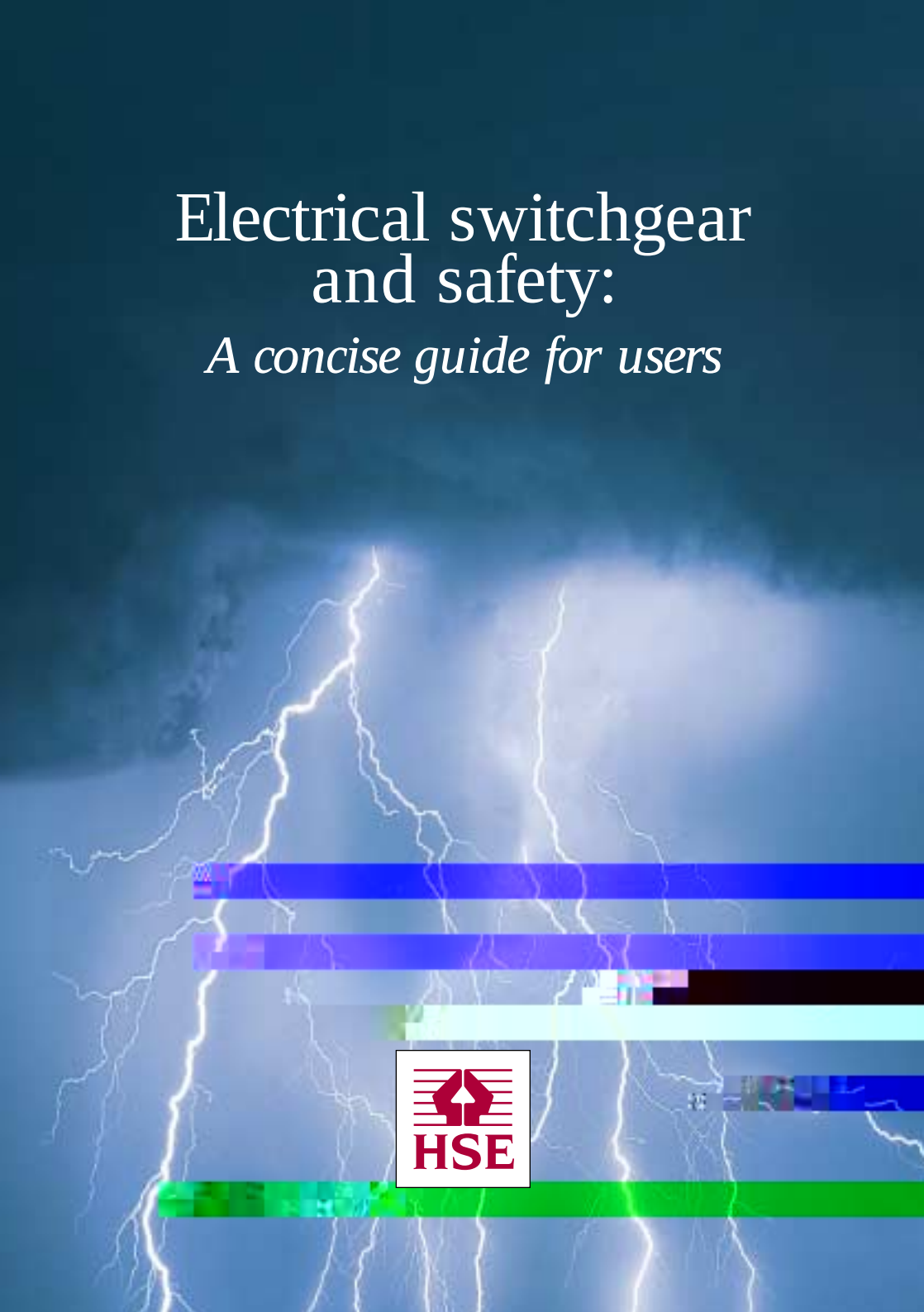
Electrical switchgear and safety:

A concise guide for users



Introduction

This leaflet is aimed at owners and operators of electrical switchgear in industrial and commercial organisations who have little knowledge and expertise available in-house on electrical matters. It summarises the comprehensive advice given in the HSE guide *Keeping electrical switchgear safe*, which is aimed at organisations employing electrical engineering

equipment. How switchgear is operated, its condition and the circumstances existing in the electrical network at the time of operation, can affect its ability to perform safely.

Managing switchgear

If you use switchgear you are required by law to provide management systems that will ensure safe operation and minimise the risk of injury. Such management systems should include the following:

- an appropriate system of records;
- policies and procedures covering the installation, commissioning, operation, maintenance and removal of the equipment;
- definitions of responsibilities and training requirements for your people;
- an auditing regime to monitor and maintain the effectiveness of procedures.

Records

Check that the records of all switchgear in service, network diagrams and configurations, including prospective fault level values at every relevant point on the system, are available and up to date. If no records are found you will need to prepare these as a matter of urgency.

The switchgear record should include:

- a diagram(s) of the electrical network showing the interconnections between the various plant items including the switchgear and their location(s);
- fault levels at all relevant points;
- types of equipment as part of an asset register, which needs to include details such as manufacturer and type, serial number and year of manufacture, date of installation, voltage and current rating, short-circuit rating and type of operating mechanism;

- details of operational limitations due, for example, to the possibility of overstressing;
- a maintenance record of each item of switchgear;
- the number of fault clearance operations since circuit-breakers were last maintained (if known);
- details of any modifications carried out, for example the fitting of anti-reflex control handles; and
- whether there are arc control devices for oil-filled circuit-breakers.

