCEL SANCTION TO TEST	Cancel the Sanction to Test by destroying the original Parts 1 and 2 and completing and signing Part 4. Where the test was stopped in Step 6 and work is required before the Equipment is re-tested, Steps 9 and 10 shall be omitted and the procedures of Table LV1 are to be followed.
STEP 9: REMOVE EARTHS	Remove the Locks and earths applied in Steps 3 and 6.
STEP 10: MAKE EQUIPMENT OPERATIONAL	Remove the Safety Locks, barriers and Signs fixed in Steps 2 and restore the Equipment to an operational state.
STEP 11: COMPLETE RECORDS	Adjust the Mimic Diagram if installed. Complete the Electrical Distribution Operating Record. File the cancelled Sanction in the Electrical Safety Document Register.

Table LV3 For Nominated Persons Working on or Testing Low Voltage Equipment

Except where a Risk Assessment indicates that an explosion, electric shock or possibility of short circuit exists, Equipment operating at Extra Low Voltage is exempt from these procedures.
Steps in Column 1 are to be undertaken in numerical order.

Columns 2 and 3 provide detail for the specified Equipment.

The Nominated Person is to be in possession of a current Nominated Person's letter of Appointment appropriate to the Equipment being worked on or tested, and is responsible for all steps.

COLUMN 1	COLUMN 2	COLUMN 3
EQUIPMENT	Cables and other Equipment on the load side of a main intake switch and sub-distribution boards or equipment, with a single point of isolation rated at less than 100A or two sources of supplies, if one of the supplies is for controls / instrumentation only. (For main intake switches and Equipment having two or more sources of supply, cables and other Equipment on the supply side of a main intake switch and underground cables, see Column 2 of Tables LV1 and LV2 and refer to the Authorised Person).	Generating sets started by manual initiation. (For generating sets started by manual initiation from a remote location, or automatically on receipt of a signal, see column 3 of Tables LV1 and LV2 and refer to the Authorised Person).
STEP 1: PREPARATION	COMPLY WITH ANY PARTICULAR SAFETY PROCEDURES APPLICABLE TO THE LOCATION. Obtain approval from equipment owner before proceeding to step 2.	
STEP 2: ISOLATE AND FIX SIGNS	ISOLATE FROM ALL SOURCES OF SUPPLY. Make Equipment safe to work on or test. Prevent unauthorised connection or unauthorised operation by fixing Safety Locks and Caution Notices at all the points of isolation. The need to isolate neutral conductors should be assessed on each job and should be stated on the permit whether or not the neutral link has been broken. Fix Caution Notices on motor starting Equipment. Fix Electrical Equipment Warning Signs on adjacent live Equipment at the places of the work or test.	INHIBIT ENGINE START, ISOLATE GENERATOR. Make Equipment safe to work on or test. Prevent unauthorised connection, or unauthorised operation or unauthorised starting by fixing Safety Locks. Fix Caution Notices at all the points of isolation and on the engine start panel. Fix Electrical Equipment Warning Signs on adjacent live Equipment.

STEP 3: PROVE DEAD AND EARTH	ENSURE THAT THE EQUIPMENT TO BE WORKED ON OR TESTED IS THE EQUIPMENT THAT HAS BEEN ISOLATED.	
	Where practicable prove dead, with a voltage Test Indicator, at all the points of isolation and at the places of the work or test. Where practicable earth the line and neutral conductors and where practicable fix Safety Locks to Temporary Earths and Earthing Locks to Removable Temporary Earths. Identify cables with certainty at the places of the work or for testing, at the places of test and at the distant end.	Where practicable prove dead with a voltage Test Indicator at all the points of isolation and at the places of the work or test. Earth the line and neutral generator output terminals or conductors and, where practicable, fix Safety Locks to Temporary Earths and Earthing Locks to Removable Temporary Earths.
STEP 4: CONFIRM DEAD	Where it was not practicable in Step 3 to prove the Equipment dead at the places of work or test, the Nominated Person, using appropriate tools and Protective Equipment where necessary, is to confirm dead at the places of the test, as soon as the conductors have been made accessible to a voltage Test Indicator. Where practicable earth the lines and neutral conductors unless they were earthed in Step 3.	
STEP 5: UNDERTAKE WORK OR TEST	Undertake or directly supervise the work or test.	
STEP 6: CHECK WORK OR TEST	Check that the work or test has been satisfactorily completed, that the Equipment has been restored to working order and that it may be safely energised.	
STEP 7: REMOVE EARTHS	Remove any earths applied in Steps 3 or 4.	
STEP 8: MAKE EQUIPMENT OPERATIONAL	Remove the Safety Locks, and Signs fixed in Steps 2 and restore the Equipment to an operational state. Clear area of work materials, tools and litter.	

B3 WORKING ON AND TESTING HIGH VOLTAGE EQUIPMENT

General

B3.1 This SHE Code does not apply where high voltage equipment has been discharged, disconnected, removed from the system or installation and is not energised by other means.

B3.2 High voltage equipment, which is considered by the Authorised Person to be in a dangerous condition or is subject to a Health and Safety Warning Notice, that requires it to be immediately switched off, is to be isolated elsewhere and action taken by the Authorised Person to prevent it being re-connected to the supply of electricity. The Authorised Person is to report the matter as soon as reasonably practicable to the Authorising Engineer.

B3.3 Unless the provisions of Clause B3.19 to B3.22 apply all working on or testing of High Voltage Equipment connected to a system is to follow the procedures set out in tables HV1 or HV2 of this SHE Code as appropriate.

B3.4 All working on or testing of high voltage equipment connected to a system is to be authorised by a Permit to Work or a Sanction to Test.

B3.5 All issued safety documentation must prevent unauthorised changes to content by completing all sections and using word ‘none’ or striking through unused section.

B3.6 Safety Locks and Caution Signs are to be applied wherever practicable at points of isolation to prevent unauthorised operation or re-connection.

B3.7 A means of positively isolating high voltage equipment shall be provided and shall be clearly marked.

B3.8 All high voltage equipment shall be provided with a means of applying an earth to circuits (Circuit Main Earths), and to internal bus sections of switchboards.

B3.9 It shall be possible to apply and maintain a circuit main earth between all possible points of HV Supply and the point of work.

B3.10 Any test device used on high voltage systems should be suitably rated for the voltage to be tested. Proving units must be compatible with the test indicator. (See definitions - test indicators)

B3.11 A High voltage potential indicator is to be tested immediately before and after use against a high voltage test supply. Only the Authorised Person, or a Nominated Person acting on the instructions of and personally supervised by the Authorised Person are to use a high voltage potential indicator to prove dead in accordance with this SHE Code.

B3.12 Equipment is to be proved dead prior to earthing. Where it is not practicable to prove dead any earth connection shall be made by means of a switch or circuit breaker. Other forms of earth connection shall not be used until the equipment and its conductors have been proved dead.

B3.13 Where the procedures involve the application of Temporary Earths the unauthorised removal of such earth connections is to be prevented wherever practicable by the application of Safety Locks. These Safety Locks are in-addition to those required by clause B3.5

B3.14 Where the procedures involve the application of Removable Temporary Earths the unauthorised removal of such earth connections is to be prevented wherever practicable by the application of padlocks. The keys of the padlocks are to be issued to the Person in Charge who is to retain control of them for the duration of the tests.

B3.15 Prior to the issue of a Permit to Work or Sanction to Test, the Authorised Person is to show the prospective Person in Charge the electrical diagram on the Safety Programme, the safety arrangements at the points of isolation and at the places of work or test and is to ensure that the person understands all the relevant safety procedures and precautions. After accepting the Permit or Sanction that person

becomes the Person in Charge and is responsible for the defined Work or Test until the Permit or Sanction is cancelled.

High Voltage Enclosures

B3.16 Except in a high voltage (HV) enclosure, access to live high voltage conductors is to be possible only by the use of a tool or key. See A10.1 for experimental HV enclosures.

B3.17 A HV enclosure contains exposed live HV conductors, with safe distance providing primary protection, these can only be entered by:

- the Authorised Person; or
- a Nominated Person acting on the instructions of and personally supervised by the Authorised Person; or
- the Person in Charge in receipt of a Sanction to Test, when the high voltage enclosure is created as part of the test procedure; or
- a Nominated Person acting on the instructions of and personally supervised by the Person in Charge in receipt of a Sanction to Test, when the high voltage enclosure is created as part of the test procedure; or
- an Accompanying Safety Person in connection with their safety role;

Operation of High Voltage Switchgear

B3.18 In an emergency high voltage switchgear in service may be switched off or tripped off by any person deemed competent who should immediately inform the Authorised Person.

B3.19 In normal circumstances high voltage switchgear is to be operated only by: -

- the Authorised Person;
- a Person in Charge who has been issued with a Standing Instruction giving authority for the operation;
- a Person in Charge who has been issued with a Specific Written Instruction giving authority for the operation;
- a Nominated Person acting on the instructions and personally supervised by the Authorised Person;
- the Person in Charge in receipt of a Sanction to Test, when the operation is part of the test procedure;
- a Nominated Person acting on the instructions of and personally supervised by the Person in Charge in receipt of a Sanction to Test, when the operation is part of the test procedure.

Testing at High Voltage

B3.20 Where high voltage tests are to be undertaken on high voltage equipment a Sanction to Test is to be issued to an Authorised Person or Nominated Person, on acceptance, they become the Person in Charge who is to be present throughout the duration of the tests.

B3.21 Should a testing device introduce high voltages to an area then the area should then be regarded as a high voltage enclosure for the duration of the testing.

B3.22 Unauthorised access to such areas is to be prevented by utilising barriers or tape and signage.

B3.23 High Voltage Potential Indicators and Proving Units should comply with Electricity Association Engineering Recommendation G9/6 – Voltage Testing Devices, or BS EN 61243/IEC 61243 as appropriate. Extension rods, end adapters, and other fittings should be available to suit the equipment on which work is to be undertaken.

B3.24 The Person in Charge and the Accompanying Safety Person are to be present throughout the duration of the tests. The Accompanying Safety Person is to have

duties, as described in B8 explained before the commencement of any testing.

B3.25 Unauthorised access to the testing area is to be prevented by suitable erected / positioned barriers and danger signs.

Voltage and Phasing Tests

B3.26 Voltage and phasing tests on high voltage equipment may be undertaken provided adequate precautions are taken to prevent accidental contact with, and prevent injury from, live high voltage conductors.

B3.27 Conformation of phasing shall be carried out after any jointing or termination works to confirm the phase sequence.

B3.28 Test equipment shall be tested, inspected and maintained in accordance with manufacturers recommendations or appropriate Standards.

B3.29 Test equipment for live voltage and phasing tests is to be tested immediately before and after use against a suitable test supply.

B3.30 Live voltage and phasing tests on high voltage equipment are to be undertaken only by the Authorised Person, with assistance, if necessary, from a Nominated Person acting on verbal instructions from the Authorised Person, with an Accompanying Safety Person in attendance.

B3.31 Neither a Permit to Work nor a Sanction to Test is appropriate for this activity.

B3.32 Where available it is acceptable to use Pfisterer phase comparators for phasing tests.

B3.33 When working on cables, tests to confirm the correct phase sequence shall be carried out before or immediately after cutting a cable, and after any works, to ensure the correct phase sequence is maintained.

- This shall include verification of the phase rotation (clockwise or anticlockwise). This can be carried out at HV phase comparators and LV connections.
- *'Colour-true' phasing (L1 to L1, L2 to L2, etc.)* shall be confirmed after a cable is exposed or opened. This should be checked between the cut end of the cable and the associated termination, test point, or cable end box. This may include the use of 'spider' resistance lead sets or an equivalent approved device.

Table HV1 For Working on High Voltage Equipment

Steps in Column 1 are to be undertaken in numerical order.
Columns 2 and 3 provide detail for the specified Equipment.

The Authorised Person is to be in possession of a current Authorised Person's letter of Appointment appropriate to the Equipment being worked on, and is responsible for Steps 1, 2, 3, 4, 5, 6 and 8, 9, 10, 11, 12.

The Person in Charge must be in possession of a current Nominated Person's letter of Appointment appropriate to the Equipment being worked on, and is responsible for Step 7.

COLUMN 1	COLUMN 2	COLUMN 3
EQUIPMENT	Cables	Equipment other than cables
STEP 1: PREPARE SAFETY PROGRAMME	COMPLY WITH ANY PARTICULAR SAFETY PROCEDURES APPLICABLE TO THE LOCATION. Prepare a Safety Programme, obtain an AP countersignature and gain approval from equipment owner before proceeding to Step 2.	
STEP 2: ISOLATE AND FIX SIGNS	ISOLATE FROM ALL SOURCES OF SUPPLY. Prevent unauthorised connection or unauthorised operation by fixing Safety Locks and Caution Notices at all points of isolation. Fix Electrical Equipment Warning Signs on adjacent live Equipment and/or cables at the places of the work.	
STEP 3: PROVE DEAD	ENSURE THAT THE EQUIPMENT TO BE WORKED ON IS THE EQUIPMENT THAT HAS BEEN ISOLATED. Prove dead, with a High Voltage potential indicator, at all accessible points of isolation and, except for cables, at the places of the work (and, where appropriate, confirm dead on the low voltage side of the transformer). (Exceptionally, in abnormal cases, it may not be practicable to prove the Equipment dead. In these circumstances the conductors are not to be earthed in Step 4 and are to be proved dead and earthed as described in Step 6).	
STEP 4: EARTH	Earth conductors at all the points of isolation and, where practicable, fix Safety Locks. Identify cables with certainty at the places of the work.	Earth conductors at all the points of isolation and, where practicable, fix Safety Locks. Where practicable, earth conductors at the places of the work.
STEP 5: ISSUE PERMIT TO WORK	The prospective Person in Charge is to be shown the electrical diagram on the Safety Programme and the safety arrangements at all the points of isolation and at the places of the work. The Person in Charge is to fit their own Safety Locks at all points of isolation or is to be issued with a Lock-out Box Key by the Authorised Person. After issuing the Permit the Mimic Diagram, if installed, must be adjusted to reflect the current status, the Electrical Distribution Operating Record is to be completed and the Safety Programme shall be filed in the Electrical Safety Documents Register.	
STEP 6: CONFIRM DEAD	Where it was not practicable in Step 3 to prove dead the Authorised Person is to remain with and supervise the Person in Charge until	

	conductors have been made accessible to a High Voltage potential indicator. The Authorised Person is then to confirm the Equipment dead at all accessible points and then earth the conductors at those points and, where practicable, fix Safety Locks. The Authorised Person is then to confirm the Equipment (except cables) dead at the places of the work before allowing the Person in Charge to assume control of the work.
STEP 7: UNDERTAKE WORK	The Person in Charge undertakes or directly supervises the work and, on completion, or when the work is stopped and made safe, returns the Permit to Work to the Authorised Person and completes and signs Part 3.
STEP 8: CHECK WORK	If the work has been completed, check that the work is satisfactory, that the Equipment has been restored to working order and that it may be safely energised. If the work was stopped in Step 7, check that the Equipment has been made safe.
STEP 9: CANCEL PERMIT TO WORK	Cancel the Permit to Work by placing the complete Permit to Work in the “Cancelled PTW File” and completing and signing Part 4. The Person in Charge removes their own Safety Locks or returns their Lock-out Box Key to the Authorised Person. Where a test is required before the Equipment is energised, Steps 10 & 11 shall be omitted, and the procedures of Table HV2 are to be followed. Where other Permits relate to the Equipment and have not been cancelled, Steps 10 & 11 shall be omitted.
STEP 10: REMOVE EARTHS	Remove the Safety Locks and Earths applied in Steps 4 & 6.
STEP 11: MAKE EQUIPMENT OPERATIONAL	Remove the Safety Locks and signs fixed in Step 2 and restore the Equipment to an operational state.
STEP 12: COMPLETE RECORDS	Adjust the Mimic Diagram if installed. Complete the Electrical Distribution Operating Record.

