



DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

OCT 24 2001

FROM: AFCESA/CES
139 Barnes Drive, Suite 1
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SUBJECT: **Engineering Technical Letter (ETL) 01-18: Fire Protection Engineering Criteria – Electronic Equipment Installations**

1. Purpose. This ETL establishes criteria for protecting electronic equipment from smoke and fire. This ETL supersedes ETL 93-5, 22 December 1993.

2. Application. Requirements of this ETL are mandatory for all commands with electronic equipment installations. It applies to new construction, renovation, modernization, and rehabilitation. It applies to those facilities housing training systems when required by Air Force Occupational Safety and Health (AFOSH) Standard 91-118, *Training Systems Fire Protection*. It applies to all Air Force installations both inside and outside the United States of America, its territories, and its possessions.

Note: Use of “will” or “must” indicates a mandatory requirement. “May” or “should” indicates a non-mandatory action or condition.

2.1. Authority: Air Force Instruction (AFI) 32-1023, *Design and Construction Standards and Execution of Facility Construction Projects*.

2.2. Effective Date: Immediately.

2.3. Ultimate Recipients:

- Major command (MAJCOM) and base civil engineers (BCE)
- Design and construction agents

2.4. Waivers. Waivers to requirements of this ETL require approval as specified in MIL-HDBK-1008, *Fire Protection for Facilities Engineering, Design, and Construction*.

2.5. Coordination:

- MAJCOMs
- Air Force Communications Agency/Civil Engineer (HQ AFCA/CCQM)
- Air Intelligence Agency/Civil Engineer (HQ AIA/XRC)

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3. Referenced Publications:

3.1. Air Force:

- Air Force Instruction (AFI) 32-1023, *Design and Construction Standards and Execution of Facility Construction Projects*
- Air Force Occupational Safety and Health (AFOSH) Standard 91-118, *Training Systems Fire Protection*
- Secretary of the Air Force (SAF) Action Memorandum, *Air Force Ban on Purchases of Ozone Depleting Chemicals*, 7 January 1993
- *Air Traffic Control Tower Design Guide* published by the Design Group Division at Headquarters, Air Force Center for Environmental Excellence (HQ AFCEE/DCD)

3.2. Department of Defense (DoD):

- MIL-HDBK-1008, *Fire Protection for Facilities Engineering, Design, and Construction*
- Department of Defense Instruction (DoDI) 6055.6, *Department of Defense Fire Protection Program*

3.3. National Fire Protection Association (NFPA):

- NFPA 13, *Standard for the Installation of Sprinkler Systems*
- NFPA 70, *National Electrical Code*
- NFPA 72, *National Fire Alarm Code*
- NFPA 75, *Standard for the Protection of Electronic Computer/Data Processing Equipment*
- NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*
- NFPA 101, *Life Safety Code*
- NFPA 750, *Standard on Water Mist Fire Protection Systems*
- NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*

4. Acronyms and Terms:

ETL	- Engineering Technical Letter
AFOSH	- Air Force Occupational Safety and Health
AFI	- Air Force Instruction
MAJCOM	- major command
BCE	- base civil engineer
DoD	- Department of Defense
DoDI	- Department of Defense Instruction
NFPA	- National Fire Protection Association
PC	- personal computer
LAN	- local area network
CD	- compact disc
SAF	- Secretary of the Air Force

STU	- secure telephone unit
DMS	- Defense Messaging System
ATCT	- air traffic control tower
OPLANS	- operational plans
MAN	- metropolitan area network
WAN	- wide area network
ORM	- operational risk management
HVAC	- heating, ventilation, and air conditioning
HFC	- hydrofluorocarbon
PFC	- perfluorocarbon
CO ₂	- carbon dioxide
AGE	- aerospace ground equipment
OEM	- original equipment manufacturer

5. Definitions:

5.1. Information Technology Equipment Room: Term used by the *National Electrical Code* (National Fire Protection Association [NFPA] 70) to replace several terms that describe computer and communications facilities, such as computer room, automatic data processing area, network control center, and communications center.

5.2. Incidental Equipment: Electronic equipment that is used for the majority of administrative or routine operational functions. The loss of this equipment due to fire or other causes would be inconvenient, but a work-around can easily be put into place. Electronic equipment typically designated as incidental equipment includes, but is not limited to:

- Desktop-style personal computers (PC)
- Printers, plotters, and scanners
- Facsimile machines and copy machines
- Typewriters and office-use electronic accessories
- Telephones
- Video conferencing centers

5.3. Mission-Support Equipment: Electronic equipment whose function is important to the operations of an individual unit, a single base, or to multiple Air Force bases, but will not have a direct and immediate impact on combat mission capability. Mission-support equipment should be so designated by each individual unit or base. Optimum protection is provided for this equipment if it is located in an information technology equipment room. When individual items of mission-support equipment are located in communications closets or small rooms, they must be provided with the minimum required fire protection features for this equipment. When duplicate on-line electronic backup capability is not provided, plans should be in place to establish backup functions within 24 to 48 hours. Examples of the functions of mission-support equipment include:

- Local area networks (LAN). Mission-support equipment often includes servers and associated equipment such as compact disc (CD) towers and magnetic storage media (such as backup tape drives).
- Research, development, and other scientific and engineering functions. Mission-support equipment often includes most special and/or unique assets such as supercomputers.
- Ground-based aircrew training. AFOSH Standard 91-118 provides fire protection requirements for training systems.
- Secure telephone unit (STU) functions. Mission-support equipment normally includes the base telephone exchange and any building telephone switches that provide STU functions other than those used in direct support of combat mission assets.
- Defense Messaging System (DMS) functions. Mission-support equipment normally includes LAN systems that provide DMS functions other than those used in direct support of combat mission assets.
- Information and communication functions normally used by multiple Air Force bases or geographically separated units.
- Functions performed at most air traffic control towers (ATCT). Additional information on fire protection requirements for ATCT may be obtained from the Air Force Flight Standards Agency, Andrews AFB, Maryland, or the *Air Traffic Control Tower Design Guide* published by the Design Group Division at Headquarters, Air Force Center for Environmental Excellence (HQ AFCEE/DCD).

5.4. Mission-Essential Equipment: Electronic equipment whose function has a direct impact on combat mission capabilities, including equipment integral to combat mission assets or used in direct control of these assets. Mission-essential equipment should be so designated by each individual unit or base. To provide optimum protection for this equipment, it should be located in an information technology equipment room. Occasionally, individual or a few items of mission-essential equipment may be located in communications closets or small rooms if provided with the minimum required fire protection features for this equipment; however, it is important to ensure that the system design will permit failure of a single piece of equipment or failure at a single cable routing location without disabling mission-essential functions. Often this equipment is of such high importance that duplicate on-line electronic backup capability is provided. When this duplicate capability is provided at geographically separated locations, completion of a special fire protection analysis may be required. See paragraph 6.6 for additional information on geographical separation. Examples of the functions involving mission-essential equipment include:

- Command, control, communication, and intelligence functions that order the launch and recovery of tactical or strategic assets essential to the defense of the United States and its allies. Most mission-essential equipment is used in accomplishing these functions.

