



# ***European Guideline***

CFPA-E No 28:2012 F

Fire safety in laboratories





## **FOREWORD**

The European fire protection associations have decided to produce common guidelines in order to achieve similar interpretation in European countries and to give examples of acceptable solutions, concepts and models. The Confederation of Fire Protection Associations in Europe (CFPA E) has the aim to facilitate and support fire protection work in European countries.

The market imposes new demands for quality and safety. Today, fire protection forms an integral part of a modern strategy for survival and competitiveness.

This guideline is primarily intended for those responsible for safety in companies and organisations. It is also addressed to fire and rescue services, consultants, safety companies etc. so that, in course of their work, they may be able to help companies and organisations to increase their levels of fire safety.

The proposals within this guideline have been produced by the Fire Protection Association and the author is Adair Lewis from the UK.

This Guideline has been compiled by Guidelines Commission and adopted by all fire protection associations in the Confederation of Fire Protection Associations Europe.

These guidelines reflect best practice developed by the countries of CFPA Europe. Where the guidelines and national requirement conflict, national requirements must apply.

Copenhagen, 14 September 2012  
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Key words: laboratory, chemical, pharmaceutical, bio-science, physical



## 1. Introduction

Although laboratories differ widely in their construction and application, two general types of laboratory are encountered:

- Physical laboratories are used for testing the size, shape, weight, strength, corrosion resistance, fire related properties and other physical and mechanical qualities of materials.
- Chemical, pharmaceutical and bio-science laboratories where qualitative and quantitative analyses are undertaken to determine the composition of a material or product.

Generally, the hazards encountered in laboratories are low to moderate because of the relatively small quantities of materials being involved. However, some facilities may present serious fire hazards from:

- excessive quantities of flammable or reactive chemicals;
- uncontrolled ignition sources; and
- inadequate procedures or equipment for handling hazardous materials.

There is often a need for controlled conditions to achieve precise measurements and these can assist in reducing the hazards.

As well as the life risk associated with fires and explosions in laboratories, many of these facilities will contain sophisticated equipment of high asset value and damage to these may have a significant impact on the continuing smooth running of the business operations of the organisation concerned or even those in neighbouring premises. These factors should be addressed at the time of the outline fire risk assessment undertaken during the planning stage of the facility. As soon as the laboratory is operational a substantive fire risk assessment should be undertaken in accordance with national fire safety legislation.

In order to maintain business continuity it is vital that in all laboratories an appropriate fire safety strategy is developed and adopted with staff receiving detailed instruction in the actions that they should take in an emergency.

Incidents are thus measured not only in the direct material loss of the building and contents but in the loss of business earnings and productive time. The replacement value of the building and its contents must be taken into account when considering measures necessary to address the fire risk assessment and not only the time necessary to construct or find new premises but the time necessary to duplicate research or production that has been carried out, in order to replace lost samples and essential data that will be needed before any new work can be undertaken.

A significant fire loss can seriously undermine international collaboration on projects and have an impact on marketing and hence the income to be derived from new products. A loss may also affect customers' or potential future research partners' perceptions of the



organisation. The likelihood of an incident occurring must be minimised and if a fire does occur the quicker it is under control, the more likely it is that disruption to business will be minimised and normal operations will resume.

The general fire precautions should be the subject to a fire risk assessment in accordance with national legislation or practice. Where chemicals are present an assessment may also need to be undertaken in accordance with relevant national legislation concerning the control and management of dangerous substances.

These assessments should be subject to periodic review and should always be reviewed at the planning stage of a new research project.

Other national legislation may also be relevant to the work being carried out in laboratories and appropriate action should be taken and recorded, including complying with such environmental legislation and controls as may be necessary.

## 2. Scope

These recommendations are applicable to all laboratories. In addition to life safety, losses due to fire, explosion, ingress of water, intruders, and consequential losses are considered. Health hazards and the reactions of chemicals, biohazards and radioactive materials are not considered in this document. Also outside the scope of this document are clean rooms (areas with strictly controlled environmental conditions) which are situated within laboratory or manufacturing premises.

This publication provides recommendations to supplement national regulations for fire safety in laboratories of all sizes from small rooms to multi-million pound facilities. The guidance is directed to property protection and business continuity, as well as life safety issues.

The majority of laboratories will be used for quality control, research and development, or experimental studies in a particular branch of science or engineering. Others may be specialist facilities, such as pathological, animal, electronic, hydraulic, radioactive, biological or mechanical laboratories. This Guideline also applies to teaching facilities in hospitals, schools and colleges where large numbers of relatively inexperienced people may undertake a range of experiments under supervision.

Because of the wide application of these recommendations they are written to enable general application. Further, specific, guidance should be referred to for additional information regarding the chemicals, equipment or processes being employed. This is particularly important in those areas where radioactive or pathogenic materials may be handled.



### 3. Definitions

#### Hazardous areas

Hazardous areas in which open processes are carried out are classified in accordance with a risk assessment carried out in compliance with the ATEX Directives, BS EN 60079-10, International or national standards. These standards address the following Zones:

- Zone 0: An area in which an explosive gas atmosphere is present continuously or for long periods.
- Zone 1: An area in which an explosive gas atmosphere is likely to occur in normal operation.
- Zone 2: An area in which an explosive gas atmosphere is not likely to occur in normal operation and, if it does occur will persist for a short period only.

#### Fire compartment

Distinct part of a building in which a fire may develop during a prescribed minimum period without spreading to other parts of the building.

#### Fire doors and shutters

A door set or shutter which conforms to national guidelines or standards and which is capable of achieving a prescribed period of fire resistance with respect to integrity and insulation.

#### Fire resistance

The ability of an element of building construction to withstand exposure to a recognised standard time/temperature and pressure regime without loss of its fire separating function, load-bearing function, or both for a given time.

#### Flammable liquid

A flammable liquid is any liquid, liquid solution, emulsion or suspension, other than aqueous ammonia, liquefied flammable gas or liquefied petroleum gas, which meets Category 3 when tested in accordance with Regulation 1272/2008/EC Annex 1, part 2, section 2.6 (see Figure 1).

It should be noted that for the purpose of this regulation gas oils, diesel fuel and light heating oils having a flash point between 55°C and 75°C are regarded as Category 3.

#### Highly flammable liquid

A highly flammable liquid is any liquid, liquid solution, emulsion or suspension that is classified as Category 1 or 2 according to Regulation 1272/2008/EC (see Figure 1).

Category	Criteria
1	Flash point <23°C and initial boiling point ≤35°C
2	Flash point <23°C and initial boiling point >35°C
3	Flash point ≥23°C and ≤60°C

Figure 1: Categories for flammable liquids set out in Regulation 1272/2008/EC



### **Non-combustible**

A non-combustible material is one which satisfies the requirements for non-combustibility when tested in accordance with national guidelines or standards.

### **Oxidising substances**

Substances which react with other materials, either at room temperature or with the application of heat, to cause a type of chemical reaction often involving the bonding of oxygen atoms. Oxidation reactions may be exothermic, proceeding sufficiently vigorously to cause explosions. Oxidising materials, however, are not necessarily themselves combustible.

### **Organic peroxides**

Substances which contain carbon, hydrogen and oxygen and may be considered to be derivatives of hydrogen peroxide. Organic peroxides are thermally unstable substances which may exhibit exothermic decomposition. Organic peroxides tend to:

- be liable to explosive decomposition
- burn rapidly
- be sensitive to impact or friction
- react dangerously with other substances

## **4. Construction**

- 4.1 Buildings should comply with national building codes or regulations and should incorporate compartment walls and floors where appropriate to provide a suitable degree of fire resistance between fire compartments. In all areas of the building consideration should be given to fire-resistant construction, compartmentation, protected stairways and lifts, and the absence of combustible linings.
- 4.2 During the planning stage an outline assessment of the work to be carried out should be undertaken to consider the type and number of potential hazards that may be present. Consideration should also be given to the replacement value of the equipment and any potential exposure to hazards from surrounding occupancies. Property protection and business continuity considerations may indicate that increased protection should be provided in some, or all, areas of the premises.
- 4.3 Where the fire risk assessment identifies especially hazardous tests or experiments, these should only be undertaken in separate, specially designed laboratories, preferably detached from the main laboratory or facility building. Where detached accommodation is not available, compartment walls providing a suitable degree of fire resistance in accordance with national guidelines should be constructed between the high risk areas and other parts of the premises and there should be no doorways providing direct access between these areas.
- 4.4 All laboratory and preparation areas should be separated by a compartment wall from:



