Offshore Major Accident Regulator

Offshore Petroleum Regulator for Environment & Decommissioning

HSE

Energy Division Offshore Inspection Guide Electrical Power Systems

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Target Audience

ED Offshore Inspectors / ED Specialist Inspectors

Whilst primarily aimed at HSE EC&I inspectors, this guide will be useful to Duty Holders in managing risk in relation to major accident hazards and preparing for OMAR inspections.

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Summary

This Inspection Guide outlines an approach to the inspection of duty holder's arrangements with respect to Electrical Power Systems and the key areas that inspectors should consider when inspecting this topic. It also sets out the criteria for satisfactory and unsatisfactory performance factors against which duty holder performance will be rated. References are made to technical standards and guidance that inspectors will use to form an opinion of legal compliance.

Introduction

The aim of this Inspection Guide is to provide information and guidance to ED Inspectors to support the delivery of consistent and effective inspection of duty holder arrangements to comply with the Offshore Installations (Offshore Safety Directive) (Safety Case etc) Regulations 2015, Safety Case Material Changes, Combined Operations Notifications, Safety Case Thorough Reviews, Safety and Environmental Critical Elements, Performance Standards and other relevant legislation and guidance.

This Inspection Guide outlines the key areas to be assessed and provides a framework for inspectors to judge compliance, rate performance, and determine appropriate enforcement action where legislative breaches occur. It supports HSE's Enforcement Policy Statement (EPS) and Enforcement Management Model (EMM), ensuring electrical safety both for major accident prevention and personal protection is embedded in regulatory decisions.

Inspection of electrical power systems focuses on:

Major Accident Hazard Controls

- Preventing the initiation of fires, explosions or loss-of-containment events arising from electrical equipment, faults or unsafe energisation, consistent with Electricity at Work Regulations (EAWR) requirement to prevent danger from electrical systems.
- Ensuring electrical systems are designed, installed, operated and maintained so they remain suitable, safe, and reliable, consistent with EAWR requirements for *safe construction*, *adequate protection*, and *proper maintenance.*
- Verifying that electrical systems are maintained in a safe condition through appropriate inspection, testing and defect management so that reliability is ensured and major accident hazards are effectively controlled.
- Confirming that systems remain adequately protected against overload, fault current, atmospheric conditions and deterioration.

Electrical Personal Safety

Consistent with EAWR duties to prevent danger, electrical safety measures must also protect personnel from:

- electric shock and electrocution
- arc flash and arc blast hazards, including thermal, pressure and projectiles
- burns and fire resulting from electrical faults

- inadvertent energisation due to inadequate isolation, testing, or lock-off practices
- failures related to competence, supervision or use of unsuitable tools, test equipment or PPE

Effective inspection therefore considers:

- the adequacy of safe systems of work for electrical tasks, including isolation, proving dead, and permit-to-work controls
- the competence of persons working on or near electrical systems, as required by EAWR
- whether employers have taken all reasonably practicable measures to prevent electrical danger to individuals and to prevent electrical systems from contributing to major accidents

Effective inspection considers both the role of electrical systems in preventing major accidents and the measures in place to protect individuals from everyday electrical hazards.

This operational guidance outlines HSE's current Electrical Power Systems intervention practices undertaken during onshore and offshore inspection. The topic breaks down into six core areas, detailed in the following appendices:

1. Power generation and distribution
2. Power Quality and Analysis
3. Control and Protection
4. Temporary and Portable Systems
5. Safety and Compliance
6. Documentation and records Equipment, Safety Notices and Personal Protective Equipment (PPE)

NB - It should be noted that the Electrical Power Systems guide excludes ATEX equipment, as this topic is considered a separate subject in its own right and will be covered under a distinct inspection guide.

Relevant Legislation

There is a comprehensive range of guidance documents available from professional institutions and trade associations which can be helpful to duty holder's in meeting the benchmark standards in this inspection guide. This inspection guide does not list these guidance documents specifically as there are many such documents from different organisations, often addressing the same subject-matter.

Not all of the benchmark standards contained in the guide are necessarily applicable at every platform. The duty holder should already be aware of the hazards and risks on their installation and hence which benchmark standards are applicable.

- **Health and Safety At Work etc. Act 1974 (Application outside Great Britain) Order 2013 (AOGBO)** applies the Health and Safety at Work etc. Act (HSWA) to offshore installations and any activity in connection with an offshore installation, or any activity which is immediately preparatory thereto from a vessel or in any other manner, other than towing the installation (see MAR Reg 4)

- **Offshore Installations (Offshore Safety Directive) (Safety Case etc) Regulations 2015**

- **Management of Health and Safety at Work Regulations 1999** focusses on risk assessments and how to use them effectively to identify potential hazards and risks, preventive measures that can be applied and the management and surveillance of health and safety and procedures that should be followed in the event of serious or imminent danger.

