



HEALTH AND SAFETY
AUTHORITY

Guide to the Safety, Health and Welfare at Work (General Application) Regulations 2007



Part 3:
Electricity

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**Guide to the
Safety, Health and Welfare at Work
(General Application)
Regulations 2007**

**Part 3:
Electricity**

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Guide to Part 3 of the General Application Regulations 2007

PART 3: ELECTRICITY

Introduction

This Guide is aimed at safety and health practitioners, employers, managers, employees, safety representatives and others, including those in the business of managing electrical networks involved in the generation and transmission of electricity to consumers. It is designed to give guidance on Part 3 of the Safety, Health and Welfare at Work (General Application) Regulations 2007 (S.I. No. 299 of 2007) as amended by the Safety, Health and Welfare at Work (General Application) (Amendment) Regulations 2007 (S.I. No. 732 of 2007) relating to the use of electricity in the workplace. The objective of the Guide is to give general guidance aimed at the prevention of occupational accidents or ill health. *It is not intended as a legal interpretation of the legislation.*

Part 3 of the General Application Regulations 2007 requires precautions to be taken against the risk of death or personal injury and to prevent danger so far as is reasonably practicable from electricity used in work activities.

From 1 November 2007, Part 3 of the Safety, Health and Welfare at Work (General Application) Regulations 2007 as amended, replaces Part VIII of the Safety, Health and Welfare at Work (General Application) Regulations 1993 (S.I. No. 44 of 1993) relating to electricity which is revoked from that date.

In this Guide the text of the Regulations is shown in italics.

The General Application Regulations 2007 are made under the Safety, Health and Welfare at Work Act 2005 (No. 10 of 2005) referred to elsewhere in this Guide as “the Act”.

Provisions for electrical safety also exist in the Safety, Health and Welfare at Work (Offshore Installations) (Operations) Regulations 1991 (S.I. No. 16 of 1991).

Part 3 of the General Application Regulations 2007 imposes duties principally on employers, the self-employed and employees in respect of electrical equipment and installations in a place of work and in respect of work activities on or near electrical equipment. It also imposes duties on persons who design, install, maintain, use or are in control of electrical networks.

The purpose of this Guide is to describe the nature of the precautions in general terms.

The Regulations are a framework in nature and state principles of electrical safety in a form which may be applied to any electrical equipment and any work activity that come within the scope of the Regulations.

Detailed technical guidance is available from:

- Electro-Technical Council of Ireland (ETCI)
- National Standards Authority of Ireland (NSAI)
- Comité Européen de Normalisation Electrotechnique (CENELEC)
- International Electrotechnical Commission (IEC).

The Regulations do not address issues associated with radiation from electric sources or interference effects. They do not address the CE marking of equipment nor other aspects of the Low Voltage Directive 2006/95/EC.

Electricity in workplaces in Ireland is generally supplied at three distinct voltages: 110 volts, 220 volts and 380 volts. Larger industrial workplaces may have electrical supplies at higher voltages than those listed above depending on their power needs. In general with electrical work, the higher the supply voltage the higher the level of risk presented by a relevant electrical installation. However, electricity at all voltages, if not managed in a safe way, can present significant hazards to those working with electrical installations or using electrically powered work equipment.

Electrical hazards associated with electrical systems and equipment include:

- Electric shock
- Burns sustained at the point of accidental electrical contact, or due to arcing from high voltage conductors
- Fires caused by overheating or ignition of explosive atmospheres
- Secondary injuries as a result of muscle spasms during shock or, for example, falling from a ladder after a mild shock.

Every employer must deal with these hazards in order to prevent the risk of injury.

Regulation 74: Interpretation for Part 3

Many of the terms used are self-explanatory. The definitions take into account definitions included in the ETCI Rules, which are in accordance with internationally accepted and harmonised terminology.

74. *In this Part:*

“authorised person” means a person who is—

- (a) competent for the purpose of this Part, in relation to which the expression is used,*
- (b) either an employer, a self-employed person, or an employee appointed or selected by the employer or self-employed person, and*
- (c) engaged in work or duties incidental to the generation, transformation, conversion, switching, controlling, regulating, rectification, storage, transmission, distribution, provision, measurement or use of electrical energy;*

Under the Regulations, the carrying out of certain tasks is confined to “authorised persons” who, whether they are the employer or otherwise, should possess sufficient training, experience and knowledge to do the work so that they do not put themselves and others at risk when carrying out work on the electrical installation or network involved.

“circuit” means part of an electrical installation supplied from the same origin, which may be protected against overcurrents by the same protective device;

“circuit breaker” means an electro-mechanical device capable of making, carrying and breaking currents under normal circuit conditions and also capable of making, carrying for a specified time, and breaking currents under specified abnormal circuit conditions such as those of short circuit;

“conductive part” means a part capable of conducting current although not necessarily used for carrying current in normal conditions;

“conductor” means a conductor of electrical energy;

“danger” means risk of personal injury from—

- (a) electric shock, electric burn, electrical explosion or arcing,*
- (b) fire or explosion caused by the use of electricity, or*
- (c) mechanical movement of electrically driven equipment,*

and preventing danger in this Part shall be construed as preventing danger so far as is reasonably practicable;

“earthing” means the connection of the exposed conductive parts of an installation to the conductive mass of the earth;

“electrical equipment” includes any conductor or electric cable and any part of any machine, apparatus or appliance, intended to be used or installed for use for the generation, transformation, conversion, switching, controlling, regulating, rectification, storage, transmission, distribution, provision, measurement or use of electrical energy;

“electrical installation” means an assembly of associated electrical equipment fulfilling a specific purpose or purposes and having co-ordinated characteristics;

“higher voltage” means any voltage exceeding –

- (a) 1000 volts alternating current, or*

(b) 1500 volts direct current;

“isolation” means the disconnection and separation of electrical equipment from every source of electrical energy in such a way that the disconnection and separation is secure;

“live” means electrically energised;

“medical electrical equipment” means medical electrical equipment as defined in the Electro-Technical Council of Ireland (ETCI) document entitled “National Rules for Electrical Installations in Medically Used Rooms” or other equipment as may be prescribed by the Minister;

“overcurrent” means any current exceeding the rated value of the electrical equipment concerned;

“overhead line” means any electric line suspended above ground carrying or intended to carry electrical energy at a voltage exceeding 80 volts to earth;

“portable equipment” means equipment, including hand-held portable equipment, which—

- (a) because of the manner in which it is to be used, requires to be moved while it is working,
- (b) is designed so that it can be moved while it is working, or
- (c) is moved from time to time between the periods during which it is working;

Portable equipment includes not only electrical tools, such as electric drills and grinders, which can be carried, but also transportable electrical equipment which is moved about on wheels or a trolley, such as electric arc welders, floor-cleaning equipment and steam/water pressure cleaners.