- process plant
  - areas used for the storage of highly flammable and flammable liquids
  - gas cylinder stores
  - stores of radioactive materials
  - stores of biological samples (including pathogens)
  - areas used for the storage of combustible waste and other materials
- 4.5 Fire rated glazing should be used in glazed screens; in all cases these should be compatible with the fire compartmentation of the building. Glazing onto escape routes should be minimised to avoid radiated heat compromising the route and to eliminate fragments of glass causing a hazard in the event of an explosion.
- 4.5 Structural steelwork should be fire-protected to provide a suitable degree of fire resistance in accordance with national guidelines so as to prevent, in the event of a fire, premature collapse of main building elements.
- 4.6 Small individual rooms such as offices within laboratories should be of non-combustible construction; any prefabricated panels incorporated into the structure must have non-combustible cores. These rooms should be located so that, as far as possible, there is a route from the room to a final exit from the laboratory that does not pass through a high fire hazard area.
- 4.7 The travel distance for means of escape should be subject to a suitable and sufficient risk assessment but wherever possible travel should always be available in more than one direction. Exits that lead directly to a place of safety (i.e. outside of the building) are the preferred option.
- 4.8 Multiple means of escape must be considered where:
- there is a high explosion hazard,
  - there is a fume cupboard or extraction hood located adjacent to an escape door,
  - highly hazardous materials are present,
  - a gas cylinder or flammable liquids are in use.
- 4.9 Emergency escape lighting shall be installed in accordance with national standards on all escape routes and in areas where high hazard processes are being undertaken. All escape routes shall be adequately signed.
- 4.10 Where the fire risk is assessed as being of a 'low' or 'normal' level (such as where simple quality assurance tests are carried out or mechanical properties of materials are being investigated) the requirements for the building construction may be reduced from that indicated in paragraph 4.3 with the agreement of the local building authority and the insurer of the premises.
- 4.11 Similarly, a reduced level of passive fire protection may be acceptable in areas fitted with a fixed fire suppression system, such as an automatic sprinkler installation or a



total gas flooding system. In the case of sprinklers this will only be the case where water pressures and flow rates are suitable, following a risk assessment and the approval of the local authority and the insurer of the premises. Sprinkler installations and other fixed fire suppression systems should be installed and maintained in compliance with national standards.

- 4.12 Internal and external glazing of laboratories where explosion hazards may be present is a potential threat to personnel. These features should thus be minimised and the glazing specified with care.
- 4.13 All holes around electrical and other services where they pass through compartment walls and compartment floors should be filled to provide an equivalent level of protection as the structural element in which they are situated.
- 4.14 Serious consideration should be given to installing lightning protection in accordance with national standards.

## 5. Services and equipment

- 5.1 An assessment of work and storage areas should be carried out and appropriate hazard zones assigned in accordance with national codes of standards.
- 5.2 All electrical installations should conform to national codes of practice and standards with the work being undertaken by a competent electrician.
- 5.3 All electrical circuits in laboratories should be protected by residual current devices.
- 5.4 A sufficient number of switched sockets should be provided at required locations to avoid the need for extension leads. Power-on indicator lights should be provided on sockets and provision should be made for emergency shutdown of power in laboratories where high hazard processes are carried out.
- 5.5 The use of a portable multi-outlet socket block should only be permitted if the device is equipped with its own residual current device. Care should be taken to ensure that the maximum current capacity of the plug fitted to the device is not exceeded.
- 5.6 Electrical wiring should be certified as suitable for use within the zone in which a flammable liquid or gas is being stored or processed as determined by a risk assessment.
- 5.7 All items of electrical equipment, such as fridges, stirrers and vacuum pumps, must be suitable for use in the zone in which they are to be located. Care must be taken when moving equipment from zone to zone.
- 5.8 Electrical installations, fixed equipment and portable electrical equipment must be inspected periodically in compliance with national regulations.

## 6. Space heating and air conditioning

- 6.1 No type of portable space heater is considered suitable in a laboratory environment due to the possible tripping, overturning, and ignition hazards it presents.
- 6.2 Any ducted air-handling system serving the laboratory facility should be a self-contained system kept entirely separate from other air-handling systems serving the remainder of the building. This is to reduce hazards from both incoming and outgoing contamination and fire spread.
- 6.3 Separate heating, ventilation and air conditioning systems should be installed in laboratory fire compartments that house high value or business critical equipment.
- 6.4 Fresh-air intakes and outlets should be carefully sited to avoid ingress of undesirable contaminants into the laboratory or the release of noxious materials into the atmosphere outside.
- 6.5 Ducting should:
- be of non-combustible construction;
  - have limited directional changes and take as short a route as possible;
  - be arranged so that vapours cannot condense and collect at low points in the ductwork;
- 6.6 Exhaust air should pass through an efficient filter system, especially where infectious, toxic or radioactive materials could be discharged.
- 6.7 Ducts passing through compartment walls and floors should be fitted with automatic fire dampers to maintain the fire separation. Dampers should operate automatically by means of a fusible link, or preferably by smoke detectors if appropriate.



*Figure 2: A modern teaching laboratory*



- 6.8 Where an automatic fire detection system is to be used in an area where there are fume cupboards or in an air-conditioned environment, the air-movement characteristics need careful study to ensure that the detector configuration will operate efficiently with the air-handling systems both on and off. In a similar manner, care must also be taken when installing automatic fire detection in clean rooms and other areas where positive pressure is maintained.
- 6.9 The effects of air movement resulting from the use of fume cupboards and similar equipment should be assessed to ensure that effective operation of heating and ventilation systems are not compromised.
- 6.10 All ventilation and air conditioning ductwork should be installed and maintained in accordance with national standards.
- 6.11 All laboratories where constant hazardous or toxic atmospheres exist (including micro-biological laboratories) should have a negative pressure to ensure that hazardous materials do not leak into the rest of the building. The need for pressure differentials to be provided in other laboratories should be determined by a risk assessment.

## **7. Fume cupboards (including glove boxes)**

- 7.1 Fume cupboards should be constructed from material suitable for their intended application. Material selection should reflect the most aggressive environment likely to be encountered during the lifetime of the fume cupboard, and should be non-combustible wherever practicable.
- 7.2 Fume cupboards and glove boxes operated in series should be provided with separate ducting and fire separation between adjacent units.
- 7.3 In order to protect the environment, fume cupboards should not be regarded as convenient extraction routes for waste toxic or flammable gases or vapours. The design of the equipment should cater for the removal of these by appropriate means such as scrubbing or chemical absorption.
- 7.4 Fume cupboards should not be used as storage places for flammable substances, oxidising agents or other chemicals.
- 7.5 It should be recognised that there is likely to be an ignition risk with the introduction of some portable electric equipment that is not designed to be used in a fume cupboard environment. It must be ensured that all electrical equipment is suitable for the hazard zone in which it is to be used.
- 7.6 Exhaust fan motors should not be located within ducting. Their controls should be located outside the fume cupboard together with the controls for gases and other



services unless they are appropriate for use in the hazard zone.

- 7.7 Airflow indicators should be installed. If not, procedures should be in place to ensure inspections of fan units (and in particular the drive belts) are performed regularly and the face velocities are measured to demonstrate that the cupboard is fit for purpose.
- 7.8 All fume cupboards and glove boxes should be designed to provide adequate ventilation to avoid a build up of flammable vapours and be serviced and maintained, to include face velocity and containment requirements, in accordance with national standards and the manufacturer's instructions.

## **8. Hot plates, ovens, furnaces and heating equipment**

- 8.1 Heating equipment should not be installed in or adjacent to areas where flammable liquids are handled.
- 8.2 Free-standing equipment should be placed on heat-resistant surfaces. Built-in equipment should have appropriate insulation and ventilation.
- 8.3 Ovens and furnaces should be fitted with overriding non-automatically re-setting thermal cut-out devices, in addition to normal thermostats. This is particularly important where the oven or furnace may be left operating unattended.
- 8.4 Solvent distillation using portable heating mantles and similar equipment should not be left unattended.
- 8.5 Wherever possible, hazardous materials such as hydraulic fluids should be handled away from hot surfaces.
- 8.6 Whenever a laboratory is left unattended, all heating equipment should be checked to ensure that it has not been left on accidentally.

