



# Fire Prevention Requirements for ICT rooms

## Best Practice Document

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## Executive Summary

This document provides specification of the Norwegian HE sector's recommended fire protection requirements for ICT rooms.

In general, all requirements stipulated by the authorities in relation to fire detection and extinguishing must be met.

Each institution must prepare written response procedures/instructions for its own ICT personnel in the event of fire. These will focus on loss reduction measures. The procedures and instructions shall also apply to fire prevention measures.

All ICT rooms must be equipped with smoke detectors. Essential ICT rooms (e.g., those utilised for data processing/storage, core switch/routers and redundancy functions) must be equipped with an early detection facility based on high-sensitivity aspiration detectors. Less essential ICT rooms (e.g., telecommunications rooms) must be equipped with high-sensitivity point smoke detectors. Other ICT rooms must be equipped with point smoke detectors similar to those employed in the remainder of the building.

In general, a fire alarm system based on early detection, employed in combination with procedures/instructions, will greatly reduce the risk of fire. If an overall assessment of the importance of an ICT room, together with the procedures/instructions, indicates that a fire extinguishing system ought to be installed, this document recommends the use of hypoxic air venting.

# Introduction

This document provides specification of the Norwegian HE sector's recommended fire protection requirements for ICT rooms, and is version 2 of the document (dated 2 July 2008). A revision log will be found in Chapter 9.

The target group comprises IT managers and IT operations personnel in the HE sector. The aim of this document is to raise personnel awareness concerning the fire protection issue, and to enhance the quality of fire protection measures within the sector. Furthermore, it is intended that the recommendations in this document will form the basis of expansion, renovation and new building projects, and that they will be applied in everyday work contexts.

# 1 Overall requirements

Systems and procedures for fire detection, alarms and extinguishing must comply with all requirements and directives stipulated by local and/or national fire authorities and, if relevant, insurance companies.

All institutions must prepare written fire protection regulations which, in addition to including personnel safety and loss reduction measures, shall also incorporate measures aimed at mitigating damage to computer equipment and data loss.

Measures such as backup systems, mirror servers etc., are effective in mitigating consequential damage and reducing vulnerability in the event of fire.

Good fire hygiene procedures such as cleaning, tidiness, the replacement of filters, the removal of packaging, the disconnection and removal of equipment that is not in use, etc., all represent important fire prevention measures. ICT rooms must not be used as storage rooms. Moreover, adjacent rooms should not be used for the storage of inflammable material unless they are fitted with an automatic extinguishing system. Evacuation routes must be unobstructed.

## 2 Fire detection

All ICT rooms must be equipped with smoke detectors connected to automatically addressable fire alarm systems to enable the registration of smoke generation/fire and alarm activation.

Fire alarm activation shall occur at two levels:

1. A local alarm to enable the implementation of measures described in local fire protection regulations (e.g., the notification of the institution's own fire contingency procedures, personnel evacuation and the implementation of damage limitation measures such as local fire extinguishing, computer equipment shutdown, etc.). Local alarm systems fall into two categories, i.e.;
  - a. Early alarm systems (see the chapter dealing with early detection)
  - b. Local fire alarms.
2. Emergency notification of external, e.g., municipal, fire fighting services.

The National Fire Protection Association (NFPA) Standard 72 Annex B Edition 2010 is recommended as a tool to aid selection of detector types for use in the various rooms.

### 2.1 Early detection

The "early detection" principle is based on the earliest possible notification of the outbreak of a fire so that personnel are given sufficient time to intervene before the outbreak develops into a major fire resulting in material loss.

Early detection imposes certain requirements on the selection of fire detector systems and it is essential that the detectors used in such systems are more sensitive than standard optical/ionisation point smoke detectors. The sensitivity of the detectors is expressed as the percentage visibility reduction (per metre). The following nominal sensitivities are most commonly used:

1. Standard point detector: 1 - 5% visibility reduction (per metre)
2. High-sensitivity point detector: approx. 1% visibility reduction (per metre)
3. Aspirating detector: 0.005 - 20% visibility reduction (per metre)

If smoke is emitted from an electrical component in an ICT room with effective air circulation, the smoke particles will be dispersed rapidly within the total volume of the room to the extent that a standard point detector will only respond after the initial outbreak has developed into a major fire.

