Local Rule:
Electrical Safety

1. Significant Hazards

Excessive electric current flowing through the body causes muscles to go into spasm, inhibits the respiratory centre in the brain, causes fibrillation of the heart and destroys body tissue. Electric shock can cause cardiac arrest or cessation of breathing either of which can be fatal.

Fire or explosions may arise from sparks, arcs, short circuits, overloading and old wiring.

The University aims to manage its risks from electricity by fulfilling the requirements of the Electricity at Work Regulations 1989.

2. Key Definitions

Electrical equipment includes anything used, intended to be used or installed for use, to generate, provide, transmit, transform, rectify, convert, conduct, distribute control, store, measure or use electrical energy. This includes every type of electrical equipment from, for example, a 44kV overhead line to a battery powered hand lamp. No voltage limits appear in the Regulations, the criteria of application is the test as to whether 'danger' (as defined) may arise. It is appropriate for the Regulations to apply even at the very lowest end of the voltage or power spectrum because the Regulations are concerned with for example explosion risks which may be caused by very low levels of energy igniting flammable gases even though there may be no risk of electric shock or burn.

Circuit conductor means any conductor in a system which is intended to carry electric current in normal conditions, or to be energised in normal conditions, and includes combined neutral and earth conductor, but does not include a conductor provided solely to perform a protective function by connection to earth or other reference point.

Conductor means a conductor of electrical energy.

System means an electrical system in which all the electrical equipment is or may be, electrically connected to a common source of electrical energy, and includes such source and such equipment.

Responsible Person means a person in charge of a unit, e.g. Head of Department, Director of Service, and Head of School. (Hereafter referred to as Head of Department).

Authorised Person means a competent person authorised by the Responsible Person or his/her nominated representative, to carry out specified functions.

Competent Person means a person with sufficient technical knowledge or experience to enable him/her to prevent danger and avoid injury when carrying out his/her duties. Where individuals do not have sufficient expertise, the degree of supervision must be appropriate for the hazard involved with that particular type of work. Technical knowledge and experience may include:

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

Danger is defined as 'risk of injury'.

Injury means death or personal injury from electric shock, electric burn, electrical explosion or arcing, or from fire or explosion initiated by electrical energy.

The purpose of the distinction between 'injury' and 'danger' is to accommodate those circumstances when persons must work on or so near to live equipment that there is a risk of 'injury', i.e. where 'danger is present and cannot be prevented. In these circumstances under Regulation 14, danger may be present but injury **must** be prevented.

3. Departmental Roles

3.1 Nominated Co-ordinator

Head of Department must nominate a person(s) to:

- co-ordinate the statutory inspection and testing of portable electrical appliances within the department's responsibility. This will include determining suitable timeframes for inspections/tests; arranging for inspections/tests to be carried out by suitable competent persons (either approved contractors via Estates Services or trained in-house staff); a process for removing failed equipment from service and arrangements made for its repair or disposal; records of inspection/test are maintained; new equipment is added to the inventory of equipment for inspecting/testing.
- co-ordinate the statutory inspection and testing of fixed electrical equipment or systems within the department's responsibility. Note Estates Services are responsible for the fixed electrical installation.
- maintain a list of Departmental Authorised Persons for electrical work and their specified functions and this is regularly reviewed with the Head of Department.

3.2 Estates Services

Estates Services are responsible for all electrical services within the University, e.g. isolators, busbars, sockets etc. and no department (or contractors hired by the department) is authorised to break into the electrical system without the authorisation of the University's Electrical Engineer.

3.3. Authorised Persons and Staff with Supervisory Responsibility for Electrical Work

Authorised persons and staff with supervisory responsibility for electrical work e.g. (Laboratory Supervisors, Principal Investigators, Supervisors and Line Managers), must ensure that all electrical equipment and electrical work undertaken within their areas of responsibility is adequately risk assessed and safe systems of work developed for this work.