## **9. High-value equipment**

- 9.1 High-value equipment, such as computers, spectrometers, electron microscopes and similar items which could easily be damaged by liquids, should be protected from water or chemical spillages occurring on the floor above. While the provision of non-combustible canopies may assist, it is better to re-route water and heating pipes around the room perimeter if possible. Welded joints, as opposed to compression fittings, should be used in all plumbing. Caution should be exercised where false ceilings are installed as pipework is often hidden from view. Alternatively, the floor over the equipment should be made impervious to liquids.
- 9.2 Electronic data processing equipment should be installed in accordance with national codes of practice. These codes may also be applicable in respect of high-value

laboratory equipment other than electronic data-processing equipment.



*Figure 3: High value equipment is common in some laboratories*

## 10. Flammable liquids and gases

### 10.1 Piped services

- 10.1.1 Liquids and gases should be delivered from cylinders or bulk tanks, preferably at a safe location outside the building via permanently installed hard metal piping. Quick-acting isolation valves linked to the automatic fire detection system should be installed both at the point of supply and delivery.
- 10.1.2 Supply and discharge terminals must be clearly and permanently marked at each end and along the pipe run to identify the liquid or gas carried.
- 10.1.3 Pipelines should be colour-coded throughout their length to comply with national standards. Pipelines should be clearly marked to show the direction of flow of the contents.
- 10.1.4 Pipelines should take the shortest practical route and be located and adequately supported well clear of heat sources, electric cables, and other services or areas where mechanical damage is possible.
- 10.1.5 Pipework passing through compartment walls and compartment floors should be protected so as to maintain the fire resistant integrity of the structural elements concerned.



## 10.2 Gas cylinders

- 10.2.1 Where liquefied petroleum gas (LPG) is involved, national standards and codes of practice relating to the storage and use of LPG should be followed.
- 10.2.2 Cylinders containing flammable gas should preferably be stored in a secure compound in the open air to enable natural ventilation to disperse any small leaks. If this is not practicable, the cylinders should be stored in a separate designated building or in a designated storage place within a building provided with suitable high and low level ventilation. Designated buildings and storage places should comply with national standards.
- 10.2.3 The storage area or storage building for gas cylinders should be at least 4m from other buildings and ignition sources. Gas leakage detectors (such as for hydrogen) should be installed in cylinder stores with the alarm monitored in the security control room.
- 10.2.4 Different types of gases should be segregated from each other, particularly flammable gases and oxidising gases. Empty cylinders should not be kept with full cylinders. Gas cylinders should be protected from direct sunlight.
- 10.2.5 Smoking and naked lights should be prohibited in all flammable gas storage areas and buildings; permanent warning notices should be prominently displayed.
- 10.2.6 Gas cylinders should only be moved on trolleys designed for this purpose. The cylinders should be secured in place on the trolley at all times.
- 10.2.7 The total quantity of flammable gases in a laboratory should be kept to the minimum needed for effective operations. Where it is unavoidable to have cylinders containing flammable gases or oxygen inside the laboratory the cylinders must be secured in a vertical position, preferably within a cabinet providing at least 60 minutes fire resistance. Appropriate hazard warning signs should be displayed prominently on the cabinet.
- 10.2.8 An acetylene cylinder should only be allowed in a laboratory following a specific risk assessment and the determination of any necessary exclusion zone(s).
- 10.2.9 Regulators, pipes and pressure valves appropriate to the type of gas to be used should be fitted.
- 10.2.10 Grease or oil must not be allowed to come into contact with cylinders, their valves or associated equipment. ***This is particularly important with cylinders containing oxygen as this gas will react dangerously with grease or oil.***
- 10.2.11 Where there is the possibility of a gas supply at a higher pressure feeding back into a lower pressure system, suitable back-pressure valves should be installed.



10.2.12 Gas supply valves should be closed when a supply is not required.

10.2.13 Staff should be trained in the moving, connection and disconnection of gas cylinders. This should include instruction in the hazards associated with the processes, for example, the reason why oxygen cylinder couplings should not have threads greased.

### 10.3 Highly flammable and flammable liquids

10.3.1 The quantity of highly flammable and flammable liquids in laboratories and elsewhere on site should be subject to a risk assessment and kept to a minimum.

10.3.2 Such liquids should be stored in purpose-built cabinets or bins providing at least 30 minutes fire resistance and having integral spillage trays. Cabinets or bins must be clearly marked with appropriate hazard warning signs. Ducting to vented cabinets should be of non-combustible construction with a plastic lining.

10.3.3 The size of any container of highly flammable liquid kept on a bench should be no more than that required for the work period and not exceed 500ml.

10.3.4 Highly flammable liquids should, wherever practicable, be carried in approved safety containers. If glass containers are necessary for corrosion resistance or to maintain the purity of a liquid, their capacity should not exceed 5 litres and they should be contained in protective carrying containers.

10.3.5 Only refrigerators designed or modified for the storage of flammable liquids should be used for this purpose. The storage of volatile, flammable liquids in domestic refrigerators has led to serious explosions and thus these appliances should not be used in a laboratory environment.

10.3.6 Bulk supplies should preferably be kept in a separate, non-combustible, suitably marked building.

10.3.7 Whenever possible, experiments using flammable liquids should be carried out in a fume cupboard and on a metal tray to retain the contents of the apparatus should it fracture.

10.3.8 Highly flammable and flammable liquids should not be stored near hazardous materials such as oxidising agents, organic peroxides, strong reducing agents, and strong acids.

10.3.9 A supply of non-combustible absorbent material should be kept immediately available to deal with any spillages of flammable liquid. Staff should be instructed in the use of this material and its safe disposal.



## 10.4 Hazardous chemicals

- 10.4.1 Adequate attention should be paid to fire and explosion hazards which might arise from the non-compatibility of some chemicals should they become mixed following an accident or breakage.
- 10.4.2 Compliance with national regulations concerning the control of hazardous materials is essential.
- 10.4.3 All radioactive materials should be stored securely in suitable containers. Particular care should be taken with tritium, a radioactive isotope of hydrogen with a half life of over 12 years that poses particular hazard if released and absorbed into the structure of the building. If this were to happen, controlled demolition of all or parts of the building may be necessary. Tritium should be kept in a proprietary container and refrigerated.

## 11. Fire safety management

### 11.1 General provisions

- 11.1.1 The laboratory should be the subject of a fire risk assessment in compliance with national legislation. Where chemicals are present, an assessment may also need to be undertaken in accordance with other relevant legislation concerning hazardous or dangerous substances.
- 11.1.2 A complete list of all substances stored or in use on the site together with the material safety data sheets should be available at all times.
- 11.1.3 The premises should be kept clean and tidy and only the minimum daily requirements of hazardous chemicals or goods should be present in the laboratory itself. Bulk stocks should be kept outside or in properly designed storerooms remote from the laboratory.
- 11.1.4 When an experiment or research project is finished, the apparatus should be dismantled, cleaned and inspected and the components returned to store or disposed of safely. The products of the experiment and any surplus chemicals should also be suitably stored or disposed of at this time.
- 11.1.5 Service ducts or enclosures should be kept clean and not be used for storage or other purposes. The doors should be kept closed and locked and be labelled to this effect.
- 11.1.6 The shelf life of chemicals and samples should be checked regularly; the interval depending on the ageing qualities of the materials. Any found to be out of date should be disposed of safely with specialist advice being sought in respect of any



substances found or prepared which may be unstable or highly reactive due to their age or conditions of storage.

- 11.1.7 All plant and equipment should be operated and maintained in accordance with manufacturers' instructions. Records of service history should be kept. Regular and frequent inspections should be made to ensure that all equipment is in safe working order.
- 11.1.8 A safety committee should be established, particularly in research laboratories, to oversee working practices and vet any new projects before work starts. It should meet regularly and report to a senior manager with budgetary control for health and safety matters.
- 11.1.9 For hazardous operations, a written permit-to-work system should be established and strictly implemented to ensure that both the operator and the management are fully aware of the risks and the safeguards to be adopted. Only trained personnel should be allowed to undertake such work, and they must be provided with suitable protective clothing and equipment.
- 11.1.10 Hazardous experimental work involving pilot plant should be carried out in a special area separated from the remainder of the laboratory by walls constructed entirely of brickwork, masonry or concrete having at least 120 minutes fire resistance and any openings fitted with self-closing fire doors with 120 minutes fire resistance; such doors to have been tested and approved by an independent third-party approvals organisation. No doors should connect these areas directly to other parts of the building; all doors should open directly to the outside to minimise contamination by toxic, radioactive or biological materials. Where necessary, suitable provisions should be made to vent an explosion.
- 11.1.11 The transport of flammable and highly flammable liquids and gas cylinders on trolleys in lifts should be subject to a risk assessment.
- 11.1.12 There should be an annual audit of the laboratory to ensure that:
- fire and health and safety measures are in place and are used and followed,
  - all staff in the area are trained and familiar with the standard operating procedures, and
  - all the equipment is in place and maintained as required.