- Command, control, communication, and intelligence functions necessary for implementation of wartime operational plans (OPLANS).
- Direct flight/mission control functions.
- STU functions. Mission-essential equipment normally includes the base telephone exchange and any building telephone switches that provide a STU function in support of combat mission assets.
- DMS functions. Mission-essential equipment normally includes LAN systems that provide a DMS function in support of combat mission assets.

5.5. *Ultrasensitive Smoke Detection:* Systems capable of detecting an extremely low concentration of smoke with a very low probability of spurious (false) alarms. Several manufacturers have developed these systems, but each uses a different type of technology; each also uses different terminology in marketing their systems. No standard industry term has been adopted, although the term “Very Early Warning Fire Detection” has been suggested. The generic term “ultrasensitive” is used in this ETL to avoid the impression of endorsing any particular manufacturer. This ETL specifies performance requirements for an ultrasensitive smoke detection system, including a minimum sensitivity range and a minimum number of programmable detection threshold signals.

6. Background.

6.1. Until the mid-1980s, the Air Force centrally located most of its important communications and information electronic equipment in designated communications, data processing, or other electronics facilities. The 1980s also saw the wide application of desktop PCs. Fire protection criteria were revised so this new type of office equipment was not overprotected out of proportion to its value. The 1990s brought new types of electronic equipment, particularly networks (LANs, metropolitan area networks [MAN], wide area networks [WAN], and especially the Internet) in which PCs are interconnected through switches, hubs, routers, servers, and occasionally mainframe computers. The different parts that make up these networks are typically located in several separate facilities. Additionally, purely administrative functions are often performed using the same network resources that are provided for critical unit or base operations. Accompanying these changes in equipment functions have been changes in equipment locations. Designated electronics facilities are less frequently used. In some cases this has resulted in inadequate fire protection for critical equipment. For example, although the present trend is to locate servers in a network control center or small server farm, critically important items of electronic equipment are still found installed in unprotected communications closets or under desks. A challenge for fire protection is to provide adequate protection for the equipment while still permitting a flexible network topology. This ETL attempts to meet the challenge in a cost-effective manner.

6.2. Adequate protection of electronic equipment includes protection from fire and combustion byproducts, such as heat and smoke. This ETL provides guidelines and

requirements for protection using a series of increasingly effective (but also increasingly expensive) features that are directly related to the importance of the electronic equipment to Air Force missions. Only normal building protection is required for incidental equipment. Some additional protection is required for mission-support equipment. Because of its importance, mission essential equipment must be protected using several special fire protection features and systems, some of which rely on human intervention to reduce the likelihood of mission failure. These features, including ultrasensitive smoke detection and smoke exhaust systems, are described in paragraph 7.3.

6.3. Fire threats can originate from either inside or outside the electronic equipment space. Historically, the most significant fire and smoke threats have originated in rooms or equipment located outside the electronic equipment space. This was confirmed by a New Mexico Engineering Research Institute study in 1989 that included a fire risk analysis of Air Force computer/electronic equipment. An analysis of five years of fire history showed that both the Air Force and the United States as a whole had very similar fire scenarios for this type of equipment. Conclusions from this study include:

- Origin of the fire:
 - About one-third of the fires that cause damage originate within the vicinity of the equipment.
 - Less than one-fourth of these fires originate within the equipment.
 - Two-thirds of the fires that cause damage originate outside the computer/electronic equipment space.
- Cause of ignition:
 - The single largest threat of fire to computer/electronic equipment is the electrical distribution system.
 - Over one-third of the fires and nearly two-thirds of the dollar loss are caused by fixed wiring, transformers, power switching gear, light fixtures, and extension cords.
- Material Ignited. In over half the fires, the first material ignited is some type of plastic, including electrical insulation.

6.4. The Secretary of the Air Force has provided guidance on the use of halogenated fire extinguishing agents (commonly referred to as halon systems) for the protection of the earth's atmospheric ozone. This guidance requires reduction and eventual elimination of the agents. In previous decades, halon systems were widely used in the Air Force for the protection of electronic equipment. This ETL provides fire protection methods that are effective without the use of halogenated agents.

6.5. Considerable damage to electronic components will occur if corrosive smoke and other fire byproducts are allowed to remain in contact with circuit boards. This smoke might originate within the mission-essential information technology equipment room, or originate elsewhere (inside or outside the building) and enter the room through the heating and air conditioning system. Corrosive particles found in smoke are electrically

conductive, and often quite “sticky” (i.e., not easily removable from electronic components). If allowed to settle on the components, the particles may create short circuits. Combined with normal humidity, they will also quickly corrode the metals used in integrated circuits and cause component failure. The degree of damage by the corrosive particles is directly related to the concentration of smoke and the length of time that the smoke is allowed to remain in contact with the electronics. Quick removal of the smoke will minimize damage; however, removal of smoke from a mission-essential information technology equipment room can prove difficult. Mission-essential information technology equipment rooms are usually located away from exterior walls. The rooms rarely have windows or doors leading directly outside the building. For these reasons, this ETL requires a separate smoke exhaust system for most mission-essential information technology equipment rooms to assist in removing smoke.

6.6. Paragraph 7 provides specific fire protection requirements that are appropriate for the vast majority of Air Force electronic equipment; however, there are some nationally critical missions that require fully redundant electronic equipment at geographically separated locations. Use of such geographic redundancy is recognized and approved by this ETL as an optional feature in providing fire protection for the mission. Geographic redundancy may be required in addition to the specific requirements of this ETL, or geographic redundancy may allow some of the usual specific requirements to be omitted. Nationally critical missions are so important and unique that an individual analysis is required prior to use of geographic redundancy as part of the fire protection methodology. The host MAJCOM is responsible for approving this individual analysis and ensuring the fire protection design provides the required level of mission reliability and continuity, in addition to any economic considerations. All users of the facility (both inside and outside the MAJCOM) should coordinate on the analysis. A copy of the analysis should also be sent to HQ AFCESA/CESM (see paragraph 9).

7. Specific Requirements.

7.1. Protection for Incidental Equipment. Provide normal facility protection as required for a non-electronic equipment facility. No special or additional protection is required for the electronic equipment.