    - Regulation 3 - The regulation requires you to ensure that you make a suitable and sufficient assessment of the risks to the health and safety of employees and personnel not in your employment, for the purpose of identifying the measures you need to take to comply with relevant statutory provisions. In particular the Electricity at Work Regulations 1989, Regulation 4 (3), whereby every work activity, including operation, use and maintenance of a system and work near a system, shall be carried out in such a manner as not to give rise, so far as is reasonably practicable, to danger.

    - Regulation 5 – This regulation requires employers to have health and safety arrangements in place for the nature of his activities for the effective planning, organisation, control, monitoring and review of the preventive and protective measures.

- **The Prevention of Fire, Explosion and Emergency Response Regulations 1995 (PFEER)** specifies the goals for the preventative and protective measures to manage fire and explosion.
    - Regulation 19 - requires the duty holder to ensure that all plant on the installation is constructed or adapted as to be suitable for the purpose for which it is used or provided and is maintained in an efficient state, in efficient working order and in good repair.

- **The Electricity at Work Regulations 1989** highlights the nature of the precautions in general terms to help duty holders achieve high standards of electrical safety in compliance with the duties imposed.

- **Provision and Use of Work Equipment Regulations 1998 (PUWER)** deal with the regulations for use of work equipment and machinery used every day in workplaces.

    - Regulation 5 - This new regulation covers the extent and nature of inspection. It formalises the practice of systematic in-house checks on work equipment setting out general requirements for ensuring that work equipment is kept in a suitable condition.
    - Regulation 6 - This regulation covers the extent and nature of inspection. It formalises the practice of systematic in-house checks on work equipment.
    - Regulation 8 - The regulation requires the duty holder to ensure that all persons who use work equipment have available to them written instructions pertaining to the use of the work equipment. Written instructions should provide sufficient information to enable the safe operation and maintenance of the work equipment.

Relevant HSE Guidance

- **HSR25** – **Electricity at Work Regulations** (Guidance on Regulations)
- **HSG85 – Electricity at Work** includes advice on safe working practices for managers and supervisors who control or influence the design, specification, selection, installation, commissioning, maintenance or operation of electrical equipment.
- **HSG107 – Maintaining Portable Electrical Equipment** provides advice on maintaining portable electrical equipment to prevent danger.
- **HSG230 – Keeping Electrical Switchgear Safe** includes guidance on the selection, use, care and maintenance of high-voltage and low-voltage switchgear
- **HSG253 – Safe Isolation of Plant and Equipment** provides guidance on how to isolate plant and equipment safely

Action

Inspectors should review relevant documentation (see Appendix 1 Pre-inspection Information Request) prior to the installation visit.

By the conclusion of the inspection, it should be possible to:

- Have an understanding of the health of the duty holders Electrical Power Systems
- An acknowledgement of any action plan and some assurance that the plan will be resourced and executed.
- Reveal any findings related to EPS that require enforcement action

When carrying out inspections covered by this Inspection Guide, inspectors should:

- Use the performance descriptors detailed in Appendices 2 to 6 to:
    - Determine the appropriate performance rating
    - The initial enforcement expectation
    - Consider how and when the issues raised during an inspection are to be closed out

Background

An EPS inspection should address the Safety Management System that underpins one or more of the following elements of the EPS topics in order to assess duty holder risk management performance against relevant good practice:

- hazard and risk assessment
- specification, design and engineering
- operation and maintenance
- competence.

There may be circumstances where the inspector may decide to inspect areas other than in this guide because of specific known issues or issues identified at site during the inspection.

Other relevant Inspection Guides

It should be noted that, due to the nature of Electrical Power Systems as a topic, there is a degree of cross over to many other specialist topic areas:

- The Offshore Audit, Monitoring and Review Inspection Guide - This inspection guide provides more detail on the requirements for inspecting policies and procedures which form part of the duty holder's safety management system.
- Maintenance Management - This inspection guide provides further details on the maintenance management aspects of key topic areas.
- The Offshore SECE Management and Verification Inspection Guide.
- Cyber Security for Industrial Automation and Control Systems (IACS) Inspection Guide - This inspection guide provides details on how cyber security risk management would be inspected.
- Control of Work - This inspection guide provides information on hazard identification, Risk Assessment, Permit to Work and Isolation Management.
- Operational Risk Assessment - This inspection guide provides information and guidance on how to manage effective operational risk assessment and provides details for identifying and assessing the implications of any impairment of safety critical elements and other abnormal situations which affect major accident hazard control systems.