Table HV2 for Testing High Voltage Equipment

Steps in Column 1 are to be undertaken in numerical order. Columns 2 and 3 provide detail for the specified Equipment.

The Authorised Person is to be in possession of a current Authorised Person's letter of Appointment appropriate to the Equipment being tested, and is responsible for Steps 1,2,3,4,5,6 and 8,9,10,11,12.

The Person in Charge is to be in possession of a current Nominated Person's letter of Appointment appropriate to the Equipment being tested, and is responsible for Step 7.

COLUMN 1	COLUMN 2	COLUMN 3
EQUIPMENT	Cables.	Equipment other than cables.
STEP 1: PREPARE SAFETY PROGRAMME	COMPLY WITH ANY PARTICULAR SAFETY PROCEDURES APPLICABLE TO THE LOCATION. Prepare a Safety Programme, obtain an AP countersignature and gain approval from equipment owner before proceeding to Step 2.	
STEP 2: ISOLATE AND FIX SIGNS	ISOLATE FROM ALL SOURCES OF SUPPLY. Prevent unauthorised connection or unauthorised operation by fixing Safety Locks and Caution Notices at all points of isolation. Fix Electrical Equipment Warning Signs on adjacent live Equipment at the places of the test.	ISOLATE FROM ALL SOURCES OF SUPPLY. Prevent unauthorised connection or unauthorised operation by fixing Safety Locks and Caution Notices at all points of isolation. Fix Caution Notices on motor starting Equipment. Fix Electrical Equipment Warning Signs on adjacent live Equipment at the places of the test.
STEP 3: PROVE DEAD	ENSURE THAT THE EQUIPMENT TO BE TESTED IS THE EQUIPMENT THAT HAS BEEN ISOLATED. Prove dead, with a High Voltage potential indicator, at all accessible points of isolation and at the places of the test (and where appropriate, confirm dead on the low voltage side of the transformer). (Exceptionally, in abnormal cases, it may not be practicable to prove the Equipment dead. In these circumstances the conductors are not to be earthed in Step 4 and are to be proved dead and earthed as described in Step 6).	
STEP 4: EARTH	Earth conductors at all the points of isolation and, where practicable, fix Safety Locks to Temporary Earths and Earthing Locks to Removable Temporary Earths. Identify cables with certainty at the places of the test.	Earth conductors at all the points of isolation and, where practicable, fix Safety Locks to Temporary Earths and Earthing Locks to Removable Temporary Earths. Identify cables with certainty at the places of the test.
STEP 5: ISSUE SANCTION TO TEST	The prospective Person in Charge is to be shown the electrical diagram on the Safety Programme and the safety arrangements at all the points of isolation and at the places of the test. If a High Voltage Enclosure is to be set up, fix High Voltage Enclosure	

	Signs and barriers. The Person in Charge is to fit their own Safety Locks at all points of isolation or is to be issued with a Lock-out Box Key by the Authorised Person. After issuing the Sanction the Mimic Diagram, if installed, must be adjusted, the Electrical Distribution Operating Record is to be completed and the original of the Safety Programme substituted for the duplicate in the Electrical Safety Documents Register.
STEP 6: CONFIRM DEAD	Where it was not practicable in Step 3 to prove dead the Authorised Person is to remain with and supervise the Person in Charge until conductors have been made accessible to a High Voltage potential indicator. The Authorised Person is then to confirm the Equipment dead at all accessible points and then earth the conductors at those points and, where practicable, fix Safety Locks and Earthing Locks. The Authorised Person is then to confirm the Equipment (except cables) dead at the places of the test before allowing the Person in Charge to assume control of the test.
STEP 7: UNDERTAKE TEST	The Person in Charge undertakes or directly supervises the test, including the disconnection of any Removable Temporary Earths. On satisfactory completion of the test, or when the test is stopped and made safe, the conductors are to be discharged and any Removable Temporary Earths restored. The Person in Charge then returns the original Parts 1 & 2 of the Sanction to Test to the Authorised Person and completes and signs part 3.
STEP 8: CHECK TEST	If the test has been completed, check that the work is satisfactory, that the Equipment has been restored to working order and that it may be safely energised. If the test was stopped in Step 7, check that the Equipment has been made safe.
STEP 9: CANCEL SANCTION TO TEST	Cancel the Sanction to Test by destroying the original Parts 1 & 2 and completing and signing Part 4. The Person in Charge removes their own Safety Locks or returns their Lock-out Box Key to the Authorised Person. Where the test was stopped in Step 7 and work is required before the Equipment is re-tested Steps 10 & 11 shall be omitted, and the procedures of Table HV1 are to be followed.
STEP 10: REMOVE EARTHS	Remove the Safety Locks and Earths applied in Steps 4 & 6
STEP 11: MAKE EQUIPMENT OPERATIONAL	Remove the Safety Locks and signs fixed in Step 2 and restore the Equipment to an operational state.
STEP 12: COMPLETE RECORDS	Adjust the Mimic Diagram if installed. Complete the Electrical Distribution Operating Record.

B4 ENVIRONMENTAL HAZARDS

General

B4.1 Electrical equipment may be located where additional non-electrical environmental hazards may be present. All electrical equipment must be suitable for operation within the environment in which it is installed and operated. Examples of environmental hazards are dangerous substances (SF6 – HV dielectric insulator and Asbestos – Arc suppression / electrical insulators), explosive atmospheres, electromagnetic radiation, ionising radiation, strong magnetic fields, oxygen-depletion, laser light and confined spaces. All environmental hazards should be considered. The list provided is for reference and is not exhaustive.

B4.2 Where environmental hazards are present reference must be made to:

- Relevant Safety Legislation and Regulations;
- Relevant SHE codes;
- Local Operating Instructions;
- Local Rules; and
- Manufacturer's Instructions.

B4.3 Advice should be sought from SHE Group, local Department Safety Contacts, experimental facility operations managers, relevant Authorising Engineers.

B4.4 When working on or testing high or low voltage electrical equipment located within an area containing non-electrical environmental hazards or explosive atmospheres the Authorised Person and / or Nominated Person must comply with other SHE Codes or Local Rules and Appendix H – Hazardous Areas.

B5 DISPLAY OF SAFETY SIGNS AND POSTERS

General

B5.1 The design and colours of Warning signs and Caution Notices shall conform to with BS 5499/EN 7010. See examples of Temporary Warning Signs, Caution Notices, Display of Information and Permanent Safety Signs in Appendix F.

Display of Temporary Warning Signs and Caution Notices

B5.2 Authorised Persons and Nominated Persons shall ensure signs and notices are available when required. Caution Notices will bear the Authorised Persons or Nominated Persons name and the date of when the Notice was displayed.

B5.3 Caution Notices are to be fixed at the points of isolation and prominently displayed before the start and for the duration of work or testing, and before the issue and for the duration of any Permit to Work or Sanction to Test.

B5.4 High Voltage Enclosure Signs are to be prominently displayed so that they are visible from every angle of approach to a High Voltage Enclosure, before the issue and for the duration of a Sanction to Test.

B5.5 Warning Signs are to be prominently displayed, on any equipment which remains live and is adjacent to the Equipment to be worked on or tested, before the start and for the duration of work or testing and before the issue and for the duration of any Permit to Work or a Sanction to Test.

B5.6 Where work or testing is to be undertaken on any part of a multi-cubicle switchboard, Warning Signs shall be prominently displayed on the cubicles or compartments adjacent to the part being worked on or tested. If the board has rear access Electrical Equipment Warning Signs shall similarly be displayed at both the front and rear of the board. In identifying parts at the rear of the board, reliance is not to be placed upon the switchboard labelling.

B5.7 Before a Permit to Work or a Sanction to Test is issued the Authorised Person is required to have identified the equipment upon which the work or test is to be undertaken. If the work or test involves, or may involve, obtaining access to items of Equipment over which confusion could occur, the Authorised Person is to identify such items to the prospective Person in Charge and apply temporary marking to them.

B5.8 Temporary Safety Signs and Notices are to be suspended from non-conducting cords.

Display of Permanent Safety Signs

B5.9 Signage design should be approved by the Authorising Engineer.

B5.10 Permanent Safety Signs are to be securely and permanently fixed.

B5.11 Signs shall be manufactured from non-metallic weather resistant material.

B5.12 Non-corrosive materials are to be used when fixing Permanent Safety Signs.

B5.13 A Danger of Death Sign and a Notice identifying the installation are to be displayed in a prominent position outside every substation. A Notice identifying the installation is to include a contact number in case of emergency or access.

B5.14 A Main Intake Switch Sign is to be displayed on all Low Voltage main intake switches, except for domestic consumer units.

B5.15 A Multiple Supplies Sign is to be displayed on all Low Voltage switchboards and Equipment having two or more sources of supply.

B5.16 A Remotely/ Automatically Controlled Generating Set Sign is to be displayed on or adjacent to all remotely or automatically controlled generating sets.

B5.17 A Remotely/Automatically Controlled Machine Sign is to be displayed on or adjacent to all remotely or automatically controlled machines, except for small, sealed refrigerator motors, in-line circulating pumps and other such domestic items.

B5.18 A Danger High Voltage/First Aid for Electrical Shock Sign is to be displayed in all High Voltage switch rooms.

B5.19 A First Aid for Electric Shock Sign is to be displayed in all Low Voltage switch rooms and any other area deemed appropriate by the Authorising Engineer.

B5.20 A Danger Live Bus-Bars Sign is to be displayed on switchgear and equipment covers that when removed expose live un-insulated busbars.

B5.21 An Uninterruptible Power Supply (UPS) Safety sign is to be displayed on, or adjacent to all circuits and equipment connected to an uninterruptible power supply system.

Display of Information

B5.22 The Authorising Engineer is to determine the requirement and location for the display of information in connection with this SHE Code, and Health and Safety matters. Information is to be displayed permanently in a suitable and prominent position. The locations to be considered include all areas housing electrical distribution, plant rooms and workshops within the area of appointment.

B5.23 Information and posters to be displayed may include the following: (smart code where applicable)

- Danger of Death notice
- ‘The Electricity at Work Regulations’;
- ‘Emergency First-Aid’ (including treatment for electric shock);
- Any of the Tables from this SHE Code;

- Hazard Assessments;
- COSHH Assessments (where required);
- Drawings;
- Emergency Action Sign;
- Other relevant information pertaining to equipment housed in the area (i.e. Emergency Procedures for hand-winding lifts).

B6 ACCOMPANYING SAFETY PERSON

B15.1 An Accompanying Safety Person shall be in attendance of electrical work where the Authorised Person considers that it is necessary, and in the following specific circumstances:

- Where working or testing in accordance with Tables LV1, LV2, HV1 or HV2 is to be undertaken, whilst the equipment is being proved dead;
- Where working or testing in accordance with Tables LV1, LV2, HV1 or HV2 is to be undertaken, whilst the equipment is being earthed, other than by means of a switch or circuit breaker;
- Where working or testing in accordance with Table LV3 is to be undertaken on equipment for which the means of isolation is not positively identified, an Accompanying Safety Person is to be in attendance until the equipment has been isolated and proved dead;
- Where working or testing in accordance with Tables LV1, LV2, HV1 or HV2 is being undertaken on Equipment which cannot be proved dead until after the Permit to Work or Sanction to Test has been issued the Accompanying Safety Person is to be in attendance until the Equipment has been proved dead;
- Whilst work is being undertaken near live high voltage equipment in a high voltage enclosure;
- Whilst a high voltage potential indicator is in use;
- Whilst voltage and phasing tests are being undertaken at high voltage;
- Whilst tests are being undertaken using high voltage test equipment.
- Whilst inspection, fault finding or testing is being undertaken on live Low Voltage Equipment other than work covered by clause B11.3 to B11.5;
- Whilst work is being undertaken on live Low Voltage Equipment that does not have a level of protection of IP2X or better;
- Whilst the Authorised Person or a nominated Contractor appointed by the Authorised Person is spiking a cable;

B7 SWITCHGEAR AND SWITCHROOMS

B7.1 Where it is necessary to prevent danger or, where appropriate, injury, or prevent unauthorised operation, equipment cubicles and operating mechanisms are to be locked when the Equipment is unattended.

B7.2 Any entrance to dedicated HV or LV switch room and areas housing central battery system, energy storage system, permanently connected generating set, HV equipment or any other equipment specified by the AE, for example a permanently connected Uninterruptible Power Supply, is to be closed and securely locked when the equipment is unattended. These areas shall be controlled to stop unauthorised entry/ access.

B7.3 Electrical equipment when located in open access areas should be securely locked or suitably enclosed to prevent unauthorised access.

B7.4 Dedicated HV and LV switch rooms shall not be used for the storage of materials and equipment not associated with AP duties relevant to area.

B7.5 Access to Utility and private network HV substations may require training on the risks of substations or escorting by a suitably appointed, trained and competent person.

B8 SAFETY PROGRAMMES

General

B8.1 Prior to the issue of any Permit to Work or a Sanction to Test, a Safety Programme detailing the intended sequence of operations to be performed to make the Equipment safe for the execution of the work or test, is to be prepared.

B8.2 The Authorising Engineer can approve Safety Programme exemptions for Tables LV1 and LV2, provided that a suitable risk assessment has been completed and the details of the exemptions are included on the Authorised Person's letter of appointment.

B8.3 A Safety Programme form shall have an original and a duplicate of each page, and each sheet of a Programme shall bear the same pre-printed serial number. Sets of numbered forms shall be used in sequence.

B8.4 Computer based software (PCMD) can be used to generate STFC style templates, including an isolation and earthing diagram and sequence of switching operation (Switching Schedule).

Contents of Safety Programmes

B8.5 The Safety Programme is to be completed in duplicate by the Authorised Person who is responsible for issuing the Permit to Work or Sanction to Test, and is to indicate:

- The purpose of the proposed work or test;
- The equipment for which the proposed sequences of operations are intended to make safe to work on or test;
- The location of the equipment;
- Details of other safety procedures or documents that relate to the proposed work or test;
- Details of the work or test to be done;
- The date on which countersigned programme is required to commence.
- Special instructions or safety measures to be included on the Permit to Work or Sanction to Test;
- An electrical diagram of isolating and earthing arrangements; and
- The individual sequence of operations to be undertaken prior to issuing the Permit or Sanction including:
    - The location, including any name and identification code, at which each operation is to be performed;
    - The identity of each item of switchgear to be operated, including generic type, manufacturer's name and manufacturer's type or reference;
    - The operation to be performed;
    - The reason for the operation;
    - Any items required (for example keys, locks, Protective Equipment);
    - The requirement for an Accompanying Safety Person for a specific operation;
    - The name of the originating Authorised Person; and
    - The name of the countersigning Authorised Person.

B8.5 Page one of the original completed Safety Programme is to be signed by the Authorised Person and countersigned by another Authorised Person or Authorising Engineer who has knowledge of the system or installation. The countersigning Authorised Person need not be appointed for the particular equipment, installation or system.

B8.6 The originals of all subsequent Safety Programme and any additional pages should be initialled by the originating and countersigning Authorised Persons.

Implementing Safety Programmes

B8.7 Before commencing the sequence of operations detailed on the Safety Programme, the Authorised Person is to confirm that the person responsible for the area and / or equipment has given permission for the intended work or test.

B8.8 Before commencing the sequence of operations, the duplicate Safety Programme is to be retained by the Authorising Engineer.

B8.9 The Authorised Person is to note on the original Safety Programme the date and time of each operation.

B8.10 The Authorised Person is to use the electrical diagram to show the Person in Charge the safety arrangements at the points of isolation and at the places of the work or test.

Completion of Safety Programmes

B8.11 On completion of the Safety Programme, a summary of switching operation is to be entered in the Electrical Distribution Operating Record. The original Safety Programme shall be stored in a secure location for three years after the dates on which they were implemented and the duplicate destroyed.

