GUIDANCE

Electricity at Work

(Jersey) Regulations 1983

GUIDANCE

Electricity at Work

(Jersey) Regulations 1983

Contents

Foreword

Whilst there have been no changes to the Electricity at Work (Jersey) Regulations 1983, this revised guidance has been published because it is recognised that the previous version is out dated and no longer reflects recognised standards of good practice in the electrical field.

Electricity can kill or severely injure people and cause damage to property. Those using or working with electricity are not the only people at risk – poor electrical installations and faulty electrical appliances can lead to fire, which may also cause death or injury to others.

This guidance focuses on the need for all those who use, or carry out work on or near electrical equipment to be aware of the relevant electrical safety measures that should be taken to significantly reduce the risk of electrical injury to themselves and others.

By revising the guidance in 2016, it is hoped it will act as a catalyst for continued improvements in electrical health and safety in the workplace. It takes into account the technological advances in equipment and safe working practices, as well as UK and European Standards and procedures that have been updated and become accepted as industry good practice, since the previous guidance was published.

Tammy Fage

Director of Health and Safety

Introduction

What do the Regulations seek to achieve?

The Electricity at Work (Jersey) Regulations 1983, (the Regulations) came into force on 1 February 1984, and were amended in 1997. The Regulations aim to provide a flexible but comprehensive framework of legal requirements to prevent danger during the use of electricity in all places of work, including domestic situations where persons are employed to carry out work.

They apply to all electrical systems and equipment (as defined) and deal with the selection and installation of equipment, its use, systems of work and the competence of persons carrying out such work; setting safety standards to be achieved in each case without inhibiting technological development.

Who is the guidance for?

This guidance provides advice for those who have duties under the Regulations including employers, the self-employed, employees and persons having, to any extent, control of premises, plant or substances.

The aim is to provide guidance for those who control or influence the design, specification, selection, installation, commissioning, maintenance or operation of electrical equipment, and highlight the nature of the precautions required, in general terms, to help duty holders achieve high standards of electrical safety in compliance with the duties imposed.

How should the guidance be used?

This guidance sets out the Regulations and provides practical, technical and legal advice on how to comply with them.

In this publication each Regulation is highlighted on a yellow background followed by the guidance pertaining to that Regulation.

The guidance is not an authoritative interpretation of the Regulations, however, and does not take the place of the actual Regulations themselves. Whilst every care has been taken in the preparation of this publication, the States of Jersey cannot accept any responsibility in Law for its contents as any interpretation of the Regulations will ultimately be a matter for the Courts.

The Electricity at Work (Jersey) Regulations 1983, reference 05.300.70, may be viewed on the official website of the Jersey Legal Information Board: www.jerseylaw.je

Further advice on specific matters may be sought from the Health and Safety at Work Inspectorate, Social Security Department.

Use of standards

The Institution of Engineering and Technology (IET) and British Standards Institution (BSI) 'Requirements for electrical installations' (the IET Wiring Regulations), British Standard

BS 7671, is a widely recognised code of practice, both in the UK and Jersey. Compliance with this standard is likely to achieve compliance with the relevant requirements set out in the 1983 Regulations.

It should be noted, however, that there are types of electrical systems, equipment and hazard to which BS 7671 is not applicable, for example systems for public electricity supply, equipment on vehicles and installations operating at voltages greater than 1000 volts or 1500 volts ac.

There exist many codes of practice written by standards-making authorities, trade associations and other bodies setting out standards and procedures applicable to particular industries, processes or hazards. Such codes may provide useful, detailed expansion of the guidance in this publication but it must be borne in mind how and by whom these codes have been drawn up.

Where electrical equipment predates the Regulations, this does not in itself mean that the continued use of the equipment would be in contravention of the Regulations but ultimately compliance with the Regulations is required. It is likely to be reasonably practicable to replace it with equipment made to a more recent standard when it becomes unsafe or falls due for replacement other than for safety reasons, whichever occurs sooner.

Regulations

Regulation 1:
Interpretation

In these Regulations, unless the context otherwise requires -

'**conductor'** means a conductor of electrical energy and includes any metal work or any other electrically conducting material;

'danger' means danger of death or personal injury from electric shock or burn, or from fire, arcing or explosion, attendant upon the generation, transformation, conversion, distribution, control, storage or use of electrical energy;

'electrical equipment' means anything used, or installed for use, to generate, transform, convert, distribute, control, store or use electrical energy;

'personal injury' includes any disease and any impairment of a person's physical or mental condition;

'responsible person' shall be construed in accordance with Regulation 3;

'system' means an electrical system comprising electrical equipment to which these Regulations apply whose conductors are arranged so that they may be connected to a source of electromotive force arranged to supply electrical energy for that system or connect a source of electromotive force to that system.

Regulation 1 sets out the various definitions that apply for the purpose of the Regulations.

A **conductor** is any substance which will conduct electricity. Such a substance may be a solid, liquid or a gas; it may be a conductor in one state and a non-conductor in another state, e.g. molten glass conducts electricity, solid glass does not.

Danger means the risk of death or personal injury from electric shock or burn, or from fire, arcing or explosion, where any such death or injury is associated with the generation, transformation, conversion, distribution, control, storage or use of electrical energy. Dangers include:

> **Electric shock** is perhaps the most widely recognised danger of electricity, the human body responds in several ways to electrical current flowing through it. The sensation of shock is only one such effect and this can be extremely painful. When a shock is received, the electric current may take multiple paths through the body and its intensity at any one point is difficult or impossible to predict. The passage of electric current may cause muscular contractions, respiratory failure, and fibrillation

of the heart, cardiac arrest or injury from internal burns. Any of these can be fatal.

An electric shock may be received by either direct or indirect contact. The former involves contact with an exposed current-carrying (live) conductor; the latter arises through contact with a conductor, such as the metal casing of electrical equipment which, although normally expected to be at around earth potential, has inadvertently become live through a fault condition.

The nature and severity of injury depends mainly upon the magnitude and duration of the current flow through the body, but also, in the case of alternating current, on its frequency. It is not possible to identify precise thresholds for the existence of hazard because a judgement has to be made in each case taking all the circumstances into account such as body weight, physical condition of the victim and so forth. Quite low currents, of the order of only a few milliamps (mA), can cause fatal electric shock.

Factors which mainly influence the likely effect of shock current are its voltage, frequency and duration and any impedance in the current path. The effects of electric shock are most acute at about the public electricity supply frequency of 50 hertz. Susceptibility to electric shock is increased if a person is in good electrical contact with earth, such as in damp or wet conditions or in conducting locations such as inside a metal tank. Hot environments where people may become damp due to perspiration or humidity, thus reducing the insulation protection offered by clothing, may present an increased risk from electric shock.

The variability of conditions makes it impossible to specify a voltage which is guaranteed to be safe in all situations. The risk of injury from electric shock in any situation must be considered against the background of the various national and international standards and technical publications giving guidance as to the voltages and other factors which have been found by extensive experience to be safe. These documents must be interpreted carefully and with a view to the limitation of their various scopes and assumptions. However, the conventional public electricity supply voltage of 230 volts ac should always be considered as, potentially, fatally dangerous. Many fatal electric shock accidents have occurred from contact with conductors live at this voltage and possibly the most dangerous situation is where contact is made with conductors by each hand, current then flowing ‘hand to hand’ across the heart region.

Electric burns are different from burns due to fire, arcing or explosion. Electric burns are due to the heating effect caused by the passage of electric current through body tissues. They are most commonly associated with electric shock and are characterised by burn marks on the body at the points of entry and exit of the current. Whilst being confined to a relatively small surface area of the body, electric burns are usually deep-seated, painful and very slow to heal. Permanent scarring is common.

Fires of an electrical origin may be started by electricity in a number of ways. The principal mechanisms are:

- overheating of cables and electrical equipment due to overloading of conductors;
- leakage currents due to poor or inadequate insulation;

- overheating of flammable materials placed too close to electrical equipment which is otherwise operating normally; and
- the ignition of flammable materials by arcing or sparking of electrical equipment, including the scattering of hot particles from electrical equipment.

The injuries associated with fire are usually burns but may include other injuries such as smoke inhalation.

Arcing causes a particular type of burn injury which is distinct from other types. Arcing generates ultra violet radiation which causes damage similar to severe sunburn. Molten metal particles from the arc itself can penetrate, burn and lodge in the flesh. These effects are additional to any radiated heat damage caused by the arc.

On its own, ultra violet radiation can cause damage; sensitive skin and eyes are especially vulnerable to arc flash. ('Arc eye' is commonly encountered with electric arc welding if the proper precautions are not adopted.)

Arcing faults can occur if the energy available at a piece of electrical equipment is sufficient to maintain a conductive path through the air or insulation between two conductors which are at different potentials. Under fault flashover conditions, currents many times the nominal rating or setting of a protective device may flow before the circuit protection safely disconnects the incoming supply. Arc flashovers caused during work on live circuit conductors are likely to be particularly hazardous because the worker is likely to be very near to or even enveloped by the arc. Such an accident is characterised by extensive burns to the face, arms and chest, with the body being splattered with specks of molten metal. This type of accident often proves fatal within a few days from the effects of the extensive burns to the body rather than immediately due to an electric shock.

Explosions can have a direct electrical basis or be caused by ignition from an electrical source. Electrical explosions include the violent and catastrophic rupture of any electrical equipment. Switchgear, motors and power cables are liable to explode if they are subjected to excessive currents, which release violent electromagnetic forces and dissipate heat energy, or if they suffer prolonged internal arcing faults. Explosions, whose source of ignition is electrical, include ignition of flammable vapours, gases, liquids and dusts by electric sparks, arcs or the high surface temperature of electrical equipment.

The Regulations only seek to prevent injury from direct electrical causes, e.g. due to contact with a live conductor or through inadvertently causing a short circuit. The electrical contact may lead to an accident of a different type, however; for example, a minor electric shock received whilst working from a ladder may result in loss of balance and a fall from height. Although any secondary injuries are outside the scope of the Regulations, the Law and potentially other prescriptive Regulations do cover such incidents.

Electrical equipment includes every type of electrical equipment from, for example, a 400 kV overhead line to a battery-powered hand lamp. It is appropriate for the Regulations to apply even at the very lowest end of the voltage or power spectrum as the Regulations are designed to protect against electrical situations where danger may arise. For example,

explosion risks may be caused by very low levels of energy igniting flammable gases even though there may be no risk of electric shock or burn.

Electrical equipment (as defined) includes conductors used to distribute electrical energy such as cables, wires and leads and those used in the transmission at high voltage of bulk electrical energy.

Personal injury includes any impairment of a person's physical or mental condition and ill health.

Responsible person is explained in the guidance on Regulation 3.

A **system** means all parts of an electrical system including all of the electrical equipment connected together and the various electrical energy sources in that system. A system can be fixed, for example the fixed electrical installation in a building, or portable, for example a generator used on a construction site. Self-contained portable systems, such as portable generating sets, are electrical systems for the purpose of the Regulations.

The definition extends to include equipment which, although not energised, is readily capable of being made live by the system. For example, a lighting system which has been disconnected from its source of electrical energy by removing the fuses is still part of that system.