Specialist Advice

Specialist advice should be sought from the Energy Division Electrical, Control and Cyber Security Team when considering enforcement / debate over relevant standards on any aspects of Electrical Power Systems.

Organisation

Targeting

Inspections should be planned to ensure that the necessary site personnel are available and arrangements can be made to facilitate physical inspection of the system(s). OMAR will prioritise which sites to inspect and the order of inspection based on risk, duty holder performance and other intelligence. Regardless of their performance, duty holders will be subject to a degree of periodic inspection to provide public reassurance that major accident hazards continue to be managed appropriately.

Timing

Inspectors should undertake Inspections as part of the agreed Intervention Plan or as determined by the EDSLT.

Recording & Reporting

The duty holder performance ratings should be entered on the Inspection Rating (IRF) Tab of the relevant installation Intervention Plan Service Order. Findings should be recorded in the post inspection report and letter.

Appendix 1 - Electrical Power Systems Pre-inspection information request

1. Independent Competent Person / Independent Verification Body reports.
2. Copy of electrical performance standards
3. Single line diagram of the electrical distribution system.
4. Copy of arc flash study report.
5. Maintenance Management Strategy document.
6. Electrical Safety Rules.
7. Latest copy of UPS maintenance and battery discharge reports.
8. Copy of latest assurance and availability/reliability reports for Emergency power, emergency lighting an SECEs.
9. Maintenance Deferral procedure.
10. List of EC&I items in maintenance backlog and deferred maintenance items.
11. Any technical assessments carried out by the Electrical Technical Authority / Superintendent / Chief Engineer.
12. Obsolescence management / Asset Life extension report.
13. Any documents listed in the Safety Case that are relevant to the inspection.

Appendix 2 - Power Generation and Distribution

Fundamental Requirement

The duty holder should have in place suitable arrangements to ensure that Power Generation and Distribution equipment (comprising of, but not limited to: Gas turbine / Diesel Generator / Emergency DG controls; HV/LV switchgear; AC/DC distribution systems; Transformers; HV/LV motors; power cables; UPS and battery systems) is properly designed, constructed, installed and maintained so that it does not present a risk of electric shock, burns, fire or explosion when properly used.

Success Criteria

The duty holder should demonstrate that their Power Generation and distribution equipment meets the following criteria:

- **Design and Installation**: Equipment designed and installed in compliance with accepted industry standards such as IEC 61892, including proper selection of equipment and materials suitable for anticipated duty and environmental conditions.
- **Redundancy and Reliability**: Equipment designs should address equipment functionality, reliability/availability and redundancy to ensure continuous operation in line with measures detailed with PFEER 1995 regulations.
- **Maintenance Records**: Maintain up-to-date maintenance logs and records. A system must be in place to ensure that all power generation and electrical distribution equipment is maintained appropriately by people competent to do so, at an appropriate frequency to provide assurance that it remains in a safe condition. Equipment adequately rated for the duty it was intended to perform.
- **Operational Testing**: Conduct tests to ensure systems operate reliably under applicable load conditions. Ensure frequency of inspection, test, and equipment replacement are appropriate (this can be based initially on manufacturers' recommendations, operational knowledge of equipment and/or applicable standards) and that the operation, maintenance and testing of electrical systems and equipment are carried out by people who are competent for that work.
- **Management of Change**: Any changes to equipment hardware, protection setting and software updates must follow duty holder's management of change procedure to ensure that any modifications are actively risk assessed.
- **Documentation**: Ensure the following documents are accurate and kept up-to-date:
    - Electrical distribution system single line diagram and interconnection drawings
    - Electrical generation and distribution operating philosophy
    - Electrical emergency power operating philosophy and operating procedures
    - Equipment electrical equipment location drawings
    - Electrical system and equipment operating and maintenance instructions

- Switchboard and distribution board layouts and schedules
- Switchboard logbooks (where used)
- Earthing drawings
- Electrical load lists for different operating scenarios
- Electrical Safety Rules (ESR)
- Electrical equipment data sheets

Key Regulations

Electricity at Work Regulations 1989

Provision and Use of Work Equipment Regulations 1998 (PUWER)

The Prevention of Fire, Explosion and Emergency Response Regulations 1995 (PFEER)

Supporting Standards/ACoP or Guidance

See Appendix 7

Appendix 3 - Power Quality and Analysis

Fundamental Requirement

The duty holder should have in place suitable arrangements to ensure that Power quality and analysis (comprising of, but not limited to: harmonic distortion; load analysis; electromagnetic compatibility and power quality monitoring) is maintained to ensure continuity of supply within acceptable tolerances and levels.