The basic records in the case of a low-voltage installation may also contain electrical installation certificates and periodic inspection reports. See BS 7671 2001: *Requirements for Electrical Installations (IEE Wiring Regulations, Sixteenth Edition).*

Policies and procedures

Safety of the equipment

Using the information in the records, you should assess the switchgear and the electrical network to identify any potential risks and problems. These can include overstressing of switchgear, presence of equipment having dependent manual operation, absence of anti-reflex control handles and inadequate means of protection against fire.

From this assessment you will be able to identify the necessary remedial action(s) you need to take to ensure that the equipment and systems are being operated safely.

Actions you may need to take urgently could include:

- prohibiting operation of overstressed switchgear when live, including disabling automatic operation to clear faults on the system. This will involve adjustments to electrical protection upstream to ensure the system remains protected;

- preventing access to the switchgear when live;
- reducing fault levels wherever possible by reconfiguring the network;
- prohibiting the operation of dependent manually operated switchgear when live, except under very carefully controlled conditions;
- replacing overstressed switchgear.

Further actions you may need to take (the urgency of which will depend on the results of your assessment) could include:

- replacing overstressed switchgear;
- when possible, replacing the closing mechanism for dependent manually operated switchgear. When this is not possible, you will need to replace the switchgear;
- fitting anti-reflex handles;
- improving measures for protection against fire.

If you do not have sufficient technical expertise in-house to carry out an assessment and decide on the appropriate actions, you should take advice from and employ suitably competent persons/organisations, such as:

- electricity distribution companies;
- switchgear manufacturers;
- switchgear maintenance companies with particular expertise in older types of switchgear;
- consulting organisations specialising in switchgear.

Once you have decided on the actions you need to take, you should develop a plan and timetable to carry them out.

Operating procedures

You should develop operating procedures and select the appropriate category of people for the activities needed for operating, inspecting, repairing, maintaining and testing the switchgear. In all cases, the people you employ will require the appropriate knowledge of the safety rules and

will need to know how to apply the safety documents. You will also need to tell them their responsibilities to ensure safety and for safe working. Their level of knowledge of the switchgear could range from a general understanding to detailed technical knowledge depending upon the duties

Inspection

You should inspect substations regularly. During the inspection work you should prioritise any remedial actions as follows:

- immediately (this should always be the case when security of the substation enclosure has been interfered with);
- earliest possible opportunity;
- next scheduled maintenance.

You should include the following items in the inspection schedule:

- switchgear environment (switchroom access and surrounds, including fence and external walls if outdoors), signs of water getting in/dampness, signs of unauthorised access and/or interference, condition of firefighting equipment and warning notices, and general housekeeping;
- signs of abnormal conditions such as high temperature, smell of hot substances or ozone, presence of smoke, signs of fresh leakage of oil or compound, distortion and evidence of sooting on enclosures;
- general condition of switchgear, such as corrosion, evidence of leaks, fluid levels, presence/condition of labels, padlocks and key exchange interlocks, condition of instruments and protection equipment;
- condition of ancillary equipment such as batteries and chargers, control panels etc.

Maintenance

You should do this at regular pre-determined intervals by, for example, time-based preventative maintenance - see below. You should also do it, particularly in the case of oil-filled circuit-breakers, immediately after it has operated to switch off an electrical fault in the network. Certain types of switchgear (such as that using sulphur hexafluoride and vacuum) are sometimes designated or described as ‘low maintenance’. However, you should not interpret this to mean that no maintenance is required.

This system of carrying out maintenance at regular, pre-determined intervals has been in use for many years. You decide the frequency of maintenance from factors such as:

- the type of switchgear;
- whether it uses oil, sulphur hexafluoride or vacuum interruptors;
- its age; and
- how often it is operated.

You should also take the maintenance history of the switchgear into account. You should keep records for each item so you can identify aspects such as deterioration in the condition of the equipment. You can then

Factors to take into account before selecting switchgear

Before you can decide you need to obtain assurance that the high-voltage insulation components of the busbar system, current transformer chambers, cables and terminations etc have adequate remaining life to justify the costs of partial replacement, refurbishment or retrofitting. It is essential that an overall assessment of the switchgear is carried out. This includes a condition assessment of the high-voltage insulation by using partial discharge measurement techniques and the evaluation of available test data and relevant standards. Where circuit-breakers are under consideration, you also need to consider the:

- condition of the secondary wiring, protection and control equipment;
- interlocking and earthing arrangements in relation to current safety standards;
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Further reading

Keeping electrical switchgear safe HSG230

BS 6626: 1985 *Code of Practice for maintenance of electrical switchgear and controlgear for voltages above 1 kV and up to and including 36 kV*

BS 6423: 1983 *Code of Practice for maintenance of electrical switchgear and controlgear for voltages up to and including 1 kV*

BS 7671: 2001 *Requirements for Electrical Installations (IEE Wiring Regulations, Sixteenth Edition)*

(see 'Other sources of advice' for address)

Further information

British Standards are available from BSI Customer Services,

HSE priced and free publications are available by mail order from

(HSE priced publications are also available from bookshops and free leaflets can be downloaded from HSE's website: www.hse.gov.uk.)

For information about health and safety ring

Other sources of advice

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SE1 7SL
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