B9 PERMIT TO WORK

General

B9.1 A Permit to Work must be obtained before any person is allowed to work on:

- bus-bars, switchgear, or isolators located in Low Voltage switch rooms;
- incoming Low Voltage switch frames and interconnecting cable networks;
- direct coupled feeder pillars
- any other high fault capacity equipment not necessarily part of the distribution network;
- street lighting circuits fed from utility supplier
- where the Authorised Person considers that it is necessary after performing a risk assessment; and
- all High Voltage equipment.

B9.2 A Permit to Work is to be issued by an Authorised Person to the Person in Charge before any work on defined items of Equipment is commenced. The items of Equipment requiring a Permit are defined in Tables LV1 and HV1, this excludes non-electrical work.

B9.3 The Permit to Work form shall have an original and duplicate page(s) and bear the same pre-printed serial number and sets of numbered forms organised to be used in sequence.

B9.4 Unless clause B9.5 applies, a Permit to Work is not to be issued for any item of equipment for which an existing Permit to Work, a Sanction to Test or a Sanction for Work on or near Live Electrical Equipment, remains valid, nor for equipment which is within an area for which an Authority for Access exists unless a Risk Assessment indicates that it is safe to do so.

B9.5 More than one Permit to Work may be issued for one item of equipment provided that:

- A Risk Assessment indicates that it is safe to do so;
- One Safety Programme is prepared which applies to all of the permits;
- All the Permits are prepared before any one is issued;
- All the permits are issued at or about the same time;
- All the Persons in Charge are told of the existence of the other Permits, which are to be listed in Part 1 of each Permit; and

- Multiple locking devices are used, the devices having sufficient capacity to accommodate the Safety Locks required for all the Permits.

B9.6 Permits to Work are to be offered to Nominated Persons who are in possession of a current letter of appointment appropriate to the equipment to be worked on.

B9.7 Permits to Work can be offered to non-electrical staff that are deemed competent to lead non-electrical work.

B9.8 Any Competent Person accepting a Permit To work becomes the Person in Charge.

B9.9 Authorised Persons personally undertaking tasks requiring a Permit to Work must not issue a Permit to themselves. The Authorising Engineer or another Authorised Person with adequate knowledge of the system or systems to be worked on must issue the Permit.

Issue and Acceptance of Permits to Work

B9.10 A Permit to Work is, where practicable, to be issued at the place where the work is to be undertaken. The issue and cancellation of every Permit is to be recorded, for example in the Electrical Distribution Operating Record, excludes non-electrical work.

B9.11 Before carrying out any isolation, permission for the intended work must be obtained from the person responsible for the area affected by the intended work.

B9.11 Prior to issuing the Permit to Work the Authorised or Nominated Person shall:

- Positively identify to the Person in Charge the equipment upon which the work is to be undertaken;
- Explain in detail to the Person in Charge the exact extent of the work to be undertaken;
- Draw the attention of the Person in Charge to any special instructions, environmental hazards and safety measures noted on the Permit;
- Show the Person in Charge the electrical diagram on the Safety Programme, and the safety arrangements at the points of isolation and the places of work, excludes non-electrical work;
- Unless the sub-clauses below apply, demonstrate to the satisfaction of the Person in Charge that the Equipment is dead and safe to work on;
- For Low Voltage Equipment where it is not practicable to prove equipment dead prior to issuing the Permit to Work, one of the following sub-clauses shall apply;
    - the Authorised Person is to instruct the Person in Charge, using appropriate tools, and Protective Equipment where necessary, to prove the equipment dead as soon as conductors have been made accessible to a suitable voltage test indicator excludes non-electrical work; **or**
    - the Authorised or Nominated Person is to remain with and supervise the Person in Charge until conductors have been made accessible to a suitable voltage test indicator. The Equipment is to be proved dead to the satisfaction of the Authorised or Nominated Person and the Person in Charge before the work can proceed.
- Where it is not practicable to prove High Voltage equipment dead prior to issuing the Permit, the Authorised Person having issued the Permit is to remain with and supervise the Person in Charge until the conductor have been made accessible to a High Voltage potential indicator. The Authorised Person is then to prove the equipment dead before allowing the Person in Charge to undertake the work described on the Permit.

B9.12 Where keys are issued for an area under the control of the Authorised Person, these keys shall be issued daily to the Person in Charge by the Authorised Person and must be returned to the Authorised Person at the end of each working day, or when work is suspended for the day.

Completion of Work and Cancellation of Permit to Work

B9.13 After the work is completed or stopped and all persons, instruments and tools are withdrawn from the place of work, the Person in Charge is to sign off the Clearance section of the Permit to Work and returned to the Authorised or Nominated Person. When work is stopped the Person in Charge shall also confirm that the equipment has been made safe and write the reasons for stopping the work.

B9.14 Where keys are issued to the Person in Charge for an area under the control of the Authorised Person, these keys must be returned to the Authorised Person on clearance of the Permit to Work.

B9.15 The Authorised or Nominated Person is to check that the work has been satisfactorily completed, and that the equipment is safe. The Authorised or Nominated Person is then to cancel the Permit to Work by destroying the originals and signing the Cancellation section of the Permit to Work. Single copies of all the pages of the cancelled Permit are to be retained for three years after their dates of cancellation.

B9.16 If the Authorised or Nominated Person decides, or advised by the person responsible for the Area, that it is necessary to stop the work, the Permit to Work is to be withdrawn and cancelled. The reasons for withdrawal and actions taken are to be noted in the Clearance section of the Permit and in the Electrical Distribution Operating Record.

B9.17 If the Person in Charge loses any part of the original Permit to Work the loss is to be recorded by the Authorised or Nominated Person and countersigned by the Person in charge. The loss is to be reported to the Authorising Engineer.

B10 SANCTION TO TEST

General

B10.1 A Sanction to Test is to be issued by the Authorised Person to a Person in Charge before the commencement of:

- any testing of Equipment at High Voltage before removal of main circuit earth, or
- spiking or intrusive identification of an HV cable, or
- any testing on Equipment defined by Tables LV2 or HV2 of this SHE Code.

B10.2 A Sanction to Test form shall have an original page and a duplicate page. Each page of a Sanction shall bear the same pre-printed serial number and sets of numbered forms shall be used in sequence.

B10.3 When not in use the Sanction to Test forms are to be kept in a secure location.

B10.4 A Sanction to Test is not to be issued for any item of Equipment for which an existing Sanction to Test, a Permit to Work, or a Permit for Work on or near Live Electrical Equipment, remains valid, nor for Equipment which is within an area for which an Authority for Access exists.

B10.5 Sanctions to Test are to be offered only to Authorised Persons or Nominated Persons who are in possession of a current letter of Appointment appropriate to the Equipment to be tested.

B10.6 On accepting a Sanction to Test, the Authorised or Nominated Person becomes the Person in Charge.

B10.7 Authorised Persons personally undertaking tasks requiring a Sanction to Test must not issue a Sanction to themselves. The Authorising Engineer or another Authorised Person with adequate knowledge of the system or systems to be tested must issue the Sanction.

Issue and Acceptance of Sanction to Test

B10.11 A Sanction to Test is, where practicable, to be issued at the place where the testing is to be undertaken. The issue and cancellation of a Sanction is to be recorded in the Electrical Distribution Operating Record.

B10.12 Before issuing a Sanction to Test, the Authorised Person is to: -

- Confirm that permission for the intended test has been obtained from the person responsible for the area affected by the intended test, and
- Positively identify to the Person in Charge the Equipment upon which testing is to be undertaken.

B10.13 Prior to offering a Sanction to Test to the Person in Charge the Authorised is to:

- Explain in detail to the Person in Charge the exact extent of the testing to be undertaken.
- Draw the attention of the Person in Charge to any special instructions or safety measures.
- Show the Person in Charge the Equipment on which the tests are to be done.
- Show the Person in Charge the electrical diagram on the Safety Programme, and the safety arrangements at the points of isolation and the places of test, and at other places affected by the test.
- Unless sub-clauses B10.13 apply, demonstrate to the satisfaction of the Person in Charge that the Equipment is dead and safe to test.
- For Low Voltage Equipment where it is not practicable to prove Equipment dead prior to issuing the Permit to Work, one of the following sub-clauses shall apply.
    - the Authorised Person is to instruct the Person in Charge, using appropriate tools, and Protective Equipment where necessary, to prove the Equipment dead as soon as conductors have been made accessible to a suitable voltage Test Indicator, or
    - the Authorised Person is to remain with and supervise the Person in Charge until conductors have been made accessible to a suitable voltage Test Indicator. The Equipment is to be proved dead to the satisfaction of the Authorised Person and the Person in Charge before the tests can proceed.
- Exceptionally, for High Voltage Equipment, where it is not practicable to prove Equipment dead prior to issuing the Sanction the Authorised Person having issued the Sanction is to remain with and supervise the Person in Charge until conductors have been made accessible to a High Voltage potential indicator. The Authorised Person is then to prove the Equipment dead before allowing the Person in Charge to undertake the tests described on the Sanction.

B10.14 Prior to accepting the Sanction to Test, the Person in Charge, having understood the tests to be carried out, and being prepared to undertake them, is to sign any special instructions or safety measures. The Authorised Person is to retain the duplicate pages and temporarily keep them with the Electrical Distribution Operating Record.

B10.15 After signing to accept the Sanction to Test the Authorised or Nominated Person becomes the Person in Charge and is responsible for personally supervising or undertaking the defined tests. Wherever practicable the Person in Charge is to display the Sanction to Test close to the point of test. The Person in Charge is not to leave the place where the testing is being carried out, or to undertake any other work or tests while the defined tests are in progress. During any temporary absence of the Person in Charge from the place where the testing is being carried out, the tests are to be suspended, and adequate safety precautions taken until testing is resumed on the return of the Person in Charge.

B10.16 Where keys are issued for an area under the control of the Authorised Person, these keys shall be issued daily to the Person in Charge by the Authorised Person and

must be returned to the Authorised Person at the end of each working day, or when work is suspended for the day.

Completion of Tests and Cancellation of Sanction to Test

B10.17 After the testing is completed or stopped and all persons, instruments and tools are withdrawn from the place where testing was undertaken, the Person in Charge is to complete and sign off the clearance section of the Sanction to Test and return the original to the Authorised Person.

B10.18 Where keys are issued to the Person in Charge for an area under the control of the Authorised Person, these keys must be returned to the Authorised Person on clearance of the Sanction to Test.

B10.19 The Authorised Person is to check that the tests have been satisfactorily completed, and that the equipment is safe. The Authorised Person is then to cancel the Sanction to Test by destroying the originals and signing off the cancellation section of the Sanction. Hard copies of all the pages of the cancelled Sanction are to be retained for three years after their date of cancellation.

B10.20 If the Authorised Person decides or is advised by the person responsible for the Area, that it is necessary to stop the testing, the Sanction to Test is to be withdrawn and cancelled. The reasons for withdrawal and actions taken are to be noted in the clearance section of the Permit and in the Electrical Distribution Operating Record.

B10.21 If the Person in Charge has lost the original copy of the Sanction to Test, the loss is to be recorded by the Authorised Person in the cancellation section, and in the Electrical Distribution Operating Record. The Person in Charge is to countersign the cancellation section to confirm the loss of the original Sanction. The loss is to be reported to the Authorising Engineer.

B11 WORK ON OR NEAR LIVE ELECTRICAL EQUIPMENT

B11.1 No person shall be engaged in any high or low voltage work activity within the vicinity zone, (other than one suitably covered with insulating material so as to prevent danger) unless:

- it is unreasonable in all the circumstances for the conductors to be dead, **and** it is reasonable in all circumstances for the person to be at work on or near the conductor while it is live, **and** suitable precautions (including where necessary the provision of suitable Protective Equipment) are taken to prevent injury; **or**
- the work is in accordance with clause B11.3 to B11.5.

B11.2 Wording in B11.1 also applies to excavation and work around a live cable or utility service, where cable construction (shielding) and insulation method needs to be considered.

B11.3 Minimum acceptable distances must be implemented. (See Definitions: Live working and vicinity zones)

B11.4 The Authorised Engineer is to ensure that the Person in Charge has;

- specified the safety precautions necessary to prevent injury to persons and damage to equipment; **and** monitored their implementation; **and** retained copies of the Sanction (if applicable), method statement and risk assessments.

B11.5 Local Rules specific to the activity or a Sanction for Work on or near Live Electrical Equipment is not required if equipment is operating at Extra Low Voltage and a Risk Assessment indicates that live working presents no dangers.

B11.6 Inspection, fault finding and testing of equipment on systems up to 500V ac rms or DC nominal, may be undertaken, without a Sanction for Work on or near live electrical equipment provided that:

- It is unreasonable in all circumstances for the conductors to be dead; **and**

- it is reasonable in all circumstances for the person to be at work on or near the conductor while it is live; **and**
- all live parts are adequately protected to prevent direct contact (IP2X); **and**
- suitable precautions (including where necessary the provision of suitable Protective Equipment and Personal Protective Equipment) are taken to prevent injury, **and**
- test equipment and all tools in use shall be suitable, for the use for which they are provided and, maintained in a condition suitable for that use and, properly used; **and**
- adequate precautions are taken to prevent damage to equipment and accidental contact with dangerous live conductors; **and**
- supported by a specific risk assessment for live working and/or a self-check for live working dynamic assessment.

B11.7 Inspection, fault finding, testing and commissioning, having a terminal voltage not exceeding 500V may be undertaken without a Sanction for Work on or near Live Electrical Equipment. Provided that:

- they are sectionalised in such a way that disconnection and separation is secure; **and**
- each section of batteries has a terminal voltage not exceeding extra low voltage; and
- A separation distance of more than 300mm or a protection rationing of IP2X or IPxxB is achieved; and
- supported by a specific risk assessment for the live working.

Sanction to Work on or Near Live Electrical Equipment

General

B11.8 A Sanction for Work on or near Live Electrical Equipment is issued by an Authorised Person and authorised by an Authorising Engineer before the commencement of any work on or near live electrical Equipment. Unless such Equipment is operating at Extra Low Voltage and the Hazards have been assessed and appropriate control measures implemented, or the conditions of clauses B11.3 and B11.5 are applicable.

B11.9 Sanctions for Work on or near Live Electrical Equipment are to be offered only to an Authorised Person or a Nominated Person appointed for the system or installation to be worked on.

B11.10 A Sanction for Work on or near Live Electrical Equipment shall have an original and duplicate page(s) and bear the same pre-printed serial number and sets of numbered forms organised to be used in sequence.

B11.11 Only one set of Sanction for Work on or near Live Electrical Equipment forms are to be in use at any one time for a given Authorised Engineer's Area of responsibility.

B11.12 When not in use Sanction for Work on or near Live Electrical Equipment forms are to be kept by the Authorising Engineer.

B11.13 A Sanction for Work on or near Live Electrical Equipment is not to be issued for any item of Equipment for which an existing Sanction for Work on or near Live Electrical Equipment, a Sanction to Test, or a Permit to Work, remains valid, nor for Equipment that is within an area for which an Authority for Access exists.

B11.14 On accepting a Sanction for Work on or near Live Electrical Equipment, the Authorised Person or Nominated Person becomes the Person in Charge.

Issue and Acceptance of Sanction for Work on or near Live Electrical Equipment

B11.15 A Sanction for Work on or near Live Electrical Equipment shall be signed by the Authorising Engineer or their nominated representative and states that it is unreasonable for the Equipment to be dead, that it is reasonable for the Person in Charge to Work on or near Live Equipment, that suitable precautions have been specified to prevent injury and gives permission for the specified work to proceed.

B11.16 A Sanction for Work on or near Live Electrical Equipment is to be issued, where practicable, at the place where the work is to be undertaken. The issue and cancellation of a Sanction for Work on or near Live Electrical Equipment is to be recorded in the Electrical Distribution Operating Record. (if relevant to system being worked on).