The definition includes all the constituent parts of a system, for example, conductors and electrical equipment in it, and is not a reference solely to the functional circuit as a whole. It follows that something required of a system is required both of the system as a whole and of the equipment and conductors in it.

Regulation 2:
Application of Regulations

These Regulations apply to any system -

(a) on any premises on which employees are employed, or any part thereof;

(b) in any machinery or plant used by employees; or

(c) in any process or description of manual labour used by employees.

The Regulations apply to any electrical system (as defined in Regulation 1)

- in a workplace
- in any machinery or plant used by employees
- in any working activity undertaken by employees

The term “plant” is defined in the Health and Safety at Work (Jersey) Law, 1989, and includes any machinery, equipment or appliance.

Regulation 3:
Duties of the responsible person

(1) It shall be the duty of every –

(a) employer;

(b) self-employed person; and

(c) person having to any extent control of premises, plant or substances,

to observe these Regulations in so far as they relate to matters within his or her control, and references to the "responsible person" shall be construed accordingly.

(2) For the purposes of paragraph (1)(c), a person who has by virtue of any contract or tenancy an obligation to any extent in relation to the –

(a) maintenance or repair of any premises; or

(b) safety of or absence of risks to health arising from any plant or substances,

shall be treated as being a person who has control of the matters to which the person's obligation extends.

The Regulations place responsibilities on the 'responsible person' to ensure the Regulations are complied with. The 'responsible person' can be an employer, a self-employed person and/ or somebody having control over premises, plant or substance.

When a person has a contractual responsibility to maintain or repair premises, or ensure the safe use of plant or substances, they will be considered the 'responsible person' to the extent to which they have control.

The duties of the 'responsible person' are very wide and there is little room for the 'responsible person' to delegate those duties to anybody else.

In view of the dangers presented by electricity and the serious and potentially fatal consequences of an electrical accident, it is essential that all those holding responsibility for electricity at work matters has the appropriate level of competence to ensure the minimum requirements are being met.

In most cases, a 'responsible person' will need to seek the assistance of a competent electrical engineer, who has the appropriate level of technical knowledge, experience, skills and capability relevant to the electrical system in question, to assist them to meet their legal obligations.

Regulation 4:
Duties of employees

It shall be the duty of every employee –

(a) to conduct the employee's work in accordance with these Regulations; and

(b) to report as soon as possible to the employee's employer, foreman or supervisor, any defect which the employee discovers in a system to which these Regulations apply.

Regulation 4 reinforces the duties placed on employees under Article 4 of the Health and Safety at Work (Jersey) Law, 1989.

All employees must work in such a way as to not expose themselves, or anybody else who could be affected by the way they work, to electrical danger. They must also report any electrical defects or concerns that they identify during the course of their work to a senior person.

The extent to which an employee is expected to go to meet the duties imposed by this Regulation will depend on the level of 'control' and responsibility they have over the electrical safety matter in question.

For example, an employee employed within the electrical profession and carrying out work on an electrical system, would be expected to have a far greater level of competence and understanding in electrical safety and safe working practices than a labourer working on a construction site. However, the latter would still be expected to be able to identify the risk associated with the use of a portable drill with a damaged power cord, take the equipment out of use and report the damage to his supervisor.

Regulation 5:
Systems not to give rise to danger

(1) Systems to which these Regulations apply shall be constructed, installed, and where necessary, protected, commissioned and tested, so as to prevent danger so far as is reasonably practicable.

(2) Systems to which these Regulations apply shall be –

  (a) maintained in an efficient state, efficient working order and good repair so as to prevent danger so far as is reasonably practicable;

  (b) operated and used so as to prevent danger so far as is reasonably practicable.

(3) Where electrical equipment to which these Regulations apply is to be dismantled or demolished such dismantling or demolition shall be done in such a manner as to prevent danger so far as is reasonably practicable.

The duty imposed by **Regulation 5** is very extensive and generally covers those aspects of electrical systems and equipment, and work on, or near these, which are fundamental to electrical safety.

The word "constructed" in **Regulation 5(1)** has a wide application. It covers the physical condition and arrangement of the components of an electrical system at any time during its life. It will include aspects such as the design of the system and the equipment comprising that system.

In assessing the suitability of the construction of electrical systems, consideration should be given to all likely or reasonably foreseeable conditions of actual application or use of the electrical equipment in the system. This will include the testing, commissioning, operation and maintenance of the equipment throughout the life of the system.

In particular, consideration should be given to:

- the manufacturer's assigned or other certified rating of the equipment;
- the likely load and fault conditions;
- the need for suitable electrical protective devices;
- the fault level at the point of supply and the ability of the equipment and the protective devices to handle likely fault conditions;

- any contribution to the fault level from the connected loads such as from motors;
- the environmental conditions which will have a bearing on the mechanical strength and protection required of the equipment;
- the user's requirements of the installation;
- the risks that a system may create to adjacent work activities and the public;
- the manner in which commissioning, testing and subsequent maintenance or other work may need to be carried out.

The safety of a system depends upon the proper selection of all the electrical equipment in the system and the proper consideration of the inter-relationship between the individual items of equipment. For example, electrical protection against overloads and earth faults etc. may need to be provided in one part of a system to protect another, possibly remote part of the system.

The duty under **Regulation 5(2)** to, so far as is reasonably practicable, maintain the electrical system in an efficient state, efficient working order and good repair to prevent danger, is on-going.

Regular maintenance and testing of all electrical systems is essential since if the system deteriorates then it may cease to be of safe construction and a breach of Regulation 5 will occur.

Regulation 5(2) also requires that work activities of any sort, whether directly or indirectly associated with an electrical system, should be carried out in a way which, as far as is reasonably practicable, does not give rise to danger.

Maintenance

A preventative maintenance programme should be available for an electrical system. This should be sufficient to ensure, so far as is reasonably practicable, the prevention of danger, and include inspection, and where necessary, testing of equipment. British Standard, BS 7671 and associated Codes of Practice provide practical guidance in this area.

Inspection and testing: Regular inspection of the electrical system is an essential part of any preventive maintenance programme. The frequency of these inspections and, where necessary, testing, will depend on the type of electrical equipment, how it is used and the environment in which it is used.

The appropriate frequency should be determined by a competent person, with the requisite knowledge and training.

Records of maintenance, including test results, preferably kept throughout the working life of an electrical system will enable the condition of the equipment and the effectiveness of maintenance policies to be monitored. Without effective monitoring, duty holders cannot be certain that the requirement for maintenance has been complied with.

Portable electrical appliances: The duties imposed by Regulation 5 apply to portable electrical appliances, for example tools and extension leads, floor cleaners, electric kettles etc., as well as fixed and transportable electrical systems.

However, the widely held myth that all portable appliances require annual inspection and testing is incorrect. The frequency of these inspections and, where necessary, testing, will depend on the type of electrical equipment, how it is used and the environment in which it is used.

Specific guidance on maintaining portable electrical equipment is published separately by the Health and Safety at Work Inspectorate.

Work activities associated with electrical systems

Regulations 14 to 18 provide more specific requirements in connection with work of an electrical nature on or near electrical systems.

In the case of work of an electrical nature it is preferable that the conductors be made dead before work starts. In such cases, it is essential that the equipment be isolated and the conductors proved dead at the point of work before the work starts.

Safe systems of work incorporating safety isolation procedures are important for work on equipment which is to be made dead before work starts. These are also discussed under Regulations 14 and 15.

Some work, such as fault finding and testing, or live jointing by the electricity supply industry, may require electrical equipment to remain energised during the work. In these cases, Regulation 17 makes particular requirements.

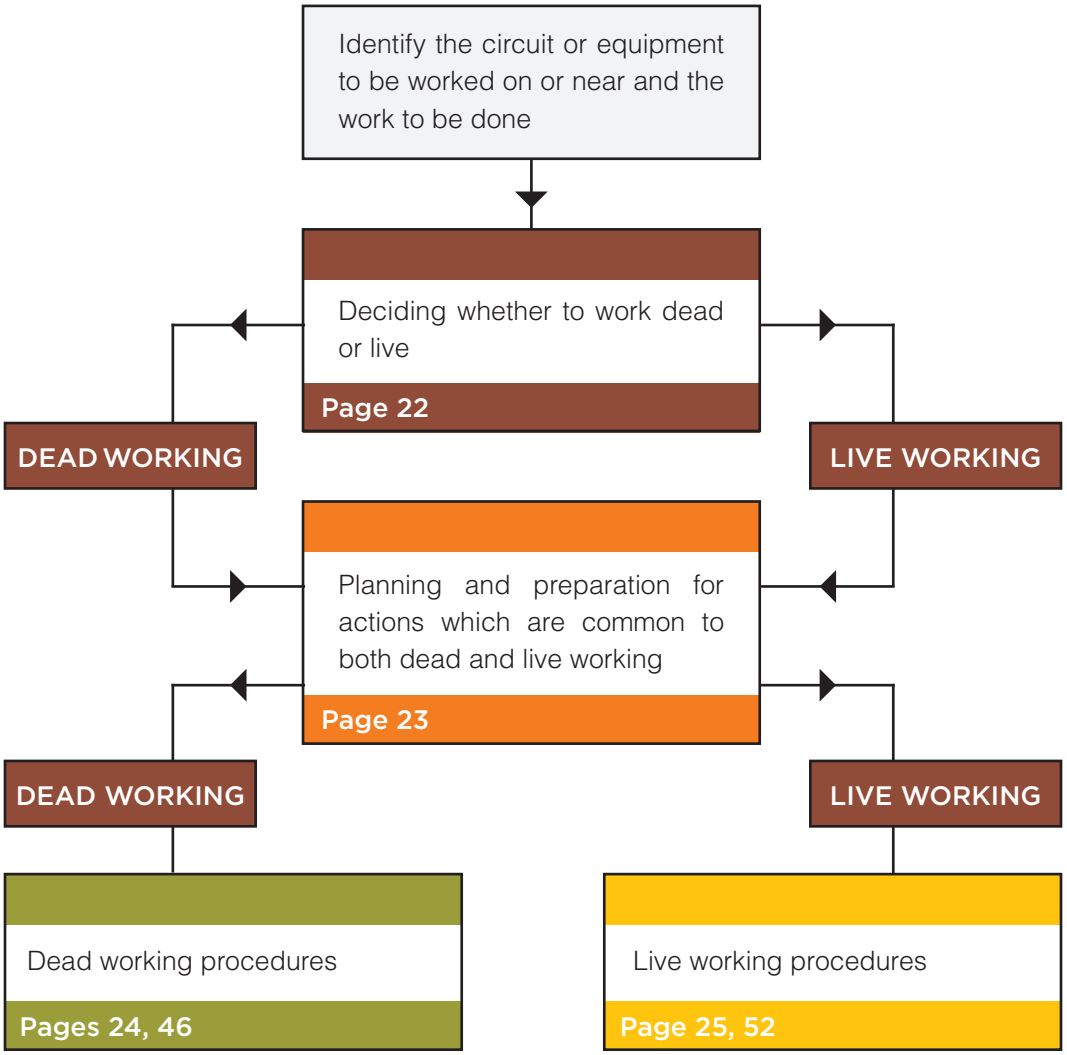
The operation, maintenance and testing of electrical systems and equipment should be carried out only by those people who are competent for the particular class of work (see also Regulation 16).