## 11.2 Waste disposal

- 11.2.1 National legislation concerning the storage and disposal of hazardous waste materials must be observed.
- 11.2.2 Waste flammable liquids must not be disposed of via the drains. They should be collected in suitable closed containers with a volume of no more than 5 litres, and be stored in a safe place outside the laboratory pending regular removal from the



premises by a specialist waste disposal company. Metal or glass containers should normally be used for this purpose but suitable plastic containers may be used, subject to local regulations. When storing waste liquids caution should be exercised to avoid mixing non-compatible materials.

- 11.2.3 Other combustible waste materials (for example, filter papers, wiping cloths, and residues) should be deposited in non-combustible lidded receptacles of limited size. Waste should be removed from the laboratory daily and stored outside in locked containers. External waste storage should be at least 10m from buildings and plant.
- 11.2.4 Waste unsaturated oils and other reactive materials that may be subject to self-heating should be stored separately in metal containers with metal lids in a location at least 10m from the buildings to await disposal.
- 11.2.5 Waste materials should not be allowed to accumulate; they should be regularly removed from the site.
- 11.2.6 As cleaners often work in isolation and may not be aware of the possible dangers in a laboratory, it is necessary to give them special training and instruction (see also 12.6).

### **11.3 Welding and other hot-work processes**

- 11.3.1 These processes should only be carried out after written approval by the laboratory manager or the safety adviser, who should stipulate when and how the work shall be carried out.
- 11.3.2 Hot work should only be undertaken by staff trained to work in accordance with Guideline 12: Fire safety basics for hot work operatives.

### **11.4 Overnight use**

- 11.4.1 In some laboratories equipment or processes may be required to operate overnight and unattended.
- Where a routine occurrence and circumstances allow, these should be housed in an area separated from the remainder of the building by brickwork, masonry or concrete walls having at least 120min fire resistance. Any openings in these walls should be fitted with self-closing fire doors with 120min fire resistance; such doors to have been tested and approved by an independent third-party approvals organisation.
  - Where a small area of a large laboratory is to be used on occasion overnight for an unattended experiment, it should be subject to a risk assessment and the production of documented emergency procedures. Copies of these procedures



should be given to the security staff and be posted on the door to the laboratory. The procedures should include the actions to be taken in the event of fire, spillage or leakage of water. Fire fighting media suitable for use and details of any personal protective equipment to be worn should also be included.

11.4.2 The installation of an automatic fire detection and alarm system and/or an automatic fire suppression installation should be considered as part of the fire risk assessment undertaken during the planning stage of the project

11.4.3 Equipment left on overnight and unattended should be recorded on a permit to work system.

### **11.5 Smoking, eating and drinking**

11.5.1 Smoking should be prohibited in all external storage areas. This is particularly important where toxic, flammable and corrosive liquids and gases and high-value equipment are present. Appropriate notices should be prominently displayed.

11.5.2 Where a smoking shelter is provided it must be:

- outside the building
- subject to a specific fire risk assessment
- constructed of non-combustible materials
- where practicable, sited at least 10m away from any building or structure, including gas cylinder and flammable liquid stores.
- provided with suitable metal ashtrays and a separate metal waste bin with a fitted metal lid
- provided with a suitable fire extinguisher.

11.5.3 The immediate area around the shelter and the shelter itself should be kept clear of combustible materials including windblown debris and vegetation.

11.5.4 Raised, slatted floors or decking should not be used and concealed or semi open spaces should be sealed to ensure combustible debris cannot accumulate beneath the shelter.

11.5.5 The use of combustible curtains, canopies and drapes to protect smokers from the elements must be avoided.

11.5.6 In no circumstances should the shelter be sited near:

- windows
- ventilation intakes or extracts
- entrances and exits from the premises
- hazardous materials
- waste storage containers (such as skips or bins) or
- beneath a canopy or low slung eaves.



- 11.5.7 Areas where smoking is allowed but no shelter is provided must be free of combustible materials and be equipped with fire fighting equipment, metal ash trays and a separate metal waste bin with a fitted metal lid.
- 11.5.8 A 'no smoking' policy must be established in outside areas where fire hazards exist. Such areas may include refuse and storage areas containing combustible materials, flammable liquids (including refuelling supplies), gas cylinders, foam plastics, fibreboard and timber. 'NO SMOKING' notices must be displayed prominently in these areas.
- 11.5.9 Eating, drinking and smoking in laboratory areas should be prohibited and suitable facilities be provided. Laboratory coats and other protective clothing should not be worn in these areas.

## 11.6 Water damage

- 11.6.1 Buildings should be maintained in good repair and gutters and downpipes cleaned out at least once a year. Roofs need to be checked annually to ensure that they are watertight and that roof coverings are securely fixed in place. Flat felt roofs have a limited life span (usually about 10 years) and need to be checked carefully for splits or blisters in the felt covering, particularly at or close to joints. Where they show signs of wear, it is better to replace them rather than risk water ingress at a later stage.
- 11.6.2 Water pipes, drains and similar services should be routed so as to be well away from, and not pass directly over, sensitive, costly or business critical equipment.
- 11.6.3 Computers and other high-value equipment should not be located in basements or places where they could be affected by flooding. Where this is unavoidable the equipment should be installed above floor level and a small pit or sump with an electric pump should be considered.
- 11.6.4 Tank and cistern overflows should discharge to safe places. With chiller systems, the drip tray must be of sufficient capacity and provided with a drain hole large enough not to become blocked.
- 11.6.5 Freezing should be avoided by setting central heating controls to maintain a minimum temperature of 4°C inside the premises. Where this is not possible and in outside areas trace heating and lagging will be necessary.
- 11.6.6 All vulnerable reactants, products and other stored materials should be kept off the floors on shelving, racks, pallets, or dunnage.
- 11.6.7 Where water sprinklers are installed, suitable measures should be taken to retain water used for fire fighting operations to avoid environmental pollution.



## 12. Fire protection

- 12.1 Portable fire extinguishers should be installed and maintained in accordance with national standards. Where flammable liquids are in use no person should have to travel more than 15m in order to reach an extinguisher.
- 12.2 Rooms containing high-value computer, diagnostic, test or analytical equipment should be provided with a fixed gas fire suppression system triggered by smoke detectors configured for coincidence connection. Automatic fire detection and suppression systems in these areas should be installed and maintained according to the installer's instructions and in consultation with the insurers of the premises.
- 12.3 Glove boxes and similar enclosures where access is difficult, and/or where flammable or highly flammable materials are handled, should be provided with a fixed extinguishing system. Systems designed for in-cabinet protection of electronic equipment may be considered for these areas. Oxygen-enriched or pressurised chambers will require special consideration.
- 12.4 Where a fixed fire suppression system is installed, means should be provided to shut down any exhaust or ventilation systems and to seal any openings before any gas is discharged. Operation of the system should also result in automatic shut down of gases and supply of reactants to the equipment (other than cooling systems).
- 12.5 For larger laboratories, consideration should be given to the installation of automatic sprinkler installations and automatic fire detection and alarm systems in accordance with national standards. Care should be taken not to install a water extinguishing system where the chemicals stored or in use are liable to react with the fire fighting water.
- 12.6 All employees should be given basic fire training covering at least the following:
- The fire related properties of materials that they may be called upon to handle
  - Actions to take in an emergency
  - how to raise the alarm
  - how to call the fire brigade
  - how to shut down hazardous processes in an emergency
  - how to escape in a safe manner.

Selected staff should receive:

- additional training so as to be able to act as fire wardens
- practical instruction in the use of the fire extinguishers
- training in clearing spillages of hazardous materials.

Cleaners should also receive suitable training, dependent on the areas in which they are called upon to work.