“residual current device” means an electro mechanical switching device intended to disconnect a circuit when the residual current attains a stated value under specific conditions;

“substation” means any building, enclosure or other structure, or any part thereof, which –

- (a) is large enough to enable a person to enter after the electrical equipment therein is in position, and
- (b) contains equipment for transforming or converting electrical energy either to or from higher voltage (not being equipment for transforming or converting electrical energy solely for the operation of switchgear or instruments),

and includes that equipment, together with any other equipment for switching, controlling or otherwise regulating electrical energy;

“switch room” means a room intended primarily to house electrical switching and distribution equipment for a building;

“underground cable” means any electric cable below ground carrying or intended to carry electrical energy at a voltage exceeding 80 volts to earth.

Regulation 75: Application of Part 3

75. (1) *This Part, without prejudice to section 16 of the Act, applies as appropriate to persons who design, install, maintain, use, or are in control to any extent of—*
- (a) *an electrical installation or part of an electrical installation in a place of work, or*
 - (b) *an electrical network, including the generation, transformation, conversion, switching, controlling, regulating, rectification, storage, transmission, distribution, provision, measurement or use of electrical energy at a place of work.*
- (2) *This Part does not apply to—*
- (a) *any electrical equipment or electrical installation used exclusively for electrical testing or research purposes, or*
 - (b) *medical electrical equipment,*

but persons using equipment referred to in subparagraph (b) shall ensure that the equipment or installation is constructed, installed, maintained, protected and used, with adequate precautions being taken, so as to prevent danger.

Part 3 of the General Application Regulations 2007 applies to a broad range of persons such as electrical designers, electrical installers/contractors, electrical maintenance personnel, users of an electrical installation and those in control of electrical installations at work. The provisions apply to employers and employees dealing with electrical installations in the workplace and they also apply to those responsible for designing, installing, maintaining, using or controlling electrical networks at a place of work.

It may be inappropriate to apply some or all of the detailed requirements of Part 3 of the Regulations to electrical equipment or installations used exclusively for testing or research purposes, or to medical electrical equipment, as described in the ETCI publication ET 106, *National Rules for Electrical Installations in Medically Used Rooms*, where the needs of patient care require a particular approach to electrical precautions. In both of these cases, safe systems of work must be applied so as to prevent danger associated with the electrical installations or networks in question.

Regulation 76: Suitability of electrical equipment and installations

76. *An employer shall ensure that—*

(a) all electrical equipment and electrical installations are—

- (i) designed,*
- (ii) constructed,*
- (iii) installed,*
- (iv) maintained,*
- (v) protected, and*
- (vi) used*

so as to prevent danger, and

(b) all electrical equipment and electrical installations, including distribution boards, sockets, transformers and connections, are suitably protected from ingress of moisture or of particles and foreseeable impacts, as appropriate to the location, without prejudice to Regulation 77.

Design and construction

The safety of electrical equipment and installations depends on:

- The design, selection and construction of equipment appropriate to the work environment in which it is to be used
- Proper co-ordination between individual items of equipment in an installation.

Consideration must be given to such factors as accessibility, the type of wiring system to be used (e.g. busbar trunking, cable ducting), possible harmful heating effects, the effects of vibration, the presence of water or dust etc. Materials used must be appropriate and ratings and capacities of all component parts must be adequate. The manner in which commissioning, testing and subsequent maintenance or other work may need to be carried out should be assessed at the design stage.

Sections 16 and 17 of the Act as well as the Safety, Health and Welfare at Work (Construction) Regulations 2006 place further duties on designers and those involved in the construction of electrical installations.

Further requirements for the design and erection of electrical installations are outlined in the ETCI National Rules for Electrical Installations.

Installation

Adherence to well-understood and established good installation practice is mandatory in carrying out installation work to ensure safety during the work activities and to ensure that the physical condition of the completed installation is adequate for its subsequent use.

Maintenance

Regular maintenance must be carried out to ensure the safety of electrical equipment or installations. The nature and frequency of maintenance should be adequate to prevent danger. Regular inspection of

equipment should be part of any preventive maintenance programme. Maintenance records, including the results of tests carried out during the working life of an electrical installation, will enable employers to monitor the effectiveness of maintenance procedures and policies. Regulation 89 deals in further detail with testing and inspection of electrical installations.

Protection

Protection may be achieved by insulation alone, but, depending on the environment of the installation, further physical protection may be necessary to ensure the continuing integrity of basic insulation, e.g. conduits, trunking, armouring or tough external sheathing on cables.

Use

Electrical equipment and installations must not be misused by users. There is a particular onus on an employer to ensure employees are supervised and trained to use electrical equipment in a safe way. For example, equipment designed for use in a dry environment should not be used in wet conditions.

Regulation 77: Adverse or hazardous environments

77. *An employer shall ensure that electrical equipment which may foreseeably be exposed to adverse or hazardous environments, including in particular—*

- (a) mechanical damage,*
- (b) the effects of weather, natural hazards, temperature or pressure,*
- (c) the effects of wet, dirty, dusty or corrosive conditions, and*
- (d) any flammable or potentially explosive atmosphere, including any mixture of air and a flammable substance in the form of gas, vapour, mist or dust,*

is constructed, installed, maintained and modified or so protected as to prevent danger arising from the exposure.

Electrical equipment must be suitable for the environment and conditions to which it will be exposed. In meeting this requirement, it is important to consider:

- Mechanical damage, including that from impact, stress, strain, abrasion, wear, vibration and hydraulic and pneumatic pressures
- Effects of the weather, including wind, ice, snow and lightning
- Effects of temperature and pressure
- Natural hazards, including flora, fauna and solar radiation
- Water and other liquids and their effects, including humidity, condensation, flooding, splashing, immersion, cleaning with liquids and hosing down

- Dirty conditions giving rise to contamination from liquids or solids
- Exposure to corrosive substances
- Flammable and explosive substances and atmospheres.

Potentially explosive atmospheres

As regards the selection of electrical equipment for use in potentially explosive atmospheres, the provisions of the European Communities (Electrical Equipment for Use in Explosive Atmospheres) Regulations 1999 (S.I. No. 83 of 1999) and Part 8 of the Safety, Health and Welfare at Work (General Application) Regulations 2007 must be applied.

The selection of electrical equipment and the design and construction of electrical installations for use in potentially explosive atmospheres should ensure that the electrical equipment or installation selected does not provide a source of ignition to the surrounding potentially explosive atmosphere.

Existing installations complying with the recommendations of earlier standards should be acceptable for continuing service, subject to proper maintenance.

The design, selection, testing, maintenance and repair of equipment suitable for use in explosive atmospheres is a specialised field of work and should be undertaken only by those who have the necessary training and expertise. These activities should be undertaken in accordance with the following ETCI publications:

- *National Rules for Electrical Installations in Potentially Explosive Atmospheres*
- *Guide to the Selection of Electrical Apparatus for Use in Potentially Explosive Atmospheres*
- *A Recommended Maintenance & Inspection Routine for Electrical Installations in Potentially Explosive Atmospheres.*

Much electrical equipment generates heat or produces sparks and such equipment should not be placed where either the heat emitted or the occurrence of sparking is likely to lead to the ignition of any substance.

