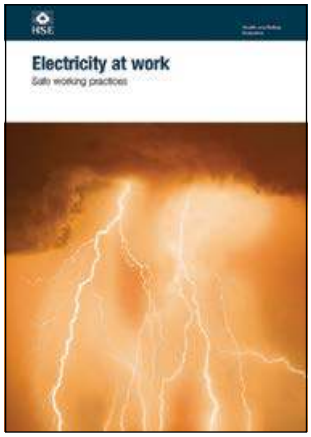
Electricity at work

Safe working practices



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The guidance covers the key elements to consider when devising safe working practices and is for people who carry out work on or near electrical equipment.

It includes advice for managers and supervisors who control or influence the design, specification, selection, installation, commissioning, maintenance or operation of electrical equipment.

This third edition updates the guidance and provides sources of further information.

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This guidance is issued by the Health and Safety Executive. Following the guidance is not compulsory, unless specifically stated, and you are free to take other action. But if you do follow the guidance you will normally be doing enough to comply with the law. Health and safety inspectors seek to secure compliance with the law and may refer to this guidance.

Contents

Introduction

1 This guidance is for people, including the self-employed, who carry out work on or near electrical equipment. It 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. Organisations that already have industry-specific rules or guidance for safe working practices should ensure that all aspects addressed in this guidance are adequately covered. Those that have no such internal rules should use this guidance to devise safe working practices relating to their own specific circumstances and activities.

2 The Electricity at Work Regulations 1989 (EAW Regulations) apply to almost all places of work. The *Memorandum of guidance on the Electricity at Work Regulations 1989*[1] (the Memorandum) is intended to help dutyholders meet the requirements of the Regulations. This guidance supplements the Memorandum with further advice on safe working practices. Where regulation numbers are given in Figures 1–5, these refer to the EAW Regulations. There is also an Approved Code of Practice covering the use of electricity at mines that provides additional guidance relevant to mining.[2] Other legislation can also apply to electrical work and some of this is listed in the 'References' or 'Further reading' sections, as are all other publications referred to in this guidance.

Definitions

3 Unless the context otherwise requires, in this guidance the following words and terms have meanings as given below (note: some of these terms are defined in the EAW Regulations):

- **charged:** the item has acquired a charge either because it is live or because it has become charged by other means such as by static or induction charging, or has retained or regained a charge due to capacitance effects even though it may be disconnected from the rest of the system;
- **dead:** not electrically 'live' or 'charged';
- **designated competent person (also known in some industries as 'authorised person' and 'senior authorised person')**: a competent 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;
- **disconnected:** equipment (or a part of an electrical system) that is not connected to any source of electrical energy;
- **equipment:** electrical equipment including anything used, intended to be used or installed for use, to generate, provide, transmit, transform, rectify, convert, conduct, distribute, control, store, measure or use electrical energy (as defined in the EAW Regulations);

- **high voltage:** a voltage in excess of 1000 V ac or 1500 V dc. Voltages below these values are 'low voltage';
- **isolated:** 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, ie it cannot be re-energised accidentally or inadvertently;
- **live:** equipment that is at a voltage by being connected to a source of electricity. Live parts that are uninsulated and exposed so that they can be touched either directly or indirectly by a conducting object are hazardous if the voltage exceeds 50 V ac or 120 V dc in dry conditions – see BSI publication PD 6519[3] – and/or if the fault energy level is high;
- **live work:** work on or near conductors that are accessible and 'live' or 'charged'. Live work includes live testing, such as using a test instrument to measure voltage on a live power distribution or control system.

What are the hazards?

4 Electricity can kill or severely injure people and cause damage to property from the effects of fires and explosions. Every year accidents at work involving electric shock or burns are reported to the Health and Safety Executive (HSE). Electric shocks do not always cause lasting injury but in certain circumstances can result in death, known as electrocution. The sudden muscular contraction during the shock can result in injuries from, for example, falling. Electric current flowing through the body can cause deep burns.

5 Electrical arcing (sometimes called a 'flashover' or 'arc flash'), perhaps as a result of a short circuit caused by unsafe working practices, can generate intense heat leading to deep-seated and slow-healing burns, even if it persists for a short time. The intense ultraviolet radiation from an electric arc can also cause damage to the eyes. Often those working with or near electricity do not appreciate the risk of serious injury and consequential damage to equipment that can arise from arcing.

6 Arcing, overheating and, in some cases, electrical leakage currents can cause fire or explosion by igniting flammable materials. This can cause death, injury and considerable financial loss.

7 Most electrical accidents occur because people are working on or near equipment that is:

- thought to be dead but which is live;
- known to be live but those involved do not have adequate training or appropriate equipment to prevent injury, or they have not taken adequate precautions.

Correct selection and use of equipment

8 Equipment must be properly designed, constructed, installed and maintained so that it does not present a risk of electric shock, burns, fire or explosion when properly used. There are many equipment-specific standards that include safety-related requirements which, if followed, will ensure that the electrical risks are adequately controlled.

9 The main standard for low-voltage electrical installations is BS 7671 *Requirements for electrical installations.*[4] It describes how systems and equipment can be designed, constructed and installed so that they can be used safely. The standard covers installations that operate at low voltage (up to 1000 V ac). Meeting the requirements of this standard is likely to achieve compliance with the relevant parts of the EAW Regulations.

10 Some old equipment that is still in use, including open-type switchboards and fuseboards used by electricity distributors and in industrial premises such as steelworks, is not designed or constructed to prevent people touching live conductors and suffering injuries from shock or burns. In these cases, the user must have sufficient knowledge and experience to recognise the danger and avoid it. This type of equipment should be located in a secure room or area, with access available only to those who have specific authority and are competent to prevent danger. Even then, you will need to further protect this type of open, uninsulated equipment to prevent accidental contact with live parts when competent persons are working near it.

11 Some equipment operates at voltages that are so low that they cannot cause a harmful electric shock but even at these extra-low voltages an arc can occur, burns can result from overheated conductors, or an explosive atmosphere can be ignited. A short-circuited car battery, for example, may cause the conductors to overheat and even cause the battery to explode. The following advice also applies to self-contained sources of electrical energy, whether the risk is from electric shock, burn, arcing, or explosion.

12 You must select equipment that is suitable for the environment in which it is used, for example cables and equipment in heavy industries such as sheet metal works need to be protected against mechanical damage. You should consider adverse environmental factors when working on equipment. For example, excessively damp or humid conditions will increase the risk of injury because of reduced effectiveness of insulation, which may undermine the effectiveness of devices used for isolation, or increase the severity should an electric shock occur. Equipment that has corroded may not function as intended.

13 Certified explosion-protected equipment must be used in places where there could be potentially explosive atmospheres, for example if there has been a leak of flammable gas or build-up of combustible dust that could be ignited by an electric spark; more information is available in the Dangerous Substances and Explosive Atmospheres Regulations 2002[5] and, for offshore installations, the Offshore

Installations (Prevention of Fire and Explosion, and Emergency Response) Regulations 1995.[6]

14 You must assess the situation before work is carried out on or near equipment. Working on equipment may result in removal of components and parts that provide protection for people against electric shock when the equipment is in normal use.