7.2. Protection for Mission-Support Equipment. Provide normal facility protection as required for a non-electronic equipment facility. Provide additional protection for the electronic equipment as follows:

Note: Mission-support equipment whose loss would cause an operational impact greater than \$2 million may be protected applying the criteria for either mission-support or mission-essential equipment, at the discretion of the MAJCOM fire protection engineering office.

7.2.1. Smoke Detection. Mission-support electronic equipment must be protected by either a standard or ultrasensitive smoke detection system. Smoke detection systems

must comply with NFPA 72, *National Fire Alarm Code*. (See paragraphs 5.5, 7.3.1, 7.4.1, and 7.5.1 for further coverage of ultrasensitive smoke detection systems.)

Note: Consider using an ultrasensitive smoke detection system when the electronic equipment presents an unusually high risk of internal fire ignition or is particularly sensitive to smoke damage. It should also be provided when the facility requires detection of incipient fires (i.e., smoldering associated with overheating or low energy release rate fires before they reach an energy release rate of about one kilowatt), or where environmental effects could result in significant delays in detection.

Note: Ultrasensitive smoke detection is often more cost-effective than standard smoke detection in larger facilities. For smaller facilities (less than 475 square meters [5100 square feet]), compact aspirating smoke detection technologies are available that may also be very cost-effective.

7.2.2. Raised Floors. Raised floor systems of mission-support information equipment technology rooms will be of noncombustible materials.

7.2.3. Cable and Wiring.

7.2.3.1. Communications and interconnecting cable and wiring between components within an information technology equipment room (and associated raised floor spaces) must comply with NFPA 70, Article 645.

7.2.3.2. Communications and interconnecting cable and wiring between an information technology equipment room and other areas of the facility or other facilities must comply with NFPA 70, Articles 725, 760, 800, and 830. Listing markings will be visible on the cable jacket/wiring insulation.

7.2.3.3. Communications and interconnecting cable and wiring between mission-support components located outside an information technology equipment room, and other components or other facilities must comply with NFPA 70, Articles 725, 760, 800, and 830. Listing markings will be visible on the cable jacket/wiring insulation.

7.2.3.4. All power and distribution circuits must comply with the appropriate NFPA 70 Article. Use of nonmetallic conduit is not permitted within an information technology equipment room.

7.3. Protection for Mission-Essential Equipment in an Information Technology Equipment Room. Facilities that locate mission-essential electronic equipment in an information technology equipment room will be provided with gradually intensifying layers of protection to provide the greatest opportunity to protect the equipment and retain mission continuity. Figure 1 shows how human personnel and fire protection systems are intended to interact to provide the required protection for a fire starting within a mission essential information technology equipment room. Figure 2 shows how

fire protection features are provided to protect the mission essential information technology equipment room from a fire starting outside the room.

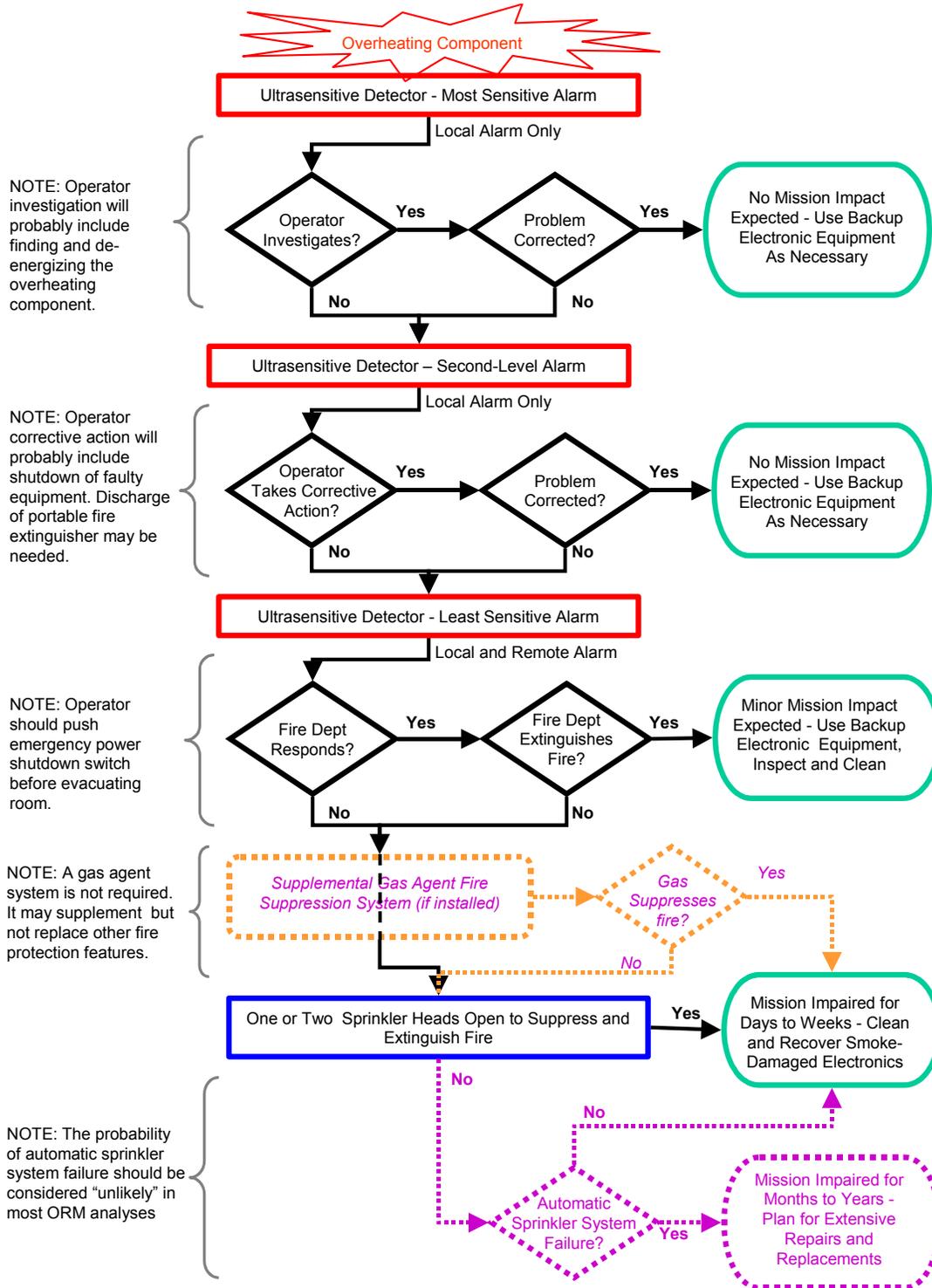


Figure 1. Fire Protection Logic Diagram for Fire Starting Within a Mission-Essential Electronic Information Technology Equipment Room.