Success Criteria

The duty holder should demonstrate that Power Quality and Analysis techniques are utilised where appropriate to ensure quality, stability and continuity of electrical supply (such as):

- **Harmonics (capacitors, inductors and reactors):** Completion of harmonic study to understand content of harmonics within power system, especially when feeding sensitive equipment such as semiconductor controlled equipment. Operators may need to take account of this in the design of electrical systems, and are advised to consider power quality issues when testing, fault finding and modification to existing electrical systems.
- **Load analysis:** Ensure load analysis is current and accurate for electrical distribution system configuration installed. Based on analysis, load shedding shall be applied when required in order to avoid blackout. Load shedding can be implemented by shedding of individual/groups of consumers or by appropriate separation of switchboard busbars. Care should be taken to ensure that the response time is sufficient to enable the load shedding system to perform its function and maintain a stable electrical system.
- **Power Quality Monitoring:** System for conducting continuous monitoring of real time power quality analysis, using appropriate devices, to check power factors and harmonics.
- **Electromagnetic capability:** Systems should not interfere with other equipment. For equipment in general, electromagnetic compatibility shall be achieved.
- **Earthing:** System earthing is provided to ensure that earth faults within an installation can be detected when a fault arises. Accordingly, as part of the duty holder's maintenance strategy, routine inspection and testing at appropriate intervals should be carried out.
- **Partial Discharge Analysis:** Partial discharge (PD) analysis can enable an assessment of the condition of the insulation in high-voltage plant to be made. Non-intrusive techniques for performing PD measurements using portable instruments include measurement of transient earth voltages, ultrasonic detection and radio frequency interference (RFI detection):
- **Thermographic surveys:** Used to identify the surface temperature of components using infra-red thermal imaging equipment or non-contact thermometers. One of the strengths of this technique is the ability to monitor equipment while in use.
- **Oil analysis:** The reliable performance of oil-filled equipment depends on the characteristics of mineral insulating oil. Oil must be tested before being introduced into equipment, even if new, to ensure that it

meets the required level of performance. Laboratory assessments of oil samples taken from equipment can provide information on the condition of both the equipment and the oil. The results can be used to assess the effectiveness of a maintenance programme.

- **SF6 / Vacuum equipment analysis**: SF6 and vacuum bottle equipment rely on a number of tests and checks to ensure reliability and safe operation. Including ensuring the purity and moisture content of SF6 gas and testing both SF6 and vacuum breaker bottle for any leakages.

Key Regulations

Electricity at Work Regulations 1989

Provision and Use of Work Equipment Regulations 1998 (PUWER)

Supporting Standards/ACoP or Guidance

See Appendix 7

Appendix 4 - Control and Protection

Fundamental Requirement

The duty holder should have in place suitable and efficient means to ensure that any abnormal conditions detected in electrical systems are protected against the effects of short circuits and overloads if these would result in currents which would otherwise result in danger. Fault currents arise as a result of short circuits between conductors caused either by inherent failure of the electrical equipment or some outside influence, e.g. mechanical damage to a cable.

Success Criteria

The duty holder should demonstrate that means of preventing danger in anticipation of excess current; ~~a~~ fault or overload exist (such as inclusion of protection relays, fuses, bus differential protection, Arc detection etc):

- **Protection relays / thermal overloads / RCD's:** Protection relays and associated systems should be inspected and tested in addition to completing routine maintenance actions. For electronic relays, the manufacturer's instructions should be referred to for guidance. Specialist equipment may be needed to interrogate the relay to determine if any internal errors have been detected.
- **Fuse protection:** For switchgear where the protection is dependent on fuse operation, the operational tests involve carrying out fuse trip-testing to ensure that single fuse operation causes all other phases to operate; and the manual ON/OFF trip mechanism operates correctly.
- **I_s Limiter / fault current limiter**: For switchgear where high levels of short circuit currents are possible, usually installed as part of system fuse protection.
- **Automatic disconnection of supply (ADS):** Automatic disconnection of supply by early detection and rapid de-energisation, utilising schemes such as bus differential protection.
- **Power Management Systems (PMS):** A PMS must provide a robust and integrated solution for real-time monitoring and analysis of the electrical distribution network across offshore installations. It should continuously collect and process critical operational data (such as system voltages, currents, and power factor) from diverse sources including power metering devices, protection relays, motor control units, and variable speed/frequency drives. The system enables continuous visibility of system health and operational efficiency, enabling proactive management to prevent overloads and maintain stability. Additionally, it must support early detection of abnormal conditions or potential faults in high-demand loads, such as large motors, to safeguard equipment integrity and ensure uninterrupted power supply for essential offshore operations. Ultimately, the PMS should ensure reliable performance, optimize energy usage, and maintain compliance with safety and operational standards.
- **Documentation:**