15 You should ensure safety by the careful design and selection of electrical equipment. For example:

- switch disconnectors should have a locking-off facility or other means of securing them in the OFF position;
- circuits and equipment should be installed so that all sections of the system can be isolated as necessary;
- switch disconnectors should be suitably located and arranged so that circuits and equipment can be isolated without disconnecting other circuits that are required to continue in service;
- devices used for isolating circuits must be clearly marked to show their relationship to the equipment they control, unless there could be no doubt that this would be obvious to anyone who may need to operate them.

HSG230 *Keeping electrical switchgear safe*[7] includes guidance on the selection, use, care and maintenance of high-voltage and low-voltage switchgear.

16 Control panels should be designed with insulated conductors and shrouded terminals so that commissioning tests, fault-finding, calibration etc can be carried out with a minimum of risk. The Engineering Equipment and Materials Users' Association (EEMUA) has produced a design guide for electrical safety.[8] Interlocking is recommended to reduce the risk of injury from contact with live parts. Equipment with segregated power and control circuits is preferred.

17 Where possible, you must avoid live working during commissioning and fault-finding; eg by using suitably designed equipment with in-built test facilities and diagnostic aids. There must be adequate space, access and lighting to work safely. Temporary systems and equipment should be designed, constructed, installed and maintained to avoid danger.

Actions for managers and supervisors

18 Managers should establish a system of rules and procedures wherever electrical work is to be carried out, or ensure that contractors brought in to do electrical work have appropriate rules and procedures. These should be written down and everybody involved must be made aware of them as they will form the basis of task-specific risk assessments. The amount of detail depends on the circumstances; the simplest form may be a brief policy statement (perhaps reflecting a policy of always switching off, securing the isolation, working dead, and never working on live equipment) backed up by a set of simple instructions to reflect that policy. Where there are extensive or complex electrical systems, especially high-voltage systems, this will be reflected in the safety rules, which should embody a methodical approach so that the safety principles involved can be clearly understood by everyone.

19 Safety rules should set out the principles and general practices clearly and in a compact format. Those carrying out the work should be instructed to carry the safety rules with them. Workers should know the limitations of their work allowed under the safety rules. Detailed procedures for safe working on particular equipment, or under particular circumstances, should be the subject of separate documents, including task-specific risk assessments or method statements, which should be readily available when required (even in out-of-hours emergencies). These safety rules should be devised to reflect, among other things, the relevant organisation, personnel, the electrical system to be worked on, and the working environment. Further guidance can be obtained from three British Standards – BS 6423,[9] BS 6626[10] and BS 6867.[11]

20 If something unforeseen occurs during a working procedure, there should be a review of the work. Even a properly trained, competent worker may not always be aware of what to do when things go wrong. The worker should have been trained to recognise that there may be a need to change to a new system of work. It will normally be necessary for the worker to know how to refer a changed situation to the correct people, by communicating both up and down the management structure in the organisation.

21 If you have managerial or supervisory responsibilities, it is important that you ensure that everyone knows how to work safely and without risk to their health, and that all workers follow the safety rules and control measures identified in risk assessments:

- you should be involved in planning the work and in the risk assessment process, coordinating the work where more than one group is involved, and discussing the necessary precautions and emergency procedures with the workers;
- you must clearly define the roles and responsibilities of the supervisors and workers, including those of any contractors who may be employed;
- you must ensure that supervisors are competent to supervise the work, with the level of supervision being appropriate to the danger and the competence of those carrying out the work;

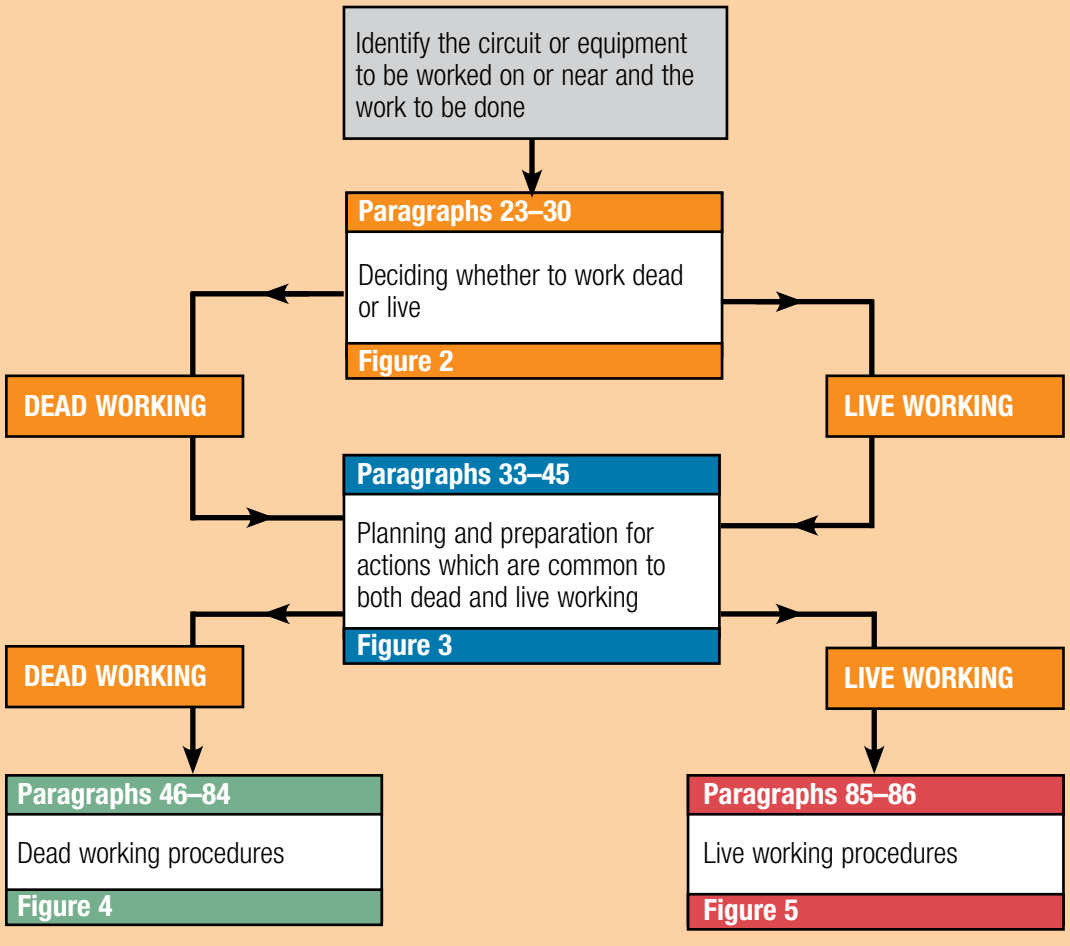
- you must identify those people who are competent and have knowledge and experience of the electrical system to be worked on. Anyone who does not have this will need a greater level of supervision, or will need to be given adequate training to make sure that they have the correct skills, knowledge and risk awareness for the task. Do not let unauthorised, unqualified or untrained people work on electrical systems.

