CHAPTER 10

BACK-UP, SECURITY, AND PROTECTION SYSTEMS

10-1. Other systems.

Previous chapters have outlined methods for servicing electrical system components such as switchgear, transformers, rotating equipment, etc. These are the major areas in which real property electrical shops are involved. There are, however, many other interior systems which merit some mention. Detailed operation and maintenance data on these systems are difficult to develop due to the wide variety of types of interior systems and the uniqueness of each system. It is, therefore, suggested that all manufacturer's publications for a particular system be obtained and all recommended maintenance and troubleshooting practices be followed.

10-2. Emergency and stand-by systems.

The function of an emergency power system is to provide a source of electrical power of required capacity reliability, and quality for a given length of time to loads within a specified time after loss or failure of the normal supply. The continued reliability and integrity of this power system is dependent upon an established program of routine maintenance and operational testing. This program shall be based upon manufacturer's recommendations, instruction books, and the minimum requirements presented in this section. Instruction books protided by the manufacturer shall contain: a detailed explanation of the operation of the system; instructions for routine maintenance; detailed instructions for repair of the components of the system; pictorial parts list and part numbers; and, pictorial and schematic electrical drawings of wiring systems, including operating and safety devices, control panels, instrumentation and annunciators.

a. Special tools and testing devices required for routine maintenance shall be available for use when needed. Spare parts shall be stocked as recommended by the manufacturer. A written record of inspections, tests, exercising, operation, and repair of an emergency power system shall be maintained on the premise. This record shall include: date of the maintenance report; identification of the servicing personnel; and, notification of any unsatisfactory conditions and corrective actions taken, including parts replacement.

b. Transfer switches shall be subjected to a maintenance program to include tightening connections, inspection or testing for evidence of overheating and excessive contact erosion, removal of dust and dirt, and replacement of contacts as required. As a minimum, a monthly load test of thirty minute duration shall be conducted on an emergency power system. Backup power should be tested at full critical emergency load. If it is impossible to test at full load, then the test load capacity shall not be less than 50 percent of the total connected critical emergency load. The test should include a complete cold start of the generator. Consideration should also be given to more stringent conditions as recommended by the individual energy converter manufacturer. At the time of emergency power system load testing, all transfer switches and emergency system circuit breakers shall be exercised. The routine maintenance and operational testing program shall be overseen by a properly instructed individual.

10-3. Signal systems.

Signal systems include nurses' call systems, paging systems, buzzers, intercommunication sets and similar devices. For the most part, these do not require servicing at regular intervals. Generally, it is sufficient to clean the equipment occasionally and perform repair after some trouble is indicated. Local evaluation will be used in determining servicing requirements.

10-4. Detection systems.

There are many types of intrusion and fire detection systems in use at military installations. All require frequent tests and checks, in some instances as often as once a day. The emphasis is on operational tests to ensure the continued functionability of the designed system, rather than on routine maintenance of component parts. Spare parts such as relays, contacts, batteries, transistors, pilot lamps and detectors should be stocked for fast replacement. Further information is available from publications listed in appendix A. In all cases, the manufacturer's instructions should be carefulIy followed. Detection alarm systems are generally composed of very rugged and reliable components. Little repair work is required other then replacement of expendable parts and maintenance generally involves the cleaning of alarm system sensors, such as smoke detectors. Because most systems appear complicated and highly sophisticated at first, the tendency is to turn over the maintenance to a service company. In actuality, the systems are much less complicated and most electrical servicemen can master the work with brief training. Electrical shops nor-

really have all the tools and test equipment needed to service these alarm systems. Consequently, the cost will be much less if the routine maintenance is performed in-house.

