

ARIZONA PUBLIC SERVICE COMPANY
PALO VERDE NUCLEAR GENERATING STATION
OPERATIONS QUALITY ASSURANCE CRITERIA MANUAL

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Table 9B.3-1

COMPARISON OF PALO VERDE NUCLEAR GENERATING STATION TO APPENDIX A OF NRC BRANCH TECHNICAL POSITION AFCSB 9.5-1 (Sheet 33 of 68)

D. GENERAL GUIDELINES FOR PLANT PROTECTION (CONTINUED)

APPLICATION DOCKETED BUT CONSTRUCTION PERMIT NOT RECEIVED AS OF 7/1/76	PLANTS UNDER CONSTRUCTION AND OPERATING PLANTS	PVNGS POSITION AND BASIS FOR NON-COMPLIANCE ITEMS
<p>5. <u>Lighting and Communication (Cont)</u></p> <p>individual 8-hour minimum battery power supplies.</p> <p>(b) Suitable sealed beam battery powered portable hand lights should be provided for emergency use.</p> <p>(c) Fixed emergency communication should use voice powered head sets at pre-selected stations.</p> <p>(d) Fixed repeaters installed to permit use of portable radio communication units should be protected from exposure to fire damage.</p>	<p>5. <u>Lighting and Communication (Cont)</u></p>	<p>5. <u>Lighting and Communication (Continued)</u></p> <p>safe shutdown equipment and in access and egress routes thereto. Emergency lighting for personnel egress from other plant areas is provided by 1-1/2-hour battery units. See section 9B.2, "Fire Hazards Analysis", for specific zones containing emergency lighting.</p> <p>(b) Suitable sealed beam battery powered portable hand lights are provided for emergency use.</p> <p>(c) Fixed emergency voice-powered headsets are provided at pre-selected stations. See section 9B.2 for specific zones containing voice powered headset phone jacks.</p> <p>(d) Fixed repeaters are not utilized in PVNGS. The design at PVNGS uses radio communications and base stations for communications between control room and remote shutdown panels. The base stations are located remotely and wired to the control stations. These base stations are not protected from exposure fire damage. (See Appendix 9A response to Question 9A.129).</p>

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 PVNGS FSAR
 COMPARISON OF PALO VERDE NUCLEAR
 GENERATING STATION TO APPENDIX A OF
 NRC BRANCH TECHNICAL POSITION AFCSB 9.5-1

OTHER AUXILIARY SYSTEMS

area. Outdoor lighting complies with the security provisions of ANSI N18.17-1973.

B. Power Generation Design Basis Two

Mercury-vapor fixtures and mercury switches are not used inside the containment building and fuel building.

C. Power Generation Design Basis Three

Lighting fixtures containing aluminum or aluminum alloys are not used inside the containment building.

9.5.3.1.3 Codes and Standards

Design and installation of the plant lighting systems use the guidance provided by the National Electrical Code (NFPA No. 70-1975/ANSI C1-75) and the Handbook of the Illuminating Engineering Society.

9.5.3.7 System Description

9.5.3.2.1 General Description

Unit lighting is divided into three subsystems: normal, essential, and emergency. The normal system is supplied from non-Class 1E ac buses. The essential system is connected to Class 1E ac buses. The emergency lighting system, consisting of batteries, battery chargers, and lamps, is fed from the same supply as the essential lighting and function upon loss of ac power. Refer to table 9.5-5 for a list of areas, requiring operator access to achieve safe shutdown in the event of fire, served by both the essential and emergency lighting systems.

9.5.3.2.2 Component Description

The three lighting categories are described briefly in the following paragraphs.