Assessing safe working practices

22 Figure 1 illustrates the sequence of the planning steps. The procedure can be divided into four stages as follows:

- deciding whether to work dead or work live (coloured orange), see Figure 2;
- planning and preparation for actions which are common to both dead and live working (coloured blue), see Figure 3;
- procedures for working dead (coloured green), see Figure 4;
- procedures for working live (coloured red), see Figure 5.

Figure 1 Basic flow chart for assessing safe working practices



Deciding whether to work dead or live

Can the normal policy of dead working be carried out?

23 The factors to consider are illustrated in Figure 2. Work on or near live exposed conductors should rarely be permitted. Many accidents to electricians, fitters, technicians and engineers occur when they are working on equipment that could have been isolated. You should plan and programme the work to allow all jobs to be carried out where possible with the equipment dead. Three conditions must be met for live working to be permitted where danger may arise. **If just one of these conditions cannot be met, live working must not be permitted and dead working is essential.** The assessment procedure illustrates this. The conditions are:

- it is unreasonable in all the circumstances for the conductor to be dead; and
- it is reasonable in all the circumstances for the person to be at work on or near that conductor while it is live; and
- suitable precautions (including, where necessary, the provision of personal protective equipment) have been taken to prevent injury.

Is it unreasonable for the work to be done dead?

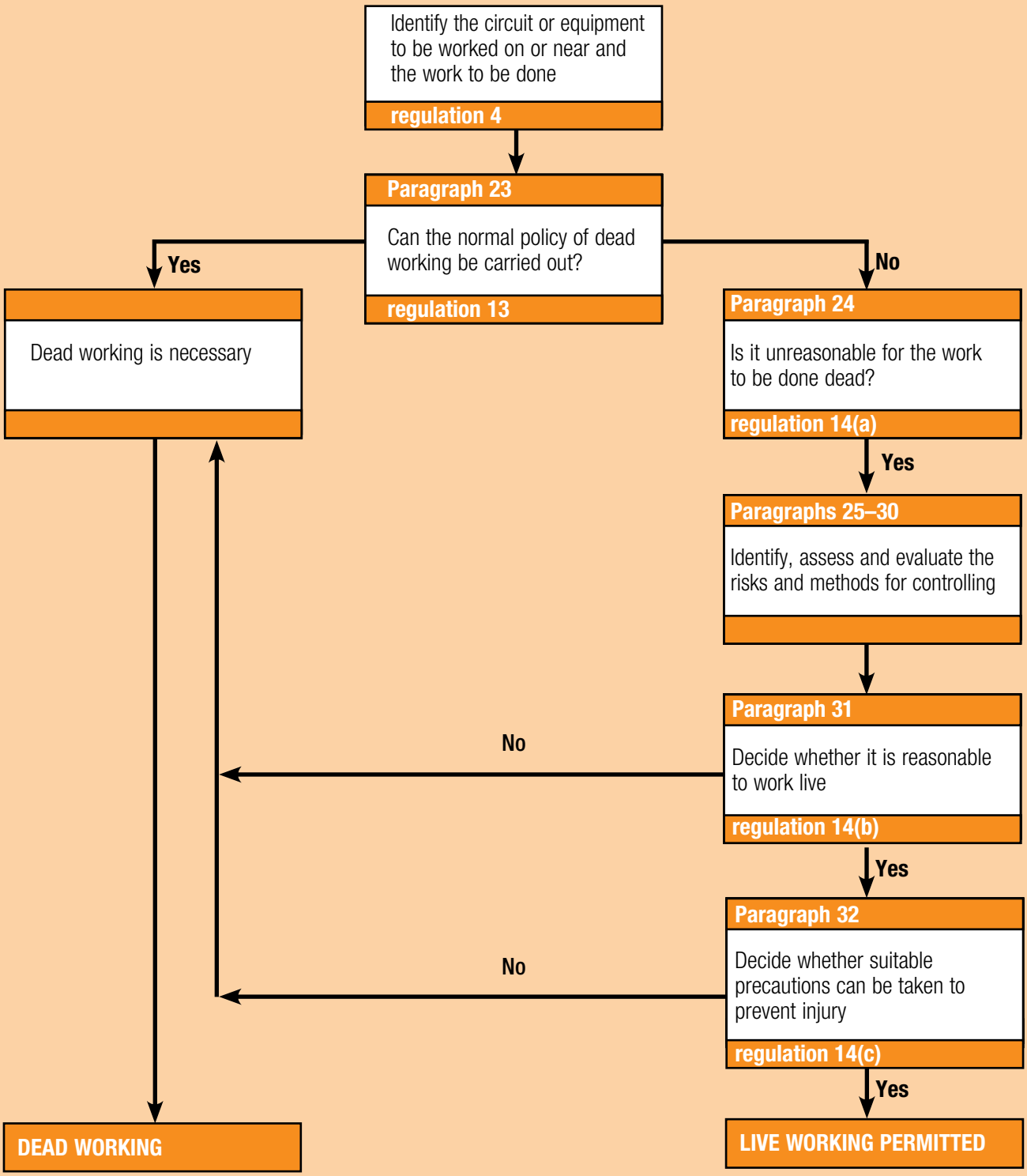
24 There are some circumstances where it is unreasonable to make equipment dead because of the difficulties it would cause. For example:

- it may be difficult, if not impossible, to commission a complex control cabinet without having it energised at some time with parts live (but not exposed so that they may be easily touched);
- it may not be technically feasible to monitor the operation and performance of a control system or to trace a malfunction of such equipment with it dead, ie fault-finding;
- a distribution network operator (DNO) needs to connect a new low-voltage service to an existing main, but it might be unreasonable to disconnect many customers. In recognition of the dangers associated with live working, the DNO must have a very strict code of safety rules and procedures to prevent injury;
- switching off a system, such as the supply to an electric railway track, to carry out maintenance or repair work may cause disproportionate disruption and cost.

Identify, assess and evaluate the risks and methods for controlling them

25 If you have decided that it is unreasonable for the work to be done dead, a risk assessment[12] is necessary. The risk assessment must cover the work on or near the specific equipment and it must be carried out by someone with comprehensive knowledge and experience of the type of work and the means of controlling the risks.

Figure 2 Deciding whether to work dead or live



26 A risk assessment is about identifying and taking sensible and proportionate measures to control the risks in your workplace, not about creating huge amounts of paperwork. Ask your employees what they think the hazards are, as they may notice things that are not obvious to you and may have some good ideas on how to control the risks.

27 Having identified the hazards arising from the live work, you then have to decide how likely it is that harm will occur and the severity of injury that might occur. Risk is a part of everyday life and you are not expected to eliminate all risks but you need to take account of the fact that electricity can cause very serious injuries and death. What you must do is make sure you know about the main risks and the things you need to do to manage them responsibly. Generally, you need to do everything reasonably practicable to protect people from harm.