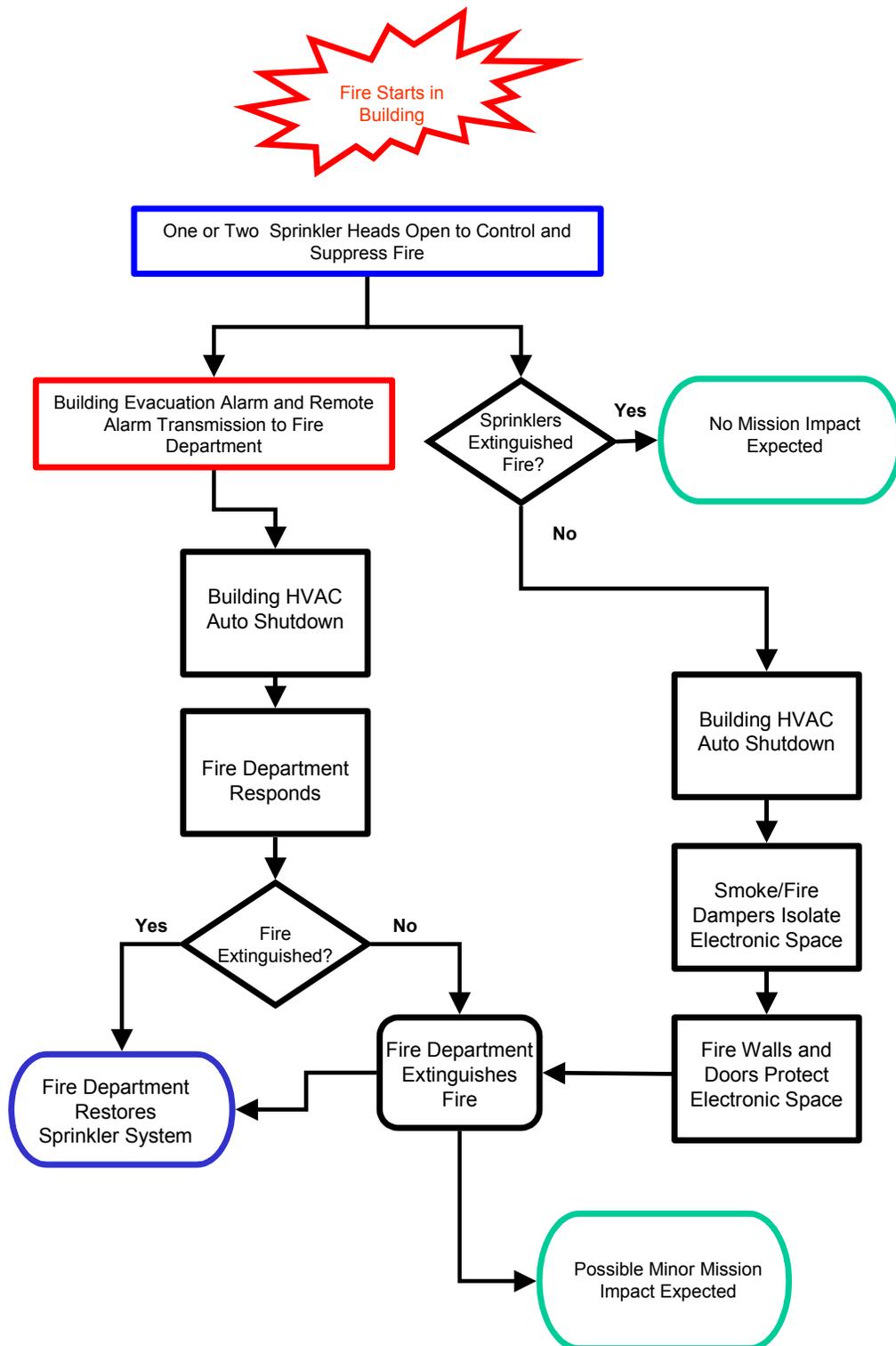


Figure 2. Fire Protection Logic Diagram for Fire Starting Outside a Mission-Essential Electronic Information Technology Equipment Room.

7.3.1. Ultrasensitive Smoke Detection. Provide a mission essential information technology equipment room (including any associated raised floor spaces) with an ultrasensitive smoke detection system (see paragraph 5.5) meeting the following requirements:

7.3.1.1. Type of Detector. Aspirating air sampling-type smoke detectors are the most commonly used type of detector for ultrasensitive smoke detection. Standard spot-type ionization and photoelectric smoke detectors must not be used because significant false alarm problems are expected when the detection threshold of standard smoke detectors is reduced to the ultrasensitive range.

7.3.1.2. Number of Detection Threshold Signals. A minimum of three programmable detection threshold signals or points must be provided within the sensitivity limits in addition to normal trouble and supervisory signals.

7.3.1.2.1. The detection threshold signals should be field-selectable within the sensitivity limits.

7.3.1.2.2. The alarm (least-sensitive) detection threshold signal must cause transmission of an alarm to the fire alarm receiving center (e.g., fire station, central alarm station).

7.3.1.2.3. The alarm (least-sensitive) detection threshold signal must cause activation of the interior fire alarm and evacuation system.

7.3.1.2.4. Other detection threshold signals should cause notifications/functions as locally defined.

7.3.1.3. Sensitivity. Sensitivity of the smoke detector must be determined by the environmental conditions expected in the mission-essential information technology equipment room.

7.3.1.3.1. Alert Detection Threshold Signal Level. The maximum sensitivity should be no less than 0.01 percent obscuration per meter (0.003 percent obscuration per foot). This sensitivity would be used in areas that are environmentally controlled and completely free of outside pollutants.

7.3.1.3.2. Alarm Detection Threshold Signal Level. The minimum sensitivity should be no greater than 5.0 percent obscuration per meter (1.5 percent obscuration per foot). This sensitivity would be used in areas with a low level of pollutants.

7.3.1.3.3. Range. The smoke detector will provide detection within a range of sensitivity. The acceptable alert detection threshold signal level (i.e., the maximum sensitivity) within this range should not be less than one-tenth of the alarm detection threshold signal level (i.e., the minimum sensitivity). For example, if the alarm detection threshold signal level for a detector is 3.5 percent obscuration per meter, the alert

detection threshold signal level should not be less than 0.35 percent obscuration per meter.

7.3.2. Power Disconnect. Provide protective means to disconnect power to all electronic equipment and to all dedicated air handling equipment in accordance with NFPA 70, Article 645. Manually operated switches should be double-action style.

7.3.3. Cable and Wiring.

7.3.3.1. Communications and interconnecting cable and wiring between components within the room (and associated raised floor spaces) will comply with NFPA 70, Article 645.