Aspirating detectors for use in ICT rooms are based on the use of sensitive detectors (commonly laser detectors) employing a tubing system with suction apertures. The tubing system is distributed around the room to be protected/monitored. A fan is used to draw air into the detection unit from the area which is being monitored. The detection unit is then activated when the smoke concentration exceeds a given value, commonly set by the user. The location of the suction apertures will be determined on the basis of the design and furnishing of the room. It is often appropriate to install the tubing in front of the air inlet of the room cooler units (see Figure 1).

Aspirating detectors are particularly well suited for the early detection of smoke generation from serial arcs, overheating or the generation of fumes in electrical equipment. They are virtually standard equipment in essential ICT rooms. This report recommends the following for the HE sector:

1. Aspirating detector: ICT rooms used for data processing/storage, housing core switches/routers and essential redundancy functions, i.e., server rooms, rooms used for taking backups, and the equipment room (ER)
2. Highly sensitive point detectors in less essential ICT rooms such as telecommunications rooms (TR)
3. Standard point detectors in offices, storage rooms, etc.

Signals from an aspiration detector can be classified at different levels:

1. "Early warning": Alerts local ICT personnel who then intervene and prevent a fire outbreak from developing
2. "Fire alarm": Fire is established and the fire alarm panel then alerts the internal/external fire services
3. Activation of automatic fire extinguishers or other devices that require a reliable detection device, such as the disconnection of power to computer equipment, the control of fire doors, smoke ventilation, ventilation systems, etc.

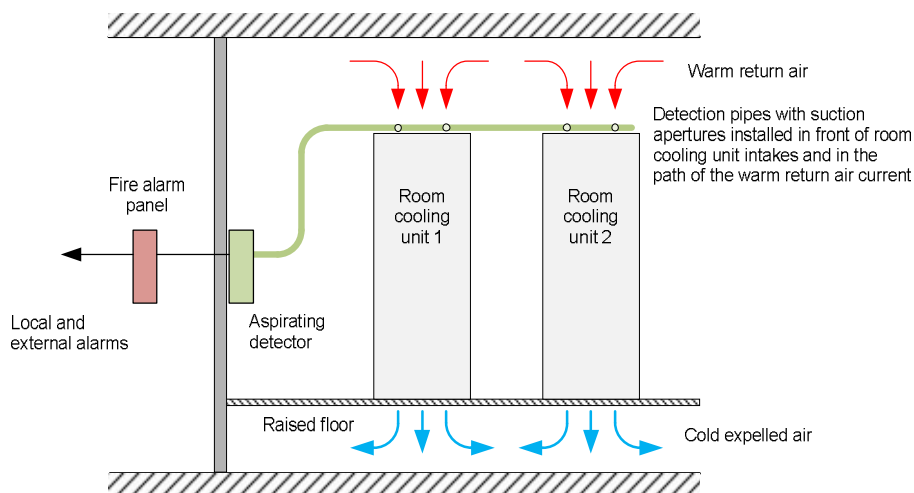


Figure 1. Early detection based on the use of an aspiration detector



The aim of early detection is to provide personnel with the opportunity in the event of fire to intervene as soon as possible so that smoke damage or damage resulting from automatic disconnection of power or the activation of the fire extinguishing system can be avoided. In general, early detection systems, which involve the intervention of personnel after having received an “early warning”, are considered to be adequate for the prevention of the majority of fire outbreaks.

### 3 Occupiable hypoxic air to prevent fire ignition

Continuous hypoxic air, i.e., air with a reduced oxygen concentration, is used to prevent fire ignition. An interior climate with hypoxic air prevents materials from catching fire and inhibits sustained flames. The oxygen concentration in hypoxic air permits normal healthy personnel to occupy and work in the room for periods of several hours. A hypoxic air venting system must be adapted and designed in combination with the ICT room's air handling system (cf. UFS 108 "Ventilation and Cooling Requirements for ICT Rooms").

Fire suppression by means of hypoxic air does not constitute "fire extinguishing" as such, but is dealt with in Chapter 4 (Fire extinguishing) so that all methods can be considered together.