28 As part of this process, you will need to consider the competence of the people who will be carrying out the work and their ability to avoid danger, taking into account the available precautions.

29 Make a record of your significant findings – the hazards, how people might be harmed by them and what you have in place to control the risks. Any record produced should be simple and focused on controls. If you have fewer than five employees, you do not have to write anything down. But it is useful to do this so you can review it at a later date, for example if something changes. If you have five or more employees, you are required by law to write it down.

30 Few workplaces stay the same, and you should review what you are doing on an ongoing basis.

Decide whether it is reasonable to work live

31 The risk assessment should inform managers and supervisors whether it is reasonable in all the circumstances to work live. The decision should not be taken lightly. At this stage the economic and operational factors should be evaluated against the risks involved before making a decision, bearing in mind that the risks associated with working live can be very serious. Minor inconveniences arising from working with the equipment dead, sometimes arising from commercial and time pressures, will very rarely outweigh the risks associated with live work.

Decide whether suitable precautions can be taken to prevent injury

32 Providing the requirements above have been met, live working can still only be justified if suitable precautions are taken to prevent injury arising from the hazards identified in the risk assessment. The precautions should have been identified in the risk assessment and might include:

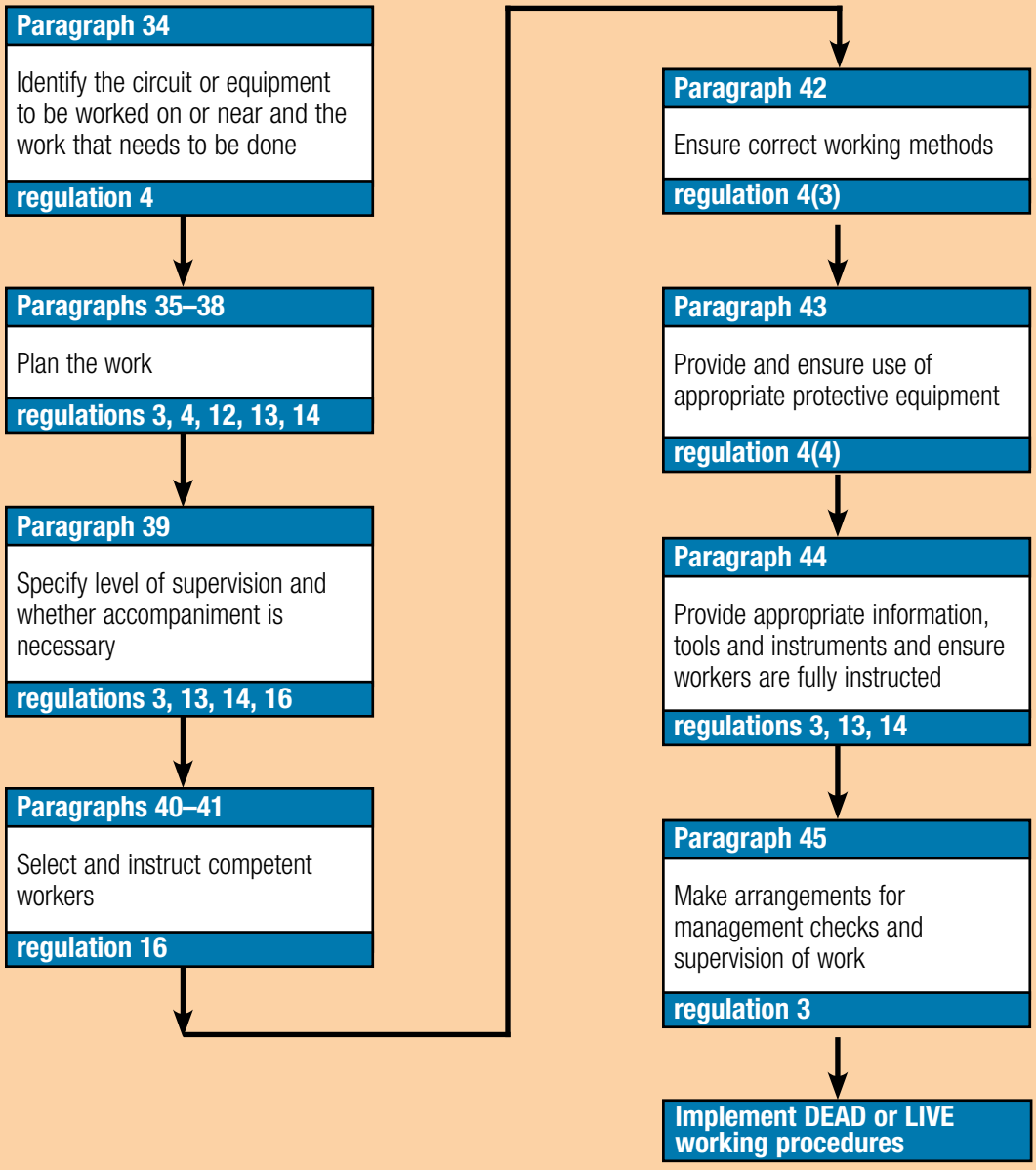
- installing temporary insulation, protective enclosures, or screens to prevent parts at different potentials being touched at the same time;
- using temporary barriers with warning notices affixed to keep unauthorised people away from the work area;
- ensuring that adequate clearances are established and maintained when working near to live equipment (see Appendix 3 of the Memorandum and Section 729 of BS 7671:2008 (+A1:2011) for information on clearances). For work near live overhead power lines, see GS6 *Avoiding danger from overhead power lines*;[13]

- making sure that workers understand the task and the system to be worked on (clarity of instructions is essential), are trained and experienced, and follow the correct procedures. They must be competent to realise their own limitations and know when to seek help;
- providing lighting and working space that is adequate and free from trip hazards. Further details on lighting at work can be found in HSG38 *Lighting at work*;[14]
- using robust and properly insulated tools (see BS EN 60900[15]);
- using test instruments with insulated probes and fused leads (see GS38 *Electrical test equipment for use by electricians*[16]);
- maintaining tools and test equipment in good condition and replacing them if damaged;
- storing tools correctly – horizontal surfaces and projections inside control cabinets should not be used – and ensuring that objects such as tools and bolts cannot fall onto exposed live parts;
- avoiding lone live working. Quick action is needed in the event of an electric shock to disconnect the supply and give assistance, so it will usually be necessary to be accompanied by someone who is competent to make the system safe and avoid injury;
- providing and using correct personal protective equipment (PPE) to reduce the risk of contact with live parts or earth, eg insulating gloves, insulating matting (see BS EN 61111:2009[17]). If there is a risk of burns from arcing or flashover that cannot be avoided, consider the use of adequately rated, thermally insulating, flame-resistant PPE (including face/eye protection). PPE should be frequently inspected and replaced if damaged. Requirements relating to PPE are covered by the Personal Protective Equipment at Work Regulations 1992.[18]

Actions common to both dead and live working

33 The actions common to both dead and live working are illustrated in Figure 3 and described below.

Figure 3 Planning and preparation for actions which are common to both dead and live working



Identify the circuit or equipment to be worked on or near and the work that needs to be done

34 These tasks should be carried out before the work starts. Factors that may affect the safe system of work should also be taken into account. In many cases, actual physical identification will be necessary and this may be aided by the use of appropriate drawings, diagrams and other written information. The features of equipment mentioned in paragraphs 8–17 should be taken into account.