They must also ensure that all appropriate persons (staff, students, contractors, visitors etc.) are made aware of the associated hazards and of the requirement to adopt working procedures designed to eliminate or reduce the risks to their health and the health of other persons as low as practicable. Where students are working with electricity, electrical equipment or performing inspections or testing of electrical equipment, adequate training is given commensurate with the task, to ensure that work can be carried out safely under supervision

Principal Investigators responsible for training students in safe working with electricity must ensure they can demonstrate that such training has been delivered and understood by the students.

3.4 Staff

Staff also have responsibilities placed on them. All members of staff should visually check electrical equipment before use and notify any defects or concerns to their Department Safety Convenor.

The Regulations recognise the level of responsibility which many staff in the electrical trades and professions are expected to take on as part of their job. The "control" which they exercise over electrical safety in any particular circumstance will determine to what extent they hold responsibilities and ensure that those responsibilities are complied with.

4. Assessing Risks from Electricity

4.1. Identifying Hazards

Working with electricity presents the following hazards:

Heat/Burning

Burns can occur externally or internally and are caused by the passage of an electric current through the skin, blood vessels and internal organs. All cases of electrical burns require immediate medical attention.

Radiation Hazards
It is important to avoid unnecessary exposure to ionising and non-ionising radiations which may be produced as a by-product of a particular electrical process, for example, equipment operating at 5,000 V or more may produce adventitious X-rays and should be monitored and, if necessary, adequately shielded.

Some equipment may also produce microwave and radiofrequency radiations, either by design or as a by-product. Again, such equipment should be appropriately protected. In the first instance, for particular advice, please contact the University Radiation Protection Advisor, through Safety Services.

Electrical arc welding can produce UV radiation, harmful fumes and extremely high temperatures. Good ventilation along with thermal insulation, protective clothing and eye protection are required. The COSHH Regulations 2002 apply to fumes given off by such processes.

Guidance on the particular electrical hazards of arc welding is to be found in HSG 118 entitled “Electrical Safety in Arc Welding”.

Fires/Explosion
Fires are frequently started by electrical apparatus and can be caused by sparks, arcs, short-circuits, overloading and old wiring.

Sparks
A spark is a sudden discharge or passage of electricity through air between two conductors or from a conductor to earth or nearby metal. Since the current produced is usually small, sparks rarely cause serious fires except in cases where there is an explosive gas nearby or where highly flammable material is in contact with the conductor. An explosion can be caused by the ignition of flammable gases by a spark from an electric contact. In all cases where a flammable or ignitable atmosphere or vapour is present, special care is necessary in the design and selection of the electrical equipment.

Arcs
An arc is a much larger and brighter discharge in which the current flow may be very large. It usually arises when a circuit is broken, e.g. when switch contacts separate or when a conductor melts or fractures leaving a gap across which electricity continues to flow. When an arc is established, the air in the vicinity becomes ionised and forms a conductor which may allow current to continue to flow to a nearby metal framework. A large arc can cause serious burns both to an operator nearby and to any adjoining material. It can also produce molten metal splashes which can cause additional injury.

Short-Circuits
A short-circuit is formed when the current finds a path from the live conductor wire to the return wire other than the route through the apparatus. Since the resistance of the leads to the by-passed apparatus is low, the current flow may be large and the leads become white hot causing the adjoining insulation to burn. The burning may then spread rapidly to any adjacent flammable material. Accumulators wired in series can give rise to extremely damaging high currents should a short-circuit occur. Protection with circuit breakers or fuses is necessary.

Overloading and Old Wiring
Wiring is overloaded when it continuously carries an electrical current greater than it is designed to carry; as a consequence it becomes overheated and the insulation is damaged. If the overload is heavy, the insulation will break down and a short-circuit may be produced; if the overheating is smaller, but persistent, the continual overheating will lead to carbonizing of the insulation and a possible short circuit.

The insulation of wiring which has been in use for a number of years can become brittle therefore alterations or additions must not be made to any old wiring without providing for its inspection. If wiring enclosed in a plastic insulation is overloaded sufficiently to raise its temperature appreciably, the insulation will become soft and lose its insulating properties. Proper consideration must be given to the load that any conductor is to carry before apparatus is connected to the supply.