Working and remaining in hypoxic air can have physiological effects and in certain cases health impacts. A so-called "threshold value" has been defined at a minimum of 17% oxygen concentration (equivalent to air at 1,500 metres above sea level), at which the human body does not display any ill effects. Hypoxic air systems used in ICT rooms normally have an oxygen concentration of approximately 15%. This corresponds to an altitude of 2,700 metres ASL, and is approximately the same concentration as in the cabin of an airliner. The risk to healthy persons remaining in such an environment for several hours is considered minimal. This also corresponds to the recommended time for occupying hypoxic environments as defined by the International Mountaineering and Climbing Federation (UIAA), the European Industrial Gases Association (EIGA), the German Federal Institute for Occupational Safety and Health (BAuA), the British Standards Institution (BSI) and the Swiss National Accident Insurance Fund (SUVA). In the case of healthy subjects, remaining for up to 8 hours in an environment with an oxygen concentration further reduced to 13% (corresponding to an altitude of 3,800 metres ASL) will entail minimal risk. A temporary increase in pulse rate and breathing frequency may be experienced, but any discomfort will gradually decrease after leaving the room. People with cardiopulmonary conditions are recommended to undergo a medical examination before working in rooms with oxygen concentration approaching 13%.

Hypoxic air systems for preventing fire are a comparatively recent development and those responsible for planning and supplying them must be thoroughly familiar with the technology. *BSI PAS 95* is recommended as the standard for the design and supply of systems. A CEN standard is under development. The standard requires an analysis of health risk. Independent inspection can be carried out by an approved design, installation and health and safety inspection body.

## 4 Fire extinguishing

Designs produced on the basis of prescriptive or performance-based codes commonly stipulate the installation of full sprinkler systems. In order to avoid having to install sprinklers in ICT rooms, it is necessary to adhere to a set of conditions stipulated in the regulations governing sprinkler systems. This is easiest to achieve when the ICT room in question is designated as a fire cell. In such cases it will be possible to protect the room in question according to the recommendations in this document without having to install a sprinkler system.

### 4.1 Fire prevention or extinguishing systems

In general, fire extinguishing systems are based on the removal of at least one of the factors necessary for the development of a fire, i.e., heat, flammable materials, oxygen and chemical reactions.

When selecting an extinguishing system, particular focus must be directed to the following:

1. Good extinguishing properties (causing the minimum overall damage)
2. Facilitation of uninterrupted communications and computer operation
3. Non-toxicity
4. Avoiding environmental damage/damage to the ozone layer
5. Minimal consequential damage (water damage, corrosion, pressure blast damage on activation, etc.).

Table 1 provides a list of fire prevention and extinguishing systems available for use in ICT rooms.

<b>Continuous hypoxic air</b>	
Function	Prevents ignition 24 hours a day.
Benefits	Prevents oxidative combustion. Based on pure air. Personnel access permitted for many hours, depending on oxygen level Straightforward

application: no detection and activation, no external re-filling of extinguishing agent.

Challenges Rooms must be airtight to a similar level as that for gas extinguishing systems, preferably more so. Employees who cannot travel in aircraft must be in possession of a medical certificate before they can enter.

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### Inert gases

Function: Arrest combustion.

Benefits: Extinguish flames efficiently. Common. Standard for system design. Present no environmental threat.

Challenges: Rooms must be sufficiently airtight. Evacuation must take place 2-5 minutes after activation, depending on oxygen level. Fire-fighting personnel must wear smoke diving equipment. Re-ignition possible when gas leaks out.

### Halocarbon gases

Function: Arrest combustion.

Benefits: Extinguish flames rapidly and efficiently. Standard for project design.

Challenges: Toxic and corrosive gases are generated in the event of fire. Environmental issues. Cost. Availability. Rooms must be sufficiently airtight. Evacuation must take place 2-5 minutes after activation, depending on oxygen level. Fire-fighting personnel must wear smoke diving equipment. Re-ignition possible when gas leaks out.

### Novac 1230 (*hydrocarbon gas, liquid at room temperature but evaporates from nozzles*)

Function: Arrests combustion.

Benefits: Extinguishes flames rapidly and efficiently. Is in liquid form and is not transported under pressure.

Challenges: Contains fluorine. Environmentally somewhat better than, but very similar to, halocarbon gases. Expensive. Evacuation must take place 2-5 minutes after activation, depending on oxygen level. Re-ignition possible when gas leaks out.

### Aerosol generator system

Function: Arrests combustion.