B11.17 Prior to offering a Sanction for Work on or near Live Electrical Equipment to the Person in Charge, the Authorised Person is to: -

- Positively and physically identify to the Person in Charge the Equipment on which the work is to be undertaken.
- Explain to the Person in Charge the safety precautions to be taken.
- Instruct the Person in Charge to inspect all Protective Equipment before use.

B11.18 To accept the Sanction for Work on or near Live Electrical Equipment the Person in Charge and Accompanying Safety Person must sign the 'receipt' section of the original and duplicate pages of the Sanction. These signatures render the Sanction valid for the defined work, the Person in Charge shall retain the original pages and the Authorised Person shall retain the duplicate pages.

B11.19 After accepting the Sanction for Work on or near Live Electrical Equipment the Person in Charge is responsible for personally undertaking the defined work. The Person in Charge is, therefore, not to leave the place where the work is being carried out, or to undertake any other work or tests while the defined work is in progress. During any temporary absence of the Person in Charge from the place where the work is being carried out, the work is to be suspended, and adequate safety precautions taken until work is resumed on the return of the Person in Charge.

B11.20 The Accompanying Safety Person is not to leave the place where the work is being carried out. During any temporary absence of the Accompanying Safety Person from the place where the work is being carried out, the work is to be suspended, and adequate safety precautions taken until work is resumed on the return of the Accompanying Safety Person.

Completion of Work and Cancellation of Sanction for Work on or near Live Electrical Equipment

B11.21 Having completed the work and having withdrawn all person, instruments and tools from the place of work, the Person in Charge is to sign the Clearance section of the Sanction, which was retained by the Authorised Person and is to return the original pages to the Authorised Person.

B11.22 Where keys are issued to the Person in Charge for an area under the control of the Authorised Person, these keys must be returned to the Authorised Person on signing the Clearance section of the Sanction.

B11.23 The Authorised Person is to check that the work has been satisfactorily completed and that the Equipment is safe. The Authorised Person shall then cancel the Sanction by destroying the original pages and signing the Cancellation section of the Sanction. A copy of each page of the cancelled Sanction is to be retained in a secure location for three years after their date of cancellation.

B11.24 If the Authorised Person decides that it is necessary to stop the work, the Sanction for Work on or near Live Electrical Equipment is to be withdrawn and cancelled. The reasons for the withdrawal and the action taken are to be noted in the Cancellation section and in the Electrical Distribution Operating Record.

B11.25 If the Person in Charge has lost the original pages of the Sanction, the loss is to be recorded by the Authorised Person in the Cancellation section and in the Electrical Distribution Operating Record. The Person in Charge is to countersign the cancellation to confirm the loss of the original Sanction. The loss is to be reported to the Authorising Engineer.

B12 STANDING INSTRUCTIONS AND SPECIFIC WRITTEN INSTRUCTIONS

Standing Instruction

B12.1 An Authorised Person may issue a Standing Instruction for:
- B12.1.1 Defined tasks on a Low Voltage system or installation;
- B12.1.2 Inspections, fault finding and testing of Equipment on systems up to 500V ac rms or DC nominal. The issuing of such a Standing Instruction is limited to areas where it has been decided that these activities may be undertaken without Permit to Work on or near Live Electrical Equipment in accordance with Clauses B11.3 to 11.5;
- B12.1.3 Defined switching operations in respect of specific items of High Voltage Equipment and Low Voltage distribution Equipment.

B12.2 A Standing Instruction form shall have original and duplicate pages. Each page of a Standing Instruction shall bear the same pre-printed serial number and sets of numbered forms shall be used in sequence.

B12.3 The original and the duplicate Standing Instruction are to be signed by the Authorised Person appointed for the system or installation to which the Instruction applies.

B12.4 A Standing Instruction is to be offered only to a Nominated Person or an Authorised Person who has knowledge of the system or installation.

B12.5 A Standing Instruction for defined tasks as described in Sub-clause B12.1.2 is to include a signed approval from the Authorising Engineer that states it is unreasonable for the Equipment to be dead, that it is reasonable for the Person in Charge to work on or near live Equipment, that suitable precautions have been specified to prevent injury and gives permission for the specified tasks to proceed.

B12.6 The Authorised or Nominated Person is to acknowledge receipt by completing and signing the Standing Instruction; the signature renders the Instruction valid for the defined work and tests. The original of the Instruction is issued to the Authorised or Nominated Person who thereafter becomes the Person in Charge.

B12.7 The issue of a Standing Instruction is to be recorded in the Electrical Distribution Operating Record.

B12.8 The duplicate of the signed Standing Instruction is to be retained from the date of issue until termination.

B12.9 An Authorised Person may, at any time, cancel a Standing Instruction by retrieving the original from the Person in Charge and destroying it. The duplicate of the Standing Instruction is to be overwritten with the word, “CANCELLED” or “EXPIRED”, as appropriate, followed by the date of termination. The duplicate is to be countersigned by each of the Authorised Persons and retained for three years after its date of termination. The Authorising Engineer is to be notified of the cancellation.

B12.10 The cancellation or expiry of a Standing Instruction is to be noted in the Electrical Distribution Operating Record.

B12.11 A Standing Instruction is to be renewed at intervals not exceeding one year and whenever a new Authorised Person is appointed.

Specific Written Instructions

B12.12 The Authorised Person may issue a Specific Written Instruction for a defined switching operation or a sequence of operations in respect of items of High and Low Voltage Equipment.

B12.13 A Specific Written Instruction form shall have the original and duplicate pages. Each page of a Specific Written Instruction shall bear the same pre-printed serial number and sets of numbered forms shall be used in sequence.

B12.14 A Specific Written Instruction is to be offered only to a Nominated Person or an Authorised Person who has knowledge of the system or installation.

B12.15 The Person in Charge is to accept the Specific Written Instruction by signing the original and duplicate; the signature renders the Instruction valid for the defined operations. The original of the Instruction is issued to the Person in Charge.

B12.16 The duplicate of the signed Specific Written Instruction is to be retained by the Authorised Person until the operations are completed and the original returned.

B12.17 The issue of a Specific Written Instruction is to be recorded in the Electrical Distribution Operating Record.

B12.18 On completion of the switching operation the Person in Charge is to return the original Instruction to the Authorised Person without any intentional delay. Details of the switching operations carried out are to be entered in the Electrical Distribution Operating Record. The original is to be retained for three years from the date of issue; the duplicate shall then be destroyed.

B13 AUTHORITY FOR ACCESS

General

B13.1 The Authorised Person may issue an Authority for Access to a person of any discipline or specialism. The Authority is issued when any work activities, not requiring a Permit to Work, Sanction to Test, a Sanction for Work on or near Live Electrical Equipment, or not covered by a Standing Instruction or Specific Written Instruction are to be undertaken in an area or location which is normally under the control of the Authorised Person.

B13.2 An Authority for Access form shall have an original and duplicate page(s) and bear the same pre-printed serial number and sets of numbered forms organised to be used in sequence.

B13.3 Provided that a documented Risk Assessment indicates that it is safe, an Authority for Access may be issued for work activities to be undertaken in an area or location containing an item of Equipment for which a Permit to Work remains valid.

B13.4 An Authority for Access is not to be issued for an area for which a Sanction to Test or a Sanction for Work on or near Live Electrical Equipment remains valid, or where a High Voltage Enclosure has been set up.

B13.5 Whilst the Authority for Access is in force, the Authorised Person is to inspect the area at the end of each working period or day to ensure that: -

- any flammable or hazardous materials introduced into the area during the work activities are removed when the activities cease at the end of each working period or day;
- access to essential electrical equipment is not obstructed;
- the area is secure.

Issue and Acceptance of Authority for Access

B13.6 An Authority for Access is to be offered to a person of any discipline or specialism who is competent to personally execute or supervise the work activities. On accepting the Authority, the person becomes the Person in Charge.

B13.7 Authorities for Access are to be issued, where practicable, at the place where the work activities are to be undertaken. The issue and cancellation of every Authority is to be recorded in the Electrical Distribution Operating Record.

B13.8 Prior to offering an Authority for Access to the Person in Charge, the Authorised Person is to: -

- confirm with the Person in Charge in detail the exact extent of the work activities to be undertaken, including the scope and limits;
- show the Person in Charge the area in which the work activities are to be done;
- draw the attention of the Person in Charge to any special instructions and safety measures, and indicate the safety measures applied by the Authorised Person;
- Identify to the Person in Charge all items of Electrical Equipment in or adjacent to the work activity area.

B13.14 To accept the Authority for Access the Person in Charge is to sign the receipt section of the original and duplicate pages of the Authority. The signature renders the Authority valid for the defined work activities, and the original pages of the Authority are issued to the Person in Charge. The Authorised Person is to retain the duplicate pages in a secure location.

B13.15 The acceptance of an Authority for Access makes the Person in Charge responsible for personally supervising or undertaking the defined work activities. If the Person in Charge needs to leave the place where the work activities are being carried out, or the work needs to be suspended for a short period of time (not through other works being carried out in the area), the Person in Charge is to ensure the area is left in a safe and tidy condition, and that access to the area is secured.

B13.16 Keys shall be issued daily to the Person in Charge by the Authorised Person and must be returned at the end of each working day, or when work is suspended for the day.

Completion of Work and Cancellation of Authority for Access

B13.17 Having completed the work activities and having withdrawn all persons, surplus materials, instruments and tools from the working place, the Person in Charge is to sign the clearance section of the Authority that was retained by the Authorised Person and is to return the original pages to the Authorised Person.

B13.18 All keys issued to the Person in Charge for the area under the control of the Authorised Person must be returned to the Authorised Person on signing the clearance.

B13.19 The Authorised Person is to check that the location has been left in a clean and tidy condition and to secure it against unauthorised access. The Authorised Person is then to cancel the Authority for Access by destroying the original pages and signing the cancellation section. A copy of each page of the cancelled Authority is to be retained in a secure location for three years after their dates of cancellation.

B13.20 If the Authorised Person decides that it is necessary to stop the work activities, the Authority is to be withdrawn and cancelled. The reasons for the withdrawal and the actions taken are to be noted in the cancellation section and in the Electrical Distribution Operating Record.

B13.21 If the Person in Charge has lost the original pages of the Authority for Access, the loss is to be recorded by the Authorised Person in the cancellation section, and in the Electrical Distribution Operating Record. The Person in Charge is to countersign the cancellation to confirm the loss of the original Authority. The loss is to be reported to the Authorising Engineer.

B14 CERTIFICATE OF TRANSFER OF CONTROL

General

B14.1 Where, under a project or minor works, the responsibility for an area or piece of apparatus is to be transferred to a Contractor, a uniquely numbered Certificate of Transfer of Control shall be issued. The Transfer of Control shall pass responsibilities for safety and for the issuing of required documentation to the Contractor for the specified area or equipment.

B14.2 Prior to the issue of a Certificate of Transfer of Control the Authorised Person is to ensure that all persons working on the system under the Certificate can demonstrate their competence on the system to be worked on.

B14.3 Where switching is required under the Certificate, or the issuing of Permits, Sanctions, Instructions, Authorities, or other Certificates, the Contractor's Authorised Person must present a copy of their Authorised Person's Certificate from a validated training institution to the STFC Authorised Person (Electrical. This certificate must clearly demonstrate training up to, or exceeding the voltage to be worked on, that has been completed within the last 3 years. The Certificate shall be presented a minimum of 14 days prior to the Transfer of Control.

B14.4 Where a Certificate of Transfer of Control is in place for more than 30 days, the Authorised Person who raised the certificate, or their appointed deputy, shall carry out a monthly audit of all documents issued and assess the progression of work and the safety procedures in place.

B14.5 Where the Authorised Person finds deficiencies in the working practices of the Contractor, the Authorised Person shall, depending on the nature or seriousness of non-compliance:

- Request any changes to working practice that the Authorised Person feels appropriate, **or**
- Issue a letter of Improvement to the contractor giving the contractor a limited period to meet these requirements, also informing the Project Manager of this action, **or**
- Issues a letter of Improvement to the contractor for immediate action, also informing the Project Manager and the Authorising Engineer of this action, **or**
- Ensures all work on the electrical system giving rise to concern is suspended until the issue is resolved, informing the Project Manager and Authorising Engineer of this action.

B14.6 The Contractor issued with the Certificate of Transfer of Control must not transfer control and / or responsibility to a sub-contractor without the approval of STFC Authorised Person.

Implementing a Certificate of Transfer of Control

B14.7 A Certificate of Transfer of Control is, where practicable, to be issued at the place covered by the Certificate. The issue and cancellation of every Certificate is to be recorded in the Electrical Distribution Operating Record

B14.8 Before issuing a Certificate of Transfer of Control the Authorised Person is to: -

- agree with the Project Manager, where applicable, the content of the Certificate, including the Conditions of Issue,
- confirm that permission for the intended work has been obtained from the person(s) responsible for the day-to-day operations of any area(s) affected by the intended work;
- positively identify with the Contractor's representative the area or equipment covered by the certificate, and thereby defining the limits of the certificate;

- ensure no permits, sanctions, instructions, authorities, or other certificates are open for the areas covered by this Certificate.

B14.9 The Authorised Person shall keep the Duplicate (STFC) copy of the certificate and issue the Original (Contractor's) copy to the Contractor's representative, ensuring that the Contractor's representative is fully aware of their duties. The Original (STFC) copy is to be retained until time of cancellation.

Cancellation of a Certificate of Transfer of Control

B14.10 Having completed the work, control shall be returned to STFC by cancellation of the certificate. Before signing acceptance of the return of control, the STFC Authorised Person shall:

- ensure the area or equipment covered by the Certificate has been left in a safe and orderly condition;
- any permits or sanctions raised by the Contractor's representative have been closed;
- all keys issued under the certificate have been returned.

B14.11 Once the Certificate has been cancelled by both parties, the Contractor's representative retains their copy (as proof that he is no longer responsible for the area or Equipment) and the Duplicate (STFC) copy is retained by the STFC Authorised Person and kept for three years after the date of cancellation.

B14.12 If the Contractor's representative has lost their copy of the Certificate, this loss is to be recorded by the STFC Authorised Person at the bottom of the Duplicate (STFC) copy and in the Electrical Distribution Operating Record. The Contractor's representative is to countersign the comment on the Duplicate (STFC) copy of the Certificate.

B15 CERTIFICATE OF ISOLATION & EARTHING

General

B15.1 A Certificate of Isolation and Earthing is a formal statement of an isolation across a boundary of control, to be completed by an Authorised Person responsible for the supply side of a demarcation line on an electrical distribution system. The Certificate is issued to enable work to be undertaken on an electrical system that is controlled by another Authorised Person, or Supply Authority having satisfied themselves that the system under their control is safe. The Certificate of Isolation and Earthing should normally be issued by the controlling authority, unless otherwise requested.

B15.2 A Certificate of Isolation and Earthing shall be used where:

- the Authorised Person requires the supply authority (DNO/DSO) to isolate and, where required, earth the supply to a main intake of a substation. The Certificate of Isolation and Earthing is to be issued by the supply authority.
- When requested by the supply authority to isolate and, where required, earth their supply to the main intake of an STFC substation.
- the Authorised Person is requested to isolate and, where required, earth an electrical supply to another department or consumer across a boundary of ownership.
- the Authorised Person is requested to isolate and, where required, earth an electrical supply to an area where a Certificate of Transfer of Control is being issued to a Contractor.
- a Risk Assessment deems it necessary to isolate and, where required, earth electrical equipment to facilitate work in the vicinity of electrical services.

- where proving / confirming dead is not practical, and a transfer of control has not being issued.

Implementation of Certificate of Isolation and Earthing

Where a Safety Programme is to be prepared prior to the issue of the Certificate of Isolation and Earthing the Safety Programme number is to be entered onto the Certificate.

