Recommendations

RC3
Part 5

for loss prevention in electronic equipment installations

Part 5: In-cabinet fire protection systems

FPA
Fire Protection Association

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LOSS PREVENTION RECOMMENDATIONS

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INTRODUCTION

One means for providing fire protection in electronic equipment installations is by the use of in-cabinet fire protection where the space within and around a specific cabinet, such as a computer cabinet, is monitored for the first signs of fire. When a fire is detected, procedures may be initiated for signalling for manual intervention, removing electrical power to the cabinet or triggering automatic suppression systems. These Recommendations aim to provide structured advice on the implementation of such equipment.

While it is the case that automatic in-cabinet detection/suppression systems may be able to provide a higher level of protection to sensitive equipment than could be achieved using a compartment based suppression system alone, this presupposes that the primary hazard arises from a fire within the cabinet rather than in the surrounding area. Consequently, an

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integrated fire protection plan should aim to provide an effective total protection package based on the needs of both the compartment and its contents. In-cabinet fire protection should be considered as just one part of this package. The level of protection chosen will depend on a risk assessment of the perceived hazards and the potential impact on business continuity of both material and consequential losses.

The information in this document is directed towards the protection of electronic equipment housed in cabinets. General recommendations for the protection of compartments containing electronic equipment are given in RC3: Recommendations for Loss Prevention in electronic equipment installations. Part 1: Fire Prevention (ref. 1). The limitation of free space in many cabinets containing electrical equipment necessitates care being taken with the selection of fire protection systems and also with respect to the degree of ventilation required for cooling purposes.

Any in-cabinet fire protection system selected for installation should be compatible with other automatic fire detection and extinguishing systems already present on the premises.

SCOPE

This document gives recommendations for the application of fire detection and control techniques designed specifically for use in and immediately around cabinets containing electrical and/or electronic equipment.

RECOMMENDATIONS

1 Definitions

1 *Cabinet.* An enclosed or semi-enclosed housing containing electrical and/or electronic equipment.

1.2 *Coincidence connection detection.* A detection method by which an output is obtained only when at least two independent detector alarm inputs are present at the same time. Thus, an output suitable for triggering a fire extinguishing system is obtained only after a detector has detected a fire, which is confirmed by at least one other independent detector covering the same protected space. The method is also known as 'double knock'.

1.3 *In-cabinet fire protection system.* A system of fire detectors linked to fire extinguishing equipment which is designed to a scale suitable for installation within a cabinet and capable of detecting and suppressing a fire within that cabinet.

2 Planning

2.1 The planning of in-cabinet fire protection systems should be conducted in consultation with all interested parties such as insurers, risk managers, fire brigades, equipment manufacturers and specifiers.

2.2 The suitability of in-cabinet fire protection systems for any particular application should be ascertained before any decision is taken to use them. In-cabinet fire protection may be considered suitable where smoke from cables, electronic components or motor windings is likely. In-cabinet fire protection systems with automatic suppression may be considered advantageous where equipment is expected to operate unattended for long periods.

The following should be considered:

(a) In some cases, the density of cabinets may make a room protection system, such as a total flooding gaseous extinguishing system, more feasible.

(b) The possibility that any air circulating systems incorporated in the cabinets will make localised protection difficult.

2.3 Within the protected area, in-cabinet fire protection should not be regarded as the sole means of protection. It is recommended that main space and void protection systems are also incorporated where appropriate. Where other protection methods are used they should comply with the appropriate standards.

2.4 The level of protection required for an installation should be commensurate with the perceived risks and possible consequences associated with a fire occurring. Guidance on using risk assessments to determine the criticality of electronic installations is given in BS 6266 (ref. 2) and summarised in RC3: Part 1 (ref. 1).

Testing and certification

In the United Kingdom, the United Kingdom Accreditation Service (UKAS) is responsible for assessing and accrediting the competence of various organisations, including test laboratories. A test laboratory which has achieved successful assessment by UKAS will receive a UKAS schedule of accreditation which specifies the tests for which it may issue certificates and/or test reports. Such a laboratory qualifies as a nationally accredited, independent, third-party certification body.