- **Discrimination Analysis**: Selectivity study for coordination of installation electrical system protective devices.
- **Arc flash study:** Analysis and assessment of risk (severity of the arc).
- **Protection setting schedule**: Master electrical protection setting schedule exist, detailing all of the individual settings and parameters for each protective device installed on electrical distribution system and is up-to-date detailing any recent protection setting changes and changes to devices installed as part of duty holder management of change process.
- **Switchgear Logbooks**: Detailing equipment operational history, such as tripping events, equipment failures, equipment maintenance such as relay calibrations.

Key Regulations

Electricity at Work Regulations 1989;

Supporting Standards/ACoP or Guidance

See Appendix 7

Appendix 5 - Temporary and Portable Systems

Fundamental Requirement

The Regulations require that electrical systems and equipment must be maintained, so far as reasonably practicable, to prevent danger. This requirement covers all items of electrical equipment including fixed, temporary or portable equipment.

Success Criteria

The duty holder should demonstrate that it has a system in place to effectively maintain all temporary and portable electrical equipment and by having a means of controlling the risks associated from the use of such equipment:

- **Risk Assessment**: Control of risks arising from the use of portable and temporary electrical equipment should be based on a risk assessment. A risk assessment is about identifying hazards and taking sensible and proportionate measures to control the risks in the workplace. Risks can be managed and controlled by setting up an appropriate maintenance plan, factors to consider when conducting a risk assessment include: equipment type, OEMs recommendations, operating environment, equipment condition, frequency of use etc.
- **Portable Appliance Testing: -** Duty Holder should have an effective maintenance system in place for temporary and portable equipment which includes user checks, visual inspections by competent person (to determine equipment condition, correct fusing, termination of cores and suitability for working environment such as hazardous areas) and equipment testing to determine equipment earth and insulation integrity.
- **Safety Compliance**: Ensure temporary installations comply with appropriate safety standards.
- **Inspection and Testing**: Regular inspection and testing of portable equipment should form part of Duty Holders maintenance plan for effective maintenance. A suitable equipment register or log is useful as a management tool for controlling and monitoring inspection and testing of temporary equipment and reviewing the effectiveness of the maintenance plan. The log can include faults found during inspection, which may be a useful indicator of places of use or types of equipment that are subject to a higher-than-average level of wear or damage
- **Proper Labelling**: Clear labelling of installed temporary installations. Labelling of portable equipment should indicate that the equipment has been tested satisfactorily, i.e. has been passed as safe, and when it was tested.

Key Regulations

Electricity at Work Regulations 1989

Provision and Use of Work Equipment Regulations 1998 (PUWER)

The Prevention of Fire, Explosion and Emergency Response Regulations 1995 (PFEER)

Supporting Standards/ACoP or Guidance

See Appendix 7

Appendix 6 - Safety and Compliance

Fundamental Requirement

The Regulations require that electrical systems and equipment achieve high standards of electrical safety in compliance with the duties imposed.

Success Criteria

The duty holder should be able to demonstrate that effective arrangements are in place to manage and control risks associated with the electrical distribution system, in accordance with the hierarchy of controls. This includes the identification of electrical hazards, the application of appropriate risk control measures - prioritising elimination, substitution, engineering controls where reasonably practicable and the implementation of supporting administrative controls and competency requirements. A formal electrical management system provides a structured and practical means of achieving compliance with relevant legal obligations and, when properly implemented, supports the safe design, operation, use, inspection, and maintenance of the electrical power system, thereby reducing the risk of harm to personnel and assets:

- **Electrical Safety Rules –** Duty holder should have set of safe working practices and procedures (including risk assessment) for live and dead working on electrical equipment with procedures for performing specific tasks, including level of competency/authorisation required performing specific tasks/roles.

- **Arc flash (risk assessment) –** Completion of an arc flash risk assessment, helps Identify what could cause injury (hazards) – derived from system parameters such as voltage, fault level, distance of work, and electrical protection arrangements (including the internal arc mitigation system present in the electrical installation); the likelihood of someone being harmed and how seriously (the risk) – derived from condition of equipment, quality of installation, measures to contain arc during switching, maintenance, correct operation and helps identify the action taken to eliminate the hazard or to control the risk. Arc flash labelling on switchgear detailing parameters such as incident energy levels and Arc flash boundary act as a useful reminder and reference for people working on the equipment.