Benefits: Cost. Space. Weight. Straightforward/potentially reliable. Low toxicity/low corrosive properties. Environmentally friendly. No pipe system. Quick installation. Fills the room rapidly.

Challenges: Particulate residue must be extracted/swept away/removed by venting. Visibility. Suppliers (there are many poor products on the market). Most types are designed for room volumes <50 m<sup>3</sup>. Design is critical in relation to multiple generator activations and high ceilings, if relevant. Rooms must be evacuated prior to release.

### Venting, inert gas, water mist (*HI-FOG - a single product, many suppliers*)

Function: Removes smoke, permits uninterrupted operations/ability to remain in

room/room cooling, cools the source of smoke, suppresses fire.

**Benefits:** See Function. Is distinct from all gas and hypoxic air technologies in that heat build-up in cables and other materials is reduced, thus preventing re-ignition. Moreover, toxic smoke is driven from cabinets and conducted away for scrubbing. A small amount of nitrogen contributes to the extinguishing process and prevents re-ignition following activation.

**Challenges:** Involves complex installation layouts in ICT rooms. Unfounded scepticism against the use of water on the part of IT and electrical engineers.

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### Early smoke detection and voltage disconnection

**Function:** Early smoke detection: Detects smoke generated by both non-oxidative and oxidative (fire) sources and serves to alert fire service personnel. Power disconnection: Stops smoke generation in the event of voltage disconnection, inhibits combustion and extinguishes electric arcs.

**Benefits:** Incipient fires are arrested before they develop into major fires. Operational shutdown is avoided. Such endothermic fires are put out without the use of an extinguishing system. The majority of fires start with non-oxidative smoke generation. Early smoke detection and power disconnection are proven to be effective.

**Challenges:** Early smoke detection systems are often installed incorrectly or using unsuitable detectors. Calculations should be performed to determine the correct type of detector and sensitivity settings. Power disconnection must be incorporated into the design phase from the start.

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*Table 1. Fire prevention and extinguishing systems available for use in ICT rooms.*

## 4.2 Fire prevention or extinguishing?

Both fire-suppressant room atmospheres (hypoxic air) and various forms of fire-suppressant gases are suitable for use in ICT rooms:

1. Hypoxic air to prevent fires from breaking out
2. Inert gases to displace oxygen
3. Suppressant gases, which intervene in the chemical combustion process.

Hypoxic air is normal air with a little oxygen removed. As a result, the increased proportion of nitrogen prevents the combustion process from obtaining access to oxygen molecules. Hypoxic air venting is utilised on a continuous basis to prevent ignition (*fire prevention*) while at the same time enabling operations personnel to remain in the room in question for long periods without breathing apparatus. Hypoxic air in ICT rooms typically contains 15% oxygen, which is sufficient to prevent the outbreak of fire. In general, normal, healthy people can remain in a room containing air with an

oxygen concentration of 15%. There is a small minority of people who are unable to remain in a room containing 15% oxygen. Such people are unable to travel on standard passenger aircraft.