UKAS lists its services on its web sites. Those interested in identifying a test laboratory with a particular line of testing should visit www.ukas.org/testing. By pursuing the link to the directory search facility option it is possible to obtain listings of laboratories concerned with testing particular products in particular capacities. For example, by specifying 'Single test search' and the family 'Construction', the product 'Fire resistance and protection, reaction to fire' and the test 'Fire detection and alarm systems', and making appropriate choices of type of laboratory and your own post code, the result is a list of laboratories which can perform the test required.

2.5 All fire protection products, including in-cabinet fire detection and suppression systems, shall have been tested and certified by a nationally accredited, independent, third-party certification body (see the box 'Testing and certification').

2.6 The installation, servicing and maintenance of in-cabinet protection systems should be carried out by competent companies approved and certified by a nationally accredited, independent, third-party certification body (see the box 'Testing and certification').

3 Design considerations

3.1 Preferably, in-cabinet fire protection systems should be incorporated when the cabinet is designed and manufactured although they can be fitted retrospectively. The former should ensure that the fire protection system and the cabinet functions are compatible and allow optimisation of the fire detection and suppression techniques employed.

3.2 When in-cabinet fire protection is installed retrospectively, the following should be considered:

(a) Any possible invalidation of manufacturers' warranties covering the cabinet and its equipment.

(b) The effect of installing fire protection equipment on the normal operation of the cabinet and its equipment.

(c) The possibility of damage, for example, thermal shock, to circuitry etc. in the cabinet from the discharge of fire suppression gases.

(d) The possible generation of corrosive/ conductive products as a result of system discharge where the suppressant is a halocarbon or powder.

(e) The ability to modify the enclosure and inner parts of the cabinet.

(f) The location of power supplies.

(g) The location of forced air inlets, passages and outlets.

(h) Accessibility to the cabinet and its interior for isolation and maintenance.

(i) The mobility of cabinets and the possible need frequently to reconfigure the in-cabinet fire protection system. (Note: Flexible connections may not be in accordance with the appropriate fire protection installation standards.)

3.3 The manufacturer of the equipment should be consulted before modification of the cabinets to incorporate the protection systems.

3.4 Cabinets containing in-cabinet protection should be identified by appropriate labelling.

4 Fire detection

4.1 Detection principles

4.1.1 Detectors should be sensitive to combustion products likely to be generated within cabinets containing electrical and electronic components, for example, products given off from overheated resistors and cables. Therefore, smoke detectors should normally be used. Although the sensitivity should be such that incipient fire conditions are quickly detected and indicated, it should be ensured that false alarms resulting from the local environmental conditions are minimised.

4.1.2 Consideration should be given to the selection of appropriate fire detection equipment. In some instances, smoke detectors may not be suitable for the cabinet or the equipment installed in it and other fire detection methods such as an aspirating system or heat sensing may be more appropriate. In this case, sensitivity settings, rate of rise or fixed temperature operating points should be chosen so that when action is initiated it will be effective.

4.1.3 All heat and smoke detectors should comply with BS EN 54: Part 5 (ref. 3) and BS EN 54: Part 7 (ref.4), respectively, and where applicable should be approved and certified by an independent, third party certification body.

4.2 Positioning of detectors

4.2.1 Detectors should be sited close to the potential fire source without affecting their efficiency, or that of the equipment in the cabinet. The location of detectors should be based on a study of air movement and on the results of testing (see section 7.1).

4.2.2 Alternatively, detectors could be sited to monitor air outlet vents only. In this case, it should be ensured that dilution of the monitored airflow would not hinder the detection of a potential fire. Possible changes in the airflow should also be considered in conjunction with external air movement.

4.2.3 Where point type smoke detectors are installed in cabinets, at least one should be installed for every 2.5m^3 of internal cabinet volume. It should be ensured that they are not adversely affected by the airflows normally encountered or by the operating environments of the enclosure.

4.2.4 Where aspirating systems are used, it should be ensured that the number of sampling points per cabinet is adequate for the airflows and monitored circuitry.

4.2.5 A minimum of one detector or sampling pipe should be used per cabinet. If it is not possible to install a detector or sampling pipe inside a cabinet

it should be located as close as possible to the cabinet at a point making optimum use of return air flows. Where it is not practicable to mount detectors inside a cabinet they should be clamped to the outside.