### 13. Security

- 13.1 The threat of deliberate fire raising is an important element of the fire risk assessment undertaken for the premises in compliance with national legislation and should receive serious attention.
- 13.2 Site security against intruders should be compatible with:
- the values at risk
  - the nature of the contents (including information media and data accrued from long research projects)
  - the location of the laboratory
  - the history of crime in the area
  - the post loss history of the site
  - the nature of the work undertaken (whether it is likely to arouse hostile reaction from organised groups or people).
- 13.3 Intruder alarms should be installed and maintained to a recognised national or international standard by a competent installer who has received accreditation from a third party body who is acceptable to the police authority. The installation should meet insurers' requirements, and needs to be designed specifically for each location.
- 13.4 On larger sites, security staff should be employed outside of working hours to check all parts of the site. Where a contractor is to be engaged, a check should be made that the security company is reputable and experienced and approved by an independent inspection body.
- 13.5 Clocking points, or similar means of recording the patrols, should be provided. Where a single security person is present, arrangements should be such that cross checks are made every hour with another site to confirm that all is well.
- 13.6 Security lighting and the provision of closed-circuit television should be considered as important elements of the security strategy. CCTV systems should be installed by an approved installer.
- 13.7 Security staff should be made aware of any experiments or production processes taking place outside working hours so that special checks may be made to ensure that everything is in order. Security personnel should have instructions on what to do in an emergency. Otherwise, they should ensure during their patrols that all services are suitably isolated and that all doors and windows are secure.
- 13.8 Laboratory access should be restricted to named persons only, and barred to others by means of suitable controls such as keying, proximity or magnetic card readers.
- 13.9 At all entry points, suitable warning notices should be posted to warn of flammable, toxic, radioactive, laser or other hazards.



## 14. Contingency planning

- 14.1 The guidance set out in national best practice documents should be adopted.
- 14.2 Where work carried out in the laboratory is a business critical operation or involves toxic, biohazard or radiological materials, a crisis management plan should be devised and comprehensively tested on a regular basis. Following the exercises, the plans should be amended as necessary to ensure that appropriate staff can be made available to provide advice to the emergency services and assist their colleagues to ensure that business operations return to normal expeditiously and in a controlled and safe manner.
- 14.3 Fire resisting safes, data safes and fire resisting cabinets are adequate to protect data on a short-term basis while waiting for 'backing up' to main files but they should not be seen as a substitute for a regime of frequent and more substantive 'backing up' of data files and the secure storage of the information off site in another building or safe location away from the laboratory.
- 14.4 Samples necessary for historical records, trial evaluations, etc should be kept in a purpose-built store room having at least 120min fire resistance and / or stored off site at a separate location.
- 14.5 Location of essential gas and water stop valves, main switches, drainage gullies, manholes, etc should be known to all staff who may have to operate these in an emergency, and to the public fire brigade on their familiarisation visits.
- 14.6 The locations of shut off points for services, stop valves for sprinkler systems and other control systems for emergency installations should be indicated on a plan of the site provided for the fire brigade. These plans are best located at the entrance to the facility adjacent to the fire alarm indicator and control panel. The locations of fire hydrants on or near the site should also be marked on these plans.
- 14.7 A 'salvage team' should be established to plan and implement effective responses to a range of possible incidents. They should be able to identify key equipment or contents that will require special or early treatment, decide on what emergency equipment should be purchased or hired to minimise the damage, and set up the necessary programme for future training and exercises. If damage is likely to spread beyond the site, joint assistance schemes should be set up in liaison with neighbouring companies and local authorities.
- 14.8 A management team should be set up to plan for recovery from a major fire or explosion. They should investigate, at least the following:
- replacement times for buildings, equipment, and contents
  - whether alternatives are available more quickly and, if so, at what cost
  - whether help can be obtained from other laboratories; and
  - the effect on production, turnover or research programmes.



The team should devise ways to reduce the impact of a major loss. Such schemes should be regularly updated and, if possible, a table top exercise should be carried out.

## 15. European guidelines

### *Fire*

- Guideline No 1:2002 F - Internal fire protection control
- Guideline No 2:2007 F - Panic & emergency exit devices
- Guideline No 3:2011 F - Certification of thermographers
- Guideline No 4:2010 F - Introduction to qualitative fire risk assessment
- Guideline No 5:2003 F - Guidance signs, emergency lighting and general lighting
- Guideline No 6:2011 F - Fire safety in care homes for the elderly
- Guideline No 7:2011 F - Safety distance between waste containers and buildings
- Guideline No 8:2004 F - Preventing arson – information to young people
- Guideline No 9:2012 F - Fire safety in restaurants
- Guideline No 10:2008 F - Smoke alarms in the home
- Guideline No 11:2005 F - Recommended numbers of fire protection trained staff
- Guideline No 12:2012 F - Fire safety basics for hot work operatives
- Guideline No 13:2006 F - Fire protection documentation
- Guideline No 14:2007 F - Fire protection in information technology facilities
- Guideline No 15:2012 F - Fire safety in guest harbours and marinas
- Guideline No 16:2008 F - Fire protection in offices
- Guideline No 17:2008 F - Fire safety in farm buildings
- Guideline No 18:2008 F - Fire protection on chemical manufacturing sites
- Guideline No 19:2009 F - Fire safety engineering concerning evacuation from buildings
- Guideline No 20:2012 F - Fire safety in camping sites
- Guideline No 21:2012 F - Fire prevention on construction sites
- Guideline No 22:2012 F - Wind turbines – Fire protection guideline
- Guideline No 23:2010 F - Securing the operational readiness of fire control system
- Guideline No 24:2010 F - Fire safe homes
- Guideline No 25:2010 F - Emergency plan
- Guideline No 26:2010 F - Fire protection of temporary buildings on construction sites
- Guideline No 27:2011 F - Fire safety in apartment buildings
- Guideline No 28:2012 F - Fire safety in laboratories

### *Natural hazards*

- Guideline No 1:2012 N - Protection against flood

### *Security*

- Guideline No 1:2010 S - Arson document
- Guideline No 2:2010 S - Protection of empty buildings
- Guideline No 3:2010 S - Security system for empty buildings
- Guideline No 4:2010 S - Guidance on key holder selections and duties



## 16. Annex 1: Checklist

<i>Section Ref.</i>		<i>Yes</i>	<i>No</i>
	<b>Section 1: Introduction</b>		
3.1	Has a fire risk assessment been undertaken in compliance with national requirements?		
3.1	Is the fire risk assessment being reviewed periodically?		
3.2	Has other national legislation referring to health, safety, dangerous substances and explosive atmospheres also been addressed?		
	<b>Section 2: Scope</b>		
	No questions		
	<b>Section 3: Definitions</b>		
	No questions		
	<b>Section 4: Construction</b>		
4.1	Do buildings comply with national building codes or regulations and incorporate compartment walls and floors where appropriate to provide a suitable degree of fire resistance between fire compartments?		
4.1	Is consideration given in all areas of the building to fire-resistant construction, compartmentation, protected stairways and lifts, and the absence of combustible linings?		
4.2	During the planning stage is an outline assessment undertaken to consider the type and number of potential hazards that may be present in the laboratory?		
4.2	Is consideration given to the replacement value of the equipment and any potential exposure to hazards from surrounding occupancies?		
4.3	Where the fire risk assessment identifies especially hazardous tests or experiments, are these only undertaken in separate, specially designed laboratories, preferably detached from the main laboratory or facility building? (Where detached accommodation is not available, have compartment walls providing a suitable degree of fire resistance in accordance with national guidelines been constructed between the high risk areas and other parts of the premises, with no doorways providing direct access between these areas?)		
4.4	Are all laboratory and preparation areas separated by a compartment wall from the following? <ul style="list-style-type: none"> <li>• process plant</li> </ul>		