From
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REQUIREMENT

DESIGN FEATURE

II. A site fire brigade shall be established, trained, and equipped for manual firefighting.

PVNGS will comply

I. The fire brigade training program shall ensure that the capability to fight potential fires is established and maintained

PVNGS will comply

J. Emergency lighting units with at least 8-hour battery supply shall be provided in all areas needed for operation of safe shutdown equipment and in access and egress routes thereto

PVNGS complies

K. Administrative controls shall be implemented to minimize fire hazards in areas important to safety

The PVNGS Manager of Nuclear Operations will establish controls as required

L. 1. Alternative or dedicated shutdown capability provided for a specific area shall be able to achieve and maintain cold shutdown. During the postfire shutdown, the reactor

PVNGS alternative shutdown capability, which is required only for the control room, has this capability

2. E. C. 1) P. 4

2. E. C. 1)

OTHER AUXILIARY SYSTEMS

area. Outdoor lighting complies with the security provisions of ANSI N18.17-1973.

B. Power Generation Design Basis Two

Mercury-vapor fixtures and mercury switches are not used inside the containment building and fuel building.

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9.5.3.2.2 Component Description

The three lighting categories are described briefly in the following paragraphs.

OTHER AUXILIARY SYSTEMS

The emergency lighting system is described in subsection 9.5.3.

* | Applicable codes and regulations of the State of Arizona, the National Fire Codes of the National Fire Protection Association (NFPA), and applicable sections of Title 29, Chapter XVII, Part 1910, Occupational Safety and Health Standards of the Code of Federal Regulations, as set forth in the Federal Register, Volume 37, Number 202, dated October 18, 1972, have been used as guidance in developing the plant fire protection system design.

9.5.1.2 System Description

The water and gaseous portions of the fire protection systems are shown schematically in figure 9.5-1.

Table 9.5-1 provides a tabulation of the types of fire protection and fire detection and actuating devices provided for each specific area in the plant.

Each unit's fire protection system is comprised of diversified monitoring, detection, alarm, suppression, and extinguishment facilities particularly selected to protect the area or equipment from damage by fire. The system includes the following major features:

- Fire protection water supplies, yard mains, and hydrants
- Wet pipe sprinkler systems (hydraulically designed)
- Deluge water spray systems (hydraulically designed)
- Automatic preaction systems (hydraulically designed)
- Low-pressure carbon dioxide systems
- Halon 1301 systems
- Standpipes and fire hose stations

FSAR Section 9.5.3.1.3 reads, "Design and installation of the plant lighting systems use the guidance provided by the National Electrical Code (NFPA No. 70-1975/ANSI C1-75) and the Handbook of the Illuminating Engineering Society".

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The results of the inspector's examination of the licensee's implementation of these requirements are as follows:

(a) Control Building, Auxiliary Building, Diesel Generator Building and Main Steam Support Structure Emergency Lighting Design and Implementation

The National Electrical Code (NFPA 70-1975/ANSI C1-75), Article 400-4, requires that emergency lighting fixtures and equipment be designed, tested and accepted for a specific purpose or application by a nationally recognized testing laboratory. The various types of battery powered emergency lighting units installed to support operator actions to achieve safe shutdown in the event of a fire at Palo Verde were tested and accepted by Underwriters Laboratories Inc., for use in environments with ambient temperatures of 77 degrees F, as specified in APS Material Requisition No. 13-EM-041B, referencing Underwriters Laboratory (UL) Standard No. 924.

The various battery manufacturer's literature state that the manufacturer's warranty is invalidated if the batteries are operated in ambient temperatures above 110 degrees F., or if the batteries are not maintained in accordance with the National Electrical Code.

FSAR Table 9.4.2 specified the maximum operating space temperatures for certain areas requiring operator actions in support of safe shutdown as follows: Auxiliary Building, 104 degrees F; ESF Pump Room, 120 degrees F; Diesel Generator Room, 140 degrees F; Diesel Generator Control Room, 122 degrees F and Essential Spray Pond Pump House, 120 degrees F. The battery powered emergency lighting units installed to support operator actions to achieve safe shutdown in these areas apparently were not tested and accepted for operation in the maximum space temperatures experienced in these areas.

Additionally, the emergency lighting units that were installed in June 1989 in the MSSS, and in access and egress routes thereto, apparently have not been tested and approved for use in outdoor wet locations, or the high ambient outdoor temperature environments experienced at Palo Verde during summer months.