Classification system of ingress protection (IP rating)

When choosing electrical equipment for adverse environments, regard should be had to the IEC's Index of Protection (IP) rating system, which classifies 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.

Regulation 78: Identification and marking

78. *An employer shall ensure that—*

- all electrical equipment is suitably identified where necessary to prevent danger,*
- all electrical equipment, other than cables and overhead lines, displays the maker's name together with all ratings necessary to show that it is suitable for the purpose for which it is used, and*

- (c) *all electrical circuits are suitably identified at their source to allow those circuits to be safely and securely de-energised and isolated.*

Regulation 78(a) requires the identification of electrical equipment, by way of labelling or otherwise, in order to prevent danger arising from confusion, mistaken identity or some other cause. Identification might indicate the purpose of switchgear or control gear. Wiring systems should be arranged or marked to ensure identification for inspection, testing or monitoring purposes. Identification of cables and wires can be facilitated by use of colour systems.

Regulation 78(b) requires that electrical equipment, other than cables, displays the maker's name together with details of those ratings which give essential information as regards safe installation and safe use of the equipment. These ratings might include voltage, current, power, frequency, IP ratings and surface temperature.

Regulation 78(c) is intended to assist in ensuring the proper identification of circuits to enable safe isolation or disconnection of these circuits for maintenance or other work. This means of identification should be of an indelible type that will not easily degrade with the passage of time. Irrespective of markings or other information provided, circuits should be checked for live conductors prior to the commencement of any work.

Regulation 79: Protection against electric shock in normal conditions

79. *An employer shall ensure that all live parts which may cause danger—*

- (a) *are suitably covered with insulating material and so protected as to prevent danger, or*
- (b) *are the subject of precautions taken to prevent danger, including, where appropriate, the live parts being suitably placed to prevent danger.*

Protection against electric shock in normal conditions (protection against direct contact) can be provided by insulation of live parts. Insulation 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 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 appropriate for the voltages applied to the conductors and the conditions of use.

The insulation should be protected, as necessary, so that danger may be prevented. Protection is primarily required to prevent mechanical damage to the insulation but it is also necessary to protect against the effects of exposure to adverse or

hazardous environments as detailed under Regulation 77. Examples of such protection include the use of steel trunking and conduits or the use of steel wire armoured cables.

Precautions other than basic insulation may be used to protect against direct contact. These may include protection by barriers and enclosures or protection by ensuring that the live part is in an inaccessible position. When deciding whether it is accessible or not, non-routine activities such as maintenance and cleaning must be considered.

Strictly controlled working practices reinforced by written instructions, training, warning notices and restricted access may also be appropriate depending on the level of risk involved.

Un-insulated conductors may be used in power distribution, for overhead travelling cranes, in electrified railways and so forth, but protective barriers etc. must be provided where there is any likelihood of contact by persons.

Regulation 80: Protection against electric shock in fault conditions as amended by the Safety, Health and Welfare at Work (General Application) (Amendment) Regulations 2007 (S.I. No. 732 of 2007)

80. *An employer shall ensure that—*

(a) precautions are taken, either by—

- (i) earthing and automatic disconnection of the supply of electricity, or*
- (ii) other suitable means,*

to prevent danger arising where any exposed conductive part may become live, and

(b) all electrical circuits supplying—

- (i) electric water heating devices,*
- (ii) electrically heated showers, and*
- (iii) pumps for electrically operated showers,*

which are located in zone (1), as defined by the Electro-Technical Council of Ireland “National Rules for Electrical Installations”, of rooms in a place of work containing a bath or shower basin, are protected by a residual current device having a tripping current not exceeding 30 milliamperes operating within such period of time so as to provide the necessary protection to prevent danger to any person coming into direct or indirect contact with any live part of the circuit.

(as amended by the Safety, Health and Welfare at Work (General Application) (Amendment) Regulations 2007)

Precautions have to be taken to prevent electric shock where conductive parts which can be touched, such as outer metallic casings, can become live under fault conditions (protection against indirect contact). These precautions include:

- Earthing and automatic disconnection of supply

- Double insulation
- Connection to a common voltage reference point
- Equipotential bonding
- Use of safe voltages
- Non-conducting locations
- Current/energy limitation
- Electrical separation (isolated circuits)
- Use of residual current devices.

Regulation 80(b) requires that electric water-heating devices, electrically heated showers and pumps for electrically operated showers located in areas of rooms (Zone 1) containing a bath or shower basin in a place of work are protected by a residual current device. For details on the extent of a Zone 1 area, reference should be made to ETCI document ET 101, *National Rules for Electrical Installations – Locations Containing a Bath or Shower Basin*.

Regulation 81: Portable equipment *as amended by the Safety, Health and Welfare at Work (General Application) (Amendment) Regulations 2007 (S.I. No. 732 of 2007)*

81. (1) *An employer shall ensure that—*

- (a) *a circuit supplying portable equipment or a socket outlet intended to supply portable equipment, including any circuit supplied by an electrical generator, and in which is used alternating current at a voltage—*
- (i) *exceeding 125 volts, and*
 - (ii) *not exceeding 1,000 volts,*

is protected by one or more residual current devices having a tripping current not exceeding 30 milliamperes operating within such period of time so as to provide the necessary protection to prevent danger to any person coming into direct or indirect contact with any live part of the circuit,

- (b) *portable equipment is maintained in a manner fit for safe use, and*
- (c) *portable equipment which is—*
- (i) *exposed to conditions causing deterioration liable to result in danger, and*
 - (ii) *supplied at a voltage exceeding 125 volts alternating current, is—*
 - (I) *visually checked by the user before use, and*

(II) periodically inspected by a competent person, appropriate to the nature, location and use of the equipment.