B15.3 A Certificate of Isolation and Earthing is to be issued to the Authorised Person responsible for undertaking the Work on the other side of a line of demarcation, detailing the isolation and earthing operations undertaken by the issuing Authorised Person.

B15.4 The recipient of the Certificate of Isolation and Earthing is to acknowledge receipt of the Certificate by signing the original and duplicate copy. The signature renders the Certificate valid for the period of the Work. The original of the Certificate is issued to the receiving Authorised Person, who thereafter takes responsibility for carrying out the work.

B15.5 The issue or receipt of a Certificate of Isolation and Earthing and details of the Safety Programme associated with the issue of a Certificate of Isolation and Earthing are to be recorded in the Electrical Distribution Operating Record.

B15.6 The duplicate copy of the signed Certificate of Isolation and Earthing is to be retained by the issuing Authorised Person until the work is completed and the original copy returned.

B15.7 Where testing is required on a supply covered by a Certificate of Isolation and Earthing, on a system which has an Earth applied, the Certificate of Isolation and Earthing shall be cancelled prior to the issuing of a Sanction to Test. A new Certificate of Isolation and Earthing shall be raised, if required, after the cancellation of the Sanction.

Completion of Certificate of Isolation and Earthing

B15.8 On completion of the Work requiring the Certificate of Isolation and Earthing, or to allow a Sanction to Test to be raised, the recipient shall:

- confirm the cancellation of all associated Permits or Sanctions;
- confirm the removal of all persons under the control of the recipient including associated tools and equipment;
- return the original copy of the Certificate to the issuing Authorised Person and sign the clearance section on the duplicate copy, and the original where required.

B15.9 The Authorised Person is to sign the cancellation section of the Certificate of Isolation and Earthing (both copies where required) and then restore the network as necessary, or as defined in the Safety Programme.

B15.10 Following cancellation, the completed certificate shall be retained for three years after the date of cancellation.

B15.11 If the recipient has lost the original Certificate, the loss is to be recorded by the Authorised Person in the Electrical Distribution Operating Record. The recipient is to sign the clearance section of the duplicate, and the Authorised Person is to sign the cancellation section and write on the Duplicate that the ‘Original was lost’. The loss is to be reported to the Authorising Engineer.

B16 CONNECTION AND DISCONNECTION NOTICES

Connection Notice

B16.1 A Connection Notice is required for all utilities connections, installation of transformer tails, major LV supplies and for new installations to be connected to distribution equipment.

B16.2 Application for a connection shall be made to Estates Services in good time to allow for assessment of the wider impact of the new supply in conjunction with the design team(s).

B16.3 Where there is a requirement the project manager shall make a formal request for review, approval and issue of the Notice using the appropriate Helpdesk.

B16.4 The Notice shall state clearly and without ambiguity what supply or supplies are to be energised.

B16.5 A Connection Notice shall have up to 4 copies: an original copy to be retained by the issuing authority and a duplicate copy retained by the Electrical Contractor, a Principal Contractor (where different) and the STFC Project Manager. Each copy shall bear the same pre-printed serial number. Sets of numbered forms shall be used in sequence.

B16.6 The issuing of a Connection Notice shall be carried out before the supply has been energised.

B16.7 The Authorised Person shall also confirm with the Authorising Engineer that the new system can be connected to the existing site system.

B16.8 Implementation of the Connection Notice should be conducted through the following process:

- The Authorising Engineer or Authorised Person shall sign the declaration section and provide details of the supply or supplies that are to be energised, along with the date and time the operation takes place.
- The acknowledgement section of the original copy shall be completed by representatives of the Electrical Contractor, the Principal Contractor (where different), and the STFC Project Manager. In so doing the representatives agree to inform all other members of staff, contractors, or sub-contractors under their control who might be affected by the operation(s) detailed in the declaration section.
- The declaration section of the copies must only be completed by a representative of the Contractor or Group associated with that copy.
- The issue of a Connection Notice is to be recorded in the Electrical Distribution Operating Record.

B16.9 Following the issue of a Connection Notice the completed original copy shall be retained in a secure location and kept for three years after the date of issue.

Disconnection Notice

B16.10 Where there is a requirement for proof of electrical disconnection, a Disconnection Notice may be issued.

B16.11 The notice shall state clearly and without ambiguity the disconnection(s) carried out.

B16.12 A Disconnection Notice shall have an original copy and a duplicate copy and shall bear the same pre-printed serial number on each sheet. Sets of numbered forms shall be used in sequence.

B16.13 The issuing of a Disconnection Notice shall be implemented through the following process:

- The declaration section shall be completed by an Authorised Person, or a Nominated Person appointed by the Authorised Person for the work, and, where necessary, in possession of a Permit to Work. The Authorised Person or Nominated Person shall ensure the circuit, system, or apparatus is fully disconnected from all sources of supply;

- The approval section of the notice shall be completed by an Authorised Person only when the declaration section has been completed by a Nominated Person and shall confirm that the disconnection has been checked.

B16.14 The duplicate copy of the Disconnection Notice shall either be:

- Issued to the person in charge of the work for which the disconnection is required;
- Posted on the apparatus that has been disconnected.

B16.15 Following the issue of a Disconnection Notice the completed STFC Copy shall be retained in a secure location and kept for three years after the date of issue.

B16.16 If the circuit, system or apparatus being disconnected is to be removed from the electrical distribution network the mimic diagram must be modified to display the current configuration.

B17 OPERATING RECORDS

Electrical Distribution Operating Record

B17.1 An Electrical Distribution Operating Record shall be kept for all HV and main LV distribution board or switch room and for any distribution system specified by the Authorising Engineer. It shall record the name of the location and installation to which the records relate and shall be kept in locations agreed by the Authorising Engineer and accessible to all Authorised Persons.

B17.2 Depending on site arrangements, individual operating records can be maintained for distinctly separate networks on the same site including low voltage and high voltage elements.

B17.3 The records will be divided into columns with the following headings: -

No.	DATE	TIME	LOCATION & IDENTITY OF SWITCH OR EQUIPMENT	EVENT OR OPERATION & REASON	SIGNATURE OF AP

B17.4 Entries are to be made in chronological order and shall record: -

- each individual operation of High Voltage switchgear, unless covered collectively by a single entry of a Switching Programme serial number.
- each operation of Low Voltage distribution switchgear down to and including main intake switches, unless covered collectively by a single entry of a Switching Programme serial number;
- adjustment of the Mimic Panel (if provided) to indicate the present state of the system or installation;
- the relinquishing and acceptance of responsibility between Authorised Person;
- the issue and cancellation of a Permit to Work, a Sanction to Test, Sanction for Work on or near Live Electrical Equipment or an Authority for Access;
- the withdrawal of a Permit to Work, a Sanction to Test, Sanction for Work on or near Live Electrical Equipment or an Authority for Access, the reason and the action taken;
- the loss of a Permit, a Sanction, a Standing Instruction, a Specific Written Instruction, Connection / Disconnection Notice, Certificate of Isolation & Earthing, Transfer of Control or an Authority for Access;
- the issuing of a connection notice;

- the receipt and termination of an Operational Restriction;
- any inspection and remedial action associated with an Operational Restriction;
- operation of Tap Changers.
- Spiking of a HV or LV cables
- Other operations of note as required by the AE or duty AP

B17.5 Electrical Distribution Operating Record are to be retained in a secure location for a period of three years after the date of the last entry.

Switchgear Maintenance and Operating Instructions

B17.6 One or more ring binder files entitled “Switchgear Maintenance and Operating Instructions” are to be prepared. The files are to be clearly and indelibly marked with the location and installation to which the records relate and are to be kept in a location approved by the Authorising Engineer.

B17.7 The ring binder files are to contain:

- Manufacturers’ maintenance and operating instructions for each type of High and Low Voltage distribution switchgear included in the system or installation with test certificates and records;
- Copies of any Operational Restrictions endorsed with their current status, which are applicable to any Equipment included in the system or installation;
- Information on where maintenance records are to be found.

Electrical Distribution Record of Information

B17.8 A file entitled “Electrical Distribution Record of Information” shall be kept in a location approved by the Authorising Engineer, which is clearly and indelibly marked with the location and installation to which the records relate.

B17.9 The file is to contain the following information applicable to the site: -

- A site location plan;
- Electrical distribution single line diagram;
- A location plan and layout drawings of the High Voltage Distribution System, of each substation, of Low Voltage distribution Equipment (up to an including main intake switches), and Low Voltage switchboards as appropriate;
- Detail of the Regional Electricity Company supplies;
- Detail of on-site electricity generation;
- A schedule of the High Voltage Switchgear, Distribution Transformers and Low Voltage Switchgear;
- Details, line diagrams and layout drawings of Uninterruptible Power Supply (UPS) Equipment (other than rack mounted UPS’s).
- A cable schedule, including as installed cable route plans and drawings;
- Details of Electrical Protection, including over current protection grading charts and voltage referenced grading charts (as applicable);
- Information on where system and circuit load monitoring records can be found.

B18 SAFETY LOCKS, EQUIPMENT SAFETY LOCKS AND LOCK-OUT BOXES

B18.1 A Safety Lock is a padlock having only one key, which is different from all other keys in use on the same electrical distribution system. Safety Locks shall be indelibly coloured in red or marked in red, and each Safety Lock and its key must be clearly identified. Safety Locks are to be used only in accordance with this SHE Code.

B18.2 Two procedures for Safety Lock systems are permissible B18.2.1 System A and B18.2.2 System B on their own, or as a mixed system, provided the locks are clearly identified.

B18.2.1 System A provides all persons with personal locks as follows:

- each Authorised and Nominated Person will be issued with Safety Locks, Safety Signs and Notices for work or testing in accordance with LV and HV Tables or for defined tasks described on a Standing Instruction. Such Signs and Locks are to be identifiable to the Authorised or Nominated Person;
- The keys to Safety Locks when in use are to be controlled by their assigned Authorised or Nominated Person and kept in a secure location; Where applicable, the lock number shall be printed on the Permit or Sanction;
- safety Locks are to be engraved to identify the Nominated Person or Authorised Person to whom they have been issued, and each safety lock and its key are to be numbered for ease of identification.

B18.2.2 System B provides for a store of locks issued as follows:

- The Duty Authorised Person will collect Safety Locks and Safety Key Boxes appropriate for the isolation being carried out from the lock store / control room before carrying out isolation and issuing electrical or local permit;
- Safety Locks will only be drawn from stock by the Duty Authorised Person, when all safety documentation including Risk Assessments have been checked and approved;
- Safety Locks and keys are to be engraved with individual identification. Where applicable, the lock number shall be printed on the Permit or Sanction;
- Each Duty Authorised Person shall also collect the required Safety Signs and Notices, including barriers and screens where applicable for the work or testing in accordance with LV and HV Tables and the Safety Signs shall contain appropriate contact details;
- When a Permit or Sanction is cancelled all Safety locks, Safety Signs and Notices must be returned to the lock store / control room.
- Additional safety locks can be held in locations specified by AE, such as main LV and HV switch rooms, and used by Authorised Person in accordance with LV and HV Tables. The Caution Notices applied shall identify the Authorised Person performing isolation.
- Where the point of work has multiple work activities operating under relevant safety documents, the isolation will be controlled by Safety Locks applied for each PiCOW. These are only to be released on completion of the issued safety document(s).

B18.3 When a Permit to Work or a Sanction to Test is to be issued, all points of isolation must be secured in the off position and where applicable earthed using a minimum of two locks or a safety key-box. One lock being an Authorised Person's Safety Lock and the other the Person in Charge's Safety Lock. They are to be arranged so that all locks must be released before the system can be made operational. When the Permit is issued the Authorised Person and Person in Charge must retain their own Safety Lock keys.

B18.4 The two Safety Locks or safety lockout box shall only be unlocked when the permit or sanction is cancelled.

B18.5 An Authorised Person can transfer control of isolation to another Authorised Person by signing and dating the Permit or Sanction and updating the EDOR.

B18.6 During an Emergency or loss of Safety Lock key the removal of the Safety lock can only be approved by the Authorising Engineer or their nominated representative. Removal of the lock must be recorded in the appropriate operating record.

B19 KEYS, KEY CABINETS, MIMIC DIAGRAMS AND PADLOCKS TO SECURE REMOVABLE TEMPORARY EARTHS

Keys for Switchgear and Buildings

B19.1 The administration and use of suited lock systems in connection with this SHE Code is to be approved by the Authorising Engineer. The Authorised Person must retain control of all keys to suited lock systems installed in connection with this SHE Code and the Authorising Engineer is to audit these control procedures.

B19.2 Keys issued to an Authorising Engineer, Authorised Person, or Nominated Person on a permanent basis, shall not be loaned or transferred to other persons.

B19.3 If an Authorised Person's or Nominated Person's letter expires and is not renewed, or is withdrawn, the Authorising Engineer is to ensure that any keys issued to that person are returned.

B19.4 Where keys to suited locks are issued to persons, other than those covered by Clause B19.2, the specific use and purpose intended for the keys is to be detailed on a Standing Instruction, a Specific Written Instruction, Permit, Sanction, or an Authority for Access issued to that person.

B19.5 Key plates may be used, and may bear the identification of the substation, building or item of Equipment to which the keys belong, or the purpose for which each key is intended.

Key Cabinets

B19.6 Key Cabinets are to be installed in appropriate locations within switch rooms and contain local working keys or additional Safety Locks.

Padlocks to Secure Removable Temporary Earths (Earthing Locks)

B19.7 Padlocks (Earthing Locks) used to secure Removable Temporary Earths are to have only one key which is different from all other keys used on the electrical distribution system. Earthing Locks shall be indelibly coloured in green or marked in green, and each Earthing Lock and its key must be clearly identified. Earthing Locks are to be used only in accordance with this SHE Code.

B19.8 The keys for locks used by the Authorised Person to secure Removable Temporary Earths are to be issued by the Authorised Person to the Person in Charge, who is to retain control of them for the duration of the test.

B19.9 Earthing Locks and their keys may be held in local Operation Key Cabinets within Substations but are not specific to one piece of Equipment.

Mimic Diagram

B19.12 A Mimic Diagram is to be provided for all High Voltage distribution systems and Low Voltage distribution systems which include a ring circuit, an automatically started generating set, or a fixed uninterruptible power supply >100kVA.

B19.13 A Mimic Diagram is to show, as a minimum, the HV electricity distribution system and Equipment that is under the control of the Authorised Person, from all sources of supply up to and including Low Voltage Interconnectors.

B19.14 Substations and major Low Voltage intakes are to be appropriately labelled on the Mimic Diagram.

B19.15 The Mimic Diagram must be permanently displayed and accessible to all Authorised Persons. The status of the electricity distribution system and Equipment is to always be visible, but the Mimic Diagram is to be lockable to prevent unauthorised adjustment.

B19.16 An electronic Mimic Diagram is acceptable as long as it conforms to clauses B19.12 to B19.14, but consideration should be given to how the diagram might be accessed during a total supply failure. A line diagram of the associated distribution system shall be displayed in all the main LV and HV switch rooms. A hard copy of the Mimic diagram showing the status of the associated distribution system must be clearly displayed when work or test is undertaken.

B20 USE AND PROVISION OF PROTECTIVE, TEST, EARTHING, AND LIFTING EQUIPMENT

Use, Storage, Inspection and Documentation

B20.1 Protective Equipment, Test Equipment and earthing Equipment is to be maintained and stored in accordance with the manufacturers or supplier's instructions, and it is to be inspected by the user on each occasion before use and is to be properly used.

B20.2 The location of Protective Equipment, Test Equipment and portable earthing Equipment is to be prominently displayed adjacent to the Working Key Cabinet.

B20.3 Where Protective Equipment, Test Equipment, and portable earthing Equipment is kept on site for use in connection with this SHE Code, details and copies of the equipment specification, operation, maintenance and where appropriate, calibration, are to be kept in a location approved by the Authorising Engineer.