Plan the work

35 Many electrical accidents are due to a failure to plan ahead. Planning should consider the management, supervision, implementation and completion of the work, and should lead to a formal system of work based on information in the safety rules and a task-specific risk assessment. In some instances, the planning requirements of the Construction (Design and Management) Regulations[19] will apply. You should consider the following:

- the work to be done;
- the hazards of the system or equipment to be worked on and the risks associated with the work;
- the people doing the work, their competence and the level of supervision necessary;
- the precautions to be taken and the system of work to be employed;
- the possibility that the nature of the work may change, eg a testing job may turn into fault finding.

36 There must be adequate information available about the electrical system and the work to be done. In the case of a newly constructed electrical system (or newly installed equipment), there should be drawings and schedules relating to the design and these should have been updated, if necessary, by the people carrying out the installation.

37 Records in the form of drawings and/or schedules should be kept for all but the most basic of installations. In the case of old installations where records may be poor, you should attempt to improve the records, eg by a combination of surveying, testing and labelling. However, when checking records before working on an installation it is unwise to rely solely on one source of information, eg a label. Labels should be securely fixed to equipment to clearly identify their function.

38 Electrical accidents often occur during fault-finding after a plant breakdown when pressure to repair the equipment results in risks being taken. To anticipate this, you should plan and establish safe fault-finding procedures to be implemented during breakdown maintenance.

Specify level of supervision and whether accompaniment is necessary

39 The planning process will have indicated the level of supervision required. An important factor to consider is the amount of training and experience workers have had to do the specific jobs – the less experienced or knowledgeable the worker is, including the level of familiarity with the system to be worked on, the greater will be the need for supervision. There will also be a greater need for supervision when working live. The need for accompaniment is also greater for live work, although it may still be necessary for some cases of working dead, especially if there are

adjacent live parts. The accompanying person should be trained to recognise danger, to switch off and, if necessary, to give assistance in the event of an emergency.

Select and instruct competent workers

40 Training as part of making a person competent is very important. Even the most highly qualified and capable people may not be competent to carry out specific types of work without suitable training. Competent workers will be self-disciplined and aware that reckless behaviour with electricity can lead to injury and death.

41 Those in control of the work should:

- assess the degree of competence of individual workers against the **specific** type of work to be done;
- provide clear instructions, information and adequate training for employees on:
  - the risks they may face;
  - the measures in place to control the risks, emphasising the safe system of work to be used;
  - how to follow emergency procedures;
- arrange for those being trained or those newly trained to be accompanied and supervised.

Ensure correct working methods

42 Managers and supervisors should ensure that workers understand the correct working methods, related to the specific work in hand. People doing the work should be aware of the limitations of that work and the constraints as to how they carry out the work. This includes recognising when it is unsafe to continue with the work and knowing how to deal with any contingencies that may arise.

Provide and ensure use of appropriate protective equipment

43 Managers, supervisors and workers have a responsibility to provide the protective equipment identified in the task-specific risk assessment and make sure that it is:

- suitable for the use for which it is provided;
- maintained in a condition suitable for that use; and
- used properly.

Provide information, tools and instruments and ensure workers are fully instructed

44 The workers must be supplied with and use correct and appropriate information, such as electrical drawings, tools, instruments.

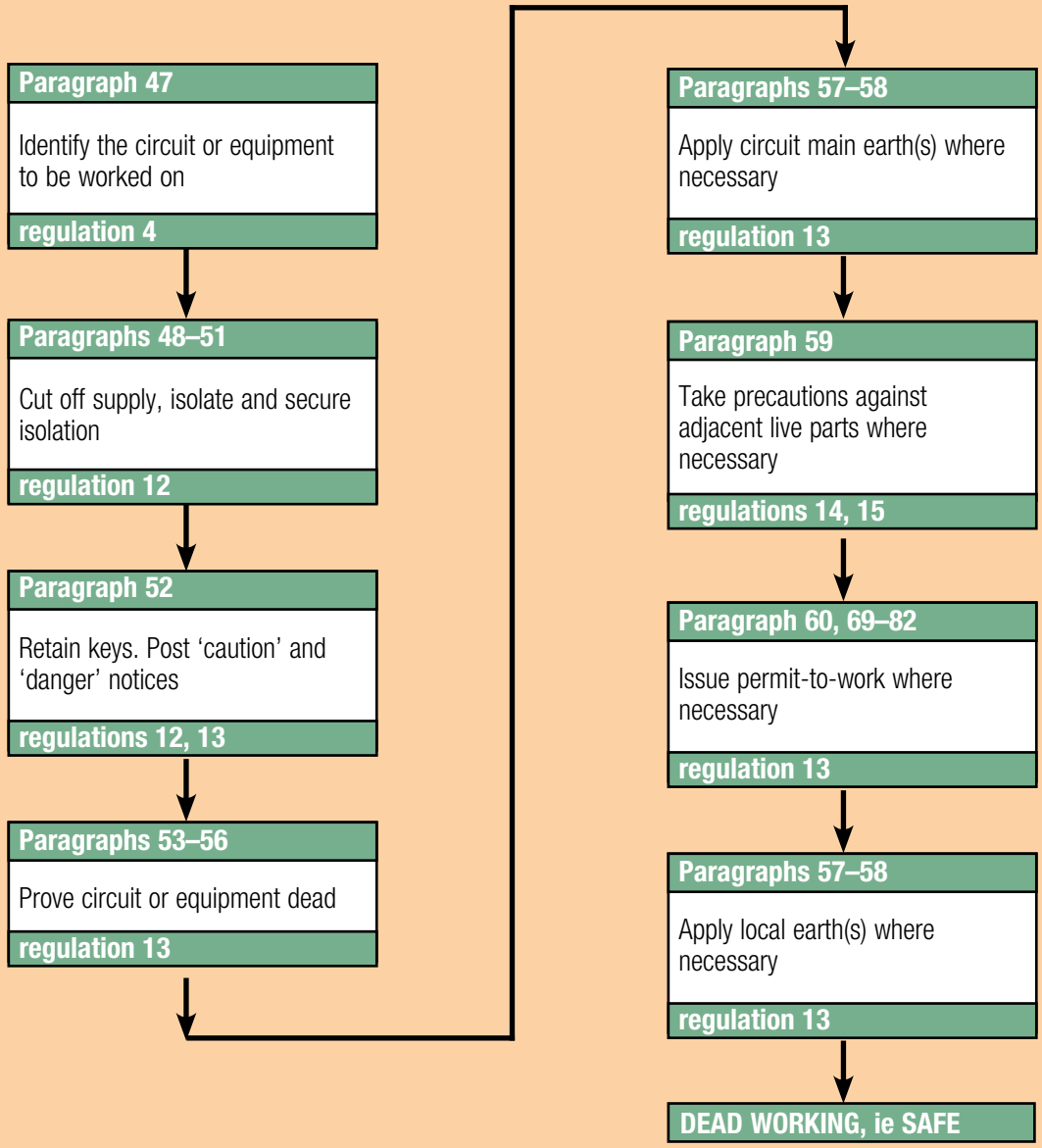
Make arrangements for management checks and supervision of work

45 Employers and workers must comply with the EAW Regulations in so far as they relate to matters within their control. You should check that workers are following the rules and correct procedures. Sometimes, some or all of these checks may be delegated to the supervisor of the work. Even in organisations with effective written safety rules and safe systems of work, regular and systematic management checks of the work are necessary. This is particularly important if the work is being done in the field, on another occupier's premises, or by peripatetic workers.