- (2) An employer shall ensure, where appropriate, that a competent person—*
- (a) tests any portable equipment described in paragraph (1)(c)(i) and (ii), and*
 - (b) certifies whether or not the portable equipment (including any cables and plugs) was, on the day of test, as far as could reasonably be ascertained, safe and without risk to persons coming into direct or indirect contact with any live part of the equipment.*
- (3) If the certificate of the competent person referred to in paragraph (2) indicates that the portable equipment tested was not, on the day of the test, safe and without risk, as described in that paragraph, the employer shall ensure that the equipment is not used until it is made safe and certified as such in compliance with paragraph (2).*
- (4) An employer shall ensure that—*
- (a) portable equipment, other than portable transformers and portable generators, supplied at a voltage exceeding 125 volts alternating current is not used in—*
 - (i) construction work,*
 - (ii) external quarrying activities, or*
 - (iii) damp or confined locations,**unless its rating exceeds 2 kilovolt amperes,*
 - (b) portable hand lamps supplied at a voltage exceeding 25 volts alternating current or 50 volts direct current are not used in—*
 - (i) construction work,*
 - (ii) external quarrying activities, or*
 - (iii) damp or confined locations, and*
 - (c) where a transformer or engine-driven generator is used to supply electricity to portable equipment at a voltage greater than 25 volts, but not exceeding 125 volts, alternating current, the neutral (star) point of the secondary windings of three-phase transformers and generators, or the midpoint of the secondary windings of single-phase transformers and generators, shall be connected to earth and in the case of transformers these shall be of the double wound isolating type.*

(as amended by the Safety, Health and Welfare at Work (General Application) (Amendment) Regulations 2007)

Portable equipment supplied at a voltage exceeding 125 volts AC and not exceeding 1000 volts AC must be protected by a residual current device (RCD), also known as an earth leakage circuit breaker (ELCB) or a residual current circuit breaker (RCCB). Many accidents have been caused by the metal

casing of portable or transportable equipment becoming live or the equipment cable being damaged by wear and tear etc. Danger is reduced by the use of an RCD designed to operate at leakage currents not exceeding 30 milliamperes (mA).

Correctly functioning RCDs are key to minimising risk and preventing shock or electrocution. An RCD must be tested by regular operation of the test trip button, as stipulated by the device manufacturer. This would ensure that the RCD would be less likely to fail to operate when needed as any “stiction” difficulties (electro-mechanical protective devices that are exposed to any moisture and dust are likely to stick if not operated periodically) would be overcome.

While the push-to-test routine should ensure that the RCD will operate when required, it should also be functionally tested by a competent person periodically to ensure that it operates for the rated leakage current (e.g. at 30 mA) and within the time permitted (e.g. < 0.3 seconds). Such testing should form part of the periodic installation tests as outlined in Regulation 89(b).

Portable transformers supplied at a voltage exceeding 125 volts AC come within the application of Regulation 81(1) and a maximum cable length of two metres should be used on the high voltage or supply side. Where an extension lead is required, this should be used on the low voltage or secondary side of the transformer and it should be suitable for the environment in which it is used.

Guidance on the selection of RCDs is available from the ETCI.

Inspection and maintenance

Portable equipment, by its nature, is more susceptible to damage than fixed electrical equipment. It is also more likely to be used in different environments and is often directly in contact with the user. For these reasons it is important that portable electrical equipment is maintained so as to be safe.

To make sure that it continues to be safe to use, employers must ensure that portable equipment which is exposed to conditions likely to cause deterioration and consequent danger, and is supplied at a voltage in excess of 125 volts AC, undergoes a visual check by the user and is periodically inspected by a person competent to establish the ongoing safety of the electrical equipment. The nature and frequency of these inspections will vary dependent on the use and location of the equipment.

In addition to these periodic inspections, where the portable equipment is subject to conditions causing deterioration and is supplied at a voltage exceeding 125 volts AC, then the portable equipment and associated leads and plug tops must be tested and certified as being safe by a person competent to carry out such tests. If the certificate issued indicates that the equipment is not safe, then this equipment must not be used until it has been made safe and has been certified as such.

A system of visual inspection is necessary in order for an employer to ensure that safe equipment is being provided for use. The frequency of inspections should be related to the likelihood of equipment damage. Where required by manufacturers or where it is subject to heavy wear and tear, equipment will need to be tested.

Employees should visually check portable electrically operated equipment before they use it. They should visually check for:

- Obvious damage on the equipment enclosures and insulation
- Obvious damage to the cable or lead supplying the equipment or evidence of any temporary repairs such as taped connections
- Loose connections or loose cabling
- Damage to the plug tops or sockets being used
- Scorch or burn marks on the equipment, leads or plug tops.

Employees discovering a defect in portable equipment during these checks should not use the equipment and should report the defect to their supervisor. Employees should be instructed in the carrying out of these checks.

It is anticipated that equipment located in environments where it is safe from accidental damage or environmental degradation and that is rarely moved should not need to be tested unless a risk assessment shows otherwise.

Care should be exercised in the use of second-hand equipment where history of its previous use is not known.

Portable electrical equipment supplied at a voltage less than 125 volts AC, such as the majority of electrical equipment used during construction activities, is not specifically included in Regulations 81(1)(c), 81(2) and 81(3) but must be maintained in a manner fit for safe use (Regulation 81(1)(b)) and should be subject to an appropriate inspection regime by employers to ensure that this is the case.

These obligations are closely related to more general provisions for inspection of work equipment contained in Regulation 30 of the General Application Regulations 2007, which requires periodic inspections and testing of work equipment that is exposed to conditions causing deterioration liable to result in a danger to safety or health.

Reduced low voltage

Reduced low voltage supply (not exceeding 125 volts AC) is required for portable equipment used in areas with increased risks of dangerous shock currents. These include temporary work locations such as construction sites, external work in quarry locations and work in damp or confined locations. Because of the power limitations imposed by lower supply voltages, there is an exception to this requirement for portable equipment with a power rating in excess of 2 kilovolt amperes (approximately 2 kilowatt). In this instance greater supply voltages can be utilised provided the cabling is protected from mechanical damage and the circuit is protected by a residual current device.

This requirement does not apply to portable transformers or generators. Transformers supplying electricity at reduced low voltage (Regulation 81(4)(c)) must be of a double wound isolating type. Transformers and generators must have the star point (three phase) or midpoint (single phase) on the secondary windings (low/output voltage side) connected to earth. These earthing arrangements reduce the potential level of shock and the possibility of electrocution.

If switching and overcurrent protection is provided, double pole switches and fusing in both (live) poles of the supply are required where the supply is from a centre tap to earth source.

Portable hand-lamps, that is electric lamps for inspection purposes and suitable for carrying in the hand, used in construction work, external workplaces, quarries or damp or confined locations must be supplied at a voltage not exceeding 25 volts AC or 50 volts DC. Hand-lamp bulbs are particularly prone to breakage with consequent exposure of live elements.

Regulation 82: Connections and cables

82. *An employer shall ensure that—*

- (a) an electrical joint and connection is of adequate construction as regards conductance, insulation, mechanical strength and protection so as to prevent danger;*
- (b) where a cable is used in construction work or in external quarrying operations, it is appropriately protected and insulated for the voltage of the cable to prevent danger; and*
- (c) a cable for portable equipment—*
 - (i) is connected to the equipment and to the system either by efficient permanent joints or by a properly constructed connector; and*
 - (ii) is arranged so that tension in the cable cannot be transmitted through the conductors to the terminals at either end of the cable.*

All connections in circuit and protective conductors, including connections to terminals, plugs and sockets and any other means of joining or connecting conductors, must be adequate for the purposes for which they are used. This applies equally to temporary and permanent connections. The insulation and conductance of the connections must be suitable, having regard to the conditions of use, including likely fault conditions.