B20.4 Unless more frequent intervals are specified by the manufacturer or supplier an Authorised Person is to inspect each item of Protective Equipment and portable earthing Equipment, kept on the site, at least once a year and in accordance with the manufacturer's or supplier's instructions, to ensure that it is suitable for the use for which it is provided and it is maintained in a condition suitable for that use. Where protective equipment, test equipment and portable earthing equipment is found to be defective or faulty it is to be taken out of use and suitable precautions implemented to prevent further use. The inspecting Authorised Person is to instigate the appropriate remedial or replacement action where necessary. These inspections are to be recorded in the Electrical Distribution Operating Record, as well as in any other maintenance and inspection record system.

B20.5 Where practicable, lifting equipment shall be kept with the switchgear for which it is associated.

B20.6 Reports for each inspection of lifting equipment are to be kept in the Switchgear Maintenance and Operating Instructions ring binder.

B20.7 The Authorising Engineer is to review the records every twelve months to determine that the maintenance and inspection is being carried out for protective equipment, lifting equipment, test equipment and portable earthing equipment kept on site.

Protective Equipment

B20.8 Appropriate protective equipment is to be provided and is to always be readily available to those who need it in connection with this SHE Code. Protective equipment is to be used whenever necessary to prevent danger or, where appropriate, injury and as required by this SHE Code.

B20.9 Protective equipment, in normal circumstance is to be provided by the person responsible for the work activities. Protective equipment provided by the Person in Charge may be used if the Authorised Person agrees, and such use is to be recorded.

B20.10 Protective equipment is to be inspected by the Person in Charge for visible defects on each occasion prior to use to ensure that it is suitable for the use for which it is provided, and that it has been maintained in a condition suitable for that use, when properly used. Any suspect item is to be reported to the Authorised Person who is to consider its withdrawal and replacement.

Test Equipment

B20.11 The Authorised Person is to arrange for the necessary test equipment to be available when required in connection with this SHE Code.

B20.12 Test equipment is to be, where appropriate, calibrated in accordance with the manufacturer or supplier's instructions.

B20.13 Test equipment is to be inspected by the user for visible defects on each occasion prior to use to ensure that it is suitable for the use for which it is provided, and that it has been maintained in a condition suitable for that use, when properly used. Any suspect item is to be reported to the Authorised Person who is to consider its withdrawal and replacement.

Earthing Equipment

B20.14 Before conductors are earthed a check is to be made to confirm that the earthing Equipment to be used is of sufficient strength and current-carrying capability to discharge electrical energy to earth without danger or, where appropriate, risk of injury.

B20.15 The appropriate manufacturers or supplier's proprietary earthing Equipment is to be used where it is available; where none is available, purpose made earthing Equipment may be used with the Authorising Engineer's approval.

B20.16 Portable earthing Equipment is to be inspected by the user before each use to confirm that it is suitable for use for which it is provided, and that it has been maintained in a condition suitable for that use, when properly used. Any suspect item is to be reported to the Authorised Person who is to consider its withdrawal and replacement.

Lifting Equipment

B20.17 Registered and inspected lifting equipment associated with the switchgear shall be always used. Where none is available, other means may be used with the Authorising Engineer's approval, see SHE code 26 Safe use of lifting equipment.

B21 TEMPORARY SUPPLIES, INTERLOCKS, & EMERGENCY SHUTDOWN CONTROLS

Temporary Supplies

B21.1 The use of general-purpose extension leads shall only be used for very limited periods, less than 3 months. Their lay-out shall be such as to eliminate any trip hazards.

B21.2 "Hard wired temporary supplies" using protected or armoured cable should be considered for most temporary installations and follow manufactures guidelines. Temporary Supplies shall be registered, installed, and subjected to monthly inspection and testing.

B21.3 A temporary supply is an installation in service for less than 3 months. If longer required, then AE approval required.

B21.4 An electrical cable that has been installed for a particular purpose and will be removed when no longer required for that purpose.

B21.5 The designer of the temporary system should consider whether the system should conform to BS7671 and BS7909 as applicable.

B21.6 Before any Temporary Supply is put into service a full electrical test as required under a BS7671/BS7909 installation certificate shall be carried out and the certificate forwarded to the Authorised Person.

B21.7 All Temporary Supplies shall be inspected every month. This will involve the following work to be carried out:

- A visual inspection of the cable throughout its route, ensuring all labels are in place. Any changes, not previously identified, to the route, fixings, or condition of the cable shall be recorded and a full electrical test and inspection shall be carried out as described in BS7671/BS7909 for periodic testing;
- An earth-loop impedance test shall be carried out;
- Inspection and test results shall be forwarded to the defined Authorised Person who is to place the documents in the Temporary Supplies Document Folder.

B21.8 If a Temporary Supply has not been inspected or tested for a period greater than 60 days (due to non-compliance of the user to agree an inspection to be carried out as described in Clause B21.4 or where changes have occurred, the Authorised Person should isolate the supply and lock it off until a full test has been carried out on the installation.

B21.9 A Temporary Supply shall have a life span not exceeding 1 year.

B21.10 Inspection and test results for a temporary supply are to be kept for 3 months following its removal.

Interlocks

B21.11 Interlock Key-Codes are used throughout STFC sites and ensure that no duplicates exist.

B21.12 Where Interlocks are used on Distribution Networks, override Maintenance Keys may be available to change the supply configuration without an interruption of supply. Maintenance Keys shall be:

- kept in a Key Cabinet remote from the Equipment they control;
- issued only by the Authorising Engineer as a requirement under a Safety Programme;
- used only by the Authorising Engineer or an Authorised Person; and
- returned to the Key Cabinet as soon as the work is completed. It is the responsibility of the Authorising Engineer to ensure the Maintenance Key is returned.

B21.13 Where Interlocks are used on Experimental Equipment reference shall also be made to appendix A5.

Emergency Shutdown Facilities

B21.14 Where there is an increased danger that an electrical incident or fire may occur, such as in experimental areas and laboratories, the inclusion of emergency shutdown buttons or break-glass units to interrupt all electrical supplies should be considered.

B21.15 Emergency shutdown control points shall be situated in prominent positions and shall be clearly labelled to indicate what they control. Circuit reference numbers shall also be included.

B21.16 All personnel working in these areas shall be shown where these control points are located and instructed in their operation.

B21.17 The design and positioning of such control points shall include consideration to avoid accidental tripping.

B21.18 Consideration should also be given in the design to the way tripped circuits are reset. Whilst for most applications an automatic reset occurs when the button is released or the glass replaced, other applications may require a more controlled method of reset.

B21.19 Shutdown circuits shall be fully tested annually. For main High Voltage and Low Voltage distribution panels only, however, local procedures, agreed with the Authorising Engineer, may be used to prevent a full trip of the breakers.

B22 IDENTIFICATION OF SERVICES AND SPIKING CABLES

B22.1 Prior to undertaking electrical work where hidden services may be present, for example gas, electric and water, undertake a site survey, see SHE Code SC19 Work on buildings, services, premises and infrastructure.

B22.2 Before the conductors of a cable are cut or exposed, the origin, the point of the work and the destination of the cable to be worked on are to be identified with certainty.

B22.3 The identification may be regarded as clear and certain if the cable is visible throughout its length.

B22.4 Identifying a cable by passing an electrical signal along it is not by itself a reliable means of identification, since cables running alongside are inductively coupled and may give a false identification.

B22.5 Cables without an earth bonded metallic sheath or armouring are not to be spiked.

B22.6 In the absence of clear and certain identification, the cable is to be spiked at the point of the work and thereafter identified by an appropriate procedure. Before spiking it may be necessary to undertake tests, which are to be repeated after spiking, and the results compared.

B22.7 Cable spiking equipment is available in two forms of operation; hydraulically or by explosive cartridge. The spiking of cables is to be undertaken only by:

- An STFC Authorised Person trained in the use of cable spiking equipment;
- An Authorised Person employed directly or indirectly by a Contractor, trained in the use of cable spiking equipment, and approved by an STFC Authorised Person.
- A contractor trained in the use of cable spiking equipment, who has demonstrated sufficient competency, and who is in possession of Specific Written Instruction issued by an STFC Authorised Person.

B22.8 Cable locating devices should, as a minimum, be rugged and weatherproof to NEMA 3S, comply with EMC standards, and be produced by BS EN ISO 90001:2008 accredited manufacturers.

B22.9 Cable spiking shall be carried out under a sanction to test when points of isolation (and earthing where available) have been applied.

B22.10 Where points of isolation cannot be clearly identified, safety will be controlled after consultation with AE and on completion of a risk assessment.

B22.11 Cable spiking must be noted in the Electrical Distribution Operation Record.

B22.12 An AE approved course on spiking a cable is required and includes the operation of cable identification equipment, and cable avoidance tools. These should be recorded in the APs individual training record and may be requested during an audit.

B23 OPERATIONAL RESTRICTIONS

This is a written instruction or notice, issued by the Authorising Engineer, a supply authority, Energy Network Association, NHS central alerting system, a manufacturer, or a supplier of Electrical Equipment, modifying or prohibiting the normal operating procedures associated with a particular type of Equipment.

The receipt of this instruction or notice shall be recorded in the systems operating record by the Authorised Person or shall be posted at each piece of equipment covered by this instruction.

ENA monthly reports are to be filed in the Electrical Safety Group SharePoint site.

General

B23.1 Any Authorising Engineer receiving or discovering an Operational Restriction without any indication of it having been advised through STFC is to forward a copy, as soon as is practicable, to all other Authorising Engineers within STFC.

B23.2 Any Authorised Person receiving or discovering an Operational Restriction is to advise the Authorising Engineer as soon as is practicable.

B23.3 On receipt of an Operational Restriction, the Authorising Engineer shall:

- Investigate whether or not the Equipment is included in their appointed systems or installations;
- Retained a copy of Operational Restriction in a secure location;
- Shall communicate this instruction or notice to the Co-ordinating Authorised Person.

B23.4 Where the Operational Restriction relates to equipment that forms part of the appointed systems or installations, the Authorising Engineer or Authorised Person shall ensure:

- An Operational Restriction notice is securely fixed to the Equipment warning of the Restriction and ensure all other Authorised Persons are informed of the Notice;
- The withdrawal or revision (if applicable) of any Standing Instructions permitting operation of the Equipment, any revisions must incorporate the Operational Restrictions;
- The Operational Restriction is noted in the Electrical Distribution Operation Record;
- Arrangement of any necessary inspections and remedial work or replacements;

B23.5 The completion of inspections and remedial work arising from the Operational Restriction is to be noted in the Electrical Distribution Operation Record and reported to the Authorising Engineer.

B23.6 The Authorised Person is to ensure that copies of the inspection reports and details of any remedial work undertaken are:

- Retained in a location approved by the Authorising Engineer;
- Forwarded to the Authorising Engineer.

B23.7 The Authorising Engineer is to notify all Authorised Persons (Electrical) of the termination of an Operational Restriction. The termination of an Operational Restriction shall also be noted in the Electrical Distribution Operating Record.

B23.8 On termination:

- The copy of the Operational Restriction held by the Authorising Engineer (Electrical) is to be overwritten with the word “CANCELLED” followed by the date of the cancellation. It should be retained for a period of three years after the date of cancellation;
- The copy in the Switchgear Maintenance and Operating Instructions file is to be overwritten with the word “CANCELLED” followed by the date of cancellation, and retained in the file;
- Any Standing Instructions which incorporate the conditions of the Operational Restriction are to be withdrawn and replaced by new Standing Instructions.

B24 CONSTRUCTION (DESIGN AND MANAGEMENT) REGULATIONS (2007)

B24.1 For further information regarding the application of CDM to electrical works, see STFC Safety Code SC13 and Safety Code SC19 Work on building, premises, services and infrastructure.

B25 ADDITIONS, ALTERATIONS AND THE ACCEPTANCE OF NEW WORKS

B25.1 To ensure the safety and integrity of STFC electrical equipment and infrastructure, the Authorising Engineer and the Coordinating Authorised Person must be consulted before the procurement of any major electrical equipment or while undertaking

significant alterations to electrical equipment / infrastructure (which could adversely affect the existing installation).

B25.2 All work must be approved by the Authorising Engineer and in accordance with:
- Current Legislation and associated Standards: and
- the current edition of the Estates Mechanical, Electrical and Public Health Design standard

B25.3 The Authorising Engineer must be satisfied that any alterations or installation of equipment do not compromise the electrical system.

B25.4 Contractors and internal electrical departments shall nominate a competent supervisor to have direct responsibility, on a day-to-day basis, for the safety, quality and technical standard of the electrotechnical work undertaken.

B25.5 For new works, alterations or additions on main LV or HV Electrical Distribution Systems, the Authorising Engineer, electrical designers and Authorised Persons must be consulted and satisfied that:
- there is adequate space and suitable access to enable maintenance and operation to be safely undertaken;
- the installation is of an acceptable standard, meeting the requirements of the relevant STFC design standards. Deviations shall be formally agreed in a statement of derogation;
- the Equipment is suitable for its intended purpose;
- compatible design philosophies have been applied to the entire electrical installation for the new works;
- the new works do not compromise the integrity of the existing electrical installation; and
- there is a Health and Safety File holding sufficient information to enable operation and maintenance to be undertaken safely.

B25.6 The Authorising Engineer can accept an installation that does not satisfy Clause B25.5 subject to issuing of an Operational Restriction.

B25.7 The STFC Authorising Engineer is to nominate and appoint an Authorised Person(s) for the new systems or installation. The Authorising Engineer is to ensure appropriate familiarisation and on-site training in accordance with Appendix C is given to the appointed Authorised Person(s).

B25.8 Only a contractor or STFC staff that has been checked, verified, and recorded as a competent person by the sponsoring departments Authorised Person(s) can undertake electrical work on STFC sites. Contractors must have suitable insurance, and all work or test must have a risk assessment, approved by the sponsoring departments Authorised Person. Contractor competency and certification must be annually updated and audited.

B25.9 Before an installation is connected to the system for the first time:
- An approved application for connection (RAL*) - (Connection Notice)*
- STFC must be satisfied that the installation complies with the Electricity at Work Regulations, the Electricity Safety, Quality and Continuity Regulations, and any other appropriate statutory and mandatory regulations;
- all required design, installation, commissioning, and test certificates must be handed over to STFC prior to commissioning being completed;
- fuse ratings or protection settings must be checked for strength and capability, including arc flash incident energy, to ensure both discrepancy and protection levels are acceptable;

- all necessary signage and labelling must be fitted;
- all keys associated with the new works must be handed over to STFC.

B25.10 Before initial energising system, the Authorised Person may request to witness all dead tests to services connected to that point of isolation.

B25.11 All installations will have full certification to BS7671, BS7909, and Machinery Directive as appropriate.

B25.12 Before a formal handover is deemed complete, the Contractor will ensure the area has been left in an acceptable condition with all waste removed and any ground works made good.