4.2 Evaluating Risks

For many departments the use of electricity will be limited to the use of equipment such as computers, kettles and other low risk appliances. In such circumstances the department safety arrangements would cover visual inspection, portable appliance testing, prohibition of staff working on electrical equipment and ensuring electrical faults are reported and faulty equipment taken out of service.

For departments who work with electricity or on electrical equipment, further arrangements will be required; risk assessments, safe systems of work, inspection and testing and competence of staff etc., because of the higher risk these activities present.

Staff and students must not be allowed to work with electricity unless a risk assessment for the work has been completed.

The background information required to effectively evaluate the risks must be gathered by the members of staff in charge of the work and the task risk assessed in accordance with HSE Guidance Electricity at Work – Safe Working Practices, HSE Guidance HSG 85

4.3. Deciding on and Implementing Risk Control Measures

Periodic Testing and Inspection of Electrical Installations and Apparatus

Fixed electrical installations should be tested by a competent person at least every 5 years (3 years in the case of agricultural/horticultural installations). Guidance on inspection and testing may be found in the IEE Regulations for Electrical Installations. A test certificate should be prepared showing the date and results of the investigation and test. The University Electrical Engineer in Estates Services is responsible for co-ordinating this on a University wide basis. Heads of Department or nominated person should liaise with the University Electrical Engineer to ensure testing is up to date and that any proposed changes to the fixed electrical installation is notified to Estates Services prior to commencement of any work.

Inspection of Portable Electrical Apparatus

All portable equipment should be inspected at regular intervals. The Head of Department is responsible for ensuring that all portable electrical appliances within their areas of responsibility are inspected at the required intervals. When setting the frequency of an inspection, account should be taken of any recommendations which the manufacturer may make along with the use and service conditions.

Departments with suitably qualified competent persons can undertake the testing and management of the testing programme themselves, or alternatively they can opt to use an approved electrical testing organisation. Departments opting to use the University approved testing organisation can arrange this through Estates Services.

An Inspection procedure for portable electric appliances is given in Appendix 2 of the accompanying University Guidance on Electrical Safety.

The Head of Department may approve members of staff bringing in their own, personal, electrical equipment (except open-bar electric fires and non-automatic kettles which are not allowed in the University). However, the Head of Department must then ensure that such equipment is included in the department's inventory of electrical equipment and must be appropriately inspected and tested.

(It should be noted that the University Electrical Engineer may have objections to particular pieces of equipment if they feel that their use may greatly increase the electrical consumption of the department or the area.)

Reporting and Repair of Defective Electrical Equipment

The Head of Department must ensure they have in place a full reporting system, whereby if an individual is aware that a piece of electrical equipment is obviously faulty, e.g. a broken 13 amp plug top, a 13 amp plug with the cable not gripped, or an electrical cable with a break in it etc., then there is a well-defined written system for reporting such instances to the Departmental Safety Convenor who will take the appropriate action to remedy the situation.

The Head of Department may assign specified functions in relation to the safe condition of those appliances which plug into the normal 240V supply to the Estates Services Department, outside Electrical Contractors or suitably qualified members of staff. To this end, personnel may be given appropriate training and be authorised by the Head of Department to fit plugs and carry out other routine tasks that are within their technical knowledge and experience.

Safe Electrical Working Practices
All work involving electricity must be undertaken under a Safe System of Work (SSOW). In planning the SSOW staff must consider the following five stages:

- identify the circuit or equipment to be worked on or near and the work to be done;
- decide whether to work dead or work live;
- planning and preparation for actions which are common to both dead and live working;
- procedures for working dead; and
- procedures for working live.

Staff should refer to HSE guidance HSG85 Electricity at Work, Safe Working Practices for a fuller understanding of the requirements for each of these stages.