a. Fire detection system. The concept of defense in depth is applied in fire protection when an early warning fire detection system is used to communicate plant or equipment status to a central location or assigned staff. The first line of defense is the early warning fire detection system designed to detect the particles of combustion formed before overt signs of fire appear, followed by systems designed to detect fire and release extinguishing agents. The system's purpose is to provide the earliest possible warning of a potential fire hazard, principally by the extensive use of ionization smoke detections. One of the major advantages of using a remote multiplexing system for fire detection is the ease of adding alarm detectors without the requirement of long conduit and multiple cable runs throughout the plant. A sample arrangement of this type of system is as shown in figure 10-1. The early warning fire detection system may be a Class A proprietary protective signaling system that meets the requirements of The National Fire Protection Association (NFPA) Standard for the Installation, Maintenance, and Use of Protective Signaling Systems (NFPA 72-90). Class A and Class B fire detection circuits are shown in figure 10-2. Class A means a fire alarm can be received and displayed at the central alarm station in the abnormal presence of a single break of a single ground fault in any signaling circuit. A Class B system does not include this emergency operating feature. NFPA 72-90 also deals with the styles of supervisory circuits. NFPA 72-90 further requires that the central alarm station be continuously manned. Alternative main power supply sources must be provided within the supervisory central station. The signal-initiating device in the fire detection system is the fire detector. The three basic types of detectors can detect smoke, heat, and flame. In addition to these generic types, detectors can be configure as spot type or line type (table 10-1). In spop-type detectors, such as smoke detectors, the sensing element is concentrated at a particular location. Line-type detectors sense temperature changes along the length of a metal wire. When heat above a predetermined level reaches the lines strung throughout an area to be protected, an alarm or alarm and fire-suppression system is triggered. Heat detectors are fixed-temperature, rate-compensated, or rate-of-rise types. A fixed-temperature detector is a device that responds when its operating element becomes heated to a predetermined level or higher. A rate-compensated detector is a device that responds when the temperature of the air surrounding the device reaches a predetermined level, regardless of the rate of temperature rise. A rate-of-rise detector is a device that responds when the temperature rises at a rate exceeding a predetermined amount.

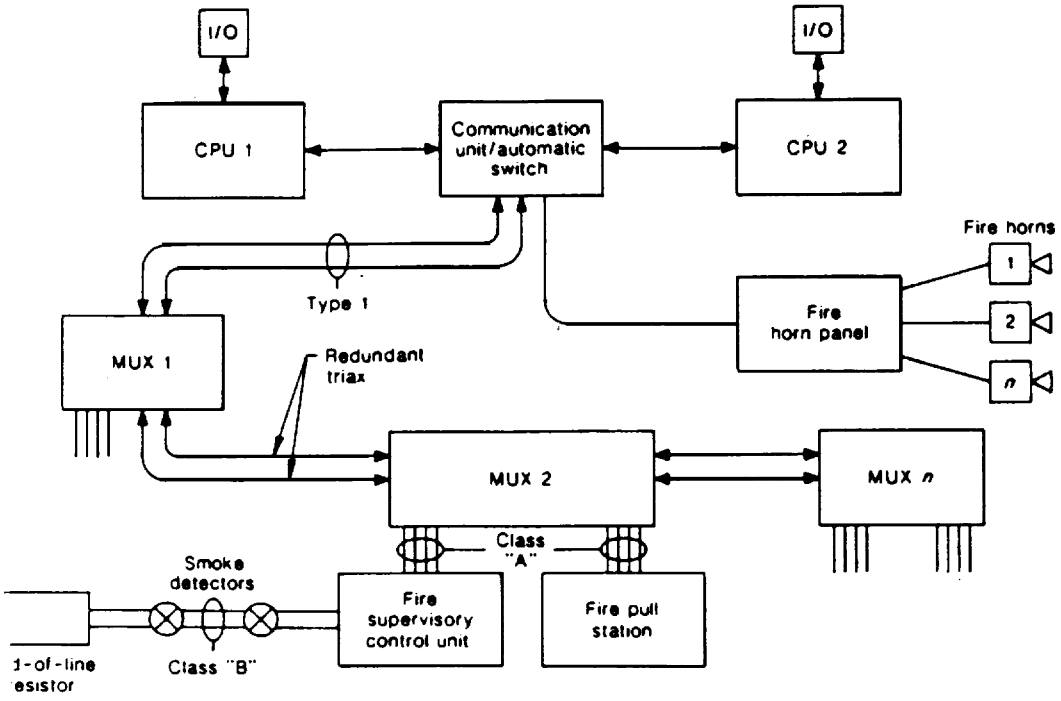
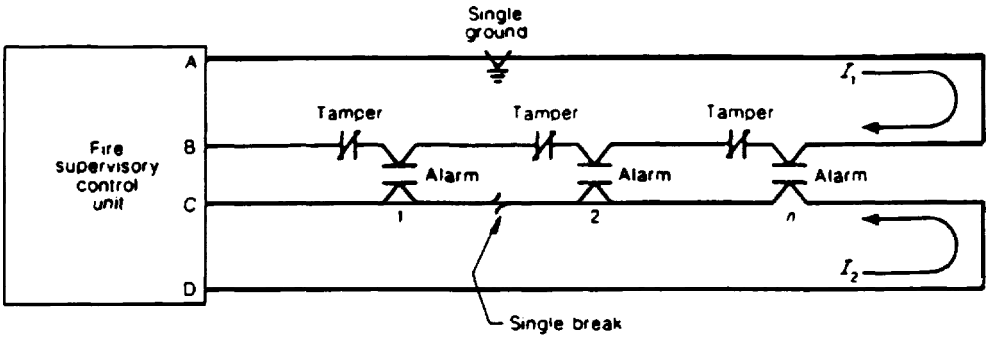
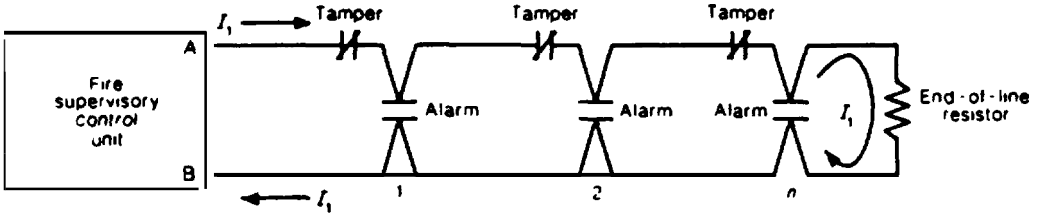