- **PPE** – Where risk cannot be eliminated or controlled, PPE forms the last line of defence in helping to prevent injury. Duty holder must conduct a PPE assessment which includes analysis and assessment of risk (predicting severity of the arc), define the PPE characteristics (working environment – indoor/out, compatibility with other PPE) and compare PPE characteristics with market availability.
- **Competence –** Duty holder to ensure people working on or with electrical equipment/systems are competent for the task being performed (having received suitable training, possess adequate knowledge and experience) to prevent injury to themselves and others.
- **Roles and responsibilities -** Employees must be trained and instructed to ensure that they understand the safety procedures which are relevant to their work and must work in accordance with any instructions

or rules laid down by their employer and directed at ensuring safety. A person appointed by the employer, preferably in writing, to undertake certain specific responsibilities and duties, which may include the issue and/or receipt of safety documents such as permits-to-work. The person must be competent by way of training, qualifications and/or experience and knowledge of the system to be worked on. The Electricity at work regulations regulation recognises that, in many circumstances, people will require some degree of supervision where they do not have sufficient technical knowledge or experience to ensure that they can undertake the work safely. Duty holders, when allocating to supervisors' responsibilities for supervision, should clearly state to the supervisor exactly what their responsibilities are and consider stating these responsibilities in writing.

- **Authorised Person / Technical Authority audits -** Duty holders should ensure that measures are taken to monitor the implementation of their management systems. There should be regular audits of the overall effectiveness of the management system, this audit should ensure that personnel are fully aware of their responsibilities and accountabilities in relation to the electrical function.
- **Long Term Isolations –** Duty holder must have in place a robust auditing procedure for formally reviewing any long-term isolations in place against electrical operating plant and have a plan in place to repair/rectify equipment in line with duty holder inhibit/override procedure**.**
- **Control of work – Permit to work –** An electrical permit-to-work is primarily a statement that a circuit or item of equipment is safe to work on, it has been isolated and, where appropriate, earthed. Electrical permit-to-work should include: the person the permit is addressed to, i.e. the leader of the group or working party, who will be present throughout the work; the exact equipment which has been made dead and its precise location; the points of isolation; where the conductors are earthed; where warning notices are posted and special safety locks fitted; the nature of the work to be carried out; the presence of any other source of hazard, with cross-reference to other relevant permits and any further precautions to be taken during the course of the work.
- **Management of Change –** Any changes to equipment hardware, protection setting and software updates must follow duty holder's management of change procedure to ensure that any modifications are actively risk assessed.
- **Obsolescence –** Duty holder has completed an assessment into electrical equipment obsolescence to determine equipment longevity and continued support from equipment specialist vendor/OEM. Since the risk of catastrophic failure increases with age (especially oil switchgear), a process of assessment should be used to decide on the appropriate action for dealing with aged equipment in service. Such an approach should incorporate condition assessment. This will enable decisions to be made on whether to retain, refurbish or replace aged equipment and allow investment to be directed to best effect.
- **Switching schedules –** Duty holder should have a system in place for detailing program of steps when carrying out operations on the HV/LV power generation and distribution system. The switching schedule should include: the switching schedule number; the name of the location (including voltage, if appropriate) at which the switching is to be carried out; identification and nomenclature of the apparatus

involved; details of the intended operation; details of any earths applied; identification of the authorised person carrying out the operation; details of all safety notices and barriers.

- **Cyber security –** Duty holder has considered power generation and critical supplies as part of cyber security risk assessments.
- **Asbestos management -** Older switchgear may contain parts that were manufactured from asbestos or asbestos-containing materials (ACMs). The Control of Asbestos Regulations 2012 place a duty on those who have responsibility for the maintenance and repair of equipment to manage the risks from the potential for exposure to asbestos. This includes the responsibility to determine if asbestos is present so that others can be made aware of the hazard and take appropriate action (this includes forming part of asbestos register).
- **SF6 Management -** SF_6 is widely used in High-Voltage (HV) and Medium-Voltage (MV) switchgear because of its excellent insulating and arc-quenching properties, although it introduces other hazards such as toxic by-products from arching and is an asphyxiant. Management policies must be in place to covering installation, operation, maintenance and end of life decommissioning of SF_6 equipment. IEC 62271 covers handling, filling, recovering, and overall safety procedures for gas-insulated switchgear.
- **Test equipment – Calibration / proving dead equipment –** Duty Holder to ensure that procedures exist for the periodic examination and, where necessary, testing and replacement of measurement / test equipment.
- **Safety equipment –** Duty Holder to ensure that protective equipment suitable for the work activity should only be used as a last resort, i.e. when all other ways to eliminate or reduce risks have been considered. Examples of equipment that can protect someone from the effects of electricity are: (a) suitable clothing, including insulating helmets, goggles and gloves; (b) insulating materials used as fixed or temporary screening to prevent: (i) electric shock; (ii) short circuit between live conductors; (iii) short circuit between live conductors and earth; (c) insulated safety hook; (d) insulating mats and stands to prevent electric shock current via the feet; (e) insulated tools; (f) insulated test probes.