Work on or near live conductors should rarely be permitted. In most cases adequate planning and work programming will allow work to be carried out as the regulations require, i.e. with the equipment dead. There can be a temptation to justify working on live equipment if it is 'convenient' rather than necessary. This is **not permissible**. Personnel doing this type of work are reminded that, under the Electricity at Work Regulations 1989, they may only work on live equipment if there is no reasonably practicable alternative. Regulation 14 requires that three conditions are met for live working to be permitted. It is stressed that if just one of those conditions cannot be met, live working cannot be permitted and dead working is necessary. The conditions are:

- it is unreasonable in all the circumstances for the conductor to be dead;

- it is reasonable in all the circumstances for the person to be at work on or near the conductor while it is alive; and

- suitable precautions (including, where necessary, the provision of personal protective equipment) have been taken to prevent injury.

Departments wishing personnel to work on live equipment *must* complete a risk assessment of the work and draw up a justification for the need to work live and a Safe System of Work detailing the control measures which will be put in place to ensure the safety of personnel under all appropriate circumstances.

Obviously these control measures will vary depending on the particular job but they may include such provisions as earth free zones, double wound transformers and circuit breakers (remembering the operating characteristics of these), Perspex guarding with test point access etc., and the competency of the person who is working 'live'.

Heads of Department must ensure that the experience and technical knowledge of those who are asked to work live is compatible with the particular job.

The competency of those carrying out such work, therefore, must be assessed and, if necessary, appropriate supervision must be given.

As a general rule, members of staff, and especially research students, should not work 'live' on their own and should be accompanied by another person who has suitable and appropriate technical knowledge of the work being carried out.

Control Measures
Departments must consider the range of control measures available for the type of electrical work undertaken and implement such measures as necessary to reduce risk and prevent injury. In developing suitable control measures departments must make reference to appropriate guidance such as:

- HSR 25 Memorandum of Guidance on the Electricity at Work Regulations 1989 – Available from HSE Books;

- Electricity At Work – Safe Working Practices, HSE Guidance HSG 85;

- BS 7671:2008 Requirements for Electrical Installations. IEE Wiring Regulations. 17th Edition – Available from The Institution of Engineering and Technology;

- Electrical Testing – Safety in Electrical Testing, HSE Guidance INDG 354;

- University Guidance; and

- Specific pertinent technical guidance listed in section 6 or other technical reference documents.

4.4 Recording the Significant Findings

The significant findings of the risk assessment process must be recorded on the General risk assessment Form (S20) and include the following:

- the work activity assessed;
- the hazards identified;
- who could be affected and how;
- the control measures already in place;
- the relevant information, instruction and training to, or proposed for staff and students;
- the arrangements for supervising the work; and
- where necessary additional controls to reduce the risk.

The risk assessment will need to be reviewed if there is any reason to believe that the original assessment is no longer valid, there has been a significant change in the work to which the assessment relates. In any case the risk assessment should be reviewed annually.

5. Providing Information, Instruction, Training and Supervision

5.1. Information

Where staff and students are exposed to risks from electricity then departments must inform them about:

- the risks from working with electricity;
- the significant risks from the risk assessment; and
- how the risks can be controlled.

This can be imparted during a staff briefing or a tool box talk.

5.2. Instruction and Training

Staff and students must be provided with relevant instruction and training on how to use control measures, personal protective equipment, etc. correctly. Instruction must also be given on how to maintain the control measure where the member of staff will be expected to carry this out e.g. required maintenance on test equipment.

Clear instruction must be given on how to deal with accidents, incidents and any emergencies that may arise from working with electricity.

5.3. Supervision

Where there is a risk of exposure to electricity, departments must provide adequate supervision to monitor that risk control measures required to eliminate or reduce the risk are being implemented and remain effective.