7.3.3.2. Communications and interconnecting cable and wiring between components in the room and other areas of the facility or other facilities will comply with NFPA 70, Articles 725, 760, 800, and 830. Listing markings must be visible on the cable jacket/wiring insulation.

7.3.3.3. All power and distribution circuits must comply with the appropriate NFPA 70 article. Use of nonmetallic conduit is not permitted.

7.3.4. Fire Rated Construction. Separate information technology equipment rooms from other spaces/occupancies and from operationally distinct adjacent information technology equipment rooms in the facility by a minimum of one-hour rated construction. The one-hour rated construction will extend from the structural floor to the structural ceiling/roof. Backup electronic equipment, if provided, will be physically located to minimize the potential for damage from fire, smoke, sprinkler system actuation, or other cause which may also damage the primary electronic equipment.

7.3.5. Raised Floors.

7.3.5.1. Divide raised floor spaces in the same manner as the information technology equipment rooms they serve; use at least equivalent fire rated construction.

7.3.5.2. Raised floor systems must be made of noncombustible materials.

7.3.6. Joint Air Handling System. If the information technology equipment room is served by air handling equipment which also serves any other part of the facility (including an adjacent information technology equipment room), provide the following:

7.3.6.1. Automatic smoke and fire dampers installed in accordance with NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*, must shut off the information technology equipment room from the remainder of the facility upon any fire alarm indication anywhere in the facility. Smoke dampers and combination fire and smoke dampers must be of the automatic-resetting type. Use fire dampers to protect openings in fire rated construction in accordance with NFPA 90A.

7.3.6.2. Install smoke detectors listed for use in air distribution systems that will also provide facility fire alarm indications.

7.3.7. Separate Air Handling System (If Provided). An air handling system that exclusively serves the information technology equipment room does not need to be deactivated upon a fire alarm indication except for conditions originating in the information technology equipment room.

7.3.8. Smoke Exhaust System. Provide a smoke exhaust system to remove smoke from the information technology equipment room to the exterior of the building. The system must be designed to minimize damage to the electronic equipment from corrosive action by smoke and other byproducts of the fire. The system air handling equipment will be separate from the normal air handling equipment provided for the information technology equipment room. Include these features:

- The system will override all normal air handling equipment for the information technology equipment room. Automatic smoke and fire dampers will isolate the information technology equipment room from the remainder of the facility.
- The system will automatically activate upon detecting smoke within the information technology equipment room, and will manually deactivate using a key-operated switch at a location outside the information technology equipment room. Activation should occur at the least-sensitive alarm detection threshold signal.
- The system will provide a minimum smoke exhaust capacity of 5 liters per second per square meter (1 cubic foot per minute per square foot) of floor area against a differential pressure of 12 pascals (0.05 inches of water, gauge).
- The system will have emergency or standby power in accordance with NFPA 70. Connection ahead of (but not within the same cabinet, enclosure, or vertical switchboard section) the main service disconnect should be used for facilities without other sources of emergency or standby power.
- Materials used for the system must comply with NFPA 90A.

7.3.9. Wet-Pipe Sprinkler System.

7.3.9.1. Locate mission-essential information technology equipment rooms only in fully sprinklered facilities, protected by a wet-pipe sprinkler system designed and constructed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*.

Note: The MAJCOM fire protection engineering office may authorize fire protection features as an alternative to installing a wet-pipe sprinkler system (see paragraph 7.3.10).

Note: Sprinkler systems may be omitted from normally unoccupied and remote facilities (see paragraphs 7.4 and 7.5).

7.3.9.2. Activating the automatic sprinkler system in the information technology equipment room will not automatically disconnect power to the information technology equipment room unless authorized by the MAJCOM fire protection engineering office.

Note: Activation of an automatic sprinkler system is usually detected by connection to a pressure or flow switch in the system; however, these switches are susceptible to false activation by pressure surges in the water supply lines and would cause unacceptable power shutdowns of mission-essential equipment if connected to a power supply-tripping circuit. Little personnel hazard is created by this requirement since sprinkler activation normally will occur only when the space is already untenable by occupants, and risk of electrical shock is minimal. The emergency power shutdown features required in NFPA 70 adequately provide for protection from electric shock in the unlikely event of inadvertent sprinkler activation.

7.3.10. Alternative Fire Protection Features in Lieu of Wet-Pipe Sprinklers.

CAUTION

Alternative protection features are intended for a typical Air Force installation with a fully equipped and staffed fire department within the time and distance criteria of Department of Defense Instruction (DoDI) 6055.6, *Department of Defense Fire Protection Program*. Use of these alternative protection features at other installations/locations is not recommended without a complete fire engineering risk analysis.

7.3.10.1. The MAJCOM fire protection engineering office is authorized to adopt one or more of the following alternative fire protection features.

7.3.10.1.1. Features of Construction:

- Installation of four-hour walls and floor/ceiling assemblies (fire divisions) around the information technology equipment room within a larger facility. This option eliminates the need for the wet-pipe sprinkler in the information technology equipment room only; the remainder of the facility still requires a wet-pipe sprinkler system. Also, the facility must comply with more restrictive *Life Safety Code* (NFPA 101) requirements for a non-fully sprinklered facility.
- A physically separate Type I or Type II (fire-resistive or one-hour rated) building to house the information technology equipment room. No offices or storage space would be permitted in such a building, and combustible materials would be

restricted to the minimum practical level. The physically separate building does not require a sprinkler system.

Note: Backup electronic equipment should be physically located to minimize the potential for damage from fire, smoke, or other causes which may also damage the primary electronic equipment.

7.3.10.1.2. Substitution for Wet-pipe Sprinkler System:

- Installation of a water mist fire suppression system in the information technology equipment room in accordance with NFPA 750, *Standard on Water Mist Fire Protection Systems*.
- Installation of a pre-action water sprinkler system in the information technology equipment room in accordance with NFPA 13 (also see paragraphs 7.3.10.2 and 7.3.10.3).

Note: Both options eliminate the need for the wet-piping sprinkler in the information technology equipment room only; the remainder of the facility still requires a wet-pipe sprinkler system.

7.3.10.2. The use of pre-action water sprinkler systems in information technology equipment rooms is discouraged because the reliability of pre-action systems is highly dependent on properly performed, regular maintenance. Building occupants often request pre-action sprinkler systems due to misconceptions about the actual risk of inadvertent sprinkler activation, and often do not realize that the overall risk of damage to the electronic equipment typically increases when a pre-action sprinkler system is substituted for a wet-pipe sprinkler system. Leaky roofing, air conditioning, and plumbing systems present a far greater risk of water damage than a wet-pipe sprinkler system properly installed in accordance with NFPA 13.

7.3.10.3. Dry-pipe water suppression systems should not be confused with pre-action water sprinkler systems. Dry-pipe systems are not permitted in information technology equipment rooms.