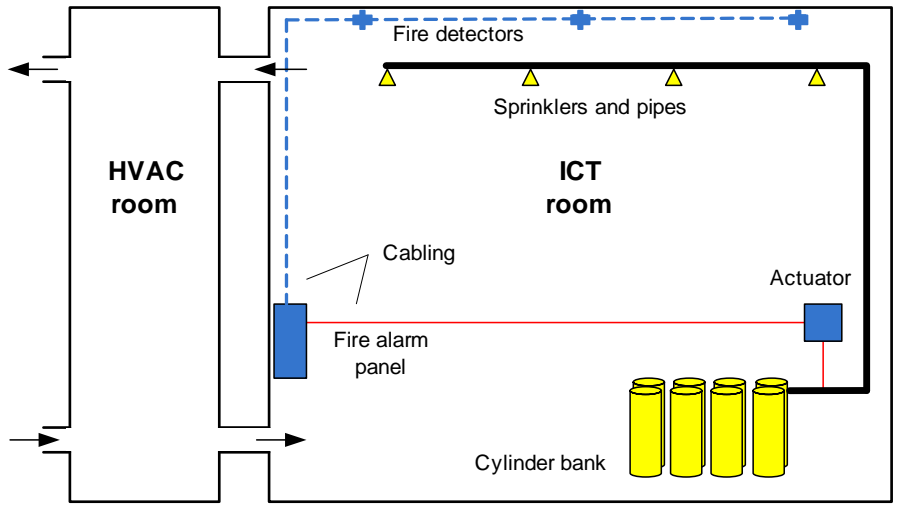


Figure 2. Principle of a system for supplying gases to suppress fire

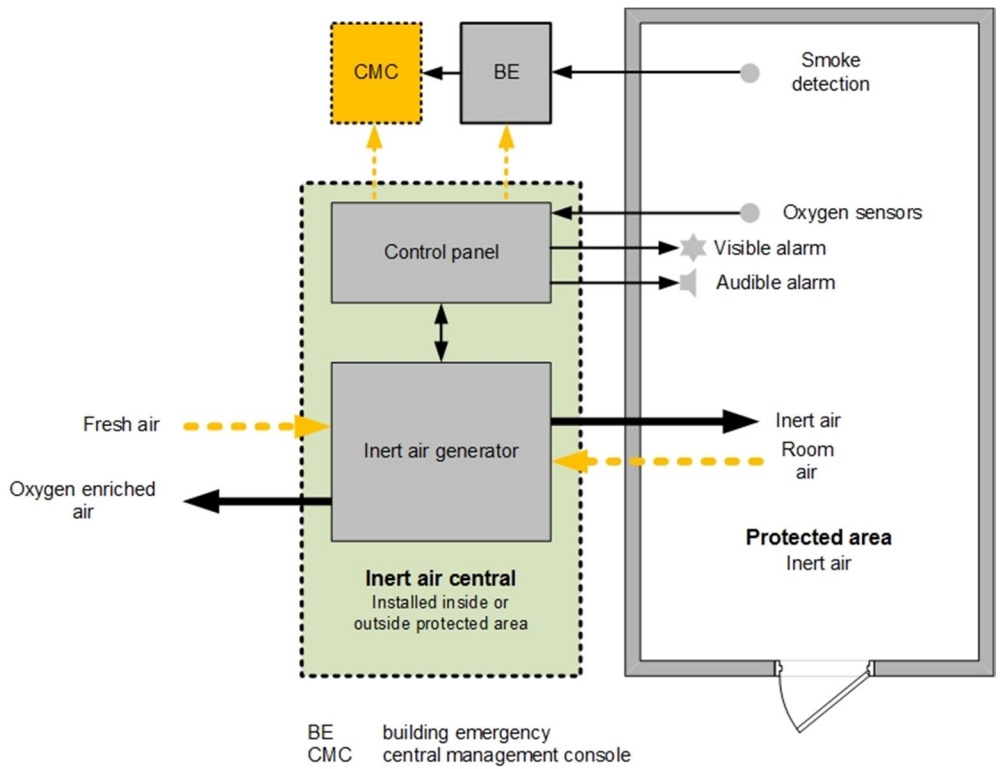


Figure 3. Principle of a system for preventing fire using hypoxic air

Suitable inert gases for fire-extinguishing:

1. Nitrogen (N<sub>2</sub>)
2. Mixtures of carbon dioxide (CO<sub>2</sub>), Argon (Ar) and Nitrogen (N<sub>2</sub>). (Inergen CO<sub>2</sub>+Ar+N<sub>2</sub>, Argonite Ar+N<sub>2</sub>)
3. Water mist absorbs heat during a fire and is converted into steam, which is inert.

Gases which extinguish fire by intervening in combustion reactions:

4. Hydrocarbon gases (*not very suitable in land-based ICT rooms owing to environmental, toxicity and corrosive risks*).

Of the fire-suppressive extinguishing gases, halon was once commonly used for extinguishing fires in ICT rooms. Due to environmental concerns, the use of halon has been prohibited since 1 January 2000. Replacements for halon are available on the market, such as the extinguishing gas Novec 1230, manufactured by 3M. Fire-suppressive gases of varying compositions are supplied by a variety of manufacturers. It is essential to ensure that the gas used is not harmful to personnel in the period before evacuation is required, i.e., a maximum of 2-5 minutes. It is also important that the gases used do not contribute in any major way either to global warming or the destruction of the ozone layer, and that they decompose rapidly in the atmosphere.