6. Further Information and Guidance

The Health and Safety at Work etc. Act 1974 - Health & Safety Executive

The Electricity at Work Regulations 1989 - www.legislation.gov.uk

Electrical Apparatus for Use in Potentially Explosive Atmospheres: BS EN 60079-27:2006
BSI Shop

Protection against Electric Shock, IEE Guidance Note 5, 5th Edition

Maintaining Portable Electrical Equipment in Offices and Other Low Risk Environments:
HSE Guidance INDG 236

Maintaining Portable and Transportable Electrical Equipment: HSE Guidance HSG 107

Avoiding Danger from Underground Services: HSG Guidance 47

Electrical Test Equipment for Use by Electricians: HSE Guidance Note GS38

Selection and Use of Electric Handlamps: HSE Guidance Note GNPM38

Electrical Risks From Steam/Water Pressure Cleaners: HSE Guidance Note PM29

Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory use. General requirements: BS EN 61010-1: 2010

Code of Practice for Control of Undesirable Static Electricity: BS 5958:

Electrical Apparatus for Explosive Gas Atmospheres: BS EN 60079: 9 Parts1993-2004

Specification for Degrees of Protection provided by Enclosures (IP code): BS EN 60529:1992

Medical Electrical Equipment: General Requirements for Safety: BS EN 60601-1:2006

Handheld Motor-Operated Electric Tools. Safety. General Requirements: BS EN 60745-1:2009

Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use General Requirements: BS EN 61010-1 2010

Construction of Electrical Equipment For Protection Against Electric Shock: BS 2754:1976
Memorandum

NRPB Vol 4, No 5, Restrictions on Human Exposure to Static and Time-Varying Electromagnetic Fields and Radiation

NRPB Vol 15, No 2, Advice on Limiting Exposure to Electromagnetic Fields (0-300 GHz)

NRPB Vol 15, No 3, Review of the Scientific Evidence for Limiting Exposure to Electromagnetic Fields (0-300GHz)

Code of Practice for Maintenance of Electrical Switchgear and Control Gear for Voltages up to and including 1kV: BS 6423: 1983

Code of Practice for Maintenance of Electrical Switchgear and Control Gear for Voltages Above 1kV and up to and including 36kV: BS6626: 2010

Code of Practice for Earthing: BS7430: 1998

Operation of Electrical Installations: BS EN 50110 Parts 1 and 2: 1997

Specification for Degrees of Protection Provided by Enclosures BS EN 60529:1992 (IP code)

Low-Voltage Switchgear and Controlgear. General Rules: BS EN 60947-1:2007

6.1. Other Sources

University Guidance on Electrical Safety, Safety Services webpage www.strath.ac.uk/safetyservices

The following summarises how departments can effectively implement this Local Rule and integrate it into their management systems. These processes will be monitored as part of Safety Services' Audit Programme, and where departments are able to demonstrate fulfilment of key actions, this is likely to provide strong evidence of good practice.

		Key Management Actions
1.	**Departmental Roles**	• ensure that at least one responsible person (nominated co-ordinator) is appointed by the Head of Department to co-ordinate the electrical inspections and testing programme; • ensure that the duties of the nominated co-ordinator are defined based on those in paragraph 3.1 above; • ensure that appropriate management, administrative and technical systems and procedures are in place to effectively control risks from electricity and these are regularly reviewed; and • ensure that above systems and procedures are incorporated into general departmental arrangements and communicated to relevant staff.
2.	**Identifying Hazards**	• ensure all hazards associated with any electrical work are identified .
3.	**Evaluating Risks**	• ensure staff and students are not allowed to work with electricity or on electrical equipment unless a suitable and sufficient risk assessment process is in place for the work; • ensure relevant background information concerning the work with electricity is gathered by the member of staff in charge of the work; • ensure a risk assessment for the work is carried out in accordance with the University risk assessment process and HSE Guidance HSG 85.
4.	**Implementing Risk Control Measures**	• ensure the range of risk control measures available is considered for the type of work undertaken; • ensure control measures selected are monitored to ensure they remain effective.
5.	**Recording the Significant Findings**	• ensure records of risk assessments and significant findings for electricity are recorded on the S20 Form. • ensure assessment(s) are reviewed at least every year unless other changes occur before this period.
6.	**Providing Information, Instruction, Training and Supervision**	Where staff and students are exposed to risk from electricity • ensure relevant information, instruction, training and supervision about the risks is provided. • ensure a record of the training provided, staff/students attending and any information issued is retained. • ensure that adequate supervision of the work is undertaken.