Note: Dry-pipe systems are generally intended only for areas exposed to below-freezing temperatures.

7.3.11. Supplemental Gaseous-Agent Fire Suppression Systems. Gaseous-agent fire suppression systems may be added to mission-essential information technology equipment rooms only when all of the following conditions are met:

- The gaseous-agent system is not listed in paragraph 7.6 as a prohibited system.

Note: Several of the most common commercially available gaseous-agent systems are classified as hydrofluorocarbon (HFC) or perfluorocarbon (PFC) clean extinguishing agents. Significant questions have been raised about the appropriateness of continued

use of these agents due to atmospheric lifetime and global warming potential. Other commercially available gaseous agents have no known adverse environmental impact.

- The gaseous agent complies with NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*.
- The gaseous-agent system is designed by a fire protection engineer qualified in accordance with MIL-HDBK-1008.
- All fire protection features are provided in the mission-essential information technology equipment room as required by this ETL for a space without a gaseous-agent system. An optional gaseous-agent fire suppression system may supplement but may not replace any of the minimum required protective features.
- Installation of the gaseous-agent system is approved by the MAJCOM fire protection engineering office.

7.4. Protection for Mission-Essential Equipment in Normally Unoccupied Rooms and Facilities. Use the requirements of this paragraph when mission-essential electronic equipment cannot be located in facilities meeting the requirements of an information technology equipment room (paragraph 7.3). Unoccupied equipment spaces will have a minimal amount of mission-essential electronic equipment, and are typically controlled from a separate location with only periodic visits for maintenance. Use the requirements for a remote equipment space (paragraph 7.5) if the facility is situated in a geographically remote location without an adequate water supply for an automatic sprinkler system, or if considerable delay will occur in the fire department's response to a fire.

7.4.1. Ultrasensitive Smoke Detection. Provide mission-essential equipment spaces (and any associated raised floor spaces) in unoccupied facilities with an ultrasensitive smoke detection system meeting the following requirements:

7.4.1.1. Type of Detector. Aspirating air sampling-type smoke detectors are the most commonly used type of detector for ultrasensitive smoke detection. Standard spot-type ionization and photoelectric smoke detectors must not be used because significant false alarm problems are expected when the detection threshold of standard smoke detectors is reduced to the ultrasensitive range.

7.4.1.2. Number of Detection Threshold Signals. A minimum of three programmable detection threshold signals or points must be provided within the sensitivity limits in addition to normal trouble and supervisory signals.

7.4.1.2.1. The detection threshold signals should be field-selectable within the sensitivity limits.

7.4.1.2.2. Each detection threshold level must transmit to a continuously occupied location. The receiving location may be an office of the flight or organization receiving

the normal data from the unoccupied facility. Use of separate transmission equipment meeting the requirements of NFPA 72 is not required.

7.4.1.2.3. The alarm (least-sensitive) detection threshold signal must cause activation of an interior fire alarm and evacuation system in the facility housing the unoccupied electronic equipment space and cause an alarm transmission to the fire receiving center (e.g., fire station, central alarm station).

7.4.1.2.4. The alarm (least-sensitive) detection threshold signal will automatically disconnect power to all electronic equipment and to all dedicated air handling equipment of the unoccupied electronic equipment space.

7.4.1.2.5. Other detection threshold signals should cause notifications/functions as locally defined.

7.4.1.3. Sensitivity. Sensitivity of the smoke detector must be determined by the environmental conditions expected in the electronic equipment space.

7.4.1.3.1. Alert Detection Threshold Signal Level. The maximum sensitivity should be no less than 0.01 percent obscuration per meter. This sensitivity would be used in areas that are environmentally controlled and completely free of outside pollutants.

7.4.1.3.2. Alarm Detection Threshold Signal Level. The minimum sensitivity should be no greater than 5.0 percent obscuration per meter. This sensitivity would be used in areas with a low level of pollutants.

7.4.1.3.3. Range. The smoke detector will provide detection within a range of sensitivity. The acceptable alert detection threshold signal level (i.e., the maximum sensitivity) within this range should not be less than one-tenth of the alarm detection threshold signal level (i.e., the minimum sensitivity). For example, if the alarm detection threshold signal level for a detector is 3.5 percent obscuration per meter, the alert detection threshold signal level should not be less than 0.35 percent obscuration per meter.

7.4.2. Power Disconnect. Provide protective means to disconnect power to all electronic equipment and to all dedicated air handling equipment of the unoccupied electronic equipment space. Manually operated switches should be double-action style.

7.4.3. Cable and Wiring.

7.4.3.1. Communications and interconnecting cable and wiring between mission-essential components located in an unoccupied electronic equipment space, and other components or other facilities will comply with NFPA 70, Articles 725, 760, 800, and 830. Listing markings must be visible on the cable jacket/wiring insulation.

7.4.3.2. All power and distribution circuits must comply with the appropriate NFPA 70 article.

7.4.4. Construction Features for Unoccupied Electronic Equipment Spaces.

7.4.4.1. In facilities not fully protected by a sprinkler system, separate unoccupied electronic equipment spaces from the remainder of the facility by a minimum of four-hour walls and floor/ceiling assemblies (fire divisions). Use combination smoke/fire dampers to protect openings in fire rated construction in accordance with NFPA 90A. Use automatic resetting-type dampers.

7.4.4.2. In fully sprinklered facilities, separate unoccupied electronic equipment spaces from the remainder of the facility by a minimum of two-hour walls and floor/ceiling assemblies (fire divisions). Use combination smoke/fire dampers to protect openings in fire rated construction in accordance with NFPA 90A. Use automatic resetting-type dampers.

7.4.5. Smoke Exhaust System. Provide a smoke exhaust system to remove smoke from the unoccupied electronic equipment space to the exterior of the building. The system must be designed to minimize damage to the electronic equipment from corrosive action by smoke and other byproducts of the fire. The system air handling equipment will be separate from the normal air handling equipment provided for the unoccupied electronic equipment space. Include these features:

- It will override all normal air handling equipment for the unoccupied electronic equipment space. Automatic smoke and fire dampers will isolate the unoccupied electronic equipment space from the remainder of the facility.
- It will automatically activate upon detecting smoke within the unoccupied electronic equipment space, and manually deactivate using a key-operated switch at a location outside of the unoccupied electronic equipment space. Activation should occur at the least-sensitive alarm detection threshold signal.
- It will provide a minimum smoke exhaust capacity of 5 liters per second per square meter of floor area against a differential pressure of 12 pascals.
- It will have emergency or standby power in accordance with NFPA 70. Connection ahead of (but not within the same cabinet, enclosure, or vertical switchboard section) the main service disconnect should be used for facilities without other sources of emergency or standby power.
- Materials used for the system must comply with NFPA 90A.