When selecting an extinguishing agent it is important to be aware of the properties and applications of the various gases. For example, inert gases such as carbon dioxide, nitrogen, argon and steam extinguish fires by reducing the oxygen concentration in air to between 10 and 12%. However, these gases provide little cooling effect at the scene of the fire, and this may cause it to re-ignite if oxygen becomes available. The gases also require airtight rooms.

Note: The conventionally stipulated lowest recommended oxygen concentration for humans not wearing protective equipment is 19.5% by volume. The rationale for this limit no longer exists, but such an oxygen concentration is still regarded as a signal indicating that something is wrong with the breathing air (the presence of CO<sub>2</sub> or other gases). Normally, the cabin air in civil passenger aircraft has a partial pressure equivalent to an oxygen concentration of 15% at a pressure of 1 atmosphere. When using toxic or suffocating extinguishing gases such as CO<sub>2</sub> or N<sub>2</sub>, the safety of personnel must be thoroughly evaluated. On the other hand, hypoxic air is safe, having a concentration of 15% oxygen.

Water mist can be used as an alternative to the aforementioned gases. In traditional water-based sprinkler systems, the water droplets are so large that only a small proportion of the water is converted into the steam which is required to displace the oxygen. In many cases, the water supply is uncontrolled and can result in major water damage. Water mist systems utilise a controlled water volume, together with a propellant gas such as nitrogen. The water and propellant gas mixture, combined with specially designed sprinkler nozzles, serve to atomise the water. Atomisation promotes a large droplet surface area and rapid vaporisation in the event of major fires (combined with displacement of oxygen). Water mist systems are not harmful to humans, and promote a satisfactory cooling effect at the fire source.

Be aware that the majority of extinguisher systems, especially those using hypoxic air, require sealed rooms. This requirement may be in conflict with energy-saving requirements when using "free cooling" systems, which use virtually untreated ambient air to cool equipment in active use, cf. UFS 108 "Ventilation and cooling requirements for ICT Rooms". In this context we recommend that free cooling is achieved using a heat exchanger, i.e. that the ICT equipment is not in contact with exterior air, but only with re-circulated (hypoxic) air in a closed system.

## 5 Course of events in an ICT room

### 5.1 Course of events when using early detection and a fire extinguishing system

An ICT room contains many different plastic products (such as the PVC in cables), which in the event of fire generate highly corrosive hydrogen chloride gas (HCl). If the concentration of hydrogen chloride on the surface of a printed circuit card exceeds  $10 \mu\text{g}/\text{cm}^2$ , it will commonly require cleaning. The activation of a gas extinguishing system will often result in the effective dispersal of smoke (hydrogen chloride, soot and dust) throughout the room and to all equipment components. When fire-suppressant gases decompose during the fire extinguishing process, highly toxic and corrosive gases may be released.

Two possible courses of events are envisaged in the event of a fire in an ICT room equipped with both early detection and extinguishing systems:

1. The aspirating detector detects smoke emission in the ICT room and sends an early warning to IT personnel via the ICT management system (NAV, GSM, etc.). Local contingency resources, comprising fire officers and IT personnel, will be mobilised in compliance with the institution's fire regulations, and will identify the source and take action. Smoke generation is stopped and the fire alarm panel is reset to its normal status.
2. The fire outbreak is not stopped and a fire develops. An aspiration detector detects smoke levels that exceed the early warning threshold and activates the fire alarm. The fire alarm panel activates:
  - a. Internal and external alarms
  - b. The closing of all fire doors
  - c. The shutdown of the ventilation system in the ICT room
  - d. The gas extinguishing system
  - e. Power disconnection to the ICT room, as appropriate (main fuse in the fuse cabinet).

Automatic power disconnection may involve a risk of interruption to operations and data loss. Moreover, the equipment employed for power disconnection (contactors) will in itself represent an unstable power supply source.

It may be desirable to transfer information from the fire alarm panels to the BMS, mainly to enable the receipt and storage of information/statistics, and hand over control to the fire alarm panel during the different phases of the fire outbreak/fire. In order to maximise safety, the fire alarm panel will in the



majority of cases be linked directly to those systems that require control. Such systems will thus not be controlled via the BMS.

## **5.2 Course of events when using hypoxic air (*to prevent the occurrence of fire*)**

Hypoxic air will be present and will remain in the room in order to prevent oxidative fires. For this reason there is no need for a detection system to activate an alarm, or for actuators (programmable control units) to activate the extinguishing system, and often no piping and nozzles are needed.

