

IEEE Guide for Substation Fire Protection

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Abstract: Guidance is provided to substation engineers in determining the design, equipment, and practices deemed necessary for the fire protection of substations. A list of publications that can be used to acquire more detailed information for specific substations or substation components is presented.

Keywords: fire, fire protection, safety, substation design, substations

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Introduction

(This introduction is not a part of IEEE Std 979-1994, IEEE Guide for Substation Fire Protection.)

This guide was written to direct substation engineers in determining fire protection design, equipment, and practices deemed necessary for substation safety. Nothing contained in this guide is mandatory. Its sole purpose is to give guidance by presenting items that should be considered in substation design and by presenting a list of publications that can be used to acquire more detailed information for specific substations or substation components.

Substation fire protection has not significantly changed since 1984, when the original guide was written. However, there have been a number of areas that have necessitated revision. These areas include changes to metric units, environmental issues regarding the use of Halon, and the advancement of fire detection technology.

All of the members of the current working group, except A. J. Bolger, J. A. Buchsbaum, G. M. Ihle, and D. R. Torgerson, were members of the 1984 originating working group.

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IEEE Guide for Substation Fire Protection

1. General

1.1 Scope

This guide was developed to identify substation fire protection practices that generally have been accepted by industry.

1.2 Purpose

The purpose of this document is to give design guidance in the area of fire protection to substation engineers. Existing fire protection standards, guides, etc., that may aid in the design of specific substations or substation components, are listed in the annex.

NOTE — No recommendation listed in this document should be followed if it is less restrictive than that specified in any local code or ordinance.

2. Control and relay buildings

2.1 General

This clause contains recommendations for fire protection practices that should be used as a guide in designing substation control and relay buildings.

2.2 Cable

Cable installed either in trays, below the floor (raised floor), or in trenches cast into the floor could spread a fire from one area or piece of equipment to another. Therefore, the following precautions are suggested: Removable covers for trenches should be made of metal or fire-retardant material. If the floor is raised, use of a fire protection system beneath the floor should be considered. When cables are installed in either covered trays, under raised floors, or in trenches cast into floors, consideration should be given to the installation of cable fire breaks. Cable fire breaks should be repaired and maintained to correct damage that may occur when cables are removed or installed. The cable used in substation control houses should be of a material that does not readily propagate a fire. The cables used should be qualified by the flame test parameters specified in IEEE Std 383-1974 [B46].¹ Consideration should be given to adding either a fire-protective coating or covering, or sprinkler protection, to any cable installation that does not meet the flame requirements of IEEE Std 383-1974 [B46].

¹The numbers in brackets preceded by the letter B correspond to those of the bibliography in the annex.

2.3 Exits

Most control houses should have a minimum of two exits. These exits should be located at opposite ends of the building to prevent the possibility of personnel being trapped by a fire. These doors should open outward and be equipped with illuminated exit signs. Panel and equipment arrangements should be designed so personnel can exit the equipment area from both ends. Additional guidance can be found in ANSI/NFPA 70-1993 [B22], ANSI/NFPA 101-1994 [B26], and ANSI/NFPA 101A-1995 [B27].

2.4 Door locks

Panic hardware on all doors should override any exterior lock or padlock to allow egress from the building. This feature is recommended because personnel may enter the building without first unlocking all of the exterior doors.

2.5 Fire extinguishers

2.5.1 Portable extinguishers

Portable fire extinguishers should be located in accordance with ANSI/NFPA 10-1994 [B2]. Locations adjacent to normal entrance/exit doors are suggested. See clause 7 for guidance in selection of the type of extinguishing agent.

2.5.2 Fixed extinguishing systems

Local fire codes may require fixed fire-extinguishing systems, or their installation may be necessary due to the critical location or type of substation. Guidance in selection of this type of system may be found in clause 7.

2.6 Alarms

It may be desirable to equip unattended substations with smoke or heat detectors to sense a fire. Duct smoke detectors, installed in the return ducts of heating and cooling equipment, provide an effective means of detecting fire. The detectors should activate an audible/visual fire alarm at the substation site, the master station (if the substation is equipped with supervisory control equipment), and, if desired, the local fire station. Attended substations should be equipped with similar devices that should actuate a local alarm. See clause 6 for guidance in the selection of the detection system.

2.7 Combustible materials

The use of combustible materials with flame-spread, fuel-contributed, and smoke-developed ratings greater than 25 should be avoided in the selection of desks, chairs, filing cabinets, storage boxes, display boards, building insulation, interior wall panels, mounting boards, etc. The flame spread is calculated utilizing ANSI/NFPA 255-1990 [B29].

2.7.1 Housekeeping

Good housekeeping practices should be followed to eliminate the accumulation of combustible materials, e.g., discarded papers, prints, cups, newspapers, etc. Waste cans should be fire approved and self-closing.

2.7.2 Storage

The storage of paper products, cleaning fluids, and other combustible materials in a control building should be minimized. If stored in the control building, they should be kept in a separate area having a minimum 1 h rating to prevent a fire from spreading to the main control and relay areas. Flammable liquids should be stored only in safety cans approved by Underwriters Laboratories. Guidance for the storage of flammable liquids can be found in ANSI/NFPA 30-1993 [B18].

2.8 Ventilation

Since most fires produce extremely heavy smoke that inhibits manual fire fighting, special portable or fixed exhaust and ventilating systems that bring in outside air should be utilized to remove or reduce the smoke. This is especially important in confined areas where manual fire fighting is the only practical method of fire extinguishment. Fixed exhaust and ventilating systems should shut down automatically during a fire and be equipped with an override device to allow for smoke removal when fire fighters deem it necessary. The fan override switch should be located outside the fire hazard area, clearly marked, and easily accessible to fire fighters. For additional guidance, see ANSI/NFPA 204M-1991 [B28] and SMACNA [B53].

2.9 Lighting

Exit lights and emergency lighting sufficient to provide egress from the building should be considered. These lights should be supplied per ANSI/NFPA 101-1994 [B26] and ANSI/NFPA 101A-1995 [B27].

2.10 Construction

The control and relay building should be constructed of fire-resistive or noncombustible materials. The building should be located and designed so that the largest credible fire (e.g., of an oil-filled transformer, a circuit breaker, or neighboring plants or storage facilities) will not involve or affect the operation of the equipment within the building or vice versa.

2.10.1 Fire ratings

All fire walls, doors, floors, and ceilings should have a fire rating commensurate with the largest credible fire they could encounter. All fire doors should be equipped with self-closing devices to maintain the fire rating of the wall.

2.10.2 Floor and wall openings

In multistory structures and fire-rated rooms, all floor and wall openings should be sealed in a manner that will not reduce the fire rating of the floor or wall. Guidance for installations of cable penetrations can be found in IEEE Std 634-1978 [B50].

2.10.3 Conduits

Conduits should be sealed at ceiling, floor, and wall penetration(s) to prevent the transfer of liquid fires, smoke, flammable gases, or vapors from one area to another. Consideration should be given to using conduits made of fire-retardant materials.

2.10.4 Heating equipment

Portable heating equipment should not be used in control buildings unless their design, installation, electrical supplies, etc., are deemed suitable by the fire protection engineer or another responsible individual. Clearances for heat-producing appliances should be adequate to minimize the risk of igniting adjacent combustible material. Guidance for air-conditioning systems can be found in ANSI/NFPA 90A-1993 [B25].

2.11 Uses

Substation control and relay buildings should not be used for any other purpose. If welding, repair, storage of spare clothing, storage of crated spare parts, oil testing, etc., is unavoidable, a separate fire-rated area should be provided.