The mechanical protection and strength must be such as to ensure the integrity of the insulation and conductance under all conditions of use including likely fault conditions. Joints and connections in protective conductors must be of sufficient strength and conductance to allow for the passage of fault currents.

Cabling used in construction work or in external workplaces in quarries must be provided with adequate insulation and mechanical protection (such as armouring) bearing in mind the voltage used.

Cables connecting to items of portable equipment should, in addition to being fixed at the terminals, be fixed to prevent putting undue strain directly on the terminals (e.g. the use of secured cord grips). This provision is necessary to deal with the most common failure in plug–cable connections

Regulation 83: Overcurrent protection

83. *An employer shall ensure that effective means suitably located are provided to protect all electrical equipment and electrical installations from overcurrent so as to prevent danger.*

Live conductors must be protected by one or more devices which automatically disconnect the supply of electricity in the event of overcurrent, where such overcurrent is of a magnitude or duration which could give rise to danger or could damage the electrical equipment or installation. Destructive arcing and heating should be minimised. Protection against overcurrent consists of protection against overload and protection against short circuit currents, and may be provided by fuses, circuit breakers or other protective devices.

In selecting the means of overcurrent protection, the following factors must be considered:

- Nature of the circuits and the type of equipment or installation to be protected
- Maximum potential short circuit (fault) current with which the protective device may have to cope
- Nature of the environment
- Whether the system is earthed or not.

Regulation 84: Auxiliary generator and battery supply

84. *An employer shall ensure that—*

- (a) *appropriate precautions are taken to prevent danger—*
 - (i) *when operating, installing, maintaining, transporting or storing auxiliary power supply batteries or auxiliary generators, and*
 - (ii) *to persons who install, maintain or use an electrical installation where auxiliary batteries or generators have been fitted or are intended to be fitted, and*
- (b) *where auxiliary batteries or generators have been fitted or are intended to be fitted, appropriate precautions are taken to prevent danger to persons working on the external electrical network supplying an electrical installation.*

Generators and/or battery standby supplies are used in a broad range of workplaces to ensure continuation of supply in the event of loss of supply from the utility provider. Auxiliary battery supply is also used to ensure integrity of supply to critical equipment such as information technology equipment, fire safety critical systems etc.

The design, installation, maintenance, transportation and storage of such systems have safety implications and must be carried out so as to prevent danger. The design and installation of changeover mechanisms from the normal to the auxiliary supplies must be carried out in a way that prevents danger. These mechanisms must be put in place in such a way as to prevent danger to persons working on external networks supplying the electrical installation. For detailed guidance on the use of low voltage generators in the workplace, reference should be made to the ETCI's *Code of Practice for the Selection and Installation of Low Voltage Generators*.

Regulation 85: Switching and isolation for work on equipment made dead

85. (1) *An employer shall ensure that—*

- (a) *subject to paragraph (2), where necessary to prevent danger, suitable means (including, where appropriate, methods of identifying circuits) are available to switch off the supply of electricity to any electrical equipment and to isolate any electrical equipment,*
- (b) *every switch, circuit breaker or other control device provided under subparagraph (a) is, where necessary to prevent danger,*
 - (i) *clearly marked to indicate the “ON” and “OFF” positions, unless these are otherwise self-evident, and*
 - (ii) *readily accessible for authorised persons and in a suitable and adequately lit location, and*
- (c) *adequate precautions are taken to prevent the operation of any switch while carrying current where that switch is not capable of safely interrupting normal load current.*

(2) *Paragraph (1) does not apply to electrical equipment which is itself a source of electrical energy, provided that adequate precautions are taken to prevent danger.*

Suitable means must be provided by which the electricity supply to any piece of equipment can be switched off. Switching can be, for example, by direct manual operation such as physically operating a switch or isolator or by indirect operation via “stop” buttons in the control circuits of contactors or circuit breakers.

“Switch off” the supply as outlined in Regulation 85(1)(a) requires means to be provided whereby the supply of electrical energy can be switched off. “Isolate”, as outlined in this Regulation, requires that there will be available suitable means, through isolation, of ensuring that the supply will remain switched off and that inadvertent reconnection will be prevented as necessary. This provision, together with safe working practices, will enable work to be carried out on or near electrical equipment which is dead, without risk of it becoming live during the course of that work (see Regulation 86(c)).

Switches, circuit breakers and other control devices provided in accordance with Regulation 85 must, where necessary to prevent danger:

- Clearly indicate whether the circuits they control are switched ON or OFF
- Be readily accessible for operation by authorised persons.

They must be suitably located and lighting must be adequate to ensure correct identification of each switch and its ON/OFF status. Suitability of location would depend on the nature of the risks, the availability of persons authorised to operate the means of switching or isolation and the speed at which an operation may be necessary to prevent danger. Access to switches etc. must be kept free from obstruction.

Danger can arise if an attempt is made to interrupt current by operating a switching device that is not capable of safely interrupting normal load current. Danger may arise from continued arcing in the switch after operation, from heat generated, from disintegration of insulation and from fire or explosion.

Precautions may be taken either by interlocking non-load break switches with switches or circuit breakers that are capable of interrupting load current or by the provision of formal systems of work that are so planned, organised, performed and maintained as to prevent danger.

It may be impracticable to switch off or isolate equipment such as large capacitors, generator windings or accumulator terminals, which constitute an integral part of a source of electricity. However, adequate precautions such as are required under these Regulations for work on electrical equipment (see Regulation 86) must be taken to minimise risk.

Regulation 86: Precautions for work on electrical equipment

86. (1) *An employer shall ensure that—*

- (a) *work activity, including the operation, use and maintenance of electrical equipment or electrical installations, is carried out in a manner that prevents danger,*
- (b) *before work is carried out on live electrical equipment the equipment is, where appropriate, made dead so as to prevent danger,*
- (c) *adequate precautions are taken to prevent danger arising from—*
 - (i) *electrical equipment which has been made dead becoming live while work is carried out on or near that equipment, and*
 - (ii) *any electrical equipment inadvertently becoming live,*
- (d) *where it is necessary for work to be carried out on or near any live part, other than one suitably covered with insulating material so as to prevent danger, of electrical equipment, a person is not engaged in work activity unless—*
 - (i) *it is unreasonable in the circumstances for it to be dead,*
 - (ii) *it is reasonable in the circumstances for such person to be at work on or near it while it is live, and*
 - (iii) *suitable precautions are taken to prevent danger, including, where necessary, the provision of protective equipment.*

- (2) *An employer shall ensure that any equipment provided under this Part for the purpose of protecting employees, or others to whom the relevant statutory provisions apply, near electrical equipment is—*
- (a) *suitable for the use for which it is provided,*
 - (b) *maintained in a condition suitable for that use, and*
 - (c) *properly used.*

Where electrical equipment has been made dead to facilitate maintenance or other work, whether electrical or non-electrical, to be carried out safely, adequate precautions must be taken to prevent the equipment becoming live if this will give rise to danger. Means for isolating electrical equipment provided in accordance with Regulation 85(1)(a) will facilitate compliance with this requirement. An isolator-locking device must be used. Where work must be done on or near conductors which have been isolated, the conductors should be proved dead by testing with a suitable monitoring device at the work location before work commences. Where necessary, suitable means must be provided for the discharge of stored electrical energy.