Regulation 5(3) requires electrical equipment to be disconnected from all sources of supply and isolated before it is decommissioned, dismantled or abandoned for any reason. Isolation requires taking effective steps to ensure that it is dead and cannot become inadvertently re-energised or charged by induction or capacitance effects. Suitable labels, markings or notices to bring people's attention to the state of the equipment are likely to be necessary in preventing inadvertent re-energisation (see also Regulation 15).

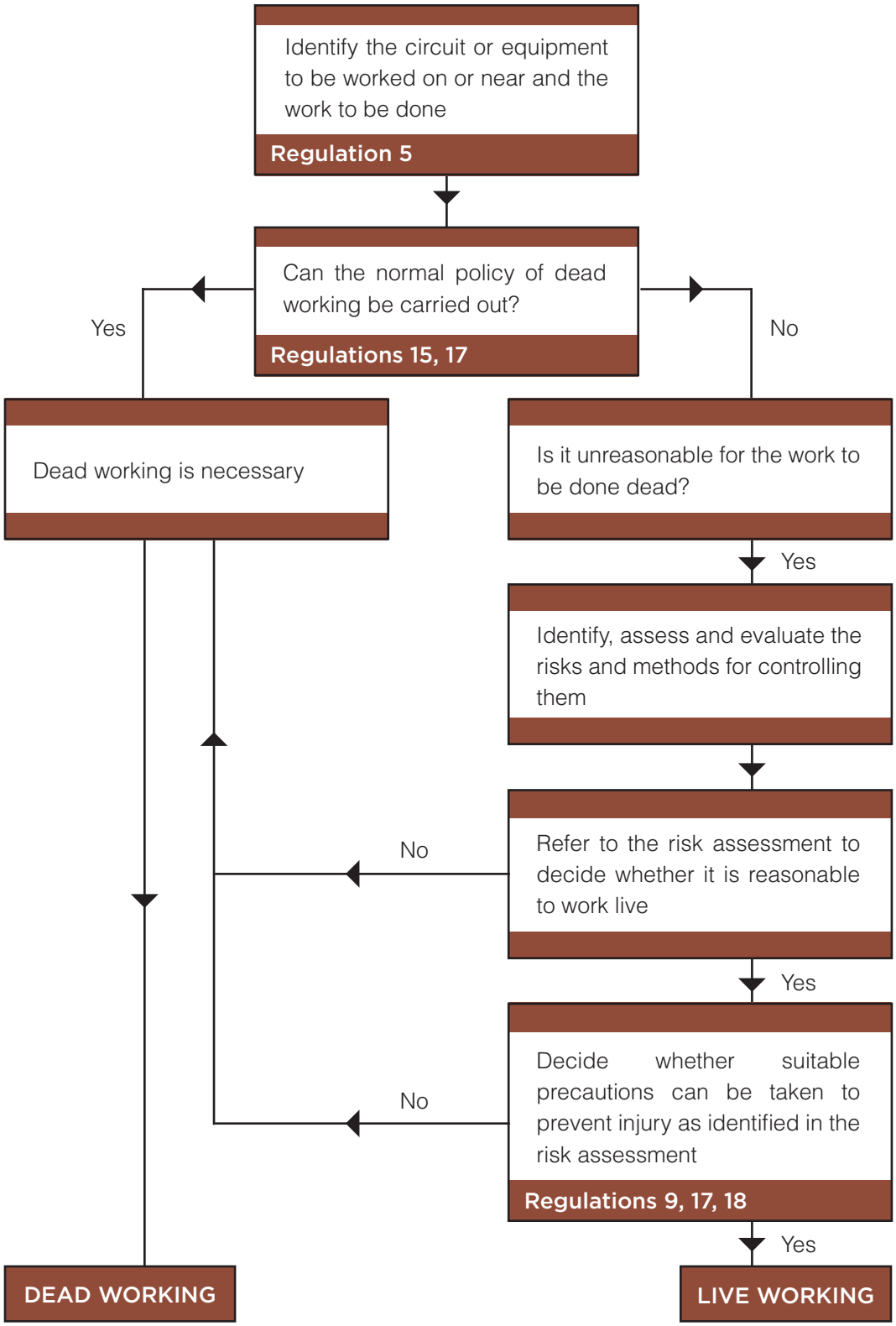
Safe working practices

The flow chart below illustrates the sequence of the planning steps. The procedure can be divided into four stages:

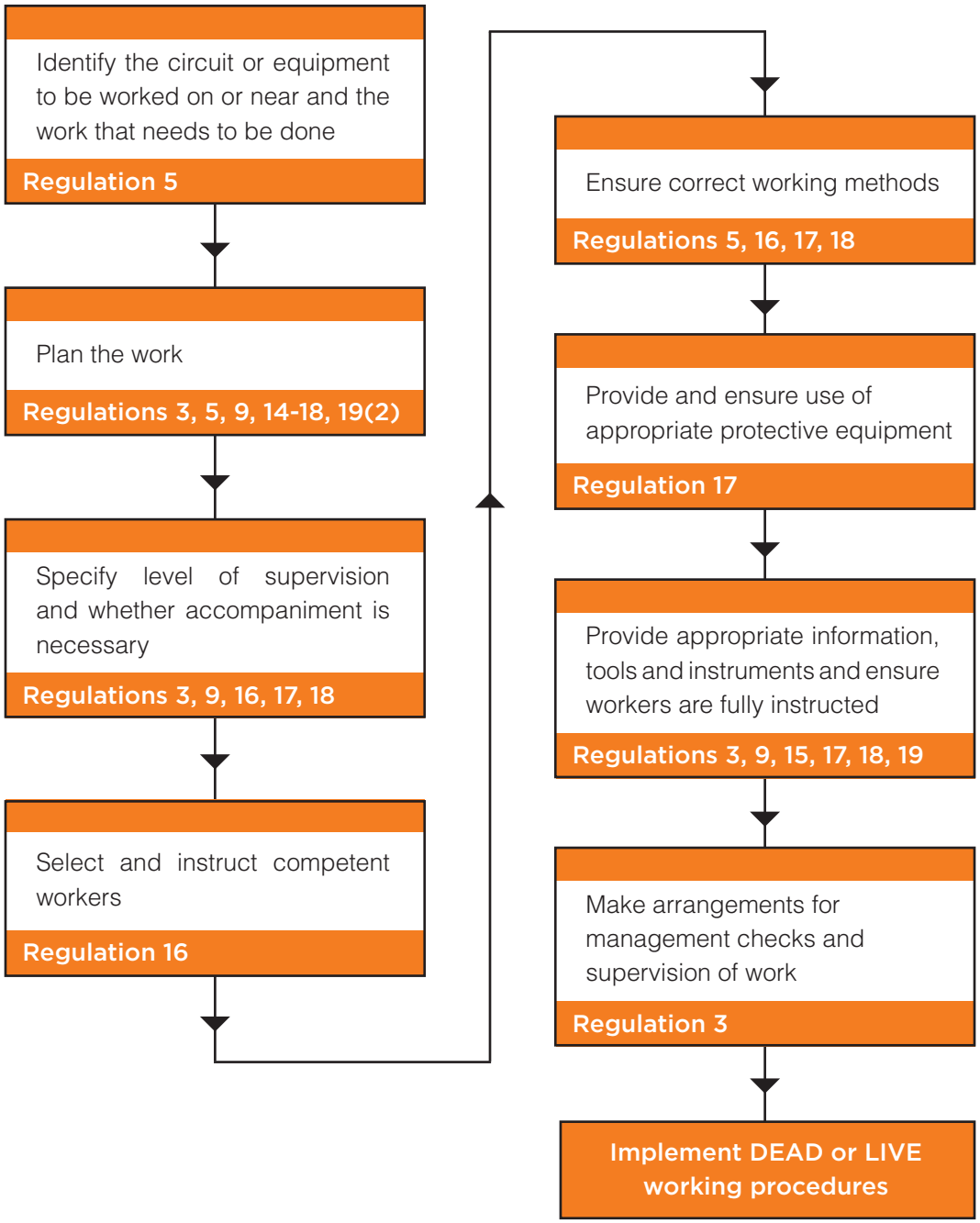
- deciding whether to work dead or work live (coloured brown)
- planning and preparation for actions which are common to both dead and live working (coloured orange)
- procedures for working dead (coloured green)
- procedures for working live (coloured yellow)