Figure 10-1. Sample computer based fire detection system.



a. Class 'A' fire detection circuit - NFPA 72D-1975



b. Class 'B' fire detection circuit - NFPA 72D-1975

Figure 10-2. Class A and B fire detection circuits.

(1) *Smoke detectors.* Two types of smoke detectors are used: ionization and photoelectric. Ionization smoke detectors contain a small amount of radioactive material which ionizes the air in the sensing chamber, thus rendering it conductive and permitting a current flow through the air between two charged electrodes. When smoke particles enter the ionization area, the detector circuit responds with an alarm or buzzing.

(a) Photoelectric spot-type detectors contain a chamber that has either overlapping or porous covers of light that allows the entry of smoke. The unit contains a light source and a special photosensitive cell in the darkened chamber. The cell is either placed in the darkened chamber at an angle different from the light path or has the light blocked from it by a light stop or shield placed between the light source and the cell. With the admission of smoke particles, light strikes the particles and is scattered and reflected into the photosensitive cell. This causes the photosensing circuit to respond to the presence of smoke particles in the smoke chamber.

(b) Flame detector is a device that responds to the appearance of radiant energy visible to the human eye or to radiant energy outside the range of human vision.

(c) Photoelectric flame detector is a device which the sensing element is a photocell that either changes its electrical conductivity or produces an electrical potential when exposed to radiant energy.

(d) Flame flicker detector is a photoelectric flame detector with means to prevent response to visible light unless the observed light is modulated at a frequency characteristic of the flicker of a flame.

(e) Infrared detector is a device with a sensing element which is responsive to radiant energy outside the range of human vision.

(f) Ultraviolet detector is a device with a sensing element which is responsive to radiant energy outside the range of human vision.

(2) *Sprinkler systems.* Protecting the plant from fire frequently requires the installation of a sprinkler system. Equipment consisting of overhead piping and attached sprinklers connected to an automatic water supply protects defined spaces and a variety of hazards. There are four major types 'of sprinkler systems: The wet-pipe system is the simplest and most common. The piping is always filled with water, which begins to flow as soon as the first sprinkler opens. Other types are dry-pipe, deluge, and pre-action systems.

b. Security system. Before the advent of low-cost computer multiplexed hardware, security systems were simple hardwired alarm systems, providing a minimum level of intrusion detection. Today, the system may be a fully redundant computer-based system interfaced with a redundant looped time-division-multiplexed communication network for gathering alarm data from sensors and for sending

Table 10-1. Comparison of fire detectors.

Type of Detector	Applications	Response	Comments
Photoelectric	Offices, computer rooms; projected beam type used in open areas and to protect high rack storage	Early warning to smoldering fires, sometimes in seconds	Must be used indoors where smoke can be contained; not adversely affected by wind; moderate cost
Ionization	Offices, computer rooms	Early warning to fast flaming fires, sometimes in seconds	Adversely affected by wind; should be used indoors. moderate cost
Fixed temperature	Large areas where life safety is not paramount; and to protect heat generating equipment	Responds when a predetermined temperature is reached, usually in minutes	Usually limited to indoor applications; has a very low false alarm rate; a simple reliable device; low cost
Rate of rise; rate compensated	Large areas where life safety is not paramount	Responds to a specified temperature rise or a selected protection level, usually faster than fixed-temperature detector	Should be used indoors; may be affected by space heaters; low false alarm rate; suitable for corrosive environments: low cost
Infrared	Hazardous processes; explosion suppression, ducts or other dark, enclosed areas; aircraft hangars	Rapid response in milliseconds to infrared radiation generated by fire	Indoor use, may be affected by temperature, other IR sources; explosion-proof housings available; high cost
Ultraviolet	Hazardous processes, explosion suppression, fuel loading, aircraft hangars	Rapid response in milliseconds to ultraviolet radiation generated by fire	May be used indoors or out; explosion-proof housings available; may be blinded by oil film, thick smoke, sensitive to arc welding; high cost

commands to release locked doors under the card-access control subsystem. The remote multiplexer may be microprocessor-based units, capable of data collection, communication with the host computer, and performing limited-access control functions. The security system provides location information as well as delay time for the guards. By successive detections, the security force can track the intruder and relay location information via portable radio communications equipment to the responding guards. In turn, the guards can constantly inform the security force on the progress of their work or the need for additional assistance. The cameras, using various means of target intensification, can "see" better than the human eye. Guard patrols are also used to detect unusual activity. Perimeter detection is accomplished by the application of electronic detection systems.