As is the case for all gas extinguisher and inertisation systems, it is possible that smoke may be generated by electric arcs, overheated insulation materials and such like. Early detection is therefore essential. A situation involving smoke emission must thus be dealt with in the same way as described for phase 1 in Section 5.1.

## 6 HE sector system strategy for fire prevention and suppression systems: Assessment of need and type of system

In ICT rooms where a fire may have major consequences for equipment, communications, data storage, operations, etc., an assessment should be made as to whether there is a need for a hypoxic air venting or an extinguishing system (early detection must always be incorporated).

Hypoxic air venting is by far the best method of which we are currently aware. In practice, the use of hypoxic air entails no direct fire damage and no secondary damage such as corrosion, environmental harm or toxicity as a result of the extinguishing process. If the room is not adequately sealed, running costs may be higher than those for an inert gas extinguishing system. However, the use of an extinguishing system also requires taking into account factors such as false alarms, the maintenance of a detector-activated activation system, re-filling costs, damage caused by the initial fire outbreak, further damage incurred while personnel are required to wait outside the room for the smoke divers, together with the administration and maintenance of pressure relief dampers. A second option involves a dual-level water mist system incorporating smoke scrubbing. This is the only system which can effectively cool down the scene of the fire sufficiently to prevent re-ignition. Such a system can replace air cooling units for a period if these are accidentally rendered inoperative. This is very reliable because the second level, involving high pressure water mist, also permits uninterrupted operations, and can be activated as required.

Under normal circumstances the real options can be ranked as follows:

1. Hypoxic air venting to prevent ignition
2. Dual-level water mist system to remove smoke and extinguish fire.
  - a. Extinguishes fire and scrubs smoke of particles using nitrogen and water
  - b. Extinguishes using high pressure water mist
3. Inert gas as an extinguishing agent.

Option 1 is the most straightforward and provides the optimum protection. It is relatively expensive in small ICT rooms but is better in multiple small rooms which can be supplied from a central system, and is best in large ICT rooms. Option 2 is less expensive and provides satisfactory protection in terms of operational interruption. Option 3 is the least expensive, but has lower loss reduction ability. It is less reliable and exhibits many disadvantages compared to Option 1. Based on the foregoing,

hypoxic air venting systems are recommended for the prevention of fires in essential ICT rooms and those of greater volume than 1,000 m<sup>3</sup>.