4.3 Control and indication

4.3.1 Detectors should be capable of providing alarm and fault signals to control and indicating equipment in accordance with the recommendations of BS 5839: Part 1 (ref. 5) and BS EN 54: Part 2 (ref. 6). Recommendations specific to the electrical actuation of gaseous suppression systems are given in BS 7273: Part 1 (ref. 7).

4.3.2 Detection should be arranged so that each cabinet or specified group of cabinets is separately identifiable at the control and indicating equipment.

4.4 Power supplies

4.4.1 All power supplies for in-cabinet detection should meet the requirements of BS 5839: Part 1 (ref. 5) and BS EN 54: Part 4 (ref. 8).

5 Fire control

5.1 Power removal

5.1.1 An effective method of fire control is to remove electrical power from the protected equipment at the earliest instance. In-cabinet fire detection systems are particularly suitable for providing an early warning of fire conditions and for initiating the removal of power. However, it should be noted that it is not necessarily advantageous to initiate suppression systems at an early stage, see 6.3.2. The fire detection system should be capable of initiating power removal automatically but facilities should be provided for manual operation.

5.1.2 Instantaneous power removal may cause loss of data or physical damage to some protected equipment. In this case, a staged shut down may be required. The manufacturer of the protected equipment should be consulted.

5.1.3 Isolating switches for removing power to protected equipment should be labelled to identify the equipment they control. They should be strategically located to facilitate quick operation. A suitably worded warning notice should be provided to prevent accidental operation.

5.1.4 Power removal should be initiated before commencement of fire suppression (see section 5.2 and section 6).

5.2 Manual suppression

5.2.1 It is recommended that power removal be accompanied by measures to suppress and extinguish fires within the protected cabinets. This may be achieved:

(a) manually using portable fire extinguishers, and/or

(b) automatically, using fixed extinguishing equipment (see Appendix A)

5.2.2 Portable fire extinguishers appropriate to the risks (using either CO_2 or other clean agent) should be distributed so that the distance from any cabinet to the nearest extinguisher is no greater than 15m. In addition, portable fire extinguishers may be located in other strategic positions to ensure swift suppression of fires in any of the protected cabinets.

5.2.3 Such portable extinguishers should be approved and certified by an independent, third party certification body and be installed in accordance with BS 5306: Part 8 (ref. 9) and inspected and maintained in accordance with BS 5306: Part 3 (ref. 10).

5.3 Staff training

5.3.1 Staff should be given general training on fire safety matters, including instruction on the following:

(a) fire safety awareness

(b) mode of operation of in-cabinet systems

(c) the need to keep cabinets locked when access is not necessary

(d) good housekeeping in IT areas

(e) selection and use of portable fire extinguishers.

5.3.2 Staff should receive specific training on safe methods of extinguishing fires in cabinets.

6 Automatic suppression systems

6.1 General

6.1.1 In addition to the use of in-cabinet fire detection and power removal, consideration may also be given to suppressing fires in cabinets, after detection, by automatically injecting fire-extinguishing agents into and around the protected cabinet. As discussed in the Introduction, automatic in-cabinet fire suppression systems are relatively new compared with in-cabinet fire detection and there is less practical experience in the field. Their use should therefore be planned with caution especially regarding the consequences of a false activation. They should normally be restricted to instances where conventional fire suppression measures are considered inadequate and where equipment is intended to run unsupervised for long periods.

6.1.2 Where an in-cabinet suppression system is planned it is essential that factors that might affect extinguishing efficiency such as internal cabinet profile, position of equipment, air ducting and apertures are taken into account.

6.2 Choice of agent

6.2.1 The Montreal Protocol of 1987, to which the UK is a signatory, pledged the phasing out of all gases that have a potential to deplete the Earth's ozone layer. Two of these gases (Halon 1211 and Halon 1301) are very effective as firefighting agents and until relatively recently were used extensively in industry, particularly in electronic equipment installations. However, the sale and use of halon within Europe has been banned since December 2002 and all firefighting equipment containing halons should have been decommissioned by December 2003.