	<ul style="list-style-type: none"> <li>• areas used for the storage of highly flammable and flammable liquids</li> <li>• gas cylinder stores</li> <li>• stores of radioactive materials</li> <li>• stores of biological samples (including pathogens)</li> <li>• areas used for the storage of combustible waste and other materials</li> </ul>		
4.5	Is fire rated glazing used in glazed screens and in all cases is this compatible with the fire compartmentation of the building?		
4.5	Is glazing onto escape routes minimised to avoid radiated heat compromising the route and to eliminate fragments of glass causing a hazard in the event of an explosion?		
4.6	Is structural steelwork fire-protected to provide a suitable degree of fire resistance in accordance with national guidelines so as to prevent, in the event of a fire, premature collapse of main building elements?		
4.7	Are small individual rooms such as offices within laboratories of non-combustible construction, with any prefabricated panels incorporated into the structure having non-combustible cores?		
4.7	Are these small rooms located so that, as far as possible, there is a route from the room to a final exit from the laboratory that does not pass through a high fire hazard area?		
4.8	Has the travel distance for means of escape been subject to a suitable and sufficient risk assessment and is travel, wherever possible, available in more than one direction?		
4.9	<p>Are multiple means of escape considered in the following circumstances?</p> <ul style="list-style-type: none"> <li>• where there is a high explosion hazard,</li> <li>• where there is a fume cupboard or extraction hood located adjacent to an escape door,</li> <li>• where highly hazardous materials are present,</li> <li>• where a gas cylinder or flammable liquids are in use.</li> </ul>		
4.10	Is emergency escape lighting installed in accordance with national standards on all escape routes and in areas where high hazard processes are being undertaken?		
4.10	Are all escape routes shall be adequately signed?		
4.11	Where the fire risk is assessed as being of a 'low' or 'normal' level have the requirements for the building construction been reduced from that indicated in paragraph 4.3 with the agreement of the local building authority and the insurer of the premises?		
4.12	Where the fire risk is assessed as being of a 'low' or 'normal' level and a fixed fire suppression system, such as an automatic sprinkler installation or a total gas flooding system, has been installed, has a reduced level of passive fire protection been considered acceptable?		
4.12	Where sprinkler and other fire suppression systems have been installed is maintenance in compliance with national standards?		
4.13	Has the internal and external glazing of laboratories where explosion hazards may be present been specified with care?		
4.14	Have all holes around electrical and other services where they pass through compartment walls and compartment floors been filled to provide an equivalent level of fire protection as the structural element in which they are situated?		



4.15	Has serious consideration been given to installing lightning protection in accordance with national standards?		
	<b>Section 5: Services and equipment</b>		
5.1	Has an assessment of work and storage areas been carried out and appropriate hazard zones assigned in accordance with national codes of standards?		
5.2	Do all electrical installations conform to national codes of practice and standards with the work being undertaken by a competent electrician?		
5.3	Are all electrical circuits in laboratories protected by residual current devices?		
5.4	Are a sufficient number of switched sockets provided at required locations to avoid the need for extension leads and are power-on indicator lights provided on sockets?		
5.4	Is provision made for emergency shutdown of power in laboratories where high hazard processes are carried out?		
5.5	Is the use of a portable multi-outlet socket block only permitted if the device is equipped with its own residual current device?		
5.6	Is the electrical wiring certified as suitable for use within the zone in which a flammable liquid or gas is being stored or processed?		
5.7	Are all items of electrical equipment, such as fridges, stirrers and vacuum pumps, suitable for use in the zone in which they are to be located, and is care taken when moving equipment from zone to zone?		
5.8	Are electrical installations, fixed equipment and portable electrical equipment inspected periodically in compliance with national regulations?		
	<b>Section 6: Space heating and air conditioning</b>		
6.1	Is the laboratory free of portable space heaters?		
6.2	Is any ducted air-handling system serving the laboratory facility a self-contained system kept entirely separate from other air-handling systems serving the remainder of the building?		
6.3	Are separate heating, ventilation and air conditioning systems installed in laboratory fire compartments that house high value or business critical equipment?		
6.4	Are fresh-air intakes and outlets carefully sited to avoid ingress of undesirable contaminants into the laboratory or the release of noxious materials into the atmosphere outside?		
6.5	Does ducting satisfy the following criteria? <ul style="list-style-type: none"> <li>• of non-combustible construction;</li> <li>• limited directional changes and take as short a route as possible;</li> <li>• arranged so that vapours cannot condense and collect at low points in the ductwork</li> </ul>		
6.6	Does exhaust air pass through an efficient filter system, especially where infectious, toxic or radioactive materials could be discharged?		
6.7	Are ducts passing through compartment walls and floors fitted with automatic fire dampers to maintain the fire separation, and do these		



	dampers operate automatically by means of a fusible link (or preferably by smoke detectors if appropriate)?		
6.8	Where an automatic fire detection system is to be used in an area where there are fume cupboards or in an air-conditioned environment, have the air-movement characteristics been studied carefully to ensure that the detector configuration will operate efficiently with the air-handling systems both on and off?		
6.8	In a similar manner, is care also taken to study the air flow characteristics when installing automatic fire detection in clean rooms and other areas where positive pressure is maintained?		
6.9	Have the effects of air movement resulting from the use of fume cupboards and similar equipment been assessed to ensure that effective operation of heating and ventilation systems are not compromised?		
6.10	Is all ventilation and air conditioning ductwork installed and maintained in accordance with national standards?		
6.11	Do all laboratories where constant hazardous or toxic atmospheres exist (including micro-biological laboratories) have a negative pressure to ensure that hazardous materials do not leak into the rest of the building? (And has the need for pressure differentials to be provided in other laboratories been determined by a risk assessment?)		
	<b>Section 7: Fume cupboards (including glove boxes)</b>		
7.1	Are fume cupboards constructed from material suitable for their intended application?		
7.2	Are fume cupboards and glove boxes operated in series provided with separate ducting and fire separation between adjacent units?		
7.3	In order to protect the environment, is it prohibited to use fume cupboards as convenient extraction routes for waste toxic or flammable gases or vapours?		
7.4	Are fume cupboards free of stored flammable substances, oxidising agents or other chemicals?		
7.5	Is it recognised that there is likely to be an ignition risk with the introduction of some portable electric equipment that is not designed to be used in a fume cupboard environment? (It must be ensured that all electrical equipment is suitable for the hazard zone in which it is to be used.)		
7.6	Are exhaust fan motors located outside the ducting with their controls located outside the fume cupboard together with the controls for gases and other services (unless they are appropriate for use within the hazard zone)?		
7.7	Are airflow indicators installed or if not, are procedures in place to ensure inspections of fan units (and in particular the drive belts) are performed regularly and the face velocities are measured to demonstrate that the cupboard is fit for purpose?		
7.8	Are all fume cupboards and glove boxes designed to provide adequate ventilation to avoid a build up of flammable vapours and be serviced and maintained, to include face velocity and containment requirements, in accordance with national standards and the manufacturer's instructions?		



	<b>Section 8: Hot plates, ovens, furnaces and heating equipment</b>		
8.1	Is heating equipment installed away from areas where flammable liquids are handled?		
8.2	Is free-standing equipment placed on heat-resistant surfaces?		
8.2	Does built-in equipment have appropriate insulation and ventilation?		
8.3	Are ovens and furnaces fitted with overriding non-automatically re-setting thermal cut-out devices, in addition to normal thermostats, especially where the oven or furnace may be left operating unattended?		
8.4	Solvent distillation using portable heating mantles and similar equipment should not be left unattended		
8.5	Wherever possible, are hazardous materials such as hydraulic fluids handled away from hot surfaces?		
8.6	Whenever a laboratory is left unattended, is all heating equipment checked to ensure that it has not been left on accidentally?		
	<b>Section 9: High value equipment</b>		
9.1	Is high-value equipment, such as computers, spectrometers, electron microscopes and similar items which could easily be damaged by liquids, protected from water or chemical spillages occurring on the floor above?		
9.1	Are welded joints, as opposed to compression fittings, used in all plumbing?		
9.2	Is electronic data processing equipment, and other laboratory equipment where applicable, installed in accordance with national codes of practice?		
	<b>Section 10: Flammable liquids and gases</b>		
	<b>Section 10.1: Piped services</b>		
10.1.1	Are liquids and gases delivered from cylinders or bulk tanks, located at a safe location outside the building via permanently installed hard metal piping, with quick-acting isolation valves linked to the automatic fire detection system installed both at the point of supply and delivery?		
10.1.2	Are supply and discharge terminals clearly and permanently marked at each end and along the pipe run to identify the liquid or gas carried?		
10.1.3	Are pipelines colour-coded throughout their length to comply with national standards, including clear markings to show the direction of flow of the contents?		
10.1.4	Do pipelines take the shortest practical route and are they located and adequately supported well clear of heat sources, electric cables, and other services or areas where mechanical damage is possible?		
10.1.5	Where pipework passes through compartment walls and compartment floors is it protected so as to maintain the fire resistant integrity of the structural elements concerned.		



<b>Section 10.2: gas cylinders</b>			
10.2.1	Where liquefied petroleum gas (LPG) is involved, are the national standards and codes of practice relating to the storage and use of LPG followed?		
10.2.2	Are cylinders containing flammable gas stored in a secure compound in the open air to enable natural ventilation to disperse any small leaks? (If this is not practicable, are the cylinders stored in a separate designated building or in a designated storage place within a building provided with suitable high and low level ventilation?)		
10.2.3	Is the storage area or storage building for gas cylinders at least 4m from other buildings and ignition sources?		
10.2.3	Are gas leakage detectors installed in cylinder stores with the alarm monitored in the security control room?		
10.2.4	Are different types of gases segregated from each other, particularly flammable gases and oxidising gases?		
10.2.4	Are empty cylinders stored separately from full cylinders?		
10.2.4	Are gas cylinders protected from direct sunlight?		
10.2.5	Are smoking and naked lights prohibited in all flammable gas storage areas and buildings with permanent warning notices prominently displayed?		
10.2.6	Are gas cylinders only moved on trolleys designed for this purpose, with the cylinders secured in place on the trolley at all times?		
10.2.7	Is the total quantity of flammable gases in a laboratory kept to the minimum needed for effective operations?		
	Where it is unavoidable to have cylinders containing flammable gases or oxygen inside the laboratory are the cylinders secured in a vertical position, preferably within a cabinet providing at least 60 minutes fire resistance with appropriate hazard warning signs displayed prominently?		
10.2.8	Is an acetylene cylinder only allowed in a laboratory following a specific risk assessment and the determination of any necessary exclusion zone(s)?		
10.2.9	Are regulators, pipes and pressure valves fitted appropriate to the type of gas to be used?		
10.2.10	Is care taken to keep gas cylinders, their valves and associated equipment free of grease and oil?		
10.2.11	Where there is the possibility of a gas supply at a higher pressure feeding back into a lower pressure system, are suitable back-pressure valves installed?		
10.2.12	Are gas supply valves closed when a supply is not required?		
10.2.13	Are staff trained in the moving, connection and disconnection of gas cylinders, including instruction in the hazards associated with the processes?		
<b>Section 10.3: Highly flammable and flammable liquids</b>			
10.3.1	Is the quantity of highly flammable and flammable liquids in laboratories and elsewhere on site subject to a risk assessment and kept to a minimum?		
10.3.2	Are such liquids stored in purpose-built cabinets or bins providing at least 30 minutes fire resistance and having integral spillage trays?		
10.3.2	Are cabinets or bins clearly marked with appropriate hazard warning signs?		



10.3.3	Is ducting to vented cabinets of non-combustible construction with a plastic lining?		
10.3.3	Is the size of any container of highly flammable liquid kept on a bench no more than that required for the work period and not exceed 500ml?		
10.3.4	Are highly flammable liquids carried in approved safety containers?		
10.3.4	If glass containers are necessary for corrosion resistance or to maintain the purity of a liquid, is their capacity less than 5 litres and are they contained in protective carrying containers?		
10.3.5	Are only refrigerators designed or modified for the storage of flammable liquids used for this purpose?		
10.3.6	Are bulk supplies of flammable liquids kept in a separate, non-combustible, suitably marked building?		
10.3.7	Are experiments using flammable liquids carried out in a fume cupboard and on a metal tray to retain the contents of the apparatus should it fracture?		
10.3.8	Are highly flammable and flammable liquids stored remotely from hazardous materials such as oxidising agents, organic peroxides, strong reducing agents, and strong acids?		
10.3.9	Is a supply of non-combustible absorbent material kept immediately available to deal with any spillages of flammable liquid, and have staff been instructed in the use of this material and its safe disposal?		
	<b>Section 10.4: Hazardous chemicals</b>		
10.4.1	Is adequate attention paid to fire and explosion hazards which might arise from the non-compatibility of some chemicals should they become mixed following an accident or breakage.?		
10.4.2	Is compliance with national regulations observed concerning the control of hazardous materials?		
10.4.3	Are all radioactive materials stored securely in suitable containers?		
10.4.3	Is tritium kept in a proprietary container and refrigerated to minimise the potential for release to the environment?		
	<b>Section 11: Fire safety management</b>		
	<b>Section 11.1: General provisions</b>		
11.1.1	Has the laboratory been the subject of a fire risk assessment in compliance with national legislation?		
11.1.1	Has an assessment also been undertaken in accordance with other relevant legislation concerning hazardous or dangerous substances?		
11.1.2	Is a complete list of all substances stored or in use on the site together with the material safety data sheets available at all times?		
11.1.3	Is the premises kept clean and tidy with only the minimum daily requirements of hazardous chemicals or goods present in the laboratory itself?		
11.1.3	Are bulk stocks of materials kept outside or in properly designed storerooms remote from the laboratory?		
11.1.4	When an experiment or research project is finished, is the apparatus dismantled, cleaned and inspected and the components returned to store or disposed of safely?		
11.1.5	Are service ducts or enclosures kept clean and not be used for storage or other purposes?		



11.1.6	Is the shelf life of chemicals and samples checked regularly, with the interval depending on the ageing qualities of the materials?		
11.1.6	Are any chemicals or samples found to be out of date disposed of safely with specialist advice being sought in respect of any substances found or prepared which may be unstable or highly reactive due to their age or conditions of storage?		
11.1.7	Is all plant and equipment operated and maintained regularly in accordance with manufacturers' instructions with records of service history being kept?		
11.1.8	Has a safety committee been established to oversee working practices and vet any new projects before work starts?		
11.1.8	Does the committee meet regularly and report to a senior manager with budgetary control for health and safety matters?		
11.1.9	Has a written permit-to-work system been established for hazardous operations and is it strictly implemented to ensure that both the operator and the management are fully aware of the risks and the safeguards to be adopted?		
11.1.9	Are only trained personnel allowed to undertake hazardous operations and are they provided with suitable protective clothing and equipment?		
11.1.10	Is hazardous experimental work involving pilot plant carried out in a special area separated from the remainder of the laboratory by walls constructed entirely of brickwork, masonry or concrete having at least 120 minutes fire resistance and any openings fitted with self-closing fire doors with 120 minutes fire resistance?		
11.1.10	Are the areas in which hazardous experimental work involving pilot plant carried out free of doors connecting them directly to other parts of the building; and where necessary, have suitable provisions been made to vent an explosion?		
11.1.11	Is the transport of flammable and highly flammable liquids and gas cylinders on trolleys in lifts subject to a risk assessment?		
11.1.12	Is there an annual audit of the laboratory to ensure the following? <ul style="list-style-type: none"> <li>• fire and health and safety measures are in place and are used and followed,</li> <li>• all staff in the area are trained and familiar with the standard operating procedures, and</li> <li>• all the equipment is in place and maintained as required.</li> </ul>		
<b>Section 11.2: Waste disposal</b>			
11.2.1	Is National legislation concerning the storage and disposal of hazardous waste materials observed?		
11.2.2	Is care taken not to dispose of waste flammable liquid via the drains?		
11.2.2	Is waste flammable liquid collected in suitable closed containers, with a volume of no more than 5 litres, and stored in a safe place outside the laboratory pending regular removal from the premises by a specialist waste disposal company?		
11.2.2	Is care taken to avoid mixing non-compatible materials when storing waste liquids?		
11.2.3	Are other combustible waste materials deposited in non-combustible lidded receptacles of limited size?		
11.2.3	Is waste removed from the laboratory daily and stored outside in		



	locked containers located at least 10m from buildings and plant?		
11.2.4	Are waste unsaturated oils and other reactive materials that may be subject to self-heating stored separately in metal containers with metal lids in a location at least 10m from the buildings to await disposal?		
11.2.5	Are waste materials regularly removed so as not to accumulate on site?		
11.2.6	As cleaners often work in isolation and may not be aware of the possible dangers in a laboratory, are they given special training and instruction?		
	<b>Section 11.3: Welding and other hot work processes</b>		
11.3.1	Is hot work only carried out after written approval by the laboratory manager or the safety adviser, who stipulates when and how the work shall be carried out?		
11.3.2	Is hot work only undertaken by staff trained to work in accordance with Guideline 12: Fire safety basics for hot work operatives?		
	<b>Section 11.4: Overnight use</b>		
11.4.1	Where a overnight use of the laboratory is a routine occurrence and circumstances allow, is the work undertaken in an area separated from the remainder of the building by brickwork, masonry or concrete walls having at least 120min fire resistance, with any openings in the walls fitted with self-closing fire doors with 120min fire resistance?		
11.4.2	Where a small area of a large laboratory is to be used on occasion overnight for an unattended experiment, is it subject to a risk assessment and the production of documented emergency procedures?		
11.4.2	Are copies of these procedures given to the security staff and posted on the door to the laboratory?		
11.4.2	Do the procedures include the actions to be taken in the event of fire, spillage or leakage of water, the fire fighting media suitable for use and details of any personal protective equipment to be worn?		
11.4.3	Has the installation of an automatic fire detection and alarm system and/or an automatic fire suppression installation been considered as part of the fire risk assessment undertaken during the planning stage of the project?		
11.4.4	Is equipment left on overnight and unattended recorded on a permit to work system?		
	<b>Section 11.5: Smoking, eating and drinking</b>		
11.5.1	Is smoking prohibited in all external storage areas, especially those where toxic, flammable and corrosive liquids and gases and high-value equipment are present?		
11.5.1	Are appropriate 'no smoking' notices prominently displayed?		
11.5.2	Where a smoking shelter is provided does it satisfy the following criteria? outside the building subject to a specific fire risk assessment constructed of non-combustible materials where practicable, sited at least 10m away from any building or structure, including gas cylinder and flammable liquid stores. provided with suitable metal ashtrays and a separate metal waste		



	bin with a fitted metal lid provided with a suitable fire extinguisher.		
11.45.3	Is the immediate area around the shelter and the shelter itself kept clear of combustible materials including windblown debris and vegetation?		
11.5.4	Does the construction avoid the use of raised, slatted floors or decking and are concealed or semi open spaces sealed to ensure combustible debris cannot accumulate beneath the shelter?		
11.5.5	Is the use of combustible curtains, canopies and drapes to protect smokers from the weather avoided?		
11.5.6	Is the shelter sited away from the following? windows ventilation intakes or extracts entrances and exits from the premises hazardous materials waste storage containers (such as skips or bins) and canopies or low slung eaves.		
11.5.7	Are areas where smoking is allowed but no shelter is provided, free of combustible materials and equipped with fire fighting equipment, metal ash trays and a separate metal waste bin with a fitted metal lid?		
11.5.8	Has a 'no smoking' policy been established in outside areas where fire hazards exist?		
11.5.9	Is eating, drinking and smoking prohibited in laboratory areas, with suitable facilities provided (where the wearing of laboratory coats and other protective clothing is not allowed)?		
	<b>Section 11.6: Water damage</b>		
11.6.1	Are buildings maintained in good repair and are gutters and downpipes cleaned out at least once a year?		
11.6.2	Are water pipes, drains and similar services routed so as to be well away from, and not pass directly over, sensitive, costly or business critical equipment?		
11.6.3	Are computers and other high-value equipment located away from basements or places where they could be affected by flooding? (Where this is unavoidable is the equipment installed above floor level?)		
11.6.4	Do tank and cistern overflows discharge to safe places, and are the drip trays of chiller systems of sufficient capacity and provided with a drain hole large enough not to become blocked?		
11.6.5	Is freezing avoided by setting central heating controls to maintain a minimum temperature of 4°C inside the premises?		
11.6.5	Where a minimum temperature of 4°C and in outside areas, is trace heating and lagging installed?		
11.6.6	Are all vulnerable reactants, products and other stored materials kept off the floors on shelving, racks, pallets, or dunnage?		
11.6.7	Where water sprinklers are installed, are suitable measures taken to retain water used for fire fighting operations to avoid environmental pollution?		



<b>Section 12: Fire protection</b>			
12.1	Are portable fire extinguishers installed and maintained in accordance with national standards?		
12.1	Where flammable liquids are in use are extinguishers located so that no person has to travel more than 15m in order to reach one?		
12.2	Are rooms containing high-value computer, diagnostic, test or analytical equipment provided with a fixed gas fire suppression system triggered by smoke detectors configured for coincidence connection – and are automatic fire detection and suppression systems in these areas installed and maintained according to the installer's instructions and in consultation with the insurers of the premises?		
12.3	Are glove boxes and similar enclosures provided with a fixed extinguishing system? (Have oxygen-enriched or pressurised chambers been given special consideration?)		
12.4	Where a fixed fire suppression system is installed, are means provided to shut down any exhaust or ventilation systems and to seal any openings before any gas is discharged?		
12.4	Does operation of a fixed fire suppression system also result in automatic shut down of gases and supply of reactants to the equipment (other than cooling systems)?		
12.5	For larger laboratories, is consideration given to the installation of automatic sprinkler installations and automatic fire detection and alarm systems in accordance with national standards?		
12.5	Is care taken not to install a water extinguishing system where the chemicals stored or in use are liable to react with the fire fighting water?		
12.6	Are all employees given basic fire training covering at least the following? The fire related properties of materials that they may be called upon to handle <ul style="list-style-type: none"> <li>• Actions to take in an emergency</li> <li>• how to raise the alarm</li> <li>• how to call the fire brigade</li> <li>• how to shut down hazardous processes in an emergency</li> <li>• how to escape in a safe manner.</li> </ul>		
12.6	Are selected staff given extra training as appropriate, to include, for example, the following? <ul style="list-style-type: none"> <li>• additional training so as to be able to act as fire wardens</li> <li>• practical instruction in the use of the fire extinguishers</li> <li>• training in clearing spillages of hazardous materials.</li> </ul>		
12.6	Are cleaners also given suitable training, dependent on the areas in which they are called upon to work?		
<b>Section 13: Security</b>			
13.1	Is serious attention given to the threat of deliberate fire raising in the fire risk assessment undertaken for the premises in compliance with national legislation?		
13.2	Is site security against intruders compatible with the values at risk,		



	the nature of the contents, the location of the laboratory, the history of crime in the area and the post loss history of the site?		
13.2	Is the level of security provided compatible with the nature of the work undertaken (whether it is likely to arouse hostile reaction from organised groups or people)?		
13.3	Are intruder alarms installed and maintained to a recognised national or international standard by a competent installer who has received accreditation from a third party body who is acceptable to the police authority?		
13.3	Does the security installation meet insurers' requirements, and is it designed specifically for the location?		
13.4	On larger sites, are security staff employed outside of working hours to check all parts of the site?		
13.4	Where a contractor is engaged, is a check made that the security company is reputable and experienced and approved by an independent inspection body?		
13.5	Are clocking points, or similar means of recording the patrols, provided?		
13.5	Where a single security person is present, are arrangements made to check every hour to confirm that all is well?		
13.6	Has security lighting and the provision of closed-circuit television been considered as important elements of the security strategy?		
13.6	Are CCTV systems installed by an approved installer?		
13.7	Are security staff made aware of any experiments or production processes taking place outside working hours so that special checks may be made to ensure that everything is in order?		
13.8	Is laboratory access restricted to named persons only, and barred to others by means of suitable controls such as keying, proximity or magnetic card readers?		
13.9	Are suitable warning notices posted at all entry points to warn of flammable, toxic, radioactive, laser or other hazards?		
	<b>Section 14: Contingency planning</b>		
14.1	Is the guidance set out in national best practice documents adopted?		
14.2	Where work carried out in the laboratory is a business critical operation or involves toxic, biohazard or radiological materials, has a crisis management plan been devised and is it comprehensively tested on a regular basis? (Following the exercises, are the plans amended as necessary to ensure that appropriate staff can be made available to provide advice to the emergency services and assist their colleagues to ensure that business operations return to normal expeditiously and in a controlled and safe manner?)		
14.3	Are fire resisting safes, data safes and fire resisting cabinets adequate to protect data on a short-term basis while waiting for 'backing up' to main files?		
14.4	Are samples necessary for historical records, trial evaluations, etc kept in a purpose-built store room having at least 120min fire resistance and / or stored off site at a separate location?		
14.5	Are the location of essential gas and water stop valves, main switches, drainage gullies, manholes, etc known to all staff who may		



	have to operate these in an emergency, and to the public fire brigade on their familiarisation visits?		
14.6	Are the locations of shut off points for services, stop valves for sprinkler systems and other control systems for emergency installations, together with the s of fire hydrants, indicated on a plan of the site provided for the fire brigade, and are these plans located at the entrance to the facility adjacent to the fire alarm indicator and control panel?		
14.7	Has a 'salvage team' been established and trained to plan and implement effective responses to a range of possible incidents?		
14.8	Has a management team been set up to plan for recovery from a major fire or explosion, and do they investigate, at least the following? <ul style="list-style-type: none"> <li>• replacement times for buildings, equipment, and contents</li> <li>• whether alternatives are available more quickly and, if so, at what cost</li> <li>• whether help can be obtained from other laboratories; and</li> <li>• the effect on production, turnover or research programmes.</li> </ul>		
14.8	Does the management team devise ways to reduce the impact of a major loss?		