7.4.6. Supplemental Fire Protection Features. The MAJCOM fire protection engineering office is authorized to add any of the following protection measures to unoccupied mission-essential electronic equipment spaces:

7.4.6.1. Gaseous-agent fire suppression systems may be added only when all of the following conditions are met:

- The gaseous-agent system is not listed in paragraph 7.6 as a prohibited system.

Note: Several of the most common commercially available gaseous-agent systems are classified as HFC or PFC clean extinguishing agents. Significant questions have been raised about the appropriateness of continued use of these agents due to atmospheric lifetime and global warming potential. Other commercially available gaseous agents have no known adverse environmental impact.

- The gaseous agent complies with NFPA 2001.
- The gaseous-agent system is designed by a fire protection engineer qualified in accordance with MIL-HDBK-1008.
- All fire protection features are provided in the unoccupied mission-essential electronic equipment space as required by this ETL for a space without a gaseous-agent system. An optional gaseous-agent fire suppression system may supplement but not replace any of the minimum required protective features.

7.4.6.2. An automatic sprinkler system designed and constructed in accordance with NFPA 13.

7.4.6.3. An automatic sprinkler system designed for an isolated hazardous area and connected to a domestic water supply in accordance with NFPA 101.

7.4.6.4. Installation of a water mist fire suppression system in the unoccupied electronic equipment space in accordance with NFPA 750.

7.5. Protection for Mission-Essential Equipment in Remote Rooms and Facilities. Use the requirements of this paragraph when mission-essential electronic equipment must be located in facilities not meeting the requirements of an information technology equipment room (paragraph 7.3) or unoccupied electronic equipment space (paragraph 7.4). Remote equipment spaces are typically situated in a geographically remote location without an adequate water supply for an automatic sprinkler system, or where considerable delay will occur in the fire department's response to a fire.

7.5.1. Ultrasensitive Smoke Detection. Provide mission-essential equipment spaces (and any associated raised floor spaces) in remote facilities with an ultrasensitive smoke detection system meeting the following requirements:

7.5.1.1. Type of Detector. Aspirating air sampling-type smoke detectors are the most commonly used type of detector for ultrasensitive smoke detection. Standard spot-type ionization and photoelectric smoke detectors must not be used because significant false alarm problems are expected when the detection threshold of standard smoke detectors is reduced to the ultrasensitive range.

7.5.1.2. Number of Detection Threshold Signals. A minimum of three programmable detection threshold signals or points must be provided within the sensitivity limits in addition to normal trouble and supervisory signals.

7.5.1.2.1. The detection threshold signals should be field-selectable within the sensitivity limits.

7.5.1.2.2. Each detection threshold level must transmit to a continuously occupied location. The receiving location may be an office of the flight or organization receiving the normal data from the remote facility. Use of separate transmission equipment meeting the requirements of NFPA 72 is not required.

7.5.1.2.3. The alarm (least-sensitive) detection threshold signal must cause activation of an interior fire alarm and evacuation system in the facility housing the remote electronic equipment space and cause an alarm transmission to the fire receiving center (e.g., fire station, central alarm station).

7.5.1.2.4. The alarm (least-sensitive) detection threshold signal will automatically disconnect power to all electronic equipment and to all dedicated air handling equipment of the remote electronic equipment space.

7.5.1.2.5. Other detection threshold signals should cause notifications/functions as locally defined.

7.5.1.3. Sensitivity. Sensitivity of the smoke detector must be determined by the environmental conditions expected in the electronic equipment space.

7.5.1.3.1. Alert Detection Threshold Signal Level. The maximum sensitivity should be no less than 0.01 percent obscuration per meter. This sensitivity would be used in areas that are environmentally controlled and completely free of outside pollutants.

7.5.1.3.2. Alarm Detection Threshold Signal Level. The minimum sensitivity should be no greater than 5.0 percent obscuration per meter. This sensitivity would be used in areas with a low level of pollutants.

7.5.1.3.3. Range. The smoke detector will provide detection within a range of sensitivity. The acceptable alert detection threshold signal level (i.e., the maximum sensitivity) within this range should not be less than one-tenth of the alarm detection threshold signal level (i.e., the minimum sensitivity). For example, if the alarm detection threshold signal level for a detector is 3.5 percent obscuration per meter, the alert detection threshold signal level should not be less than 0.35 percent obscuration per meter.

7.5.1.3.4. All other detector point functions should be locally defined.

7.5.2. Power Disconnect. Provide protective means to disconnect power to all electronic equipment and to all dedicated air handling equipment of the remote electronic equipment space. Manually operated switches should be double-action style.

7.5.3. Cable and Wiring.

7.5.3.1. Communications and interconnecting cable and wiring between mission-essential components located in a remote electronic equipment space and other components or other facilities will comply with NFPA 70, Articles 725, 760, 800, and 830. Listing markings must be visible on the cable jacket/wiring insulation.

7.5.3.2. All power and distribution circuits must comply with the appropriate NFPA 70 article.

7.5.4. Construction Features for Remote Electronic Equipment Spaces.

7.5.4.1. Separate remote electronic equipment spaces from any adjacent electrical power generation spaces by a minimum of two-hour rated construction. The two-hour rated construction will extend from the structural floor to the structural ceiling/roof. Use fire dampers to protect openings in fire rated construction in accordance with NFPA 90A. Use automatic resetting-type dampers.

7.5.4.2. Other walls, floors, ceilings, and roofs of the remote electronic equipment space must be of non-combustible construction. Consideration should be given to providing two-hour or greater fire rated construction for unoccupied facilities at risk from arson or forest wildfires.

7.5.4.3. Provide and maintain a buffer zone around the unoccupied facility that is free of appreciable amounts of combustible vegetation.

Note: The width of the buffer zone should be determined based on the local climate and vegetation. In dry climates with highly combustible native vegetation (e.g., southern California), a wide buffer zone (typically 10 meters [33 feet]) should be established. In damp, cool climates (e.g., the Pacific Northwest), the buffer zone may be considerably smaller (typically 2 meters [6.5 feet]).

7.5.5. Fire Suppression Systems for Remote Equipment Spaces.

7.5.5.1. Provide a fire suppression system for any electrical power generation space located within the remote facility. A fire suppression system may be provided for other spaces within the remote facility when authorized by the MAJCOM fire protection engineering office.

7.5.5.2. The suppression systems will comply with NFPA standards applicable to the suppression agent (i.e., water, chemical agent, gaseous agent) Do not install a

prohibited system (see paragraph 7.6). Follow the requirements of paragraph 7.5.6.1 for gaseous-agent fire suppression systems.