Written instructions setting out safety isolation procedures including “permits to work” may be required to ensure a safe system of work. This is particularly so where high voltage circuits are involved.

Where work is to be carried out on high voltage electrical equipment in its normal operating position, the circuit should first be earthed.

Adequate precautions must be taken to prevent danger arising where electrical equipment inadvertently becomes live. Labelling or marking will help prevent inadvertent connection. Danger may also arise from the mechanical movement of electrically driven equipment where a loss of electricity supply has caused plant or machinery to come to a halt and where subsequent restoration of supply automatically sets it in motion again. Under-voltage protective devices can be used to prevent such occurrences and also to prevent danger arising from voltage drops.

Work activities of any sort, whether directly or indirectly associated with the operation, use or maintenance of an electrical system, must be carried out in a way that does not give rise to danger. In the case of work of an electrical nature, except in exceptional circumstances (see Regulation 86(1)(d)), the live parts should be made dead before work starts. In such cases it is essential that the equipment be isolated and the live parts proved dead at the point of work, before the work starts. Where a test instrument or voltage indicator is used for this purpose, this device should itself be proved, preferably immediately before and immediately after testing the electrical equipment or installation.

It is important to use safe systems of work incorporating safety isolation procedures in making dead electrical equipment upon which work is to be carried out.

When working on exposed conductors, or apparatus directly connected to exposed conductors, the possibility of lightning needs to be considered and appropriate action taken to cease work in the event of a near approach of a lightning storm.

It is preferable that work on or near electrical equipment should be carried out when that equipment is dead, but work on or near live conductors may be permitted in exceptional circumstances.

Regulation 86(1)(d) requires three conditions to be met before live working is allowed:

- (i) It is unreasonable in the circumstances for electrical equipment to be dead
- (ii) It is reasonable in the circumstances for work to be carried out on or near the live part
- (iii) Suitable precautions have been taken to prevent danger, including using a safe system of work and the provision of personal protective equipment, as necessary.

There are circumstances where it is unreasonable to make equipment dead because of the resultant difficulties. For example, it may be necessary to energise circuits for commissioning or fault-finding, with parts live, though these should not be so exposed as to be easily touched. It would be very disruptive to disconnect a large number of electricity consumers by isolating live parts for the duration of some essential maintenance, repair or inspection work on a power distribution network. Likewise it may be necessary to work live on telephone network connections or on busy sections of electrified railway track.

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

The design of electrical equipment and of the installation should eliminate the need for live work which puts persons at risk. This can often be achieved if care is taken at the design stage of installations (e.g. 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 protection to persons from other parts which may be live).

Factors which should be considered in deciding whether it is justifiable for work to proceed with the parts live include:

- It is not practicable to carry out the work with the parts dead, e.g. where, for purposes of testing, it is necessary for the parts to be live
- Making the parts dead will create other hazards for other users of the system, e.g. in hospitals
- The disruption which the taking down of continuously operating process plants would create
- An assessment of the level of risk involved in working live and the effectiveness of the precautions taken.

Persons at work are permitted to be near live parts 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 live parts, then that work should not be done near the live parts.

Persons whose presence near the live parts is unnecessary should not be so near that they are at risk.

The precautions taken need to be appropriate to the risk involved. Suitable precautions must include as appropriate:

- Use of people who are properly trained and competent to work safely on live equipment (see also Regulation 88)
- Provision of adequate information to the person carrying out the work about the live parts involved, the associated electrical installation and the likely risks
- Use of suitable tools including insulated tools, equipment and protective clothing (see also Regulation 86(2)), e.g. a cable jointer will need insulating gloves, insulating boots and insulating rubber matting
- Use of suitable insulated barriers or screens
- Use of suitable instruments and test probes
- Accompaniment by another person or persons if their presence could contribute significantly to ensuring that danger is minimised
- Restriction of routine live test work (e.g. product testing) to a specific area and the use of special precautions within that area such as isolated power supplies, non-conducting locations etc.
- Effective control of any area where there is danger from live parts.

Where work on or near a live part is unavoidable, the system of work used must:

- Allow only a person who is competent (see Regulation 88) to work on or near exposed live conductors
- Indicate the extent of the live work
- Indicate what levels of competence apply to each category of work
- Incorporate procedures under which the person carrying out 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.

In developing a system of work, consideration should be given (based on a risk assessment of the proposed work) as to whether the person carrying out such work should be accompanied by a second person who is trained and able to act in an emergency, e.g. to switch off power and give first-aid treatment for electric shock.

The equipment referred to in Regulation 86(2) includes those special tools, protective clothing and insulating screening materials etc. necessary to undertake work safely on live electrical equipment. The protective equipment must be suitable for the task involved, maintained in good condition and properly used.

Regulation 87: Working space, access and lighting

87. *An employer shall ensure that—*

- (a) adequate working space, adequate means of access and egress and adequate lighting are provided at all electrical equipment on which, or near which, work is being done in circumstances which may cause danger, and*
- (b) emergency lighting is fitted in all switchrooms in order to give an adequate degree of lighting in the event of a loss of electrical supply.*

Sufficient working space, suitable access and egress and adequate illumination must be provided while persons are working on, at or near electrical equipment in order that they may work safely. This requirement is not restricted to those circumstances where live parts are exposed but applies where any work is being done in circumstances which may give rise to danger. (See also guidance under Regulation 85(1)(b) in respect of safe access to means of isolation.)

Where there are dangerous exposed live parts within reach, the working space dimensions should be adequate to allow persons to pull back without hazard, and, if persons need to pass one another, to allow them to do so with ease and without hazard.

Natural light is preferable to artificial light. Where artificial light is necessary (e.g. in an indoor switch room), it should be from a permanent and properly designed installation. However, in circumstances where this cannot be achieved, a strategically placed emergency light fitting, hand lamps or torches etc. may be adequate. Emergency lighting must be provided in all switch rooms.

Regulation 88: Persons to be competent to prevent danger

88. *An employer shall ensure that no person is engaged in any work activity to which this Part relates where technical knowledge and experience is necessary to prevent danger unless that person is competent or is under such degree of supervision as is appropriate, having regard to the nature of the work.*

Persons should not be placed at risk due to a lack of skills on their part or the part of others in working with electrical equipment.

Regulation 88 applies to the whole range of work associated with electrical equipment where danger may arise, e.g. maintenance work in high voltage switch rooms, whether or not danger is actually present during the work. For the duration of the work, control must be under a person who possesses sufficient technical knowledge and experience, or be supervised, so as to ensure that danger is prevented.