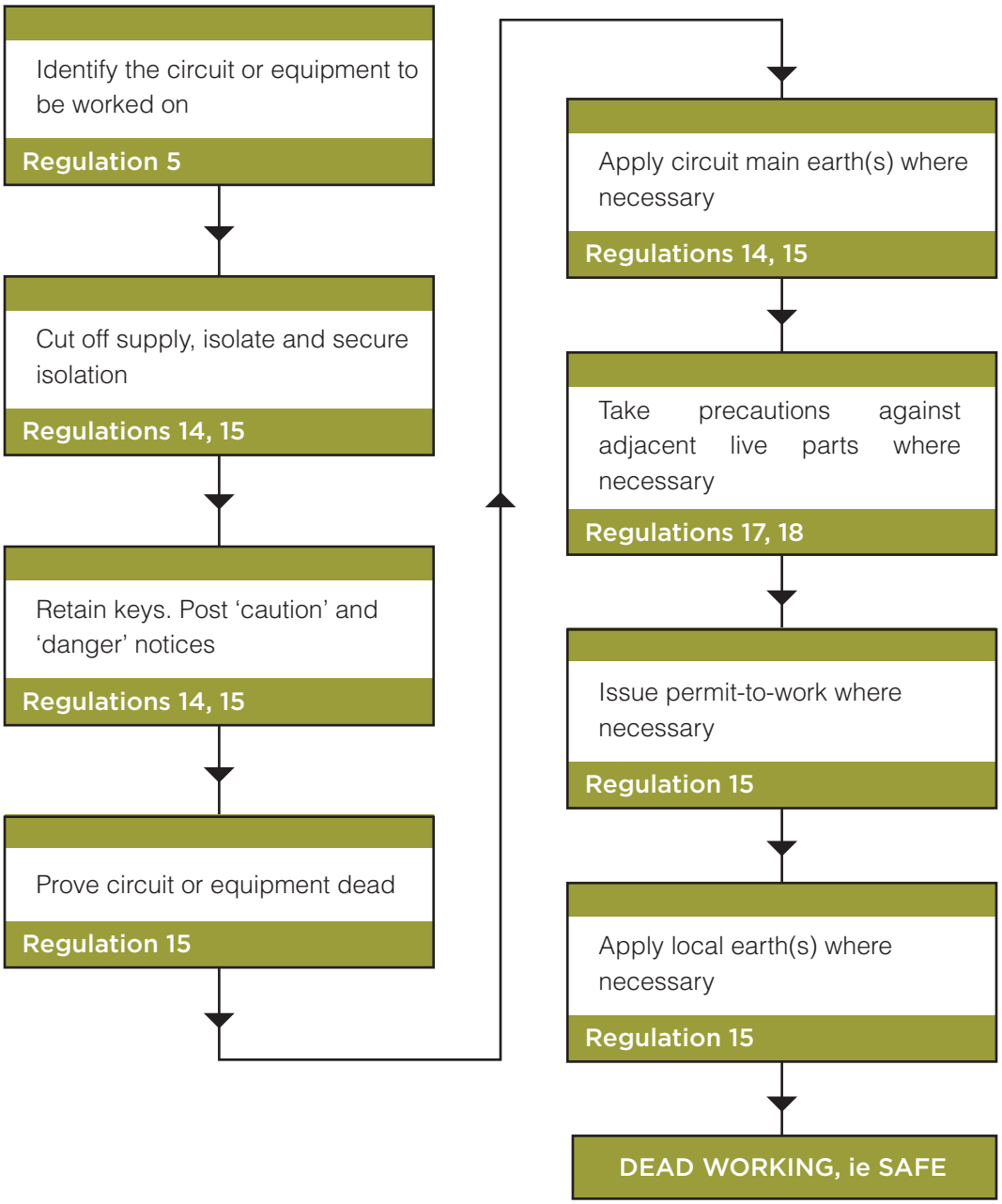
Deciding whether to work dead or live



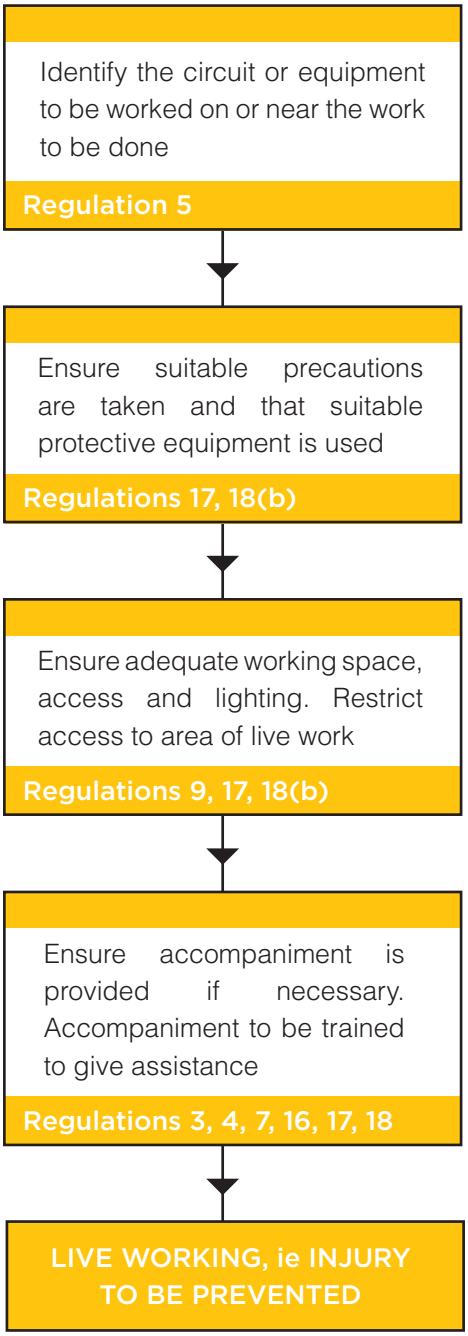
Planning and preparation for actions which are common to both dead and live working



Dead working procedures



Live working procedures



Regulation 6:
Electrical equipment to be of adequate size, strength and capacity

(1) Electrical equipment to which these Regulations apply shall be of a size, strength and capacity sufficient to prevent danger when put to use.

(2) In order to prevent danger arising from any fault or overload, electrical equipment to which these Regulations apply and systems shall be –

(a) of adequate size, strength and capacity; or

(b) suitably placed, safeguarded and protected,

so far as is reasonably practicable.

Regulation 6 requires electrical equipment to be of a suitable size, strength and capacity to prevent danger.

Before equipment is energised, the characteristics of the electrical system, to which the equipment is connected, should be taken into account. This would include the characteristics under:

- normal conditions
- possible transient conditions, and
- prospective fault conditions

so that the equipment is not subjected to stress which it is not capable of handling without causing danger. The effects to be considered include voltage stress and the heating and electromagnetic effects of current.

The term 'strength and capacity' of electrical equipment means the ability of the equipment to withstand the thermal, electromagnetic, electro-chemical or other effects of the electrical currents which might be expected when it is part of a system. These currents include, for example,

- load currents
- transient overloads

- fault currents
- pulses of current, and
- for alternating current circuits, currents at various power factors and frequencies.

Insulation must be effective to enable the equipment to withstand the applied voltage and any likely transient over-voltages.

In order that equipment may remain safe under prospective fault conditions, it is necessary when selecting equipment to take account of the fault levels and the characteristics of the electrical protection which has been provided for the purpose of interrupting or reducing fault current (excess current protection is required by Regulation 13). Most electrical equipment will be able to withstand short-circuit currents safely for limited periods only. The considerations extend also to conductors and equipment provided solely for protective purposes; for example, earthing conductors must be adequately rated to survive beyond fault clearance times to ensure satisfactory protective gear operation and fault clearance.

Regulation 7:
Exposure of electrical equipment in conditions which may give rise to danger

(1) Where electrical equipment to which these Regulations apply may foreseeably be exposed to –

(a) the effects of weather, natural hazards, temperature or pressure;

(b) the effects of wet, dirty, dusty, or corrosive conditions;

(c) flammable or explosive substances, dusts, vapours or gases; or

(d) damage by fauna or flora,

paragraph (2) shall apply.

(2) Where electrical equipment to which these Regulations apply is exposed as mentioned in paragraph (1) –

(a) it shall be –

(i) suitably constructed, installed, protected, commissioned, tested, used and operated,

(ii) maintained in an efficient state, in efficient working order and in good repair,

as may be necessary to prevent danger; and

(b) such other precautions shall be taken as may be necessary to prevent danger,

so far as is practicable.

Regulation 7 draws attention to the kind of adverse conditions where danger could arise if equipment is not constructed and protected to withstand such exposure.

Electrical equipment must be suitable for the environment and conditions of use to which it may foreseeably be exposed so that danger, due to exposure, will be prevented so far as is practicable. For example, equipment designed for use in an office is unlikely to be suitable for use outside on a construction site. Regulation 7 also requires the electrical equipment to be maintained, kept in good repair and any other precautions taken as necessary, with regard to the environment and conditions of use.

In gauging the suitability of equipment for particular environments or conditions of use it is necessary to consider only those effects or exposure which are reasonably foreseeable.

Weather, natural hazards and extreme conditions

Precautions which are taken to protect a site, structure or building from natural hazards and extreme weather conditions may give some protection to the associated electrical installation, but additional protection or precautions may also be necessary. Extremes of temperature, pressure or humidity may result either from climatic conditions or from adjacent plant or from the use of the electrical equipment itself. Standards frequently quote the range of service conditions for electrical equipment, including temperature limits, and users should consider these when selecting equipment.

Corrosive effects

If substances are present in the environment which either alone, in combination, or in the presence of moisture can cause accelerated corrosion of metallic enclosures or fittings, special materials or surface treatments may be necessary. In these cases it would be recommended that much of the electrical equipment, such as motors, be of a type which is totally enclosed by an appropriate corrosion-resistant housing, i.e. not ventilated to the atmosphere.

Insulating materials and other materials used in electrical equipment may be affected by chemical agents or solvents. Cubicles housing electrical control equipment in hostile environments may need to be kept purged or pressurised with clean air or, in special cases, inert gas.

Dirt and dusts

Most industrial enclosures for electrical equipment do not resist the entry of fine dusts. Equipment should be constructed so as to resist the entry of dust and dirt where this may give rise to electrical and mechanical failures. Regular inspection and cleaning as necessary is recommended where dirt and dusts are likely to accumulate, for example, portable motor-driven equipment incorporating ventilation slots which can give rise to the accumulation of potentially hazardous layers of dirt and dust.

Combustible dusts

In cloud form, some dusts create an explosion hazard, while layers of combustible dust on electrical equipment can give rise to fire hazards. The selection, construction or installation of equipment exposed to combustible dust must guard against the possibility of ignition. The maximum temperature attainable on the surface of any electrical equipment where these dusts may be deposited should be considered in the selection of the equipment. The temperature of such surfaces should always be below the temperature at which any charring or smoking of dust takes place. However, appropriate dust control measures and general cleanliness which minimise the problem at source are preferred.

Potentially explosive atmospheres

If electrical equipment is used where a flammable or explosive atmosphere is likely to occur the equipment must be constructed so that it is not liable to ignite that atmosphere. The selection and installation of equipment for use in potentially explosive atmospheres should be guided by the recommendations contained in the HSE guidance and British

Standards on the subject.

The choice of such electrical equipment should be certified as being in conformity with an appropriate Standard. Uncertified electrical equipment should not be used unless it will provide at least an equivalent level of safety to that provided by appropriately certified equipment.

Some manufacturing processes, for example electrostatic paint spraying, make use of the characteristics of static electricity and the design of electrical equipment needs to be such that the ignition of solvents, vapours or particulate substances is prevented.

The maintenance and repair of explosion-protected equipment is a specialised field of work and should be undertaken only by those who have the necessary training and experience.

Other flammable substances

Much electrical equipment generates heat or produces sparks and this equipment should not be placed where either the heat emitted or the occurrence of sparking is likely to lead to the uncontrolled ignition of any substance. The construction of the equipment should either exclude the substances from any part of the equipment which may be a source of ignition (for example, by suitable enclosure) or should ensure that the equipment operates at sufficiently low temperature and energy levels, as not to be a source of ignition under likely conditions of use and fault.

Classification system of ingress protection (IP rating)

There is an internationally recognised system of classifying the degree of protection provided by enclosures against the ingress of solid objects and moisture, and the protection afforded against contact with any live parts within the enclosure for all types of electrical equipment. The system is commonly known as the IP rating system (IP = Index of Protection) and is detailed in a number of standards.

Regulation 8:
Insulation and protection of circuit conductors

All conductors in a system to which these Regulations apply which may give rise to danger shall be either –

(a) suitably covered with insulating material and where necessary further suitably protected; or

(b) suitably placed and such other precautions taken,

so as to prevent, so far as is reasonably practicable, such danger.

Regulation 8 requires all conductors in an electrical system which may give rise to danger to be either suitably covered with insulating material and, where necessary, further protected, or be suitably placed and other appropriate precautions taken to prevent danger, so far as is reasonably practicable.

The danger to be protected against generally arises from differences in electrical potential (voltage) between circuit conductors or between such conductors and other conductors in a system – usually conductors at earth potential. The conventional approach is either to insulate the conductors or to place them so that people are unable to receive an electric shock or burn from them.

Some form of basic insulation, or physical separation, of conductors in a system is necessary for the system to function. That functional minimum, however, may not be sufficient to comply with the requirements of this Regulation. Factors which must be taken into account are:

- the nature and severity of the probable danger;
- the functions to be performed by the equipment;
- the location of the equipment, its environment and the conditions to which it will be subjected;
- any work which is likely to be done on, with or near the equipment.

Insulation

Suitable insulation of the conductors in an electrical system is, in the majority of cases, the

primary and necessary safeguard to prevent danger from electric shock, either between live conductors or between a live conductor and earth. It will also prevent danger from fire and explosion arising from contact of conductors either with each other or with earth. Energy from quite low levels of voltage (and levels insufficient to create a shock risk) can ignite a flammable atmosphere. The quality and effectiveness of insulation therefore needs to be commensurate with the voltages applied to the conductors and the conditions of use. BS 7671 gives some advice on these matters for fixed electrical installations up to 1000 volts ac or 1500 volts dc.