(1) *Microwave detection links.* These devices are mounted on posts inside the fence. Transmitters radiate amplitude modulated X-band energy and receivers detect and process the received energy. Thus, an invisible energy envelope is produced that will detect an intruder.

(2) *Infrared detection links.* These devices are postlike and mounted inside the fence. Transmitters radiate multiple beams of modulated infrared energy, and the receivers detect and process the energy. Penetration of the invisible infrared shield will alarm the system.

(3) *E-field links.* Transmitter wires and receiver wires are strung horizontally from mounting posts located inside the fence or mounted on the fence. A radio-frequency energy field is generated around the wires. The intrusion of a person into the invisible field will "short" energy, creating an alarm.

(4) *Buried sensor links.* Devices sensing seismic, pressure, (or electromagnetic disturbances for a combination of these) are buried inside the fence and alarm upon the intrusion of someone into the field of detection.

(5) *Other systems.* Other systems are available that can be used in combination with the previously mentioned systems. The probability of detection by these outdoor devices depends on their application. Perimeter detection equipment must be applied with consideration of the environmental limitations of the device's technology. Once the intruder has penetrated the fence, he has entered what is called the protected area. Once again, visual or closed-circuit television surveillance may detect the intruder. Entry into a building is provided by the application of a balanced magnetic switch on doors and openings. This device uses an internal bias magnet to balance a delicate reed switch in the field of the external magnet attached to the door. Should the door be opened, even a fraction of an inch, or should another magnet be introduced in an attempt to defeat it, the switch will change state and alarm. Other devices for detection of an intruder may be applied inside the building, including microwave and infrared motion detection, photoelectric or laser beams, seismic, sound detection, passive infrared, and other devices. Because all the doors are locked and alarmed, a means of allowing personnel to enter and leave must be provided. Positive-access control is established at the main guardhouse located at the perimeter fence. All persons with a need to enter the protected area are screened by explosive detectors, metal detectors, and package X-ray detection equipment. Once permitted access to the plant protected area, they are only allowed into vital areas within the plant on a need-to-enter basis. Control of personnel movement into vital areas is by closed-circuit television/electronic-access control equipment. At each vital area door, split image closed-circuit television devices check the person against his picture identification card. He then inserts his coded card into a magnetic reader, which sends the coded information to the access computer. If the person has been authorized to enter the particular vital area of the plant at that particular time, the computer verifies the code and allows access. The guard watches the entrance via wide-angle closed-circuit television to ensure that the person enters alone. Using state-of-the-art circuit design and multiplexing communication techniques, the alarm monitoring systems offer a high degree of tamper resistance. Redundancy is achieved by using a central alarm station and a separately located secondary alarm station. Electronic line supervision or digitally encoded transmissions are used to prevent unauthorized persons from touching the system wiring. Any tampering will cause an alarm. Access control, tamper indication, and administrative controls combine to prevent an insider from attempting to sabotage the plant or help an outsider penetrate the security system.

10-5. Monitoring systems.

Supervising the operations of the environmental conditions throughout a building can be achieved by the use of an integrated monitoring system. This system consists of a centrally located console capable of continually monitoring many activities. Console input signals may be initiated by pressure, temperature, speed, humidity, air flow, electric current, water, steam, sewage, or opening or closing of electric contacts. With this system, an operator can quickly determine the operating condition of any number of sewage lift stations, air conditioning equipment, boiler auxiliaries or any other measur-

able condition or situation. Malfunctions are pinpointed in moments. The necessity for making daily field checks is reduced or eliminated. Monitoring systems consist of transducers located at the monitored equipment which convert some action into a signal which, in turn, is transmitted to the console by pneumatic, electrical or electronic means. Detailed plans, instruction books and maintenance manuals on such systems should be obtained. Building personnel, whenever possible, should survey the installation of the system and be able to locate components and determine operational methods. Most monitoring systems contain solid-state devices which are very reliable, but still require annual servicing to ensure that all parts are functioning properly (see chap 7). If skilled in-house personnel are not available, local service contracts should be used to accomplish servicing.