Technical knowledge and experience includes:

- Adequate knowledge of electricity
- Adequate experience of electrical work

- Adequate understanding of the installation type to be worked on and practical experience of that class of installation
- Understanding of the hazards which may arise during the work and the precautions which need to be taken
- Ability to recognise at all times whether it is safe for work to continue.

Employees involved in working with electrical equipment likely to cause danger must be trained and instructed to ensure that they understand the safety procedures which are relevant to their work.

The primary obligation on employers is in all cases to provide competent persons to carry out electrical work. However, in some exceptional cases, e.g. during training on specialist equipment, persons may require supervision, to some degree, where their technical knowledge and experience is not sufficient to ensure that they can otherwise undertake the work safely. In such cases, the supervisor must have the requisite technical knowledge and experience.

Those in overall charge must make it clear to supervisors the full extent of their responsibilities and, where the complexity of the work warrants it, this should be in writing to avoid misunderstandings.

Regulation 89: Testing and inspection

as amended by the Safety, Health and Welfare at Work (General Application) (Amendment) Regulations 2007 (S.I. No. 732 of 2007)

89. *An employer shall ensure that—*

- (a) *a new electrical installation and a major alteration of, or extension to, an existing electrical installation is, after completion, inspected and tested by a competent person and a report of the test is completed verifying that the relevant requirements of this Part have been complied with,*
- (b) *an existing electrical installation is tested by a competent person in an appropriate manner—*
 - (i) *from time to time where required having regard to the nature, location and use of the installation, or*
 - (ii) *if an inspector so requires,*

and a report of the test is completed by the competent person carrying out the test,

(as amended by the Safety, Health and Welfare at Work (General Application) (Amendment) Regulations 2007)

- (c) *the advice of an inspector, or competent person, on the necessity for further testing of an electrical installation is acted upon having regard to the condition of the installation and the outcome of any tests referred to in paragraphs (a) and (b), and*
- (d) *all defects found during the testing and inspection of an electrical installation are rectified promptly so as to prevent danger.*

Every new installation and every major alteration or extension to an existing installation, after completion and before being made live, must be inspected and tested so as to verify that the requirements of this part of the Regulations have been fulfilled. However, certain types of test may only be made after an installation has been made live. Verification and testing must be carried out by a competent person with the necessary knowledge and experience.

All the appropriate information, including diagrams of connections, wiring diagrams, charts, tables, schedules, equipment ratings and the like, must be available to the person or persons carrying out the verification. Precautions must be taken to ensure the safety of persons and to avoid damage to the installation and equipment during inspection and testing.

Where the installation is an extension or alteration of an existing installation, it must be verified that the extension or alteration complies with this part of the Regulations and does not impair the safety of the existing installation.

Visual inspection

Visual inspection must be made of the completed installation in order to verify compliance. It must precede testing and take place before the installation is made live.

Testing

After visual inspection, tests must be carried out on the installation to ensure compliance with the Regulations. This stage must include tests of:

- Continuity
- Resistance/conductance
- Polarity
- Fault loop impedance
- Operation of RCDs.

Additional tests are required where potentially explosive atmospheres exist. The ETCI provides guidelines and suitable forms in its guidance, *A Recommended Maintenance & Inspection Routine for Electrical Installations in Potentially Explosive Atmospheres*.

Certification

After the installation has been tested and found to comply, the contractor or other person responsible for the construction of the installation, or a person duly authorised to act on his or her behalf, must sign a statement to that effect. Certification in accordance with the requirements of the ETCI Rules will be deemed to meet this requirement. In addition to the certificate, the employer must retain test record sheets containing the results of tests carried out. The certificate must be completed by an authorised person having adequate technical knowledge and experience.

Regulation 89(b) requires that all existing electrical installations in workplaces must be tested periodically as above by a competent person and that this competent person must certify that the installation is in compliance with this part of the regulations. The period between inspection and tests must be decided upon by an employer based on a process of risk assessment taking account of the nature of the installation, its uses and the environment (e.g. industrial, quarrying, mining, manufacturing, catering, office, hospital, farming, explosive atmospheres) and the need to fulfil one of his or her duties under Regulation 76.

An inspector also has the power under Regulation 89 to require an employer to carry out a test of the electrical installation if the inspector deems such a test to be necessary.

If an inspector, or a competent person that has carried out the above tests, advises of the necessity for further testing of the electrical installation then the employer must act on this advice. All defects identified in the tests and inspections outlined above must be rectified promptly by an employer so as to prevent danger.

Regulation 90: Earth leakage protection for higher voltage as amended by the Safety, Health and Welfare at Work (General Application) (Amendment) Regulations 2007 (S.I. No. 732 of 2007)

90. An employer shall ensure, so far as is reasonably practicable, that effective means are provided in relation to every circuit in which higher voltage is used to prevent danger arising from leakage currents to earth.

(as amended by the Safety, Health and Welfare at Work (General Application) (Amendment) Regulations 2007)

This Regulation recognises that overcurrent protection would not be sufficient to provide protection where there is a risk that an earth fault on a higher voltage (in excess of 1000 volts AC or 1500 volts DC) circuit could cause currents which give rise to danger but which are not strong enough to operate the overcurrent protection. Where higher voltage is used, provision must be made to address the risks arising from dangerous earth leakage currents.

Regulation 91: Substation and main switch room

91. (1) An employer shall ensure that a substation or a main switch room is—

- (a) suitably constructed,*
- (b) arranged, so far as is reasonably practicable, so that no person can obtain access thereto otherwise than by the intended entrance,*

- (c) *arranged, so far as is reasonably practicable, so that a person cannot interfere with the equipment or conductors therein from outside,*
 - (d) *provided with efficient means of ventilation and kept dry if under cover, and*

 - (e) *as appropriate to the tasks being undertaken, under the control of an authorised person or authorised persons.*
- (2) *An employer shall ensure that only an authorised person or a person acting with his or her consent, or under his or her supervision, can enter any part of a substation or switch room in which there may be danger.*

This Regulation deals with the physical construction of substations and main switch rooms and with the control of access thereto. The boundaries of substations and main switch rooms should be substantial and capable of excluding, as far as possible, the entry of all but authorised persons. A main switch room is a switch room where the main switch board is sited and where the cabling from the utility provider's switchgear/transformer is terminated. There may be more than one main switch room per electrical installation at larger places of work.

Substations and main switch rooms should be well ventilated and kept dry if under cover.

Entry by authorised persons should be through a proper entrance such as a lockable door or gate. Access by other persons must be under the control of an authorised person.

Danger areas such as transformers or switchgear cubicles, rooms or compounds should be entered only by an authorised person or a person acting under his or her supervision.