Key Regulations

Electricity at Work Regulations 1989;
Management of Health and Safety at Work Regulations 1999;
Personal Protective Equipment at work regulations 1992;
EU directive 89/391/EEC

Supporting Standards/ACoP or Guidance

See Appendix 7

Appendix 7 - Acts / Regulations / Benchmark Standards

The following benchmark standards, or equivalent should be applied:

- in full to installations built since the establishment of the benchmarks.
- so as far as reasonably practicable to installations that pre-date their publication, recognising that compliance with previous revisions of the benchmark standards might be adequate.

The benchmarks quoted are applicable at the time of publication of this guide. Where the benchmark has been updated, the equivalent clause of the updated benchmark should be applied subject to the reasonable practicability clause above.

Acts/Regulations

- Health and Safety at Work etc Act 1974
- Electricity at Work Regulations 1989
- L5 - Control of substances hazardous to health
- L21 – Management of health and safety at work regulations 1999
- L22 - Safe use of work equipment. PUWER 1998. Approved Code of practice and guidance
- L23 - Manual handling. Manual handling operations Regulations 1992 – guidance on regulations
- L65 - Prevention of fire and explosion, and emergency response on offshore regulations.
- L154 - Offshore installations (offshore safety Directive)_(safety case etc.) Regulations 2015 – Guidance on Regulations

Key benchmark standards

Subject	**Standard / Guidance**
Electrical Installations - HV	BS EN 61936-1 BS EN 61892 series BS EN 60092 series IEC 50110-1 & 2 MODU Code HSR25
Electrical Installations - LV	BS EN 61892 series BS EN 60092 series IEC 50110-1 & 2 MODU Code HSR25
Electrical Power System Earthing	BS EN 50522 BS 7430 BS EN 61892 series BS EN 60092 series MODU Code
Safe operation / safe systems of work	BS 6626 BS 6423 BS EN 61008 series BS EN 61009 series HSG 253

	HSG 230 HSG 85 HSR 25
Inspection, Maintenance and Testing	BS 6626 BS 6423 BS7430 BS EN 50522

Benchmark standards for Inspection

Hazard and Risk Assessment

Subject	Standard / Guidance
Impact of catastrophic failure of electrical equipment	Management of Health and Safety at Work Regulations 1999 BS EN 61936-1 Clause 8 BS EN 60364 series BS EN 60092 series BS EN 61892 series MODU Code
Impact of electrical power failure on other utilities & systems	Management of Health and Safety at Work Regulations 1999

Engineering and Design

Subject	Standard / Guidance
Earthing arrangements	BS EN 50522 BS 7430 BS EN 61892-2 Clause 6 & 7 MODU Code
Equipment selection and erection	BS EN 61936-1, Clause 5, 6, 7 and 8 BS EN 62271 series BS EN 61439 series BS EN 60076 HSG 230 JIP 33 Specifications IOGP S-732 IOGP S-727
Equipment strength and capability	BS EN 60909 series BS EN 60092 series BS EN 61892 series HSG 230 MODU Code
Protection arrangements	BS EN 61936-1, Clause 9 HSG 230 BS EN 60092 series BS EN 61892 series IEEE 1584 MODU Code Energy Institute - EI 3359
Electromagnetic Compatibility	BS EN 61000 series BS EN 60092 series BS EN 61892 series
Equipment layout and segregation	BS EN 61936-1, Clause 8 BS EN 60092 series BS EN 61892 series MODU Code

Operation and Maintenance

Subject	Standard / Guidance
Safe Operation / Safe Systems of Work	BS EN 61892 series BS 6626, Clause 9 and Appendix B BS 6423, Clause 4 IEC 50110-1 & 2 HSG 253 HSG 230 HSG 107 HSG 85
Inspection, Testing and Maintenance of HV systems	BS 6867 BS 6626 BS EN 60422 BS EN 60599 HSG 230
Inspection, Testing and Maintenance of LV systems	BS 6423 BS 7671, Part 6, Chapter 61, 62 & 63 HSR 25 – Guidance 4
Emergency back-up systems	BS 7698-12, Clause 11 BS EN 50272-2, Clause 14 HSR 25 – Guidance 4 The Offshore Installations (Offshore Safety Directive) (Safety Case etc) Regulations 2015
Electrical power system earthing	BS 7430, Clause 10 HSR 25 – Guidance 4