Working dead

46 While it is not always possible to follow a set procedure rigidly in every situation, the sequence illustrated in Figure 4 is recommended as a guide.

Figure 4 Dead working procedures



Identification

47 Adequate information should be supplied to identify equipment correctly (see paragraph 36). For most circuits and equipment correct labelling is important, but it should never be assumed that labelling is correct and that work can be started without having first proved that the equipment or circuit is dead. In some special cases, eg underground cables, cable-locating techniques using specialised instruments may be necessary and it may also be necessary to identify the cable both before and after switching operations and cable spiking.

Disconnection

48 Disconnect the equipment from every source of electrical energy before working on, or near, any part which has been live or is likely to be live. On equipment that is capable of storing charge, such as capacitors and high-voltage cables, ensure that any stored charge has been safely discharged.

Secure isolation

49 For adequate isolation, the disconnecting device should have an isolating gap sufficient for the voltage levels present or likely to occur. Make sure that any switch disconnector or other means of disconnection is secure. Switches, including circuit breakers, should be locked in the OFF position preferably using a 'safety' lock, ie a lock or padlock having a unique key or combination. Lockout devices that can be attached to the actuators of circuit breakers are available and should be used where appropriate. All keys should be retained in a secure place. If a plug has been withdrawn, make sure that it cannot be reconnected to the electrical supply while work is taking place on the circuits or apparatus – the use of proprietary lock-out devices for this purpose is encouraged.

50 If a fuse is removed, make sure that it or a similar one cannot be reinserted by taking it away or by locking the box or enclosure until work is completed. Some manufacturers produce lockable insulating blanks that you can insert in an empty fuseway. These prevent inadvertent fitting of a fuse while the associated circuit is being worked on.

51 If you rely on locking off where a number of people are working, the use of a multiple locking hasp attachment, lock-out box or key-safe may be appropriate to ensure that all the locks have to be removed before the equipment can be re-energised. Everyone involved in the work should apply a lock to the multiple locking hasp and keep personal possession of the key.

Post notices

52 You should put a notice or label at the place of disconnection so everyone else knows that work is being done. For example, a 'caution' notice can be used to indicate that someone is working on the apparatus and may be injured if it is re-energised, and 'danger' notices attached to live equipment adjacent to the place of work will indicate that the apparatus is still energised. Notices or labels should be easily understood by anyone in the area. You should remove labels or notices when they no longer apply so that the system does not fall into disrepute. It is often useful for the 'caution' and 'danger' notices to have a space for the name of the person responsible for the work and for the date.

Proving dead

53 Having isolated the circuit or equipment, and before working on it, check that the parts to be worked on or near really are dead, even if the isolation has been achieved automatically through an interlocking system. If it is a three-phase system or equipment with more than one supply, prove that all supply conductors are dead.

54 The instrument to do this should be properly constructed to protect against electric shock and designed to prevent short circuits occurring during use. For low voltages, proprietary voltage detectors such as two-pole voltage detectors, test lamps, or voltmeters with insulated probes and fused leads can be used (see HSE Guidance Note GS38). The use of multimeters, which can be set to the wrong function, is not recommended for proving dead on low-voltage systems, neither is the use of non-contact devices such as 'volt sticks' (note: in coal mines the use of appropriately certified non-contact devices is permitted).

55 It will be necessary to test the instrument before and after use. This may be done by means of a proving unit with a low power output. If live circuits are used to prove instruments, adequate precautions against electric shock and short circuits should be taken (see paragraphs 25–32). Training in the correct use of voltage detectors is essential to avoid risk in the event of unexpected use on a live conductor. All instruments used for checking circuits should be maintained and inspected frequently (note: in coal mines appropriately certified non-contact devices must be tested daily before they are taken underground).

56 Where underground cables cannot be positively identified and proved dead at the point of work, it may be necessary to spike the cable using a properly designed, cartridge-operated spiking gun.

Earthing

57 The risk to people if the above precautions fail can be minimised by securely earthing all the conductors using properly designed earthing devices or earthing leads, usually applied to all points where the circuit or equipment is isolated from the supply. Additional local earths at the point of work may also be necessary if this is remote from the point of isolation, but these should be applied only after proving dead at the point of work. This procedure is essential for high-voltage apparatus and stored energy equipment (eg capacitors). The earthing conductors and their connections should be suitable for the energy that may flow in the event of a failure of the above precautions.

58 Earthing low-voltage equipment is desirable if there is a risk of re-energisation, eg from a generator under someone else's control. In other low-voltage equipment, however, it may be physically impractical to apply earths, or the risk of short circuit from introducing an earth near adjacent live parts may outweigh the benefit of earthing the apparatus being worked on.

Adjacent parts

59 When the circuit or equipment to be worked on has been made dead or where the work is non-electrical, you must still protect against danger from inadvertent contact with other live parts nearby. This should preferably be done by erecting physical barriers and/or the use of temporary insulation and posting 'danger' notices. The requirements regarding adequate working space, access and lighting must also be met.

Additional procedures

60 On high-voltage systems (and often on high-energy systems) a permit-to-work should be issued but only after all the actions described in paragraphs 47–59 have been carried out. It is not common practice to issue permits-to-work for work on low-voltage systems but they should be considered if their use would contribute to safety in specific circumstances. (See paragraphs 69–84 for more information on permit-to-work systems.)

Extra precautions for high-voltage work

61 The following paragraphs apply to equipment and circuits operating at high voltage. They should also be applied to low-voltage installations where high fault power gives rise to a risk of serious burns. There are a few exceptional circumstances where high voltages will not give rise to danger, for example if the maximum possible current is reliably limited to a safe level (see PD 6519 Parts 1 and 2).

62 High-voltage equipment should be designed and installed so that it is not necessary to work on exposed live parts. However, it is commonly necessary for voltage checks or tests to be carried out, and for observations to be made from safe distances such as when carrying out phase rotation tests.

63 Because high voltages can arc across an air gap, you can suffer a shock or burn without touching live voltage parts. The dead working procedure in paragraphs 46–59 must therefore be followed. Isolation should be by means of a device that has a safe isolating gap between live parts and those that have been made dead for work to be carried out (see relevant British Standards). Earthing conductors at the point where the supply is disconnected are essential and additional earths may be necessary at the place of work.