The ETCI National Rules for Electrical Installations, Amendment Number 2 ET101:2004/A2:2005 gives further details on what must be provided in main switch rooms, as does Technical Guidance Document B: Fire Safety, under the Building Regulations, published by the Department of the Environment, Heritage and Local Government.

Regulation 92: Fencing of outdoor equipment

92. *An employer shall ensure that, wherever any transformer or switchgear in which higher voltage is used is installed otherwise than in a building, the transformer or switchgear is adequately protected either by—*
- (a) *suitable fencing not less than 2.4 m high, or*
 - (b) *some other effective means for preventing any unauthorised person gaining access to the equipment or to anything connected thereto which is used as a conductor*
- unless it is completely enclosed by—*
- (i) *a metal casing which is connected to earth, or*
 - (ii) *some other equally suitable non-metal casing.*

Where high voltage transformers or switchgear are installed out of doors, protection against danger from unauthorised access should be provided by a substantial fence of a minimum height of 2.4 metres or by some other effective means such as high walls.

The requirements of Regulation 92 do not apply where transformers and switchgear are enclosed in an earthed metal casing or some equally suitable non-metal casing. Cables connected to such equipment should be suitably protected.

Regulation 93: Overhead lines and underground cables

93. (1) *An employer shall ensure that—*

- (a) *all overhead lines and their supporting structures and underground cables are constructed, installed, connected and maintained in a manner suitable for the work and conditions under which they are to be operated to prevent danger;*
- (b) *where cables to be installed underground are to be enclosed in ducting of any material, other than in concrete ducts or in floor voids or floor slabs, such ducting—*
 - (i) *is coloured red,*
 - (ii) *has a high resistance to impact, and*
 - (iii) *is covered with suitable warning tape embedded in the ground above the duct,*
- (c) *all overhead lines and other current-carrying parts connected to or containing part of overhead lines are arranged so that adequate clearance is provided from the ground or other accessible place to prevent dangerous contact with a person, article, substance or any conducting material,*
- (d) *means are provided to prevent danger—*
 - (i) *in the event of any live conductor accidentally falling due to breakage or otherwise, and*
 - (ii) *from excessive voltage on overhead lines arising from accidental contact with or leakage from any other overhead line or otherwise, and*
- (e) *where excavation work is to be carried out in the proximity of a known or suspected underground cable—*
 - (i) *where reasonably practicable, the electrical supply to the underground cable is isolated,*

precautions must be taken to prevent danger from contact with or flashover from power lines. Precautions may be by way of line diversion or by guards or barriers to prevent machinery coming within dangerous proximity of the lines, or “goal posts” which would require cranes and other high-rise machines to drop to a safe height before passing under overhead lines. Employers have a duty to prevent danger under or near overhead lines from such hazards as:

- Operation of high-rise machines
- Tipping trucks
- Reduced clearance from ground due to site filling/raising or construction underneath the line.

Protection must be provided on farms from dangers from power lines involving high-rise machinery, tipping and unloading activities, moving irrigation pipes, erecting stacks or ricks of hay or straw underneath power lines and from burning stubble or other fires near overhead lines and support poles.

A certain level of protection can be provided by insulating overhead lines. This may not be sufficient to prevent danger from contact or impact.

Means must be provided to prevent danger arising from any live conductor falling or breaking by ceasing activities in the danger zone and reporting the matter to the appropriate person or body, e.g. the Garda Síochána and the electrical service provider. While the principal duty rests on the person in control of the line, a duty of care also rests on any employer or employee once they become aware of any line damage at their place of work.

A person in control of overhead lines must provide means to prevent danger from excessive voltage pick-up, either due to contact with or leakage from another overhead line. Protection could include insulating parts of overhead lines or replacing overhead lines with underground cables in certain places.

Underground cables

Where underground cables are enclosed in ducting, other than concrete ducts or floor voids/slabs, this ducting must be coloured red, must have a high resistance to mechanical impact damage and must be covered with suitable warning tape embedded in the ground above the duct. All excavation work in the proximity of known or suspected underground cables must be carried out as follows:

- Where possible, the electrical supply to the cable is isolated before excavation work begins
- Where possible, the position of the underground cable is accurately determined
- Material immediately surrounding the cable is excavated using a safe system of work so as to prevent danger, e.g. use manual excavation techniques.

The Health and Safety Authority has published a *Code of Practice for Avoiding Danger from Underground Services*, which gives a framework to duty-holders to

put in place systems of work to avoid danger from underground services. See also I.S. 370:2007, Colour Code for Buried Plastics Piping.

The owner of new or known underground cables must, where possible, identify the positions of these cables and must record this information on appropriate plans or 'as built' drawings. The owner of the cabling could be, amongst others, the utility provider, an employer in an industrial or other setting or bodies such as local authorities.

APPENDIX

Sources of Further Information and Bibliography

This bibliography is not intended to be exhaustive. Dates are current at time of publication. The most recent/current standard/publication should be obtained in each instance.

CENELEC (European Committee for Electrotechnical Standardisation), 35 Rue de Stassartstraat, B-1050 Brussels, Belgium; Tel: +32 2 519 6871; Fax: +32 2 519 6919; Website:

International Electrotechnical Commission (IEC), 3 Rue de Varembe, PO Box 131, CH-1211 Geneva 20, Switzerland; Tel:+ 41 22 919 0211; Fax: +41 22 919 0300; Website:

The *Irish Standards Catalogue* published by the National Standards Authority of Ireland (NSAI) may be purchased from: NSAI, Glasnevin, Dublin 9; Tel: (01) 857 6730; Fax: (01) 857 6729; Website:

I.S. 370:2007, Colour Code for Buried Plastics Piping

Electro-Technical Council of Ireland Ltd (ETCI), ETCI Offices, Unit H12, Centrepoint Business Park, Oak Road, Dublin 12; Tel: 01 429 0088; Fax: 01 429 0090; Website: www.etcie.ie

ET 101: *National Rules for Electrical Installations*, 3rd edition 2006 (incorporating Amendment No. 1 ET101:2000/A1:2001, Amendment No. 2 ET101:2004/A2:2005 and Amendment No. 3)

ET 105: *National Rules for Electrical Installations in Potentially Explosive Atmospheres*, 2nd edition

ET 106: *National Rules for Electrical Installations in Medically Used Rooms*

ET 202: *Guide to the Selection of Electrical Apparatus for Use in Potentially Explosive Atmospheres*

ET 206: *Good Practice Guide on the Management of Electrical Safety at Work*

ET 209: *A Recommended Maintenance & Inspection Routine for Electrical Installations in Potentially Explosive Atmospheres*

ET 210: *Code of Practice for the Selection and Installation of Low Voltage Generators*

European Communities (Electrical Equipment for Use in Explosive Atmospheres) Regulations 1999 (S.I. No. 83 of 1999)

Building Regulations Technical Guidance Document B: Fire Safety, published by the Department of the Environment, Heritage and Local Government

HSA Code of Practice for Avoiding Danger from Underground Services,

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