Often the protection required to prevent danger is to prevent mechanical damage to the insulation, but may include any of the conditions detailed under Regulation 7. Examples of such protection would be the use of steel trunking and conduits or the use of steel armoured cables.

Other precautions including placing

Regulation 8 permits alternative precautions to insulation to be taken to prevent danger. These may include the suitable placing of conductors and/ or strictly controlled working practices reinforced by measures such as written instructions, training and warning notices etc., but any such measures must prevent danger, so far as is reasonably practicable.

Suitable placing of the conductors may, on its own, go a considerable way towards preventing danger, for example where the conductors are within a secure enclosure or where they are placed overhead at such a height that contact with these conductors is not reasonably foreseeable, for example overhead electric power lines. However, if the placing of the conductors cannot alone be relied upon to prevent danger, then additional precautions need to be taken and rigorously applied.

Duty holders should also carefully consider the inherent risks that may still exist if bare conductors are merely placed where they cannot normally be touched; for example, during maintenance activities. This should take into account the protection of the equipment required under Regulation 7 for a range of reasonably foreseeable effects. In addition, there may be occasions when people will require access to the area or enclosure where such conductors are located, such as substations and test areas. Where work is to be done with the conductors live, Regulation 9 and 17 are relevant and the guidance under those Regulations also apply.

Regulation 9:
Exposed circuit conductors to be in controlled areas

1) All conductors which –

   (a) may give rise to danger; and

   (b) are so exposed that they may be touched by a person,

   shall be in a controlled area.

(2) For the purposes of this Regulation an area shall be a controlled area, if –

   (a) no person is permitted to have access to such area, except –

      (i) a person competent to avoid danger from conductors in such area, or

      (ii) a person acting under the immediate supervision of a person competent to avoid danger from conductors in such area; and

   (b) suitable precautions are taken to avoid danger from conductors in such area.

Regulation 9 requires all exposed, or inadequately insulated, live circuit conductors which could be touched by a person and cause danger, to be in a "controlled area". This Regulation is particularly relevant during maintenance and testing operations.

Control of the area

Effective control of an area where there is danger from live conductors means ensuring that only those persons competent to prevent the occurrence of injury and those whose presence is necessary are permitted into the area. If the person undertaking the work is continuously present while danger exists from the live conductors, and the area is small enough to be under their constant supervision and control, then further precautions to control access may not be necessary. If, however, the area is too large for them to exercise effective surveillance, or they are not continuously present, then effective control will need to be secured by other means such as the provision of lockable enclosures or barriers, and warning notices indicating the presence of live conductors.

Persons considered competent to avoid the danger from the conductors in the controlled area would need to have received adequate training, see also Regulation 16.

Testing

Testing to establish whether electrical conductors are live or dead should always be done on the assumption that they may be live and, therefore, it should be assumed that this Regulation is applicable until such time as the conductors have been proved dead.

When testing for confirmation of a 'dead' circuit, the test instrument or voltage indicator used for this purpose should itself be proved, preferably immediately before and immediately after testing the conductors. Although live testing may be justifiable it does not follow that there will necessarily be justification for subsequent repair work to be carried out live (see also Regulation 17).

Regulation 10:
Precautions to prevent danger during fault conditions

> Precautions shall be taken, by earthing or other suitable means, to prevent so far as is reasonably practicable danger arising when any conductor to which these Regulations apply, which would carry current only under fault conditions, becomes electrically charged.

Regulation 10 applies to any conductor including the conductive parts of equipment, such as outer metallic casings, which can be touched and, though not live, may become live under fault conditions. Suitable precautions, by earthing or other suitable means, must be taken to prevent, so far as is reasonably practicable, danger arising from such conditions.

Conductors which, although not part of a system, are within electrostatic or electromagnetic fields created by a system, may be subject to this Regulation. Appropriate precautions are necessary if the induced voltages or currents are large enough to give rise to danger.

The requirements of the Regulation may be met in different ways, depending on the circumstances, including:

- ensuring that such conductors do not become charged. This has the effect of excluding the conductors from the scope of this Regulation;
- ensuring that if such conductors do become charged the values of voltage and current and the duration are such that danger will not arise;
- ensuring that if such conductors do become charged the environment is such that danger will not arise.

Techniques for achieving the above include:

- double insulation;
- earthing;
- connection to a common voltage reference point on the system;
- equipotential bonding;

- use of safe voltages;
- earth-free, non-conducting environments;
- current/energy limitation; and
- separated or isolated systems.

The above techniques may be employed singly or in combination.

Double insulation: The principle of 'double insulation' is that the live conductors of the electrical equipment are covered by two discrete layers or components of insulation each of which would adequately insulate the conductor but which together ensure an improbability of danger arising from insulation failure. This arrangement avoids the need for any external metalwork of the equipment to be connected to a protective conductor or to earth. Double insulation has been found to be particularly suitable for certain types of portable equipment, for example, electric motor-driven tools etc., and the need for an earthing protective conductor is eliminated. However, the integrity of this protective provision for safety depends upon the layers of insulation remaining in sound condition and this in turn requires that the equipment be properly constructed, used and maintained.

Earthing: It is the practice in Jersey for the public electricity supply system at the usual distribution pressures of 230 volts single phase, 400 volts three phase, to be referenced to earth by a deliberate electrical connection made at the distribution substations or power transformers. It is the existence of this system 'earthing' which enables earth faults on electrical equipment to be detected and the electrical supply to faulty equipment to be cut off automatically.

Many 230/400 volt power installations are so designed that the automatic interruption of the supply upon the occurrence of an earth fault is performed by fuses or automatic circuit breakers (MCBs etc.). In most cases these devices will have been selected to provide the additional protective function of interrupting excess current required under Regulation 11. In these circumstances it is essential that the earth fault current be large enough to rupture the fuse quickly. The magnitude of the fault current under full earth fault conditions is governed mainly by the combined impedance of the fault loop which will include the impedance of the fault itself, that of the earthing or protective conductors, the circuit conductors and that of the source. Tests should, therefore, be carried out on new installations and at appropriate intervals thereafter to ascertain that the earth fault (loop) impedances are low enough to ensure that the electrical protective devices such as fuses, circuit breakers etc. will operate in the event of a breakdown of insulation leading to an 'earth fault'.

Acceptable parameters of earth loop impedance and interruption times etc. for final installations up to 1000 volts may be found in BS 7671. It is rarely sufficient to rely on an earth rod or rods to provide sufficient conductance for return fault currents. Separate protective earth cables or conductors connected to the neutral point of the supply are usually necessary unless other measures, such as the use of sensitive residual current protection equipment, are used to detect earth fault currents.

For the duration of the fault, the electrical bonding of exposed conductive parts and their connection to earth serves to limit the shock risk from the transient voltages appearing between metallic enclosures of equipment in the system or between a metallic enclosure and earth. Equipment earthing therefore includes the bonding of metallic enclosures, cable armouring, conduits and trunking etc., so that these conductors are electrically continuous and securely connected to the general mass of earth at one or more points.

Earthing and bonding conductors must be suitable for the maximum current which they may carry under fault conditions and be capable of surviving the worst-case fault. Their construction and strength must be adequate to withstand likely wear and tear. Where it might otherwise be difficult to ensure the continued effectiveness of earthing and bonding arrangements, it may be necessary to provide supplementary protection such as protective earth conductor monitoring.

Many accidents have been caused by the metalwork of portable or transportable equipment becoming live as a result of the combined effects of a fault and high impedance protective conductor connections. The danger may be reduced by the use of a residual current device (RCD) designed to operate rapidly at small leakage currents (typically not exceeding 30 mA), although these devices do not eliminate the risk of electric shock. RCDs should not be considered as the sole means of protection but as an additional protective measure. They should be operated regularly using the test trip button. This test trip procedure is important in maintaining the effectiveness of most types of RCD.

Electric arc welding brings special problems associated with earthing practices. Stray currents from electrical arc welding can damage the protective earthing conductors of electrical installations.

Connection to a common voltage reference point on the system: In the case of the public electricity supply systems where transformer neutral points are connected to earth, the voltage reference point is the general mass of earth. Other reference points, to which systems may be referenced and to which bonding conductors are connected, may be chosen to suit particular circumstances.

Equipotential bonding: Equipotential bonding is the electrical interconnection of all exposed and extraneous conductors, which may become electrically charged, in such a way that dangerous voltages between any of the conductors which may be simultaneously touched are limited.

Use of safe voltages: Reduced voltage systems are particularly appropriate for portable and transportable equipment; in highly conducting locations such as boilers and tunnels where the risk of mechanical damage to equipment and trailing cables is high; where the body may be damp and have large areas of contact with the conducting location, and on construction sites.

One example is a building or construction site supply system operating at 55-0-55 V ac single phase, or at 110 V three-phase with a phase-earth voltage of 64 V ac. Another example is that of an extra low voltage system operating at or below 50 V ac or 120 V dc. Supply systems like these are referenced to earth and are therefore a special case

of systems operating at reduced voltage for which bonding and earthing of all metallic enclosures are still recommended.

Earth-free, non-conducting environments: If a system is supplied from a source which is earth-referenced, the path for fault current and the existence of dangerous potentials to earth can be eliminated in a defined area by ensuring that the area is 'earth-free'. This does not necessarily mean that metallic components or fittings need to be prohibited but rather that no part of the defined area is earthed. It is easier to ensure the integrity of an 'earth-free' area by constructing it from non-metallic components in which case it is more appropriately known as a non-conducting location or area. 'Earth-free' and 'non-conducting' areas are specialised applications and are used mainly in certain testing of electrical equipment.

Current limitation: If fault currents which could cause electric shock are inherently limited by appropriate passive devices, for example high integrity resistors, then protection by earthing or other means may not be required. In the conventional dry, working environment, for example, if the current is limited preferably to 1 mA but certainly to no more than 5 mA this will not usually present a risk of injury from electric shock to people in good health who may be subjected to it only occasionally and for a short time only. However, even this low level of current may give perceptible shock which, although by itself is unlikely to be physiologically dangerous, may give rise to a consequential injury such as from a fall induced by the shock.

Separated or isolated systems: See also Regulation 11 for guidance on separated or isolated systems.

Regulation 11:
Precautions where electrical energy is transformed or converted

Where electrical equipment to which these Regulations apply is used to transform or convert electrical energy from one voltage to another, such precautions shall be taken as may be necessary to prevent danger arising from the lower voltage conductors becoming charged above their normal voltage from the higher voltage conductors.

Where electrical energy is transformed or converted from one voltage to another by electrical equipment, **Regulation 11** requires precautions to be taken to prevent danger arising from the lower voltage conductors becoming charged above their normal voltage from the higher voltage conductors.