64 The system of locking OFF while work is in progress should use safety locks which have unique keys so that the apparatus cannot be inadvertently re-energised. The keys should be retained in a key safe or other suitable place available only to the person in charge of the activity; see paragraphs 49–51. The precautions should be backed up with a disciplined documentation system; the electrical permit-to-work is an established system that has proved to work well in practice and is described in paragraphs 69–84.

65 Additional procedures will be necessary to adequately cover shift changes or work extending over long periods. It may also be necessary to have special rules or procedures for particular items of equipment and for particular working practices such as testing (eg it may be necessary to remove earths to facilitate testing under a clearly defined sanction-to-test procedure).

66 Precautions must be taken to prevent people approaching dangerously close to uninsulated high-voltage conductors. This will normally mean that any work on high-voltage equipment is undertaken only after all the precautions set out in paragraphs 47–54 have been taken. There are, however, some special situations where, by the use of appropriate tools, apparatus, and precautions, work on live high-voltage conductors may be permissible while the people involved are at a safe distance. Two examples are work on overhead conductors by DNOs or work on railways using long, specially designed, insulated tools.

67 Some transmission and distribution network operators carry out live, hands-on working on overhead conductors. For this type of work special vehicles, work

equipment, tools, clothing etc, together with exacting working methods, are necessary to ensure safe working. For all the special situations referred to, specific work procedures need to be devised and a very high degree of competence and discipline are essential for everyone involved. These special situations are not within the scope of this document.

68 Similar procedures may also be necessary if high-voltage apparatus is to be tested. In every case, the objective is to prevent anyone coming near to live, high-voltage conductors and the procedure should reflect this.

Electrical permits-to-work

69 A typical example of an electrical permit-to-work form is given in the Appendix. Further information is available in BS 6626 and BS 6867. 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. You must never issue an electrical permit-to-work for work on equipment that is still live or to authorise live work. The information it contains should be precise, detailed and accurate. It should state which equipment etc has been made safe, the steps by which this safety has been achieved, and exactly what work is to be done.

70 An electrical permit-to-work differs to the more general permit-to-work systems used in, for example, the petroleum and chemical industries (see HSG250 *Guidance on permit-to-work systems: A guide for the petroleum, chemical and allied industries*[20]). These more general permit-to-work systems are an integral part of safety management arrangements covering a wide range of activities and hazards. It is common for the requirement for an electrical permit-to-work to be identified through the application of a general permit-to-work system.

71 You should not allow anyone to work on equipment that is not specified in the electrical permit-to-work as having been made safe. This restriction should be understood and complied with by everyone in the premises, including directors and senior staff.

72 If a programme of work must be changed, the existing electrical permit-to-work should be cancelled and a new one issued before any variation is made to the work. The only person who has the authority to agree the change in programme and issue the new electrical permit-to-work is either the person who issued the original permit or the person nominated by management to take over the responsibility, eg at the end of a shift or during absence on leave.

73 An electrical permit-to-work should be issued by only a designated competent person (see paragraph 3) who has been assessed to be so by means of technical knowledge and/or experience and who is familiar with the system and equipment. The person should be authorised, in writing, by the employer to issue safety documents such as electrical permits-to-work relating to specified equipment or systems. Before issuing the permit, they should work out, in detail and in writing, what the various steps are to disconnect, isolate, prove dead, lock OFF, earth the equipment, post warning notices, and identify the equipment to be worked on and adjacent equipment which will still be live.

74 The electrical permit-to-work should state clearly:

- the person the permit is addressed to, ie 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;
- further precautions to be taken during the course of the work.

75 In most cases it is preferable to include a diagram on, or attached to, the permit confirming the above information and showing the zone for work.

76 It is strongly recommended that the electrical permit-to-work is issued at the place where the work is being done. The designated competent person issuing the permit should explain the work and agree the accuracy and completeness of the details with the person doing the work before they both sign the permit. The person issuing the permit must be sure that all necessary action has been taken to make the equipment safe. As a general rule, a personal inspection should be made but in geographically very large undertakings, such as the electricity supply industry, it may occasionally be necessary to make an exception to this.

77 In cases where there may be divided responsibility, roles must be defined to ensure there is no confusion over respective responsibilities, for instance:

- between a DNO and a dutyholder at the customer's premises, the electrical permit-to-work form should be countersigned by a person nominated in the joint ownership schedule or interface agreement and by the dutyholder for the premises; or
- where contractors may need to work on an occupier's system or equipment.

78 At the time the person in immediate charge of the operation accepts the permit they become responsible for ensuring that all the specified safety precautions are followed that:

- only permitted work is done; and
- the work is confined to the area defined in the permit.

79 If the permit is issued to the leader of a group, the leader accepts responsibility for the people in the group and should explain to them – before the work begins – the scope of work and the means by which safety has been achieved.

80 If the person issuing the electrical permit-to-work will also be doing the work, it is strongly recommended that someone else makes an independent check of the precautions taken. The person doing the work should then issue a permit to themselves. This routine helps to ensure that the full safety procedure is applied.

81 The recipient of an electrical permit-to-work should keep it for reference while the work is in progress and to prevent inadvertent cancellation and re-energisation of the equipment.

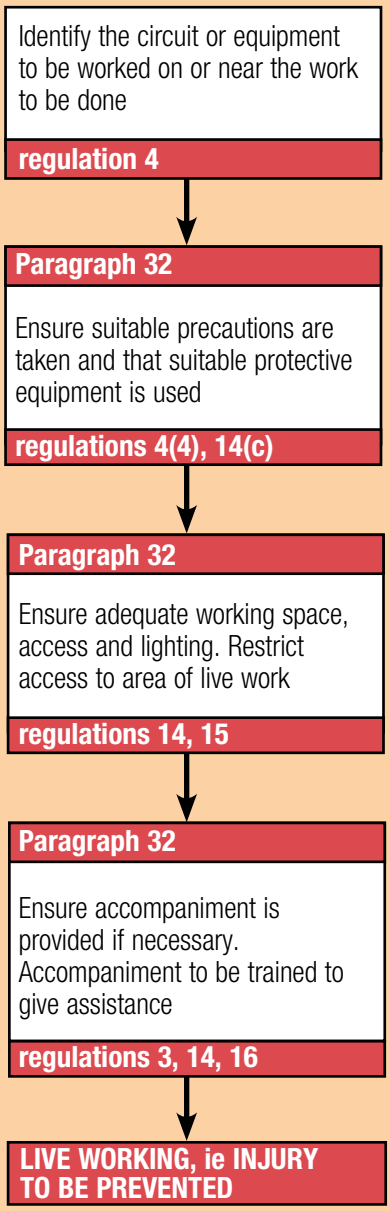
82 When the work is complete, whoever the permit was issued to should sign it to declare that any additional earths and tools have been removed and people in the group have been withdrawn and instructed not to approach the equipment again. The person clearing the permit should also indicate whether or not the equipment is fit for service. The permit is then returned, preferably to the designated competent person who originally issued it, for cancellation before the equipment is re-energised.