Competence

Subject	Standard / Guidance
Competence – Safe operation / Safe systems of work	IEC 50110-1 & 2 BS 6867, Clause 4 and 9 BS EN 6623, Clause 4 and 9 BS 6423, Clause 4 HSG 230 HSG 85 HSR 25 - Regulation 16,
Competence – Inspection, Maintenance & Testing	BS 6867, Clause 6 BS 6626, Clause 6 BS 6423, Clause 4 HSG 230 HSR 25 - Regulation 16,

Safety Management System

Subject	Standard / Guidance
Electrical power systems	BS EN 61892 series HSG 235 HSG 230 HSG 65 The Offshore Installations (Offshore Safety Directive) (Safety Case etc) Regulations 2015

Obsolescence Management

Subject	Standard / Guidance
Asset Life Extension	OEUK – Guidelines on the Management of Aging and Life Extension Aspects of Electrical, Control and Instrumentation

Appendix 8 - Application of the Enforcement Management Model (EMM) and Duty holder Performance Assessment

When inspecting Electrical Power Systems, duty holder compliance is to be assessed against the relevant success criteria. The success criteria have been determined from specific regulatory requirements, defined standards, established standards or interpretative standards.

This assessment will determine the: EMM Risk Gap, the associated topic performance score together with the Initial Enforcement Expectation as shown in the table below.

The actual enforcement may differ from that consistent with the recorded topic score depending on duty holder and strategic factors. However, should this occur then the relevant duty holder and strategic factors should be identified in the inspection report.

The initial enforcement expectation criteria differ slightly from the EMM for a 'Nominal' risk gap. This is because in practice '30' scores have been found to cover a wide range of risk gaps and a verbal warning would be an inappropriate enforcement response in many cases.

The Topic Score recorded on COIN must be consistent with the Initial Enforcement Expectation

Further guidance can be found at: http://www.hse.gov.uk/enforce/emm.pdf

EMM RISK GAP					
Extreme	**Substantial**	**Moderate**	**Nominal**	**None**	**None**
TOPIC PERFORMANCE SCORE					
60	**50**	**40**	**30**	**20**	**10**
Unacceptable	Very Poor	Poor	Broadly Compliant	Fully Compliant	Exemplary
Optional IG Specific Performance Score Guidance (delete if not used)					
Specific IG Guidance	*Specific IG Guidance*	*Specific IG Guidance*	*Specific IG Guidance*	*Specific IG Guidance*	*Specific IG Guidance*
EMM Initial Enforcement Expectation					
Prosecution / Enforcement Notice	Enforcement notice / Letter	Enforcement notice / Letter	Letter / Verbal warning	None	None

It should be noted that:

- **the recorded score should reflect the most significant compliance gap identified** relevant to the Inspection Guide.

- the Inspection Guide and hence the allocated scores may not cover all the matters that were considered during the intervention.

- the intervention may not necessarily have used every part of the Inspection Guide – consequently the score only reflects what was inspected. **The inspection report should make it clear what aspects of the Inspection Guide the duty holder has been scored against** (or it is clearly identifiable by a letter item).

- where the score only relates to limited aspect of the Inspection Guide then consideration should be given to consulting the IG owner before finalising the score.

- proposed inspection scores should be reviewed/discussed by the full inspection team before finalising.

- the impact of cumulative risk should be considered when scoring. For example, two or three substantive scores of '30' will point strongly to an overall score of '40'. There is currently no mathematical or other systematic process for doing this and inspectors must therefore use their judgement to allocate an appropriate score that best represents the overall inspection findings against this IG.

- the allocated performance score only reflects regulatory judgements about a duty holder's degree of compliance at a particular point in time.

Use of performance scores

HSE uses the performance scores as one of the many inputs to prioritise and plan future regulatory interventions. Prioritising intervention's is fundamental to ensuring HSE delivers its major hazards regulatory strategy whilst supporting businesses and the GB economy. HSE aims to ensure that regulatory activity is proportionate to the risk to people taking account a duty holder's performance in controlling risks. In general, this means the HSE will inspect major hazard installations and duty holders with relatively poorer risk management performance more frequently and in greater depth than lower hazard installations and duty holder's where there is evidence of higher risk management performance.