Separated or isolated systems

If safety depends on the supply system not being referenced to its immediate environment, whether true earth or surrounding metalwork, no potential should normally exist between live conductors and earth or exposed metallic parts. However, all systems are to some extent referenced to their environment by capacitive or inductive coupling or by leakage. That is why you cannot necessarily rely on the circuit conductors of separated or isolated systems (separate from all other systems) being at zero potential relative to their environment. Unless the isolated system is a very small and localised one, the leakage current may be large enough to provide a path for a fatal electric shock. Any difference in potential is likely to be greatest on extensive systems but, in all cases when the voltages or currents could be dangerous, precautions are needed. Examples of isolated systems are those supplied from the secondary winding of an isolating transformer or the winding of an alternator where there is no connection between them and any other source of electrical energy.

The isolation of a power system from earth may reduce the risks associated with a single fault. However, if this first fault has the effect of referencing the system to earth or other exposed conductor, subsequent faults may lead to very destructive and hazardous short circuits so extra precautions will be necessary to prevent this danger. These may include the bonding of metallic enclosures, earth fault detection, insulation monitoring or the use of an earth-free non-conducting environment. Regular inspection and testing to ensure that system isolation integrity is maintained will also be necessary.

'Isolated' in this context means separate from all other systems and does not imply 'isolation' as defined specifically for the purpose of Regulation 14.

Regulation 12:
Electrical connections

Where electrical equipment to which these Regulations apply comprises an electrical connection, such connection shall be of suitable construction for the purpose for which it is used as regards its conductance, insulation, mechanical strength and protection, so far as is reasonably practicable to prevent danger.

Regulation 12 requires that all connections, including connections to terminals, plugs and sockets, and any other means of joining or connecting conductors, should be suitable for the purposes for which they are used, including likely fault conditions. The Regulation applies equally to temporary and permanent connections.

Joints and connections in protective conductors should be made at least as carefully as those in circuit conductors and they should be of sufficient strength and conductance to allow for the passage of fault currents. Such connections may need to be treated so as to prevent corrosion. It is recommended that combinations of metals liable to produce damaging electrolytic action be avoided.

Plugs and sockets

Plug and socket connections and their use should be so arranged that accidental contact with conductors live at dangerous voltages is prevented. This should usually be achieved by selection of appropriate equipment but may involve some degree of operator skill and/or training depending on the circumstances.

Where plug and socket connections are not rated for making or breaking the maximum load current, effective arrangements should be made, for example, by mechanical interlocking with the switch that controls the power, to ensure that the connections are made or broken only under no-load conditions.

Portable equipment

Special attention should be given to joints and connections in cables and equipment which will be handled; for example, flexible cables for portable equipment. Plugs and sockets for portable equipment should be constructed in accordance with appropriate standards and arranged so that, where necessary, earthing of any metal casing of the equipment is automatically effected by the insertion of the plug.

Regulation 13:
Excess current protection

(1) In this Regulation "excess fault current" means an excess of current arising from –

(a) a failure of insulation;

(b) an unwanted interconnection of conductors; or

(c) any other electric fault.

(2) Where an excess fault current in electrical equipment to which these Regulations apply may give rise to danger, suitable automatic means of protection shall be available which shall cut off or limit such current without unreasonable delay, so far as is reasonably practicable to prevent such danger.

It is recognised that faults and overloads may occur on electrical systems. **Regulation 13** requires that systems and parts of systems be protected against the effects of short circuits and overloads if these would result in currents which would otherwise result in danger.

The means of protection is likely to be in the form of fuses or circuit breakers controlled by relays etc. or it may be provided by some other means capable of interrupting the current or reducing it to a safe value.

The need to anticipate abnormal conditions

The Regulation requires the means of preventing danger to be provided in anticipation of excess current; a fault or overload need not have occurred. Fault currents arise as a result of short circuits between conductors caused either by inherent failure of the electrical equipment or some outside influence; for example, mechanical damage to a cable. Overload currents can arise as a result of the inadequacy of a system to supply the load and may be caused by an increased demand created by outside influence on the electrical equipment, for instance, mechanical overloading of an electric motor.

The selection of excess current protection

In principle, every main circuit should be protected at its origin, i.e. at the source end of the circuit. Where the rating of the conductors forming a branch circuit is less than that of the conductors from which it is drawing power, it is conventional for protection to be placed at this point. In practice, however, there are exceptions to this principle and, depending on the nature of the system, a technical judgement must be made as to where the protection

should be placed. Guidance on some aspects of this subject is given in BS 7671.

When selecting the means of protection, consideration must be given to a number of factors among the more important of which include:

- the nature of the circuits and type of equipment to be protected;
- the short-circuit energy available in the supply (the fault level);
- the nature of the environment;
- whether the system is earthed or not.

The nature of the circuits and type of equipment to be protected: The circuits to be dealt with may vary from high-power high-voltage circuits, for example for the inter-connection of substations or for the supply to large motors, down to the smallest final circuit supplying a few low-power lamps at 6 volts. Over this range lies a great diversity of equipment, each item of which will possess characteristics which must be carefully considered in the selection of appropriate devices to protect against excess current.

The fault level: Due regard must be paid to the maximum short-circuit current with which the protective device may have to deal. (The ability of circuit breakers and fuses to operate successfully and without dangerous effects, serious arcing or, in the case of oil-filled equipment, the liberation of oil, is implicit in the requirements of Regulations 5 and 6.) The design of the protective arrangement must also provide for sufficient current to be available to operate the protective devices correctly in respect of all likely faults.

The nature of the environment may have a bearing on the choice of protective devices and their settings; for example, where the possibility of a fire being started may be considerable. In all cases, however, the protection against excess current must be effective so that short circuits and earth faults are cleared promptly to minimise destructive arcing and heating. Protective devices, whether they be circuit breakers or fuses, should therefore be set or selected for the minimum tripping currents and times consistent with ensuring the reliable operation of the device and with the need to discriminate between successive stages of protection.

Earthed system: Where a system is earthed, the nature and efficiency of the earthing system is important in relation to the design and reliability of the protective devices. In earthed systems, i.e. where some part of the windings of the machine or transformer from which the supply is derived is connected to earth, operation in the event of an earth fault of the protective device is dependent on sufficient current passing to operate the excess current or earth leakage tripping device or to blow the fuse. In many systems, the device provided to comply with this Regulation in respect of excess of current (very often a fuse) may also provide protection against earth faults – and thus be in compliance with the requirements of Regulation 10.

Regulation 14:
Means for cutting off supply and secure separation

(1) In the case of electrical equipment to which these Regulations apply, where necessary to prevent danger, but subject to paragraph (2), suitable means shall be available for –

(a) cutting off the supply of electrical energy from any electrical equipment; and

(b) the secure separation of any electrical equipment from every source of electrical energy.

(2) Paragraph (1) shall not apply to electrical equipment which is itself a source of electrical energy but in such case such precautions shall be taken as may be necessary to avoid, so far as is reasonably practicable, danger.

The objective of **Part 14(1)(a)** of the Regulation is to ensure that, where necessary to prevent danger, suitable means are available by which the electricity supply to any piece of equipment can be switched off. Switching can be, for example, by direct manual operation or by indirect operation via 'stop' buttons in the control circuits of contactors or circuit breakers. There may be a need to switch off electrical equipment for reasons other than preventing electrical danger but these considerations are outside the scope of the Regulations.

Suitable means for cutting off the supply

Suitable means for cutting off the supply should:

- be capable of cutting off the supply under all likely conditions having regard to the equipment, its normal operation conditions, any abnormal operating or fault conditions, and the characteristics of the source(s) of electrical energy;
- be in a suitable location having regard to the nature of the risks, the availability of people to operate the means and the speed at which operation may be necessary. Access to switches etc. should be kept clear and unobstructed, free of tripping and slipping hazards;
- be clearly marked so as to show its relationship to the equipment which it controls, unless there could be no doubt that this would be obvious to any person who may need to operate it; and

- only be common to several items of electric equipment where it is appropriate for these to be energised and de-energised as a group.

Part 14(1)(b) of the Regulation requires that there will be available suitable means of ensuring that the supply will remain switched off and inadvertent reconnection prevented. This is isolation. This provision, in conjunction with safe working practices, will enable work to be carried out on electrical equipment without risk of it becoming live during the course of that work; for example, if the work is to be done under the terms of Regulation 15.

Suitable means of isolation

Suitable means of isolation of equipment should:

- have the capability to positively establish an air gap or other effective dielectric which, together with adequate creepage and clearance distances, will ensure that there is no likely way in which the isolation gap can fail electrically;
- include, where necessary, means directed at preventing unauthorised interference with or improper operation of the equipment; for example, means of locking off;
- be located so that the accessibility and ease with which it may be employed is appropriate for the application. The time and effort which must be expended to effect isolation should be reasonable having regard to the nature of the equipment and the circumstances under which isolation may be required; for example, a very remote means of isolation may be acceptable if isolation is only needed infrequently and any additional time taken to effect isolation does not result in danger;
- be clearly marked so as to show which equipment it relates to, unless there could be no doubt that this would be obvious to any person who may need to operate it;
- only be common to several items of electrical equipment where it is appropriate for these to be isolated as a group.

Selection of isolator switches

Isolator switches (or disconnectors) will often be employed as the means of effecting disconnection and securing separation from the supply. When selecting appropriate equipment to perform this function particular regard should be given to:

- the isolating distances between contacts or other means of isolation which should meet an appropriate standard or be otherwise equally effective;
- the position of the contacts or other means of isolation, which should either be externally visible or clearly and reliably indicated. An indication of the isolated position, other than by direct observation of the isolating gap, should occur when the specified isolating distance has been achieved in each pole;
- the provision to enable the prevention of unauthorised, improper or unintentional energisation, such as locking-off facilities.