6.2.2 When selecting an alternative to halon, an assessment should be made of the impact of the chosen extinguishing medium on the environment. Checks should be made to ensure that the extinguishing medium is acceptable for use on environmental and legal grounds. There are a variety of alternatives that can be used in automatic suppression systems, including:

(a) carbon dioxide (CO_2)

(b) inert gases

(c) halocarbon gases

(d) fine water spray/water mist

(e) fine powders.

6.2.3 The most commonly employed fire suppression systems for protecting electronic equipment use gaseous extinguishing agents. BS ISO 14520 Parts 1-15 detail requirements for the design, installation and maintenance of halocarbon and inert gas systems, with additional guidance available in LPR 9 (ref. 13), LPR 10 (ref. 14) and LPR 16 (ref. 15). Carbon dioxide systems should comply with BS 5306: Part 4 (ref. 11). BS EN 12416: Part 2 deals with the design, construction and maintenance of fixed, powder systems (ref. 16). There is currently no UK standard for water mist systems.

6.2.4 Selection of the type of suppression system for in-cabinet protection should involve careful consideration of the possible effects, within and immediately surrounding the cabinet, that a discharge could have. The integrity and degree of ventilation of the cabinet should also be taken into account as these factors could influence the ability of the suppressant, both to put out a fire and to prevent subsequent re-ignition.

6.2.5 Care should be taken when considering the use of powder-based extinguishing systems. Although potentially effective at tackling certain fires when correctly installed, powder systems are not as invasive as a gas and the active agent can absorb moisture from the air to form a corrosive solution. There is currently no UK standard dealing with aerosol fire protection systems.

6.2.6 Suppression agents used for the protection of electronic equipment should:

(a) be non-corrosive and electrically non-conducting

(b) be appropriate for small localised applications

(c) be environmentally acceptable

(d) not produce significant amounts of toxic/corrosive by-products on contact with hot surfaces

6.2.7 The quantity of extinguishant injected in and/or around the cabinet should ensure sufficient concentration and should remain for an appropriate period of time to extinguish a potential fire and prevent re-ignition. When planning the system, account should be taken of the degree of ventilation in the cabinet; too much ventilation could dilute the agent below its extinguishing concentration whereas too little could result in the cabinet being damaged through overpressure.

6.2.8 Consideration should be given to gas released into the working environment during discharge that could be harmful to personnel. Where harmful concentrations of gas are expected, staff should be trained in immediate evacuation from the area of discharge. The installation should be set to operate manually when staff are present in the protected area.

6.3 Actuation

6.3.1 In-cabinet fire detection systems used to actuate automatic fire suppression should use the coincidence connection detection principle to reduce the likelihood of false alarms and unnecessary release of the extinguishant.

6.3.2 In-cabinet fire detection systems can provide an early warning of fire conditions but suppression systems should not necessarily be activated immediately since the extinguishant must be injected at the appropriate development stage of the fire for it to be effective.

6.3.3 Suppression systems should be actuated within 10 seconds of the actuation signal. Audible and visual indications should be provided as given in BS 7273: Part 1 (ref. 7).

6.3.4 There should be a means for manual actuation. The manual release device should be designated solely to the release of extinguishant for the in-cabinet fire protection system.

6.3.5 If multiple actuations are required, i.e. to initiate discharge simultaneously to a number of cabinets, then the maximum number of cabinets exposed to multiple actuation should be as agreed by the parties given in section 2.1.

6.4 Nozzles and pipework

6.4.1 All pipework should be fabricated from material offering structural integrity and resistance to temperatures likely to be encountered during extinguishant release (for example, galvanised steel). Where the electrical conduction properties of metals may adversely affect the operation of the cabinet, non-metallic substitutes should be considered.

6.4.2 All pipework should be permanently fixed and be prevented from movement caused by vibrations due to discharge. Flexible pipes should not normally be used.

6.4.3 Nozzles should be chosen and arranged to ensure an even spread of extinguishant throughout the enclosure. Nozzles should be positioned so that sensitive circuitry is not exposed to immediate vaporisation from the nozzle.

6.4.4 Nozzles should be fitted with filters if it is likely that the extinguishant discharge path is too convergent, with the associated possibility of damage to protected equipment. This may happen if the cross sectional diameter of the nozzle aperture is small.