APPENDIX C.1 – TRAINING REQUIREMENTS

Role	Initial Training	Refresher	Frequency	Comments
Authorising Engineers (Electrical) – *incl. HV, LV and Hazardous Areas*	**Authorising Engineer Course** Course should address the following topics: • Introduction to electrical safe systems of work; • Structure of roles and responsibilities of persons in these systems; • Practical and procedural aspects of safe working practices; • Nomination, evaluation, appointment and auditing of Authorised Persons; Candidate interviews; and • Training requirements for new and in post Authorised Persons; • Termination procedures for Authorised Persons. • Specific additional elements depending on hazard And include practical experience applying safe working procedures on a range of typical High Voltage and Low Voltage Equipment arranged to provide simulated circuits. Trainees should be assessed in both written and practical exercises, so that on completion of the course, the training organisation can make an independent assessment of their suitability and technical competence.		5 years	To be eligible for appointment, a prospective Authorising Engineer shall: • be a Chartered Engineer, in an appropriate electrical engineering discipline or as a minimum IEng, • have extensive relevant experience in the type of installations and safe systems of work for which they are to become responsible. • a working knowledge of the Electricity at Work Regulations; • have completed an approved Authorised Person training course and received a satisfactory marking in the last three years or within six months of a first-time appointment; • be familiar with the different types of Equipment, installations and systems in use within the STFC site(s) under their control; • have a basic knowledge of the systems employed on the site(s) for which they become responsible, and become familiar with the more complex systems; • be able to demonstrate their competence and suitability for the role by demonstrating a good understanding of the tasks involved and knowledge of the safe systems of work; • be an employee of STFC and passed STFC Technical managers training;

				• have an adequate knowledge of and, within the last 3 years, have received electrical First-Aid training.
Courses Available:	Wherever possible attend a City and Guilds accredited / assured course delivered by providers who are familiar with the practices detailed in this Electrical Safety Codes.			
Authorised Person (incl. Co-ordinating Authorised Person) – *incl. HV, LV and Hazardous Areas*	**Authorised Persons Courses** The type of training will depend upon what equipment the candidate has responsibility for and for what systems appointment is intended. See Appendix C.2. Authorised Person should be able to demonstrate for the systems, installations and equipment for which they are responsible: • a good working knowledge of the operation of this SHE Code, the role and duties of Authorised Person and any other relevant regulations. • a good working knowledge of the layout of the electrical distribution system. • a good working knowledge of the operation under normal, failure and fault conditions, of all the principal components of the systems and installations for which authorisation is being sought, such as switchgear, distribution Equipment and standby generating sets; • practical experience, under the direct supervision of an experienced Authorised Person, of the operation of the Electrical Equipment forming part of the system or installation; • knowledge of the location of, how to obtain access to and the use of all the appropriate Protective Equipment, Voltage detectors including appropriate Test Supplies (proving units), where applicable High Voltage Potential Indicators including appropriate Test Supplies (proving units), Earthing Equipment and Safety Signs;		5 years	To be eligible for appointment, a prospective Authorised Person shall: • have relevant experience and have or actively working towards EngTech and passed STFC Technical managers training; • have an adequate knowledge of this SHE Code and Electrical Regulations, which are applicable to the systems and installations for which the appointment is sought; • be technically competent and qualified to be able to safely operate, and make safe to work on or test the systems, installations and Equipment for which appointment is sought; • be experienced in the selection and appointment of suitably qualified and experienced Nominated Persons and Accompanying Safety Persons; • be familiar with the systems, installations and Equipment for which appointment is sought, including where applicable work on or near live low voltage Electrical Equipment; • within the last 5 years have successfully completed an appropriate approved Authorised Persons training course; • have an adequate knowledge of and, within the last 3 years, have received electrical First-Aid training.

	• a good understanding of all the necessary safety measures to be taken to prevent danger or, where appropriate, injury, and to prevent damage to Equipment; • knowledge of electricity supply authorities and contractors, having operation, repair or maintenance contracts. • Specific additional elements depending on hazard **On-Site Training** Consists of putting into practice, under the supervision of an experienced Authorised Person, the knowledge gained during the familiarisation period and on training courses. During this period the prospective Authorised Person is to keep a record of each event attended, detailing the actions taken both personally and by the Authorised Person. This record is to be reviewed with the Authorising Engineer.			
Courses Available:	Commercially available City and Guilds accredited / assured HV and LV training. delivering a course based on this electrical safety code. STFC Technical managers training course – SHE arranged.			
Nominated Persons	Due to the wide scope of potential electrical activity across STFC sites it is not possible to define specific training courses as a pre-requisite for a Nominated Person. For example: • Fire Alarm • Air Conditioning • Access control • Cable jointers • *Hazardous Areas (COMPEX)* The type of training will depend upon what equipment the candidate has responsibility for and for what systems the appointment is intended. The training must be STFC approved and be based on this SHE code.		5 years	To be eligible for appointment, a prospective Nominated Person shall: • be able to demonstrate competence to undertake the work activities required; • be familiar with the types of installation and Equipment that they are required to work on or test; • possess the necessary technical knowledge, skill and experience relevant to the nature of the work activities to be undertaken, to prevent danger or, where appropriate, injury; • If electrical qualified have successfully undertaken technical training administered by the Joint Industry Boards, the Electricity Supply Industry training Scheme, or some equivalent form of approved training and have attended an STFC

	Where nominated persons are entering/working within DSEAR/ATEX controlled areas, individuals will need to have appropriate training in accordance with BSEN60079-14. **On-Site Training** Consists of putting into practice, under the supervision of an experienced Authorised or Nominated Person, the knowledge gained during the familiarisation period and on training courses. During this period the prospective Nominated Person is to keep a record of each event attended, detailing the actions taken both personally and by the Authorised or Nominated Person. This record is to be reviewed with the Authorised Person. **Site based contractors** To appoint STFC site based term contractors as a Nominated Person they must: • hold a suitable qualification e.g. Electro-Technical Assessment Specification (EAS) • attend a formal briefing* with the appropriate AP or AE to cover the contents of this SHE Code • Satisfy the NP training requirements * Formal briefing based on this SHE Code to be developed by AEs to cover all STFC UK sites			approved training course (based on this STFC SHE Code). • If non-electrical qualified have attended an STFC approved training course as identified by an AE e.g. Mechanical to electrical conversion course. • Where the NP is not HV trained and require access they shall attend an STFC substation access course as determined by AE. • have demonstrated an adequate knowledge of the relevant parts of this SHE Code, those Associated Regulations and Documents which are applicable to the installations and Equipment on which work or tests are to be undertaken; • have an adequate knowledge of, and within the preceding three years have received training in, Electrical First-Aid. • As required, access to substations may require substation access training or supervision from a trained individual • Those carrying temporary works under BS7909 covered under IET EAS work category A1.3 will require appropriate qualifications and experience.
Qualified Supervisor/ those carrying out electrical testing on fixed wire systems	IET Electrotechnical Assessment Specification including the following: Current qualification to BS7671 and BS 2391 Plus, training as identified by the Authorising Engineer		BS7671 - Within 2 years of a version change	In addition to any requirements for a nominated person: - Technical knowledge , occupational training, and practical skills. - Industry approved apprenticeship or similar, or accredited qualifications for experiences workers.

				- to be registered with an Electrotechnical Certification Scheme (ECS/JIB Gold Card, SparkSafe or equivalent approved scheme). Or competency is verified and approved by Authorising Engineer. - Evidence of previous experience in a similar environment.
Courses Available:	STFC Electrical Nominated Persons course provided in-house – through responsible Electrical Authorising Engineer or Authorised Person, including bespoke local elements. Additional training can be arranged with commercially available accredited providers, such Competent Person LV training, as requested by AP or AE.			
Authorising Engineer, **Authorised Person ,** **Nominated Persons,** **Accompanying Safety Persons,**	Electrical First Aid training (1/2 day) Course syllabus: • The types of injuries that arise from working with electricity: electrocution/electric shock; arc flash; burns; inhalation etc.; • The effects on the body arising from: o Electrocution/electric shock; o Arc flash; o Electric burns; and o Secondary injuries arising from the above. • Emergency procedures to be followed in the case of injuries arising from working with electricity: o Calling for assistance – security and first aiders – site specific procedures; o Your personal safety and others attending the incident; and o Assessing and managing casualty(s) until first aider and others arrive. • Treatment of injuries arising from working with electricity: o Assessing and managing a conscious casualty – electrical burns/bleeding; arc flash; inhalation; and	Ditto	3 years	

	○ Assessing and managing an unconscious casualty - basic life support (Cardiovascular Pulmonary Resuscitation [CPR]) for a non-breathing casualty.			
Courses Available:	Delivered by a SHE approved and accredited supplier.			

APPENDIX D - AUDITING

This appendix addresses the audit of electrical safety as defined in this SHE code - Operational Audit of electrical safety undertaken by Authorised Engineers, and the independent Compliance Audit of this SHE code as defined in STFC SHE Code 30: SHE auditing and Inspection.

Operational Audit of Electrical Safety

The Authorising Engineer shall ensure an audit programme of electrical safety systems and procedures defined in this SHE Code is undertaken. The frequency of such audits should not exceed 3 years. Audit findings and recommendations shall be sent to the Authorising Engineer's appointing Director for consideration.

Listed below are systems and procedures to be included, as a minimum, in this audit programme.

Desk Audit:

- Safety Programmes;
- Permits to Work;
- Sanctions to Test;
- Permits to Work on or near Live Equipment;
- Authorities for Access;
- Electrical Distribution Operating Record;
- Electrical distribution equipment maintenance records;
- Electrical Safety Documents Register;
- Certificates of Transfer of Control;
- Certificates of Operation, Isolation, & Earthing;
- Connection Notices;
- Disconnection Notices;
- Standing Instructions;
- Specific Written Instructions;
- Operating Records;
- Operational Restrictions;
- Electricity Distribution system and installation record drawings;
- Electrical SHE Incidents;
- Emergency First-Aid Training;
- Fire Training and Precautions;
- Risk Management and Risk Assessment;
- Appointment and Training of Authorised Person ;
- Appointment and Training of Nominated Persons;
- SHE Group review of Authorising Engineer's; and
- Review of electrical technical reference documentation.

Site Audit:

- Signs and applicable Posters;
- Safety Locks and Lock-out Boxes;
- Use of permits;
- Keys, Key Cabinets, Document Cabinets and Mimic Diagrams;
- Protective Equipment, Test and portable Earthing Equipment; and
- Working on and Testing Low and High Voltage Equipment (including Hazardous Areas).

The programme shall include reviewing the competency of appointed Authorised Persons and include a formal meeting between the Authorising Engineer and all appointed Authorised Persons identifying the need for any training or re-training.

The Authorising Engineer responsible for the fixed wiring installation shall be satisfied with regards to BS7671 Requirements for the Electrical Installations Wiring Regulations and the IET Electrotechnical Assessment Specification, that the performance and safety of works covered in B25 has not been compromised with regards to :

- suitable and sufficient test instruments for doing electrical testing (we may already cover this),
- accurate certification, and reporting (both elements including the correct issuing of Electrical Installation Completion Certificates (EIC's), Electrical Installation Condition Reports (EICR's) and Minor Works Certificates),
- suitable insurance (adequate PL and PI), STFC don't have Employees Insurance.
- adequate personnel (competency, covered in SC34) with an annual audit (technical assessment), not currently covered in SC34.

Staff that are Skilled persons (electrically, under the requirements of the IET EAS) shall be required to undergo an on-site Technical Assessment to demonstrate that they have adequate knowledge, experience and understanding of the design, construction, maintenance, verification and/or inspection and testing procedures for Electrotechnical work (to BS7671) they carry out based on the relevant competence requirements in the IET EAS Appendices 4, 6, 7 and 9.

This surveillance programme should carry out Assessments of those Employed Persons that are Skilled persons (electrically) no less frequently than once every five years. The AE shall cascade any responsibility for this assessment as they see appropriate.

Compliance Audit Checklist

Ref	Item	Rating	Comments
1. (4.1.3)	As appropriate has the Director appointed in writing and recorded in the SHE Directory an Authorising Engineer (AE)?		
2. (4.2.2)	Are the AE's out of hours contact details listed in site emergency plans?		
3. (4.2.6)	Has the AE appointed APs for the areas they are responsible for in writing and recorded these appointments in the SHE Directory?		
4. (4.2.8)	Do APs clearly understand which electrical systems they are responsible for, it is detailed in their letters of appointment?		
5. (4.2.10)	Has AE reviewed the competence of their appointed APs?		
6. (4.2.11)	Is there evidence that the AE is communicating to their APs relevant electrical safety information, for example defects, recalls etc.		
7. (4.2.12)	Has AE established accurate documentation for their electrical systems, drawings, schematics etc.?		
8. (4.2.14)	Is there evidence that the AE has investigated electrical incidents within their area of responsibility?		
9. (4.2.15/16)	Are electrical installations suitably supported by hazard warning signs and as appropriate emergency hazard warning posters?		
10. (4.2.17)	Are there any instances of live working or working near live HV conductors? What written supporting documentation is available?		

11. (4.2.20)	Is there evidence of statutory fixed wiring testing of electrical distribution systems?		
12. (4.3.4)	Are all Nominated Persons (NPs) authorised by the AP aware of SHE Code 34?		
13. (4.3.9)	Are there any examples of instances where APs have informed their AE of electrical defects? Has the AE followed up and investigated these?		
14. (4.3.12)	Is there evidence of cable detection surveys being undertaken prior to works in their areas of responsibility?		
15. (4.3.7)	Is there evidence that electrical PPE including earthing and test equipment has been maintained and as appropriate calibrated and inspected?		
16. (4.3.16/17)	Have all NP been appointed in writing by the AP, detailing the scope of their appointment, and their appointment recorded in the SHE Directory?		
17. (4.3.18)	Have APs reviewed the competence of NPs and at what frequency?		
18. (4.3.19)	Has the AP approved for NPs to undertake specific tasks or specific documented standing instruction or written instructions?		
19. (4.4.4)	Has the NP with the support of AP undertaken a documented risk assessment of planned electrical works?		
20. (4.4.5)	Is there evidence that the NP has undertaken work outside the scope of their letter of appointment?		
21. (4.3.5)	Demonstrate that electrical PTW have been issued by the AP and recorded in EDOR?		
22. (4.7.1)	Have contract supervising officers for electrical works ensured that risk assessments and methods statements have been obtained from electrical contractors?		
23. (4.7.2)	Is there evidence that the competence of contract electrical workers has been assessment by an AP or NP prior to work commencing?		
24. (4.9.1)	Are electrical safety incidents reports to AEs by SHE Group?		
25. (4.3.5)	Demonstrate that safety programmes have been written / approved and completed by the AP and recorded in EDOR?		

APPENDIX E - SAFE USE, HANDLING, STORAGE AND MAINTENANCE OF BATTERIES

1. GENERAL INFORMATION

Batteries are used to store electrical energy. Many of the things we use every day rely on the instant power provided by batteries. However, the larger batteries found in workplaces can be dangerous and may explode if used incorrectly.

Injuries from batteries include serious chemical burns to the face, eyes and hands, and wounds from flying pieces of metal and plastic. Burns from metal objects that have become very hot or have exploded after short-circuiting the battery's terminals occur frequently. A particular concern is the overheating of batteries when in use or being charged resulting in fires on STFC sites. Electricity is a major cause of STFC fires. Serious electric shocks, arc flash and burns are common in accidents involving batteries.

Batteries require additional provisions on the grounds that they store energy which is not feasible to make safe by isolation and discharging. Suitable notices shall be provided where a voltage would not normally be expected, or to warn of high energy discharge, and should be clearly visible before access. They shall be sub-divided into sections of no more than 120V dc for charging purposes, with such sections paralleled and consideration given to the available arc flash incident energy.

A specific risk assessment shall be completed before working on any battery systems with more than 120V dc or 1.2cal/cm^2 available incident energy at the normal working distance. Batteries shall be installed within suitable enclosures to protect against the shorting of terminals, or within designated rooms with restricted access.

There are two main classes of battery: those that can be recharged and those that cannot. This appendix gives advice on how to reduce the risks of using rechargeable batteries.

The two most important types of rechargeable battery are lead/acid and alkaline. Lead/acid batteries are the most common large-capacity rechargeable batteries. There is one in almost every vehicle including cars, motorcycles and fork-lift trucks. They are extensively used in large Uninterruptible Power Supplies (UPS) systems that support computer/communication and machinery control systems.

Alkaline rechargeable batteries, such as nickel-cadmium, nickel-metal hydride and lithium-ion, are widely used in small items such as laptop computers and portable electrical equipment from phones to drills. Large-capacity versions of these cells are now used in transport including EV Cars, scooters, bicycles and UPS applications.