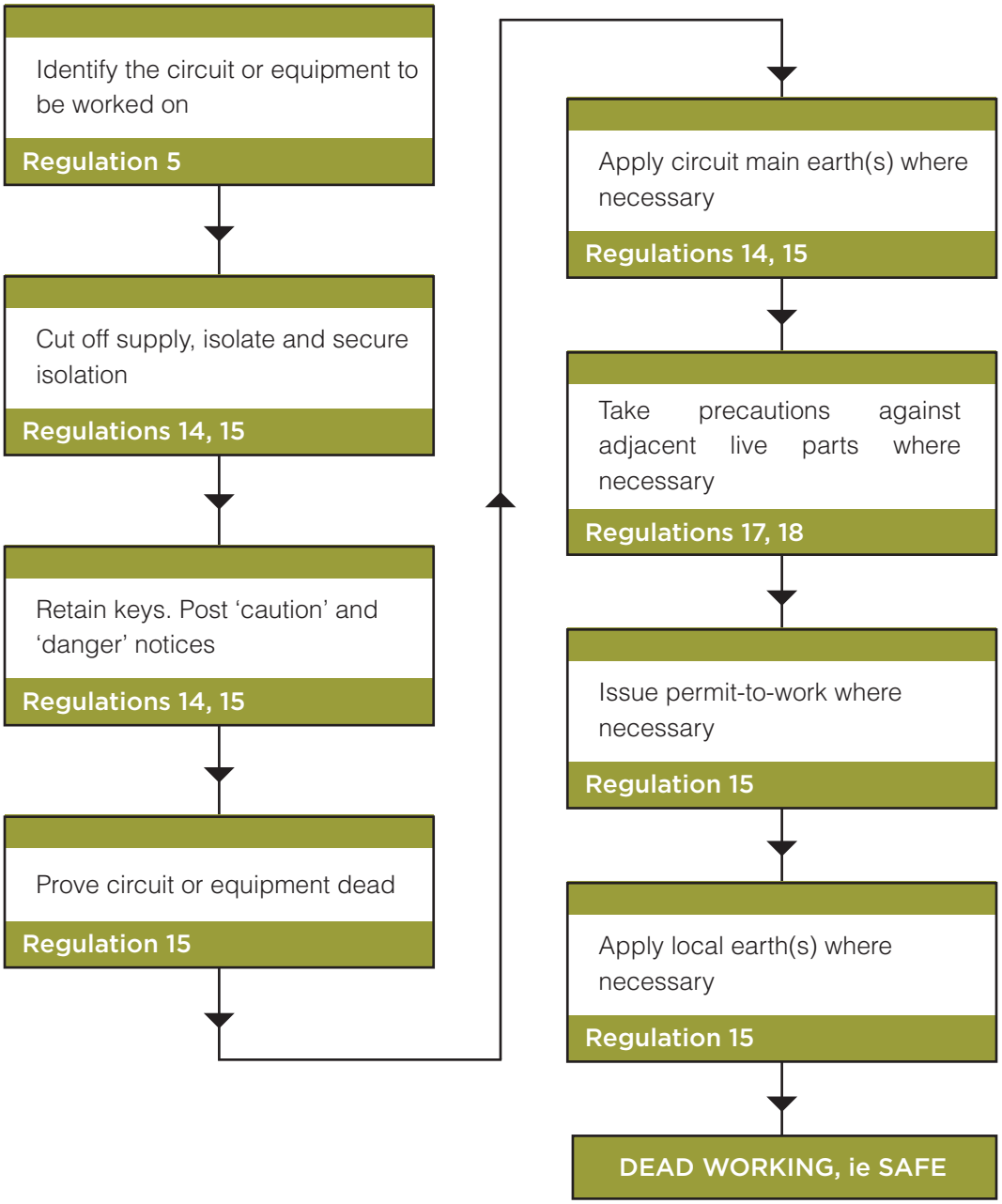
In some cases the equipment used to perform the requirement under Regulation 14(1)(a) may also serve to perform the requirement under 14(1)(b). It must be understood that the two functions of **switching off** and **isolation** are not the same, even though in some circumstances they are performed by the same action or by the same equipment.

"Where necessary to prevent danger"

The need for means to cut off the supply and effect isolation depends on factors such as likely danger in normal and abnormal conditions. This assessment may be influenced by environmental conditions and provisions to be made in case of emergencies, such as a fire in a premises. It includes consideration of which electrical equipment could be a source of danger if such means were not provided and of the installation, commissioning, operational and maintenance requirements over the life of the equipment.

Regulation 14(2) recognises the impracticability in some cases of switching off or of isolating electrical equipment which is itself an integral part of a source of electrical energy, for example the terminals of accumulators, large capacitors and the windings of generators. The Regulation requires precautions to be taken in these circumstances so that danger is prevented so far as is reasonably practicable.

Dead working procedures



Regulation 15:
Precautions to prevent danger from electrical equipment or a system becoming electrically charged

> Where electrical equipment to which these Regulations apply is not electrically charged for the time being, such precautions shall be taken as may be necessary to prevent danger arising from such electrical equipment becoming electrically charged.

Regulation 15 relates to situations in which electrical equipment has been made dead so that work either on it or near it may be carried out without danger. To prevent danger, effective precautions should be taken to prevent the electrical equipment from becoming electrically charged (see also Regulation 5).

Electrical charging includes, for example, by means of capacitance, inductance or by leakage, as well as connection to any source of supply (either directly by inadvertent closing of switches, etc. or indirectly via circuit components).

The Regulation may apply during any work, be it electrical or non-electrical and uses the term 'electrical equipment' which is defined by Regulation 1. This will include any cables, conductors, wires, connectors etc. which may have been arranged to connect together the various other items of electrical plant or equipment such as motors, transformers, switch gear etc. The Regulation may therefore apply to any or all of these.

The precautions

In the first place, the procedures for making the equipment dead will probably involve use of the means required by Regulation 14(1) (a) for cutting off the supply of electrical energy. Isolation of the electrical equipment will be necessary and the means required by Regulation 14(1) (b) will facilitate this. Ideally a means of locking off an isolator can be used. Where such facilities are not available, the removal of fuses or links and their being held in safe keeping can provide a secure arrangement if proper control procedures are used.

These precautions will prevent the equipment from becoming charged by connection to its own or normal sources of electrical energy but may not, alone, be sufficient to prevent charging. The presence of electrical energy as a result of electromagnetic induction, mutual capacitance or stored electrical energy may have to be guarded against, for example by

applying earthing connections for the duration of the work (temporary earths). The precautions may need to include means of preventing further accumulation of electrical charge, following initial discharge, because latent energy may be stored in the system, for example in the dielectric of high voltage cables or capacitors within equipment. For work on high-voltage power distribution circuits, isolation procedures should include the application of circuit main earths (primary earths) at points of isolation and additional earthing around the point of work.

Where work is to be done on or near conductors that have been isolated, the conductors must be proved dead at the point of work before the work starts. Where a test instrument or voltage indicator is used for this purpose this should itself be proved, preferably immediately before and immediately after testing the conductor.

The Regulation does not preclude the application of a test voltage to equipment, provided that this does not give rise to danger.

Written procedures

The safety isolation procedures should be formalised in written instructions or house rules. 'Permits-to-work' may form part of the written procedures and their use is considered essential to ensuring a safe system of work where this involves work on the conductors or equipment of high voltage power distribution systems (typically where the working voltage exceeds 1000 volts) or where the system is very complex. Properly formulated and regulated 'permit-to work' procedures focus the minds of those issuing and of those receiving the permits, both on the manner in which the work is to be done and on how the equipment has been made safe.

Regulation 16:
Certain employees to be competent to avoid danger

(1) No employee shall engage in work on a system to which these Regulations apply unless the employee is competent to avoid danger from so doing.

(2) For the purposes of this Regulation competence of an employee shall depend on the following –

(a) the employee's level of technical knowledge;

(b) the employee's experience of the work to be undertaken;

(c) the employee's knowledge of the electrical equipment or the system on which the work is to be carried out; and

(d) the degree of supervision which the employee is receiving.

The object of **Regulation 16** is to ensure that people are not placed at risk due to a lack of competence in dealing with electrical equipment.

The Regulation applies to the whole range of work associated with electrical equipment where danger may arise and whether or not danger is actually present during the work.

It will include situations where the prevention of danger for the duration of the work is under the control of someone who must possess sufficient technical knowledge or experience, or be so supervised, to be capable of ensuring that danger is prevented. For example, where a person is required to isolate some electrical equipment before undertaking work on the equipment, they will require sufficient technical knowledge or experience to prevent danger during the isolation, i.e. there will be no danger from the equipment during the work, provided that the isolation has been carried out properly. However, the person doing the work must have sufficient technical knowledge or experience so as to prevent danger during that work by, for example, knowing not to work on adjacent 'live' circuits.

The Regulation also covers those circumstances where danger is present, i.e. work is being done on live or charged equipment using special techniques and under the terms of Regulation 9. In these circumstances, people must possess sufficient technical knowledge or experience or be so supervised etc. to be capable of ensuring that danger is prevented.

Technical knowledge or experience

The scope of 'technical knowledge or experience' should include:

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

Allocation of 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 directed at ensuring safety which have been laid down by their employer.

Supervision

The Regulation recognises that, in many circumstances, people will require some degree of supervision where their technical knowledge or experience is not of itself sufficient to ensure that they can otherwise undertake the work safely.

Duty holders, when allocating supervisory responsibilities, should clearly state to the supervisor exactly what their responsibilities are, preferably in writing. Where the risks involved are low, verbal instructions are likely to be adequate but as the risk or complexity increases there comes a point where the need for written procedures becomes important in order that instructions may be understood and supervised more rigorously. In this context, supervision does not necessarily require continual attendance at the work site, but the degree of supervision and the manner in which it is exercised is for the dutyholders to arrange to ensure that danger is prevented.

Regulation 17:
Work near electrical equipment

(1) No employee shall work on or with or be at work near electrical equipment to which these Regulations apply which may give rise to danger, unless such equipment is made electrically dead, or such other precautions are taken as are sufficient to ensure that danger is avoided.

(2) There shall be suitable working space for employees who work on or with or are at work near electrical equipment to which these Regulations apply where such space is necessary to avoid danger from that equipment.

(3) Where necessary to avoid danger to employees who work on or with or are at work near electrical equipment suitable protective equipment shall be provided.

(4) Protective equipment which is provided for the purposes of paragraph (3) -

(a) shall be used; and

(b) shall be maintained in an efficient state, in efficient working order and in good repair.

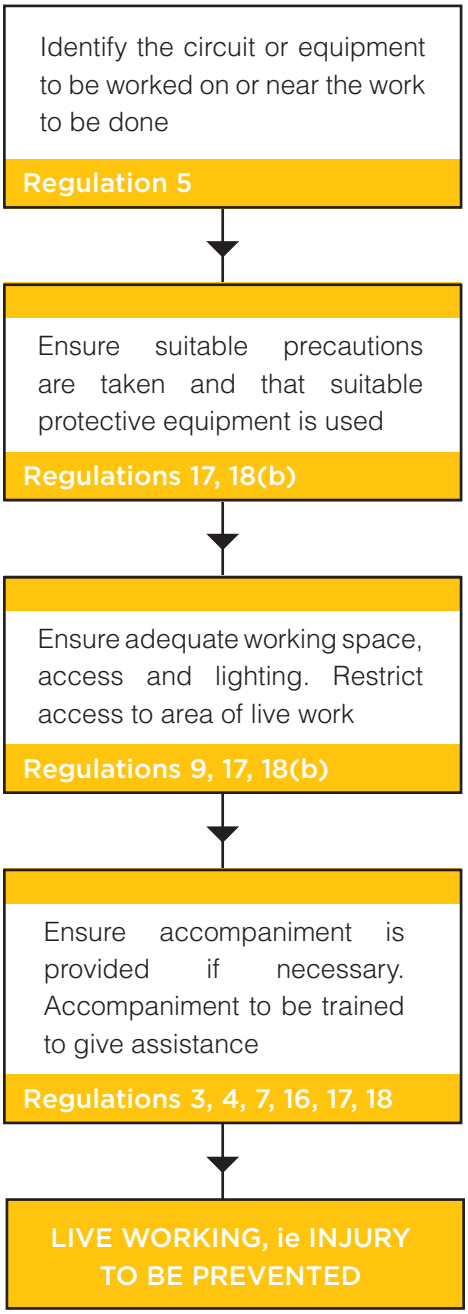
The need for the conductor to be live

Regulation 17(1) is concerned with those situations where people are at work on, with, or near live electrical equipment which may foreseeably give rise to danger. “Working on” means maintaining/repairing the equipment whilst “working with” means operating the equipment.