6.5 Storage of extinguishant

6.5.1 Extinguishant supply containers should be located close to the protected cabinet. The containers should be permanently fixed in an area unlikely to be subject to mechanical or other form of damage and should be protected against malicious, accidental and environmental hazards and not exposed to combustible materials.

6.5.2 If cabinets are to be supplied with extinguishant from remote storage positions, then the pipework should be routed in an area of low exposure to mechanical damage or damage from adverse environments.

6.5.3 Storage containers should be monitored for leakage using appropriate indication devices such as pressure gauges.

6.6 Commissioning of suppression systems

6.6.1 All pipework should be checked for leakages and blockages by using compressed air. Any reduction in the airflow should be investigated and the appropriate remedial work carried out.

6.6.2 It is normally recommended that a discharge test be undertaken involving at least one of each type of protected cabinet. The concentration of extinguishant achieved should be determined and compared with the design parameters. In addition, the level of leakage should be assessed to determine any unforeseen leakage paths.

6.6.3 All extinguishant monitoring devices should be checked. Any faults should be immediately remedied.

6.6.4 When commissioning has been successfully completed, appropriate hand over arrangements should be undertaken as given in BS 5839: Part 1 (ref. 5), BS 5306: Part 4 (ref. 11) or the appropriate parts of BS ISO 14520 (ref. 12).

7 Installation

7.1 Installation procedures should be in accordance with the appropriate detection and suppression standards, including BS 5839: Part 1 (ref. 5), BS 5306: Part 4 (ref. 11) and the relevant parts of BS ISO 14520 (ref. 12).

7.2 Modifications to cabinets to facilitate the installation of fire protection systems should not be made unless deemed essential. Where modifications are necessary, they should be undertaken with the consent of the user and the cabinet manufacturer. It should be noted that modifications might invalidate warranties.

7.3 Any modifications made to a cabinet should not adversely affect the operation of the cabinet and the protection system. All holes made and subsequently not required should be sealed with materials of equivalent integrity.

7.4 It should be ensured that the process of installation does not adversely affect the cabinet or the contained circuitry. Possible damage due to electrostatic discharge and electromagnetic radiation should be considered.

7.5 Welding of pipes and other forms of hot work should be prohibited in clean rooms.

7.6 All metal pipework and supply containers should be adequately bonded and earthed.

8 Commissioning

8.1 Detection

8.1.1 The detection system should be tested by simulating a fire condition. If the system is designed to detect early products of combustion, for example, from overheated cables or electronic components, then the high sensitivity tests described in clause 5.3 of RC3: Part 1 (ref. 1), should be used.

8.1.2 The test source should be placed as near as possible to the likely sources of fire. The cabinet manufacturer should be consulted to ensure that the test would not cause any damage.

8.1.3 The detection system should give an appropriate response to the test within one minute from the commencement of the test with any forced ventilation turned both on and off.

8.2 Power removal

8.2.1 All arrangements to initiate power removal should be tested. This should include both manual and automatic operations.

9 Use

9.1 Use of the protection system should be in accordance with the recommendations of applicable standards and in accordance with the requirements of the manufacturer.

9.2 It should be ensured that all operators and maintenance contractors working with the protected cabinets are aware of the protection system and its operation.

9.3 A suitably experienced and competent person should conduct periodic visual inspections of the pipework, extinguishant container and indicators for signs of leakage. Details of the inspection and any findings should be recorded.

9.4 Any faults or abnormal conditions noted should be recorded and rectified at the earliest possible instance. Likewise, all false and unwanted actuations of the system should be recorded for periodic analysis, as required by BS 5839: Part 1 (ref. 5).

10 Servicing

10.1 A full servicing contract should be implemented for all parts of the protection system. This contract should identify the items to be serviced and the required frequency of service for each item.

10.2 The servicing schedules should comply with the recommendations of appropriate standards and with manufacturers' recommendations.

10.3 Any faults or abnormal conditions noted during servicing inspections should be reported, logged and rectified at the earliest possible instance.

10.4 Suitable records should be kept of servicing and maintenance of the installation.

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