83 To reduce misunderstandings during suspension of work, it is better to cancel the original permit and issue a new one when required. The suspension of electrical permits-to-work is not generally recommended. Where this is necessary, it is essential to have a written procedure to ensure that tools and additional local earths are withdrawn and everyone is aware that the permit has been suspended.

84 Any electrical permit-to-work system should have a procedure for monitoring (audit) to ensure that the safety rules are followed and the documents are completed accurately. The monitoring should preferably be carried out by someone with managerial responsibilities, who is not involved in the day-to-day issuing of permits, and should be random and ongoing so that bad habits and inaccuracies can be identified and eliminated quickly.

Working live

Figure 5 Live working procedures



85 The procedures associated with live working are illustrated in Figure 5. While it is not always possible to follow rigidly a set procedure to cover all situations, you should follow the management principles described in this guidance and the safe system of work criteria set out in paragraphs 25–32.

86 The most common live working activity is testing, typically carried out as part of routine preventative maintenance, diagnostic testing, product testing, commissioning, or fault finding. Guidance on safety during electrical testing is available in INDG354 *Safety in electrical testing at work*.[21]

Appendix: Typical example of an electrical permit-to-work

1 Issue

To _____ in charge of this work.

I hereby declare that the following high-voltage apparatus in the area specified is dead, isolated from all live conductors and is connected to earth:

_____

_____

_____

Treat all other apparatus and areas as dangerous

The apparatus is efficiently connected to EARTH at the following points:

_____

_____

_____

The points of isolation are:

_____

_____

_____

CAUTION NOTICES have been posted at the following points:

_____

_____

_____

SAFETY LOCKS have been fitted at the following points:

_____

_____

_____

The following work is to be carried out:

_____

_____

_____

Diagram

Signed _____Time_____Date_____

Permit-to-work (front)

2 Receipt

I accept responsibility for carrying out the work on the apparatus detailed on this permit-to-work and no attempt will be made by me or by people under my charge to work on any other apparatus or in any other area.

Signed _____Time_____Date_____

Note: After signing the receipt, this permit-to-work should be retained by the person in charge at the place where the work is being carried out until work is complete and the clearance section is signed.

3 Clearance

The work for which this permit-to-work was issued is now suspended*/completed* and all people under my charge have been withdrawn and warned that it is no longer safe to work on the apparatus detailed on this permit-to-work.

All work equipment, tools, test instruments etc have been removed.

Additional earths have been removed.

*Delete words not applicable and where appropriate state:

The work is complete*/incomplete* as follows:

Signed _____Time_____Date_____

4 Cancellation

This permit-to-work is cancelled.

Signed _____Time_____Date_____

Permit-to-work (back)

References

1 *Memorandum of guidance on the Electricity at Work Regulations 1989. Guidance on Regulations* HSR25 HSE Books www.hse.gov.uk/pubns/books/hsr25.htm

2 *The use of electricity in mines. Electricity at Work Regulations 1989. Approved Code of Practice* L128 HSE Books www.hse.gov.uk/pubns/books/l128.htm

3 PD 6519-2:1988 *Guide to effects of current on human beings and livestock. Special aspects relating to human beings* British Standards Institution (IEC 60479 Part 2), DD IEC/TS 60479-1:2005 *Effects of current on human beings and livestock. General aspects* British Standards Institution

4 BS 7671:2008 (+A1:2011) *Requirements for electrical installations. IET Wiring Regulations. Seventeenth edition* British Standards Institution (available from the Institution of Engineering and Technology (IET))

5 *Dangerous Substances and Explosive Atmospheres. Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved Code of Practice and guidance* L138 HSE Books www.hse.gov.uk/pubns/books/l138.htm

6 *Prevention of fire and explosion and emergency response on offshore installations. Offshore Installations (Prevention of Fire and Explosion, and Emergency Response) Regulations 1995. Approved Code of Practice and guidance* L65 HSE Books www.hse.gov.uk/pubns/books/l65.htm

7 *Keeping electrical switchgear safe* HSG230 HSE Books www.hse.gov.uk/pubns/books/hsg230.htm

8 *A design guide for the electrical safety of instruments, instrument/control panels and control systems* EEMUA PUB No 178 (Second edition) Engineering Equipment and Materials Users Association 2009

9 BS 6423 *Code of practice for maintenance of electrical switchgear and controlgear for voltages up to and including 1 kV* British Standards Institution

10 BS 6626:2010 *Maintenance of electrical switchgear and controlgear for voltages above 1 kV and up to and including 36 kV. Code of practice* British Standards Institution

11 BS 6867:1987 *Code of practice for maintenance of electrical switchgear for voltages above 36 kV* British Standards Institution (New edition due for publication in 2013)

12 *Controlling the risks* www.hse.gov.uk/toolbox/managing/managingtherisks.htm

13 *Avoiding danger from overhead power lines* General Guidance Note GS6 (Fourth edition) HSE 2013 www.hse.gov.uk/pubns/gs6.htm

14 *Lighting at work* HSG38 HSE Books 1998
www.hse.gov.uk/pubns/books/hsg38.htm

15 BS EN 60900:2012 *Live working. Hand tools for use up to 1000 V ac and 1500 V dc* British Standards Institution

16 *Electrical test equipment for use by electricians* General Guidance Note GS38
www.hse.gov.uk/pubns/gs38.htm

17 BS EN 61111:2009 *Live working. Electrical insulating matting* British Standards Institution

18 *Personal protective equipment at work (Second edition). Personal Protective Equipment at Work Regulations 1992 (as amended). Guidance on Regulations* L25 HSE Books www.hse.gov.uk/pubns/books/l25.htm

19 *Managing health and safety in construction. Construction (Design and Management) Regulations 2007. Approved Code of Practice* L144 HSE Books
www.hse.gov.uk/pubns/books/l144.htm

20 *Guidance on permit-to-work systems: A guide for the petroleum, chemical and allied industries* HSG250 HSE Books www.hse.gov.uk/pubns/books/hsg250.htm

21 *Safety in electrical testing at work* Leaflet INDG354
HSE www.hse.gov.uk/pubns/indg354.htm

Further reading

HSE publications

Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of Practice and guidance L22 HSE Books www.hse.gov.uk/pubns/books/l22.htm

Avoiding danger from underground services HSG47 HSE Books www.hse.gov.uk/pubns/books/hsg47.htm

Electrical safety at places of entertainment General Guidance Note GS50 HSE www.hse.gov.uk/pubns/gs50.htm

Maintaining portable and transportable electrical equipment HSG107 HSE Books www.hse.gov.uk/pubns/books/hsg107.htm

Managing for health and safety www.hse.gov.uk/managing

Further information

For information about health and safety, or to report inconsistencies or inaccuracies in this guidance, visit www.hse.gov.uk/. You can view HSE guidance online and order priced publications from the website. HSE priced publications are also available from bookshops.

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This guidance is available at: www.hse.gov.uk/pubns/books/hsg85.htm.