It is always preferable, from the safety point of view, that work on or near electrical equipment should be carried out when that equipment is dead. There are circumstances, however, in which it is unreasonable, having regard to all relevant factors, for the equipment to be dead while work proceeds. An example of this might be where it was found necessary to undertake some maintenance, checking or repair in an area where it would be disproportionately disruptive and costly in many ways for the live conductors to be isolated for the period of the work, such as live cable jointing in the electrical supply industry, and in work done on telephone network connections.

Equipment users should bear in mind at the time of ordering, purchase and installation of plant, the manner of operation, maintenance and repair of the electrical equipment which will be necessary during the life of the plant.

Live working procedures



It is recommended that the design of electrical equipment and of the installation should eliminate the need for live work which puts people at risk of injury. This can often be done by careful thought at the design stage of installations, for example: by the provision of alternative power infeeds; properly laid out distribution systems to allow parts to be isolated for work to proceed; and, by designing equipment housings etc. to give segregation of parts to be worked on and protect people from other parts which may be live.

It is recommended that equipment which combines power and control circuitry should be arranged so that the power circuits are physically separate and segregated from logic and control circuits or so placed, recessed or otherwise arranged that the risk of accidental contact is eliminated. Diagnostic work on the low power/voltage circuits may then proceed with less risk to personnel. Where regular measurements of, for example, voltage, current etc. are to be made, consideration should be given to appropriate test and measuring equipment, such as voltmeters, ammeters, etc. or test points being built into the equipment.

Live work includes live testing; for example, the use of a potential indicator on mains power and control logic circuits. It should be noted that, although live testing may be justifiable, it does not necessarily follow that there will be justification for subsequent repair work to be carried out live.

The factors which would be considered in deciding whether it was justifiable for work to proceed with the conductors live would include the following:

- when it is not practicable to carry out the work with the conductors dead, e.g. where for the purposes of testing it is necessary for the conductors to be live;
- to make the conductors dead will create other hazards, such as to other users of the system, or for continuously operating process plants etc.;
- the need to comply with other statutory requirements;
- the level of risk involved in working live and the effectiveness of the precautions available set against economic need to perform that work.

The need to be near uninsulated live conductors

People at work are permitted to be near live conductors only if this is reasonable in all the circumstances. If, for example, it would be reasonable for the work to be carried out at a safe distance from the conductors then it would be prohibited for that work to be done near the conductors.

The need to take precautions to prevent injury

The precautions necessary to prevent injury need to be commensurate with the risk. The system of work should:

- allow only people who are competent to do so to work on or near exposed, live conductors (competence for these and other purposes is further dealt with at Regulation 16); and
- indicate within what limits the work is to be attempted; and

- indicate what levels of competence apply to each category of such work; and
- incorporate procedures under which the person attempting the work will report back if the limits specified in the system are likely to be exceeded.

This usually requires detailed planning before the work is started.

Suitable precautions should include as appropriate:

- the use of people who are properly trained and competent to work on live equipment safely (see also Regulation 16);
- the provision of adequate information to the person carrying out the work about the live conductors involved, the associated electrical system and the foreseeable risks;
- the use of suitable tools, including insulated tools, equipment and protective clothing;
- the use of suitable insulated barriers or screens;
- the use of suitable instruments and test probes;
- accompaniment by another person or people if the presence of such person or people could contribute significantly to ensuring that injury is prevented;
- the restriction of routine live test work (for example product testing) to specific areas and the use of special precautions within those areas such as isolated power supplies, non-conducting locations etc.;
- effective control of any area where there is danger from live conductors (see also Regulation 9).

Accompaniment

A duty holder's judgement as to whether someone carrying out work subject to Regulation 17 should be accompanied, should be based on considerations of how injury is to be prevented. If an accompanying person can substantially contribute towards the implementation of safe working practice, then they should be present. They should be trained to recognise danger and, if necessary, to render assistance in the event of an emergency.

Some examples of electrical work where it is likely that the person carrying out the work should be accompanied are:

- electrical work involving manipulation of live, uninsulated power conductors at say, 230 volts using insulated tools; and
- other work on or near bare live conductors where someone working on their own would not be capable of undertaking the work safely without assistance in, for example, keeping other people from the work area.

Suitable working space

Where space is necessary to avoid danger from electrical equipment, **Regulation 17(2)**

states that suitable working space must be provided for employees who work on, or with, or are at work near that electrical equipment.

In assessing the suitability of the working space, the risk of danger arising from the electrical equipment and the nature of the work to be undertaken should be taken into account. A suitable working space will have sufficient head-room and free space to allow people to pull back from dangerous live conductors without hazard, and allow people to pass one another with ease and without hazard.

Protective equipment

Regulation 17(3) states that suitable protective equipment must be provided to employees who work on, with or near electrical equipment, where this is necessary to avoid danger. Such 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:

- suitable clothing including insulating helmets, goggles and gloves;
- insulating materials used as fixed or temporary screening to prevent:
  - electric shock
  - short circuit between live conductors
  - short circuit between live conductors and earth
- insulating mats and stands to prevent electric shock current via the feet;
- insulated tools;
- insulated test probes.

There should be procedures for the periodic examination and, where necessary, testing and replacement of this protective equipment.

Regulation 17(4) is not qualified by 'so far as is reasonably practicable'. This means that where it is necessary to avoid danger, the protective equipment provided must be worn. It must also be maintained in an efficient state, in efficient working order and in good repair.

Regulation 18:
Activities near overhead or buried cables and certain electrical equipment

Where any machinery, plant, process or description of manual labour is used by employees near any electrical cable, overhead conductor or other electrical equipment which, having regard to the nature of such machinery, plant, process or description of manual labour, may give rise to danger, the responsible person shall, so far as is practicable, take all such steps as are sufficient to avoid that danger –

(a) by arranging for such electrical cable, overhead conductor or electrical equipment, as the case may be, to be made electrically dead; or

(b) by employing other means suitable to avoid that danger,

whether or not such electrical cable, overhead conductor or electrical equipment is under the control of the responsible person.

Regulation 18 states that where employees are working - including the use of machinery, plant or processes - near any electrical cable, overhead conductor or other electrical equipment that may cause danger, the 'responsible person' must avoid that danger, so far as is practicable.

Whether or not the electrical cable, overhead conductor or electrical equipment is under the control of the 'responsible person', they should:

- arrange for the electrical cable, overhead conductor or electrical equipment to be made electrically dead; or
- employ other suitable means to avoid that danger.

Work near underground cables and overhead power lines

Excavations and other work near underground power cables and work under or near overhead power lines comes within the scope of Regulation 18 if there is a risk of injury from these cables or power lines. If the electrical cable, overhead conductor or electrical equipment cannot be made electrically dead, consideration must be given to the requirements set out in Regulation 17.

Underground power cables present a risk of serious or fatal injury during excavation or similar

work, particularly to people using hand tools (e.g. picks, concrete breakers, etc.).

Overhead lines may be readily accessible to people working on elevated platforms, scaffolding or roofs. People working with tall vehicles such as cranes, tipper lorries, or farm machinery or handling metal ladders, pipes or other long articles may also be at risk from a flashover or contact with overhead power lines.

Well established advice on the steps which should be taken to avoid danger from such activities is given in 'Working safely and avoiding danger from underground services and other utility apparatus' published by the Health and Safety at Work Inspectorate.

Regulation 19:
Notices to be displayed at certain premises

(1) The responsible person shall display notices in accordance with paragraph (2) where in any premises a system to which these Regulations apply -

(a) supplies or receives electrical energy at a voltage in excess of 250 volts; or

(b) comprises conductors energised at a voltage in excess of 50 volts alternating current or 120 volts direct current which are so exposed that they may be touched by a person.

(2) The notices referred to in paragraph (1) shall –

(a) be in a form that can be easily read and understood by employees employed at the premises;

(b) give the following information –

(i) the appropriate first aid treatment for electric shock, and

(ii) details of the emergency action to be taken in case of electric shock.

The 'responsible person' must display notices at any premises where:

- an electrical system supplies or receives electrical energy at a voltage in excess of 250 volts; or
- comprises exposed conductors energised at a voltage in excess of 50 volts alternating current or 120 volts direct current and may be touched by a person.

The notices must be in a form that can be easily read and understood by employees employed at the premises and detail:

- the appropriate first aid treatment for electric shock; and
- the emergency action to be taken in case of electric shock.

Premises that may require these notices could include electrical test areas, substations and laboratories but for resuscitation techniques to be effective, those required to exercise them must receive proper training and regular practice.

Regulation 20:
Certificates of exemption

The Minister may (subject to such conditions, if any, as may be specified therein) by certificate in writing (which the Minister may at his or her discretion revoke at any time) exempt from all or any of the requirements of these Regulations –

(a) any particular electrical equipment or system or any class or description of electrical equipment or system;

(b) any particular premises on which employees are employed or any class or description of premises on which employees are employed; or

(c) any particular process or description of manual labour used by employees or any class or description of such used by employees,

if the Minister is satisfied that the requirements in respect of which the exemption is granted are not necessary for the protection of any employee or are not practicable.

An application for exemption from any individual Regulation may be made to the Minister for Social Security, Health and Safety at Work Inspectorate, for:

- electrical equipment;
- an electrical system;
- a premises on which employees are employed; or
- a particular process used by employees.

These applications will only be considered if compliance with the Regulations is not necessary to maintain the safety of employees, or if compliance with the Regulations is not reasonably practicable. Exemptions may be granted only in very exceptional circumstances.

Regulation 21:
Citation

These Regulations may be cited as the Safeguarding of Workers (Electricity at Work) (Jersey) Regulations 1983.

The Electricity at Work (Jersey) Regulations 1983 apply to all working activities involving electrical equipment and place duties on employers, employees and the self-employed to control risks arising from the use of electricity.

Contacts

Health and Safety at Work Inspectorate

The Inspectorate may be contacted for further advice on specific matters:

Social Security Department
Philip Le Feuvre House
La Motte Street
St Helier
Jersey JE4 8PE

Telephone: 01534 447300
Email: hsi@gov.je

Publications issued by the Inspectorate can be obtained from the Social Security Department. Information and guidance may also be viewed online and downloaded from the States of Jersey website: www.gov.je/hsi

Publications include:

- Working safely and avoiding danger from underground services and other utility apparatus
- Maintaining portable electrical equipment

Jersey Legal Information Board

The Electricity at Work (Jersey) Regulations 1983, reference 05.300.70, can be viewed on the official website: www.jerseylaw.je

Health and Safety Executive (HSE)

The HSE provides information and guidance on all aspects of work-related health and safety. Please note that the legislation mentioned in HSE publications does not apply in Jersey; reference to HSE publications is intended to provide useful advice.

Priced and free publications are available on the HSE website: www.hse.gov.uk

British Standards Institution (BSI)

Standards, including BS 7671, can be purchased via the website: www.bsigroup.com

Institution of Engineering and Technology (IET)

Publications relating to the IET Wiring Regulations are available on the website: www.theiet.org

Publication designed and produced by **AEA Design**
www.aeadesign.com | 01534 280888

States of Jersey

Health and Safety at Work Inspectorate
Social Security Department
P.O. Box 55
Philip Le Feuvre House
La Motte Street
St.Helier
Jersey JE4 8PE

Tel: 01534 447300
E-mail: hsi@gov.je
Website: www.gov.je/hsi

aeadesign.com - 01534 280888