2. TRANSPORT AND STORAGE

Packing and transportation of rechargeable batteries is covered in national and international regulations. The following international regulations for transport, safe packing and carriage of dangerous goods apply:

- Road: European Agreement for the International Carriage of Dangerous Goods by Road (ADR);
- Rail (international): International Convention concerning the carriage of Goods by Rail (CIM) Annex A: International regulations concerning the carriage of dangerous goods by rail (RID);
- Sea: International Maritime Organisation, Dangerous Goods Code; IMDG Code 8 Class 8 corrosives;
- Air: International Air Transport Association (IATA); Dangerous Goods Regulations (latest edition).

For the transportation of lithium cells or batteries refer also to EN 62281 “Safety of primary and secondary lithium cells and batteries during transport”.

For storage of cells or batteries under various climatic conditions, the characteristics regarding charge retention and corrosion effects shall be observed. The primary source of guidance should be the manufacturer’s recommendations which should be followed.

3. CHARGING FOR SERVICE

There are two different types of lead/acid and alkaline rechargeable batteries: valve-regulated (‘maintenance-free’) and vented. In valve-regulated batteries, any hydrogen and oxygen produced during charging does not escape but is converted back into water. You cannot add water to these batteries, as they do not need topping up. In contrast, vented batteries allow any hydrogen and oxygen produced to escape into the surrounding atmosphere. They require regular topping up with water.

A source of ignition – for example, a flame, a spark, a cigarette or any smouldering material, electrical equipment, a mobile phone etc. – will often cause mixtures of these gases to ignite and explode. The explosion is often so violent that it shatters the battery and produces a highly dangerous shower of fragments and corrosive chemicals. Refer to SC20 Controlling Explosive and flammable gases and dusts.

Hydrogen and oxygen are produced more quickly as a vented battery gets close to being fully charged. If you continue charging after the battery is fully charged, a lot of gas will be produced, greatly increasing the risk from explosion.

During charging, gas bubbles often become trapped inside the battery. The mixture of two-parts hydrogen to one-part oxygen produced is perfect for an explosion. When a vented battery is moved, the trapped gases are released into the air around the battery. A tiny spark is all that is needed to ignite the gases. If this happens in a confined space (e.g. inside the battery, or in an enclosure or a poorly ventilated battery room), a violent explosion is likely.

The gases that come out of a vented lead/acid battery during charging often contain a fine mist of sulphuric acid. Take care to avoid breathing these fumes and wear suitable eye protection.

Valve-regulated (‘maintenance-free’) batteries are much less likely to release hydrogen than vented batteries. However, it is still important to take care when charging them. Gas pressure may build up inside the battery if it is charged too quickly or for too long. If this happens, the pressure relief valves in the battery may open and let the hydrogen and oxygen escape. An explosion is likely if this happens close to an ignition source.

To minimise risk during charging of rechargeable batteries, manufacturer’s specified charging procedures and charging regimes shall be applied. For achieving long service life of rechargeable batteries, the manufacturers limit values and operating conditions shall be observed.

Rechargeable batteries should not be left on charge unsupervised for extended periods or overnight unless essential equipment. Where there is a significant number of batteries and charging units consider the use of battery charging/storage cabinets that can contain a fire and are fitted with fire detection. See SC32 Fire Risk Management for further details.

4. INSTALLATION & MAINTENANCE

Rechargeable batteries and UPS systems should be kept in a good state of charge, inspected and maintained in strict accordance with manufacturers' instructions. Where regular impedance or capacitive testing is not undertaken, manufacturer’s life expectancies shall be observed.

Before installing any battery consider orientation, environment and ventilation, other factors include protected from dust, dirt and accidental shorting of their terminals by metallic objects. If charging facilities are installed as part of the equipment, see STFC SHE Code 20: Controlling explosive and flammable gases and dusts.

All battery charging installations must be suitably located following relevant guidance and fire safety advice. See SC32 Fire Risk Management. The tops and sides of all batteries should be kept clean and dry and examined for leaks; any vent holes should be kept clear.

Some equipment is capable of carrying out 'fully controlled charging'. Here, the charging current is automatically reduced as the battery gets near to being fully charged. This type of equipment greatly reduces the risk of overcharging and so makes charging much safer. It is also important to consider charging parameters when replacing batteries including replacing wet cells for gel batteries of a similar rating.

Care should be taken with all batteries to avoid accidental shorting of their terminals. Insulated tools should be used when working around battery terminals and metal jewellery and watches should be removed. They should not be subjected to mechanical shock or to extremes of temperature. Many explosions happen when batteries are being connected or disconnected. The sparks produced when this is done incorrectly may cause the battery to explode, especially if it has just been charged.

When a battery is isolated from its load or any other battery, its bolted connections should be examined for corrosion and tightness. If connections are corroded, they should be dismantled, cleaned and greased with petroleum jelly, re-assembled and tightened. Do not use acid neutralising agents and take care when tightening bolted connections to avoid damaging battery terminal pillars.

If a battery has a vent plug, ensure it is removed and vent the cell before checking the firmness of the terminal pillars.

Batteries that have distorted or are otherwise damaged should be replaced immediately. Do not attempt to dismantle any battery and do not leave exhausted batteries in equipment.

4.1. Provision against electrolyte hazards

Most of the electrolytes used in batteries are hazardous chemicals and can create irritation or burns to eyes and skin. Inhalation and swallowing of electrolyte is dangerous. In case of direct contact with electrolyte to eyes and skin or inhalation, medical attention is always required.

Properties of electrolyte for topping-up shall comply with IEC 60993 for Ni/Cd. For electrolyte density refer to the manufacturer's specification.

The preparation of electrolyte solutions for batteries on site should be avoided, where it cannot be avoided, contact SHE Group.

4.2. Spillage and waste disposal

Batteries must **never** be disposed in general waste, contact a Waste Disposal Officer for advice on battery disposal or employ dedicated battery disposal containers for small dry batteries.

Where electrolyte is spilled:

- Sulphuric acid spillages should be cleaned up with materials such as soda ash (sodium hydrogen carbonate) or sodium carbonate (washing soda).

- Potassium hydroxide spillages should be diluted with copious amounts of water before mopping up.

Surplus electrolyte must be disposed of as hazardous waste, contact a Waste Disposal Officer and consult Safety Code 31 Controlled and hazardous waste disposal and Safety Code 41 Controlling pollution to air, land and water.

For further guidance on disposal of lithium batteries, see Safety Code 27 Receipt and dispatch of hazardous substances or contact the STFC Environmental Officer or local Waste Disposal Officer for advice.

If the spill involves a lithium metal battery, the area should be evacuated and immediately contact the on-site emergency response, who will consult with the STFC Environmental Officer, and a Fire Safety Advisor as required. If battery contents get on the skin, the area should be flushed with clean water for at least 15 minutes and contact first aider for advice.

5. Vehicle batteries

Electrically powered vehicles being equipment that transports people or goods, including, but not limited to cars, vans, trucks, MEWPs, bicycles, forklift trucks.

Electrically powered vehicles must only be charged in accordance with the manufacturer's instructions or recommendations and at a designated or approved charging point on STFC premises. Charging of electrically powered vehicles in offices or escape routes is strictly forbidden. When charging vehicles only a manufacturer’s approved charger lead can be used.

Any requirements to install new charging points/facilities for electrically powered vehicles must be made in consultation with Estates Services and must conform to the current IET Code of Practice for electric vehicle charging equipment installations. The fire safety advisor and building fire manager must be consulted prior to installing any new charging points/facilities with regards to RC59 - Recommendations for Fire Safety when charging electrical vehicles. Electrical vehicle charging and parking should be located at least 10m from combustible walls and 7.5m from unprotected openings/extensive glazing in non-combustible walls.

Any new installations must also consider the fire strategy and fire risk assessment for the building/area, and these documents must be reviewed in consultation with the Fire Safety team before any risk presented by charging electric vehicles is introduced.

When charging electrically powered bicycles only a manufacturer approved charger and charger lead shall be used.

Prior to first use, all new and used electrical chargers must be tested and inspected in accordance with SC17, during annual test programme or by a department test operative.

6. UPS

A UPS is an electrical apparatus that provides emergency power to a load when the input power source or mains power fails. It is typically used to protect hardware such as computers, data centres, telecommunication equipment or other electrically powered equipment, where an unexpected power disruption could cause injuries, fatalities, serious business disruption or data loss. UPS normally contain batteries and vary in size from units that are designed to protect a single computer without a monitor, to large units powering entire data centres or buildings. Battery systems can often reach voltage >330V dc and may be as high as 770V dc.

UPS must only be procured from reputable suppliers and must comply with European (CE) Standard and be provided with operating and maintain instruction.

All UPS systems shall be maintained to manufacturer's instructions and where larger battery systems are installed; condition monitoring of batteries should be carried out annually.

There should be a record of all UPS installed on STFC sites. This shall be accessible to any electrical person approved to work on or test the electrical installation. The information retained should include type, rating, location and person responsible.

7. REFERENCES

1. Using Electric Storage Batteries Safely, general information sheet INDG231 (rev1).
2. BS EN 50272-1:2010 Safety requirements for secondary batteries and battery installations.
3. BS EN IEC 60079-17:2007 Explosive Atmospheres Electrical
4. BS EN IEC 60079-10-1 Explosive atmospheres. Classification of Areas
5. BS EN 50110-1 Operation of electrical installations
6. BS EN 8210 – Facilities Maintenance management
7. ENA NEDeRS, EREC / UKPN G81 Engineering Recommendations
8. Personal Protective Equipment at Work Regulations 1992, leaflet INDG174.
9. BS EN 374, 420 - Industrial Gloves.
10. INDG139 Using electric storage batteries safely.
11. IEC60993 Electrolyte for nickel-cadmium cells.

APPENDIX F – EXAMPLES OF TEMPORARY SIGNS, CAUTION NOTICES, DISPLAY OF INFORMATION AND PERMANENT SAFETY SIGNS

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<tr>
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Standard electrical warning sign – for use with – Live Bus-bar, Switchgear, live electrical equipment, warning of death, uninterruptible power supplies, working near live electrical equipment etc.</td>
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Example of electrical warning sign with mandatory instructions for example for use with multiple supplies, remotely/automatically controlled generating sets, main Intake Switch Sign, switch off electrical equipment before working etc.</td>
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<td> 

Example of an electrical Prohibition Notice, primarily used as a Caution Notice</td>
<td> 

Electrical warning sign with mandatory action sign for locking HV enclosures, isolation prior to working for LV and HV equipment (Caution Notice), etc.</td>
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First Aid for High Voltage Electrical Shock Sign

Example of an electrical Prohibition Notice, primarily used as a Caution Notice.

Electrical Warning Sign used on electrical equipment such as switchgear and HV Enclosures.

APPENDIX G – PERSONAL PROTECTIVE EQUIPMENT

1. GENERAL INFORMATION

Personal Protective Clothing (PPE) is defined in this code as 'all equipment (including clothing affording protection against the weather) which is intended to be worn or held by a person at work and which protects them against one or more risks to their health or safety, e.g. safety helmets, gloves, eye protection, high visibility clothing, safety footwear and safety harnesses.

When working on or testing high or low voltage electrical equipment PPE shall be supplied and used wherever there are risks to health and safety that cannot be adequately controlled in other ways. PPE shall be:

- properly assessed before use to ensure it is suitable;
- maintained and stored properly;
- provided with instructions on how to use it safely; and
- used correctly.
- when issued recorded and validity monitored

2. ARC FLASHING PROTECTION

The Authorising Engineer shall undertake an arc flash hazard analysis of their appointed area of responsibility and assess whether flame resistant clothing, face shield and gloves are required by Authorised or Nominated Persons while working on or testing high and low voltage equipment.
An arc flash hazard analysis should determine:

- The maximum duration of a potential arc (dependent on the 3-phase fault detection and clearance time of the system)
- The incident energy level from a potential arc flash (proportional to the prospective short circuit current from the system being worked on or near)
- Whether the work will take place with any enclosure closed or open
- The flash protection boundary within which PPE will be required

The PPE assessment will then use the determined incident energy level which could be received by the person carrying out the specified task and equate this to a level of PPE.

Required level of PPE if incident level:

- <2 CAL/ cm^2 – recommended cotton overalls (AE to assess risk)
- >2 CAL/ cm^2 and <5 CAL/ cm^2 - flame resistant clothing is recommended (AE to assess risk)
- >5 CAL/ cm^2 - flame resistant clothing must be worn

If the PPE assessment determines that flame resistant clothing is required then it shall have a minimum rating of 10 CAL/cm^2 and shall include arc flash overalls, visor and gloves.
Additional layers of flame-resistant clothing can be worn to increase the flame-resistant rating above 50 CAL/cm^2 if required.

3. INSULATING GLOVES

If a risk assessment requires the use of insulating gloves during LV electrical work or test they must be suitably rated and chosen with an appropriate physical size.

The use and storage of insulating gloves must comply with the manufacturer’s instructions including use by date; the life expectancy of these gloves is dependent on application and responsibility of user.

APPENDIX H – HAZARDOUS AREAS AND EXPLOSIVE ATMOSPHERES (see SC20)

1. WORKING AND TESTING

The Authorised Person or Nominated Person is to co-ordinate all work on and testing of Electrical Equipment after discussion and approval from the person responsible for Hazardous Area.

1.1 All persons required to work on or test electrical equipment or installations in a Hazardous Area are to be familiar with and comply with all relevant SHE Codes and any instructions issued by the person responsible for the Hazardous Area. If any doubt arises as to the interpretation of such instructions, written clarification from the person responsible for the Hazardous Area is to be obtained before any work or test proceeds.

1.2 Where a Hazardous Area Classification exists, only persons with the appropriate training and experience for that classification shall be allowed to work or test in that area.

1.3 Wherever reasonably practicable, the working area is to be rendered non-hazardous for the duration of the work or test. However, the provisions of this appendix apply even if the working area has been rendered non-hazardous for the duration of the work or test.

1.4 Where an area hazard is rendered non-hazardous, e.g. gas purged and isolated, a written confirmation of the status and approval shall be obtained from the person responsible for hazardous area.

1.5 The safe system of work shall be approved by the person responsible for hazardous area, prior to any work or test commencing.

1.6 Work or test within a hazardous area may be stopped at any time by the Authorised Person or by the person responsible for Hazardous Area.

1.7 All tools, test equipment, and materials must be risk assessed to verify their suitability for use in the Hazardous Area and shall comply with any instructions issued by the person responsible for the Hazardous Area.

1.8 Before commencing any testing, in particular high current continuity tests, prospective short circuit current tests, or high voltage tests the environmental hazards for the Area must be considered. Only approved test methods shall be used in accordance with DSEAR and BSEN60079 Parts 14 and 17.

1.9 Before any work or test is deemed completed the Authorised Person and person responsible for Hazardous Area are to be satisfied with the safety and integrity of all equipment that may have been affected by the work or test.

1.10 Before equipment in a Hazardous Area is energised or restored to an operational state, the Authorised Person must obtain permission from the person responsible for Hazardous Area .

APPENDIX J – RECORD RETENTION POLICY

Records Established	Minimum Retention Period	Responsible record keeper	Location of Records	Comments/Justification
Safety Documentation (PTW, STT, AFA, Safety Programmes, etc)	Current + 5 years	Authorising Engineer and Authorised Person	Local records systems	A copy of test records must be held by STFC
EDOR	Current + 5 years	Authorising Engineer	Local records systems	Hardcopy or electronic version
External and Internal Audits	Current + 10 years	Authorising Engineer	Local records systems	Retain at least 2 previous audit reports
Appointments:				
Authorising Engineer	Most recent	Director	SHE Directory	Appointment letter
Authorised Person	Most Recent	Authorising Engineer	SHE Directory	Appointment letter
Nominated Person	Most Recent	Authorising Engineer	SHE Directory	Appointment letter