7.5.5.3. The suppression systems for the remote facility will provide fire alarm indications to the same locations that receive alarms from the ultrasensitive smoke detection system, and using the same method of signal transmission.

7.5.6. Supplemental Fire Protection Features. The MAJCOM fire protection engineering office is authorized to add any of the following protection measures to remote mission-essential electronic equipment spaces:

7.5.6.1. Gaseous-agent fire suppression systems may be added only when all of the following conditions are met:

- The gaseous-agent system is not listed in paragraph 7.6 as a prohibited system.

Note: Several of the most common commercially available gaseous-agent systems are classified as HFC or PFC clean extinguishing agents. Significant questions have been raised about the appropriateness of continued use of these agents due to atmospheric lifetime and global warming potential. Other commercially available gaseous agents have no known adverse environmental impact.

- The gaseous agent complies with NFPA 2001.
- The gaseous-agent system is designed by a fire protection engineer qualified in accordance with MIL-HDBK-1008.
- All fire protection features are provided in the remote mission-essential electronic equipment space as required by this ETL for a space without a gaseous-agent system. An optional gaseous-agent fire suppression system may supplement but may not replace any of the minimum required protective features.

7.5.6.2. An automatic sprinkler system designed and constructed in accordance with NFPA 13.

7.5.6.3. An automatic sprinkler system designed for an isolated hazardous area and connected to a domestic water supply in accordance with NFPA 101.

7.5.6.4. Installation of a water mist fire suppression system in the remote electronic equipment space in accordance with NFPA 750.

7.6. Prohibited Fire Suppression Systems. The following fire suppression systems will not be installed in any electronic equipment spaces:

- Halogenated agent systems
- Carbon dioxide (CO₂) systems
- Dry-pipe water sprinkler systems

Note: Pre-action type sprinkler systems may be installed in some facilities as described in this ETL; however, use of pre-action type sprinkler systems is generally discouraged because of maintenance and reliability concerns.

Note: Several of the most common commercially available gaseous-agent systems are classified as HFC or PFC clean extinguishing agents. Significant questions have been raised about the appropriateness of continued use of these agents due to atmospheric lifetime and global warming potential. Other commercially available gaseous agents have no known adverse environmental impact.

7.7. Immediate Actions for Damage by Fire, Smoke, or Water. Occasionally, electronic equipment, magnetic media, or paper documentation is damaged directly from fire, smoke, or water. In many cases, the equipment, media, and documentation can be recovered if immediate actions are taken. The greatest probability of success is realized if action is taken within the first 24 hours.

Note: NFPA 75, *Standard for the Protection of Electronic Computer/Data Processing Equipment*, provides similar information about immediate actions following a disaster involving electronic equipment (see NFPA 75, Appendix C); however, the information in this ETL is more applicable to Air Force facilities.

7.7.1. Electronic Equipment.

7.7.1.1. Disconnect Power. Remove power from all affected equipment immediately. Damaged but energized equipment may endanger personnel or cause fires from electrical shorts. In addition, electrochemical action in damaged, energized equipment can plate contaminants onto and remove metals from printed circuit boards, connectors, and backplanes. If allowed to continue for too long, recovery of this equipment may not be possible.

7.7.1.2. Remove Standing Water:

7.7.1.2.1. Disconnect power.

WARNING

Do NOT energize wet equipment as electrocution and/or damage to equipment could result.

7.7.1.2.2. Open cabinet doors, remove side panels and covers, and pull out chassis drawers to allow water to drain from the equipment.

Note: Equipment with open relays and transformers will likely require a special bake-out process before power can be restored.

7.7.1.2.3. Use low-pressure air to blow trapped water from the equipment. Use absorbent cotton pads (e.g., disposable diapers, sanitary napkins, etc.) as necessary to blot up water.

7.7.1.2.4. Remove standing water with wet vacuums. Vacuum or mop up water from under raised computer room floors.

7.7.1.3. Control Humidity. Reduce relative humidity to below 50 percent to significantly slow the corrosion process. **This is the most important step in the mitigation process.** Methods include:

7.7.1.3.1. Providing temporary or permanent air conditioning to the equipment area. Aerospace ground equipment (AGE) may be available for use on many Air Force bases.

7.7.1.3.2. Moving the equipment to another area with operational air conditioning systems.

7.7.1.3.3. Sealing off each piece of equipment and using desiccants.

7.7.1.3.4. Where contaminant concentration is severe, applying a thin film of non-petroleum lubricant to parts to exclude moisture and air. This film must be removed during restoration.

7.7.2. Recovery of Magnetic Media and Paper Documentation.

7.7.2.1. Contaminated Magnetic Media. Contaminated magnetic media often can be recovered by cleaning in a “clean room,” a facility or enclosure in which air content and other conditions (such as temperature, humidity, and pressure) are controlled and maintained at a specific level by special facilities and operating processes and by trained personnel. Do not attempt to copy data from contaminated magnetic media before cleaning. Store contaminated magnetic media and paper documentation in a low humidity environment, unless wet.

7.7.2.2. Wet Magnetic Media. Remove as much water as possible by shaking and exposing to low-pressure air, then freeze the media as quickly as possible; consider using a commercial blast-freezer in a local fish- or meat-processing plant. Restoration may be accomplished later using the freeze-drying process.

CAUTION

Do NOT attempt to dry wet magnetic media with heat as permanent damage will result.

7.7.2.3. Wet Paper Documentation. Remove from standing water and freeze as quickly as possible; consider using a commercial blast-freezer in a local fish- or meat-processing plant. Restoration may be accomplished later using the freeze-drying process.

CAUTION

Do NOT attempt to dry wet paper with heat as permanent damage will result.

7.7.3. Restoration and Recovery. Contact a professional restoration company able to provide immediate response. Be sure the firm is capable of restoring damaged electronic equipment to original equipment manufacturer (OEM) specifications for surface contamination and can provide freeze-drying recovery services.

8. Technical Assistance. Contact the MAJCOM fire protection engineering office for assistance. The HQ AFCESA Technical Support Directorate can assist MAJCOMs and design agents in applying these ETL requirements. AFCESA assistance with the fire protection system design process is most beneficial at the project definition stage.

9. Point of Contact: Recommendations for improvements to this ETL are encouraged and should be furnished to: HQ AFCESA/CESM, 139 Barnes Drive, Suite 1, Tyndall AFB, FL 32408-5319, Attention: Mr. Raymond N. Hansen, DSN 523-6317, commercial (850) 283-6317, FAX DSN 523-6219, Internet ray.hansen@tyndall.af.mil or www.afcesa.af.mil/Directorate/CES/Mechanical/FireEngr.

MICHAEL J. COOK, Colonel, USAF
Director of Technical Support

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