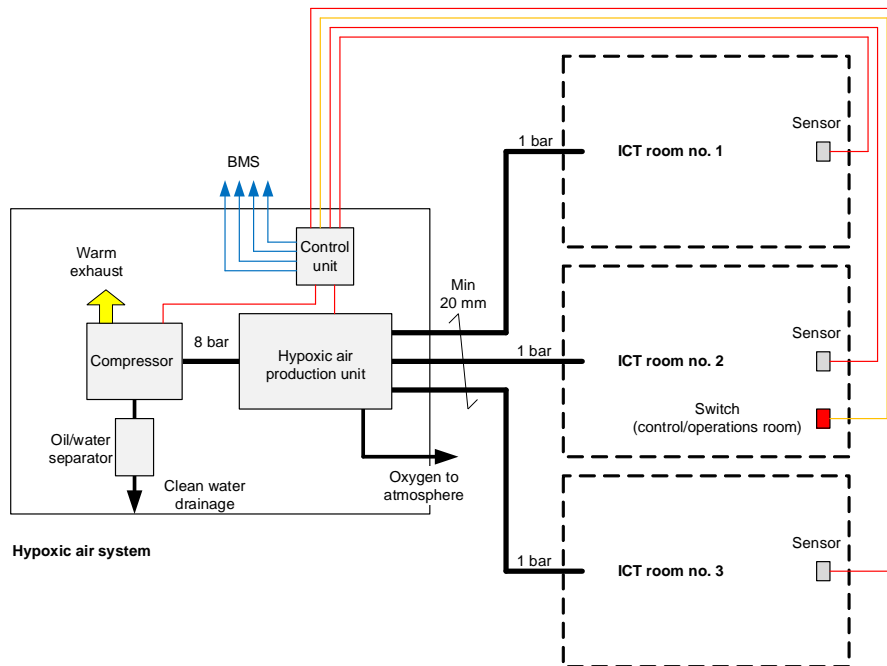


Figure 4. Hypoxic air venting system for multiple ICT rooms

## 7 Conclusions

1. All requirements stipulated by the authorities (including those specified by insurance companies) must be complied with.
2. All institutions must be equipped with a central fire alarm control system able to detect fires, activate internal and external fire alarms, and implement automatic control over technical systems such as HVAC, doors, etc.
3. All institutions must have written procedures and instructions in place describing how IT personnel should conduct themselves in the event of fire. Such procedures/instructions must focus on loss reduction. It is vital that such instructions/procedures apply 24 hours a day/365 days a year. Furthermore, such instructions must describe procedures for the testing of fire detection and extinguishing systems.
4. All ICT rooms must be equipped with smoke detectors.
5. All essential ICT rooms must be equipped with early detection systems (aspirating detectors), and less essential ICT rooms with high-sensitivity point detectors and fire extinguishing equipment in the form of manual CO<sub>2</sub> or water mist devices.
6. If necessary, following an assessment, essential ICT rooms should be equipped with hypoxic air venting systems.

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# Revisions

This version includes the following amendments to the version dated 22 December 2009.

1. General revision of text and illustrations.
2. Text dealing with fire extinguishing using continuous hypoxic air has been revised to take into account technological development and standardisation. Special attention is drawn to Chapter 3.

## Glossary

Actuators	Mechanisms that control a machine's operation and enable it to perform a given function.
Argonite	Brand name of a fire-suppressant gas (50% Ar and 50% N <sub>2</sub> ).
GSM	Global System for Mobile Communications. The ETSI standard for mobile communications.
Halon	Hydrocarbon gas with atmosphere degrading components. Not permitted in fire-fighting systems.
Inergen	Brand name of a fire-suppressant gas (a mixture of argon, nitrogen and carbon dioxide).
Inert gases	Nitrogen, argon, etc., which reduce the oxygen concentration of the air and thereby extinguish fire, or which render rooms inert to prevent the outbreak of fire.
Hypoxic air	Interior climate with reduced oxygen concentration, inhibiting ignition of materials by preventing combustion reactions. Can be occupied without the use of breathing equipment.
Suppressant gases	Gases which arrest the progression of a chemical reaction. In this context, hydrocarbon gases which prevent combustion.
Contactors	Controllable electrical/magnetic switches
NAV	Network Administration Visualized, an ICT management system developed by the HE sector under the direction of UNINETT
NFPA	National Fire Protection Association
BMS	Building Management System. A system designed to control and monitor a building's technical infrastructure (e.g., electrical, water, heating, sanitation systems, etc.)
The HE sector	The Norwegian higher education sector
Actuators	Mechanisms that control a machine's operation and enable it to perform a given function.
Argonite	Brand name of a fire-suppressant gas (50% Ar and 50% N <sub>2</sub> ).
GSM	Global System for Mobile Communications. The ETSI standard for mobile communications.
Halon	Hydrocarbon gas with atmosphere degrading components. Not permitted in fire-fighting systems.
Inergen	Brand name of a fire-suppressant gas (a mixture of argon, nitrogen



and carbon dioxide).

Inert gases	Nitrogen, argon, etc., which reduce the oxygen concentration of the air and thereby extinguish fire, or which render rooms inert to prevent the outbreak of fire.
Hypoxic air	Interior climate with reduced oxygen concentration, inhibiting ignition of materials by preventing combustion reactions. Can be occupied without the use of breathing equipment.
Suppressant gases	Gases which arrest the progression of a chemical reaction. In this context, hydrocarbon gases which prevent combustion.
Contactors	Controllable electrical/magnetic switches
NAV	Network Administration Visualized, an ICT management system developed by the HE sector under the direction of UNINETT
NFPA	National Fire Protection Association
BMS	Building Management System. A system designed to control and monitor a building's technical infrastructure (e.g., electrical, water, heating, sanitation systems, etc.)
The HE sector	The Norwegian higher education sector
Actuators	Mechanisms that control a machine's operation and enable it to perform a given function.
Argonite	Brand name of a fire-suppressant gas (50% Ar and 50% N <sub>2</sub> ).
GSM	Global System for Mobile Communications. The ETSI standard for mobile communications.