Regarding Johnson Controls Model 6VHC-96, Dynasty GC 12V-100 and 12UPS-300 lead-acid and gel-cell batteries supplying power to fluorescent emergency lighting fixtures in the Auxiliary Building, the battery capacity ratings do not appear to provide the power needed to sustain 8 hour

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NATIONAL ELECTRICAL CODE

ARTICLE 410—LIGHTING FIXTURES, ETC.

70-247

Conductors in Conduit. The number of fixture wires in the conduit shall be as given in Table 2 of Chapter 9.

Conductor Identification. One conductor of fixture wire intended to be used as a grounded conductor shall be identified by stripes or by the means described in Sections 310-11(a) through 310-11(e).

Marking. All fixture wires shall be marked to indicate the information required in Section 310-11(a).

Marking. Thermoplastic-insulated fixture wire shall be marked on its surface at intervals not exceeding 24 inches. Thermoplastic-insulated fixture wire shall be marked by means of a printed tag attached to the wire, or on the reel, or on the carton.

Permitted. Fixture wires shall be permitted: (1) for use in lighting fixtures and in similar equipment where enclosed in a raceway or subject to bending or twisting in use; or (2) for use in lighting fixtures to the branch-circuit conductors supplying the fixture.

Permitted. Fixture wires shall not be used as branch-circuit conductors for lighting fixtures as permitted by Section 725-16 for Class 1 circuits.

Protection. The protection for fixture wires shall be as specified in Section 300-10.

— LIGHTING FIXTURES, LAMPHOLDERS, RECEPTACLES, AND ROSETTES

A. General

Article covers lighting fixtures, lampholders, pendant lampholders, incandescent filament lamps, arc lamps, lamps, the wiring and equipment forming part of such lighting installations which shall conform to the requirements of this Code.

Articles. Equipment for use in hazardous locations 500 through 517.

Fixtures, lampholders, lamps, rosettes, and receptacle parts normally exposed to contact. Exposed lampholders, receptacles, and switches shall not be used in canopies or in open bases of portable table lamps.

Exception: Cleat-type lampholders, receptacles, and rosettes located at least 8 feet above the floor shall be permitted to have exposed contacts.

B. Fixture Locations

410-4. Fixtures in Specific Locations

(a) Wet and Damp Locations. Fixtures installed in wet or damp locations shall be approved for the purpose and shall be so constructed or installed that water cannot enter or accumulate in wireways, lampholders, or other electrical parts. All fixtures installed in wet locations shall be marked, "Suitable for Wet Locations." All fixtures installed in damp locations shall be marked, "Suitable for Wet Locations" or "Suitable for Damp Locations."

Installations underground or in concrete slabs or masonry in direct contact with the earth, and locations subject to saturation with water or other liquids, such as locations exposed to weather and unprotected, vehicle washing areas, and like locations, shall be considered to be wet locations with respect to the above requirement.

Interior locations protected from weather but subject to moderate degrees of moisture, such as some basements, some barns, some cold storage warehouses and the like, the partially protected locations under canopies, marquees, roofed open porches, and the like, shall be considered to be damp locations with respect to the above requirement.

See Article 680 for lighting fixtures in swimming pools, fountains, and similar installations.

(b) Corrosive Locations. Fixtures installed in corrosive locations shall be of a type approved for such locations.

See Section 210-7 for receptacles in fixtures.

(c) In Ducts or Hoods. Fixtures in nonresidential occupancies shall not be installed in ducts or hoods used for removal of cooking smoke or grease-laden vapors or located in the path of travel of such exhaust products unless approved for the purpose.

Fixtures in nonresidential occupancies having approved metal enclosures mounted on the outer surface of the hood and separated from exhaust products by tight fitting glass shall be permitted. Fixtures on hoods in nonresidential occupancies shall not be located in concealed spaces unless part of an approved grease extractor.

410-5. