



RC1

for fire  
precautions  
with temporary  
and emergency  
electrical  
supplies

## LOSS PREVENTION RECOMMENDATIONS

The aim of the FPA series of Recommendations is to provide loss prevention guidance for industrial and commercial premises and systems. The series continues a long tradition of providing authoritative guidance on loss prevention issues started by the Fire Offices' Committee (FOC) of the British insurance industry more than a hundred years ago and builds upon earlier publications from the Loss Prevention Council and the Association of British Insurers.

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## SCOPE

These Recommendations aim to outline practical measures that can be taken to reduce the number of fires associated with the provision of emergency power generating equipment. The recommendations apply to the use of fixed and portable generators fuelled by gaseous or liquid fuels and to the use of batteries, including those used with an inverter.

This guidance extends to emergency sources of power for safety services and the provision and use of uninterruptible power supplies (UPS) for computer installations and associated equipment. Although reference is made in this document to temporary lighting, the text here should be read in conjunction with the full guidelines dedicated to that subject (see the references section at the end of this publication).

This document makes no recommendations relating to the provision of emergency escape lighting; the storage of the fuel supplies is also excluded, since comprehensive guidance on these matters is available elsewhere.

## INTRODUCTION

With the increasing dependence on electrical power in industry and commerce, many organisations need an immediate back up supply of electricity in the event of main power failure. They may need the power to run life safety systems or to maintain business continuity. In many organisations there may be insurance implications in the event of a complete failure of electrical supply.

Possible standby sources of power may be:

- storage batteries,
- a fixed or portable generator capable of independent operation,
- a separate supply feed that is independent of the normal power supply and unlikely to fail concurrently.

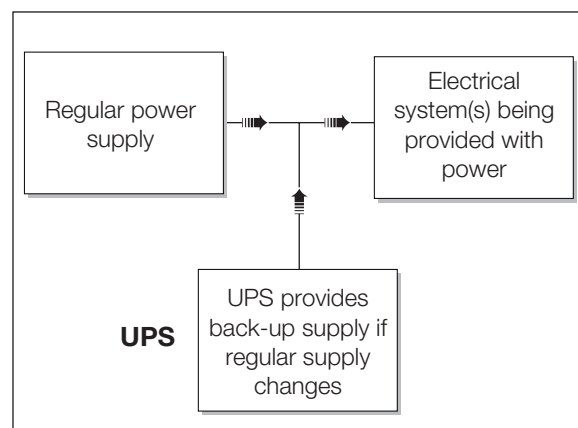
The possibility of installing a duplicate provision of power from a three-phase supply could also be considered where this can be achieved.

## RECOMMENDATIONS

### 1. Definition

Uninterruptible power supply (UPS)

An uninterruptible power supply (UPS) is an arrangement for supplying electrical power and is placed between a regular power supply and the system to which it regularly supplies electricity. In the event of a power cut or a surge or fall in power then the UPS acts to provide continuous, unvarying, back-up electrical power.



### 2. General

When considering purchasing a temporary or emergency power generator, check that the power supply specified is adequate for all intended purposes. Care should also be taken, for economy, to eliminate any unnecessary applications.

- 2.1 For a safe and reliable service, a source of supply should be selected that will maintain power of the required voltage for an adequate period of time.
- 2.2 The standby supply should operate independently of the normal source of power so that it will always be capable of operating in the event of a failure of the normal source.
- 2.3 For an element of a life safety system or a business continuity system to operate in fire conditions, all constituent equipment should be provided with fire protection of adequate duration. All elements of construction of enclosures for emergency generators, for example, should be of non-combustible material and have a minimum of 1 hour fire resistance.
- 2.4 Equipment shall be designed and installed so as to facilitate periodic inspection, testing and maintenance.
- 2.5 Stocks of fuel for generators should be kept to the minimum consistent with anticipated running requirements. See the different parts of RC20 (ref. 1) for recommendations concerning storage.
- 2.6 Fuel should not be kept in portable containers in the immediate vicinity of the generating set.
- 2.7 All permanent electrical installations, including those intended to provide emergency power, must be periodically inspected and tested in accordance with BS 7671 (ref. 2). (See also paragraph 9.4 below.)
- 2.8 Smoking should be prohibited in generator rooms and in the vicinity of portable generators.
- 2.9 During the period of the emergency, all equipment not powered by the standby power supply should be switched off. When normal power supplies are restored, automatic equipment

should be checked and any time clocks and control mechanisms should be reset as necessary.

- 2.10 Even if a UPS is present on a premises to cope with failure/variation of the normal power supply, it will still be necessary for certain systems (automatic fire detection and alarm systems, security alarms and similar installations) to have their own back-up power supplies, as specified in relevant installation and operating standards.
- 2.11 In hospitals, nursing homes and similar establishments, the power supplies to critical equipment must be maintained without significant interruption and the level of lighting must be maintained such that treatment and movement of staff can continue safely. In these instances, specialist advice regarding standby power supplies should be sought.

### 3. Fixed generators

Fixed generators tend to be fuelled by diesel fuel, natural gas or propane. The choice may be made on availability of the fuel, environmental or a practical basis. Diesel-fuelled generators tend to be quieter and need less maintenance (water-cooled diesel units operate for up to 30,000 hours before major service) than comparably sized gas or propane powered units (water-cooled gas units may operate for up to 10,000 hours before major maintenance).

The choice will also be determined by the nature of the supply required; single-phase or three-phase generators are available running at either 120V or 240V. Throughout Europe generators should produce power with a frequency of 50Hz.

The specification should also include the type of air filter, silencer and starter system. The last consists of a 12V battery and starter motor with a charging alternator and start/stop switch. Diesel units should be fitted with a pre-heat switch and should have a safety shutdown system to protect the engine in case of oil pressure loss, generator overspeed or high water temperature.

#### *Specification*

- 3.1 When specifying new equipment it should be remembered that any electric motors which need to be powered will draw several times more current when starting under load than when running freely. (That will apply, for instance, in the case of air conditioning units, air compressors, pumps, refrigerators, freezers etc.) This factor may also have a significant bearing on the choice of a single-phase or three-phase generator.
- 3.2 Generating equipment must incorporate a feature which prevents it from delivering overcurrent to the system(s) to which it is providing power. The power rating of any such integral feature shall be co-ordinated with those of the downstream protective devices ensuring, as far as possible, that the downstream devices operate first.

- 3.3 Where electronic protection takes the form of feedback to limit the current output, the internal transfer switches shall operate so as first to eliminate the least critical portion of the connected electrical load.

- 3.4 While it is important to install a generator with sufficient capacity for all foreseeable future needs, the cost of power from a generator which is only running at a fraction of its capacity is a factor to consider.

#### *Installation*

- 3.5 All fixed electrical generating equipment should be installed and operated in compliance with the manufacturers' instructions.
- 3.6 When designing a new facility:
- (a) adequate access should be incorporated to enable the equipment to be unloaded and installed safely; and
  - (b) there should be adequate clear space of at least 1m around the generator/generating equipment to allow routine maintenance and the replacement of parts as necessary;
  - (c) the clear space should be indicated by prominent marking on the floor or the provision of a suitable barrier.
- 3.7 The mounting of the generating equipment should be of sufficient strength and mass to withstand the static and dynamic forces likely to be imposed upon it.
- 3.8 The floor of the generator room should have a suitable non-slip and oil-resisting surface.

#### *Location*

- 3.9 Fixed generators should be sited in purpose-built enclosures of non-combustible construction to provide at least 1 hour fire resistance. These should be used for no other purpose.
- 3.10 Equipment should not be positioned where it may be subject to mechanical damage.
- 3.11 The location should be clear of stored combustible materials and remote from any areas where flammable gas or flammable vapours may be present or may be released.
- 3.12 The enclosure should be provided with adequate ventilation in accordance with the manufacturer's instructions. This includes suitable ventilation for the smoke and fumes produced by the engine as well as an adequate supply of cooling air.
- 3.13 Suitable fixed heating should be installed to ensure that the temperature of the enclosure does not fall below 10°C, to ensure easy starting of a diesel engine in cold weather.

*Records*

- 3.14 Up to date documentation, including installation drawings, routes of cables, details of equipment supplied by the generator and safe shut down procedures should be available for fire brigade use.
- 3.15 The location of emergency generators should be noted on the site plans that are made available for the fire service, as well as listing the equipment that is to receive emergency power when normal power is lost.

*Operation and maintenance*

- 3.16 The equipment should be serviced regularly as directed by the manufacturers and records kept of dates and maintenance work carried out.
- 3.17 The engine air intake should be fitted with a suitable air filter. A metal mesh filter is preferable to one incorporating a waxed paper cartridge, especially in circumstances where burning brands could be drawn into the engine.
- 3.18 The automatic starting and operation of the generator should not depend on any energy sources other than its batteries.
- 3.19 The engine's exhaust should be fitted with a suitable silencer.
- 3.20 An exhaust pipe should be provided for transporting exhaust gases to a safe place in the open air. Care must be taken to ensure that the smoke and gases do not re-enter the pump room and vent well away from the building. Care must be taken to ensure that the gases are not likely to be drawn into nearby premises where they may actuate an automatic fire detection installation.
- 3.21 If an exhaust pipe runs vertically, it should be fitted with suitable means to prevent any condensate from flowing back into the engine.
- 3.22 The exhaust pipe should be insulated so that it does not present a fire hazard.
- 3.23 A manual start test button and indicator lamp should be provided to permit periodic testing.
- 3.24 When an emergency is over, the equipment should be inspected, refuelled and made ready for use in case it is needed shortly afterwards.

*Batteries*

- 3.25 The starter motor should be powered by duplicate batteries positioned as close to the generating equipment as possible to minimise voltage drop.
- 3.26 Batteries should either be open nickel-cadmium prismatic rechargeable cells complying with EN 60623 (ref. 3) or lead acid positive batteries complying with EN 50342 (ref. 4). Batteries should be used, selected, charged and maintained in accordance with the relevant standard.

- 3.27 Each battery should be provided with a continuously connected charger suitable for the battery concerned.

*Fuel*

- 3.28 Fuel tanks should be of welded steel, with a separate tank for each generator, and each tank should be fitted with a fuel level gauge.
- 3.29 The fuel tanks should be positioned above the level of the generator's fuel pump, but not directly over the engine.
- 3.30 The fuel feed pipe should be at least 20mm above the bottom of the fuel tank and a drain valve of at least 20mm diameter should be fitted to the base of the tank.
- 3.31 If it is necessary to store cylinders of liquefied petroleum gas or propane then:
  - (a) the number of cylinders stored at a premises should be the minimum for effective emergency purposes; and
  - (b) they should preferably be stored in the open air but where this is not practicable then in a separate designated building.

See RC8, *Recommendations for the storage, use and handling of common industrial gases in cylinders including LPG*, for further guidance (ref. 5).

- 3.32 All pipework between the tank and the generator shall be metallic, with soldered joints.
- 3.33 Any valves in the fuel feed pipe shall be positioned adjacent to the tank, have an indicator, and be locked in the open position.
- 3.34 Fuel tanks should be fitted with a vent designed to release fuel vapour outside the building.

*Precautions with cabling*

- 3.35 All wiring from the generator to the local consumer units should be protected against fire and mechanical damage. This may be achieved by running the cables outside the building, or through those parts of the building where the fire risk is negligible or which are separated from any significant fire risk by an element of structure with a fire resistance of at least 60 minutes. Alternatively the cables may be provided with suitable protection directly or be buried beneath ground.
- 3.36 The colouring of the insulation on the cables from emergency generators should comply with current national/European standards. Where black insulation is in use in the premises to denote both neutral return cables and phase supplies, clear and prominent notices should be displayed.
- 3.37 Cables from emergency generators to the local consumer units should be of single lengths avoiding the need for joints.



### *Fire safety management*

3.38 When considering the attenuation of engine noise, care should be taken to employ materials that are compatible with the fire protection requirements.

3.39 Generator rooms should be kept free of potential sources of ignition except for suitable lighting and illuminated fire exit signs where these are necessary.

## **4. Portable generators**

4.1 To facilitate the speedy connection of a generator in an emergency, suitable connecting points should be made available.

4.2 Portable generators should be used unenclosed unless provided with a proprietary enclosure designed to reduce noise or vibration.

4.3 To ensure correct burning of the fuel and the minimisation of noxious exhaust gases, exhausts should not be blocked or restricted.

4.4 Portable generators should be sited clear of combustible materials, including dry undergrowth. An area of at least 1m around the generator should be kept clear of combustible materials.

4.5 When it is necessary to place a portable generator on an unpaved surface it should be stood on a fire-resistant board to protect any combustible materials or dry undergrowth beneath.

4.6 Equipment should not be positioned where it may be overturned or liable to suffer mechanical damage.

4.7 Portable generators should not be used in areas where a flammable atmosphere may be created by the release of gases, vapours, or dusts.

4.8 Refuelling should not take place when the generator is operating or still hot from recent use.

4.9 Portable generators should not be moved while in operation. (This also applies in the case of generators run from the power take-off shafts of tractors and other agricultural machinery.)

4.10 When an emergency is over, the equipment should be inspected, refuelled and made ready for use in case it is needed shortly afterwards

## **5. Periodic testing and maintenance**

5.1 All testing and maintenance should be carried out by a competent person.

5.2 At least two instruction manuals should be kept for each generator, one copy being located with the equipment and the other in a secure location elsewhere.

5.3 The manual should contain:

- a detailed explanation of the operation of the system,
- a schematic wiring diagram,
- a function block diagram,
- the battery specification, installation, maintenance and wiring diagram,
- instructions for routine maintenance,
- list of consumable spare parts with part numbers and sources of supply,
- routine trouble-shooting procedures.

5.4 Any special tools, test equipment and spare parts should be stored securely in the generator room.

5.5 All generating equipment should be tested, serviced and maintained in accordance with the manufacturers' instructions.

5.6 Generators should be exercised weekly, with load testing being carried out quarterly, with the generator running for at least five minutes on each occasion. Suitable records should be kept.

5.7 The inspection and servicing of the generating equipment should include:

- checking the fuel levels,
- checking of battery electrolyte levels,
- the conditions of the cells, where the batteries are not sealed,
- checking of the correct function of all indicator lamps, meters and controls,
- checking the load value to ensure that it is within the specification.

5.8 A written record of the servicing, maintenance, replacement of parts and any unsatisfactory inspection findings should be kept in a log book in the generator room. This log book should also record the corrective actions taken, by whom and when. (The Fire Protection Association's *Workplace Fire Safety Log Book* (ref. 6) gives guidance on a wide range of record keeping for fire safety equipment and systems.)

5.9 Following the running of a generator, whether for servicing or maintenance, the fuel level should be replenished to ensure that the equipment is fully operational.

## **6. Uninterruptible power supplies**

Computer systems cannot tolerate the variations of power and power cuts normally associated with commercial power systems; a momentary power surge or failure could wipe a computer's memory or damage its many sensitive circuits. To prevent this, an uninterruptible power supply (UPS) is installed between the commercial alternating current power lines and the computer system.

A UPS consists of three major elements, a rectifier/charger, a battery and a direct-current-to-alternating-current inverter. This inverter is phased to the commercial power frequency and thus any fluctuations or interruptions in commercial power should not affect the computer.

The battery is considered to be the weakest link in the equipment, with UPS systems traditionally having sealed lead acid cells. The operational life of the batteries will be affected by hostile environments, lack of maintenance, or misuse, such as poor balance of the load on three-phase inverters. Over the last 20 years there have been significant reductions in the weight and size of UPS systems.

UPS equipment may not be sufficient to protect against an excessive power surge or transient overvoltage, such as occurs with a lightning strike, for example, and specialist advice should be sought for this eventuality.

- 6.1 The equipment should be assessed periodically to ensure that it has the capacity and is capable of supplying the service quality within the required time frame for the equipment that is intended to power.
- 6.2 UPS systems should be maintained, inspected and tested in accordance with manufacturers' guidance and with NFPA 111 (ref. 7).

## 7. Batteries

- 7.1 Where batteries are to be used to power life safety equipment in an emergency they should be suitably protected from the effects of a fire, for example, by locating them in a suitable fire-resistant compartment.
- 7.2 When specifying battery power, it should be remembered that to maximise battery life, and hence minimise costs, they should not be allowed to discharge completely before recharging.
- 7.3 Ideally, the designated battery room should be located on an outer wall of the building so that adequate ventilation can be readily provided for the batteries to be charged in this location. The ventilation should allow for at least two air changes per hour.
- 7.4 Battery charging rooms should be ventilated at high level. Chargers should be mounted on non-combustible surfaces and hangers should be provided for storing charging leads when not in use.
- 7.5 There should be no combustible material stored within 2m of the charger(s) or batteries.
- 7.6 In areas where wet cells are charged, safe means must be provided for checking electrolyte levels and topping up the cells when necessary.
- 7.7 Charging facilities should also include means for mopping up and neutralising any spilled electrolyte.

- 7.8 Where necessary, barriers should be provided to protect charging apparatus from damage by trucks.
- 7.9 Processes which produce open flames, sparks or electric arcs must be excluded from battery-charging areas.

## 8. Alternative sources of power

Although wind, water and solar power units are available, they are yet to have widespread use in industry and commerce or to be accepted as viable emergency power supplies. Future advances in technology, however, may serve to make these forms of energy viable for emergency use in areas where there is not a significant seasonal variation in the climatic conditions which deliver the potential power supply.

## 9. Temporary installations

- 9.1 In all cases where a temporary installation is being considered, the fire risk assessment for the area concerned should be reviewed and the impact of the temporary circuits and equipment should be addressed where necessary. The assessment should include consideration of the risk of deliberate fire raising if elements of the equipment, such as a large portable generator, have to be located outside the premises.

### *Temporary lighting*

During periods without mains power, the provision of temporary lighting, other than emergency escape lighting, may be necessary. Where this is the case, the following guidance should be followed:

- 9.2 Under no circumstances should naked flames, such as candles, be used for the provision of temporary lighting. Where necessary, battery-powered torches should be provided, with the equipment being checked periodically and the batteries being replaced as necessary.
- 9.3 All temporary installations, including those on construction sites, should be installed in accordance with the requirements of BS 7671 (ref. 2).
- 9.4 All temporary electrical work, including that on construction sites, should be carried out by a competent electrician.
- 9.5 All temporary lighting used externally should operate at extra low voltage and, unless specially designed for the purpose, should be sited away from water features and similar hazards.
- 9.6 Temporary lighting installations should be inspected regularly and be tested at intervals not greater than every three months (whether they have been used within this period or not). The results of the tests should be recorded.

- 9.7 All luminaires and catenary installations installed outside buildings should be planned so as to be safe from passing vehicles.
- 9.8 Similarly, any temporary installations planned within buildings should be well clear of hazards such as travelling cranes and other moving plant.

#### *Installation and maintenance*

- 9.9 Electrical supply installations, both temporary and permanent, must be installed in accordance with the latest edition of BS 7671 (ref. 2) and the Electricity at Work Regulations 1989 (ref. 8).
- 9.10 All electrical work should be undertaken by a competent electrician.
- 9.11 Temporary installations should be inspected and tested at intervals not greater than every three months. The results must be recorded in a register kept for the purpose.
- 9.12 Where possible, mains switches, other than those controlling security and automatic fire detection installations, should be turned off when work ceases.
- 9.13 All equipment should be unplugged when not in use.

#### **10. Action in the event of electrical fires**

Water should never be used to fight a fire involving electrical wiring or equipment because of the danger of electrocution. In all cases, attempts should be made to isolate the power supply before taking any action to extinguish the burning materials.

- 10.1 In the event of smoke or flames being seen coming from electrical equipment or cables, isolating the circuit by using the switch may serve to remove the source of heat and thus solve the problem.
- 10.2 Sustained fires involving electrical equipment are best fought with carbon dioxide or dry powder extinguishers. Where the burning materials are within an enclosed panel or lighting unit, carbon dioxide may be the most effective extinguishing agent since it is able to reach the seat of the fire more easily.
- 10.3 Only when the power supply has been isolated should any attempt be made to extinguish burning papers and similar materials to which the fire may have spread. Alternative extinguishers will then be necessary as carbon dioxide and dry powder do not have the required cooling effect. Their use may also serve to blow burning papers around and thus spread the flames.

- 10.4 When the power supply has been isolated, spray foam extinguishers should be used as these have been designed to give added operator safety if accidentally used on electrical equipment or circuits that remain live.
- 10.5 No attempt should be made to use portable fire extinguishers on high voltage equipment such as electrical transformers.

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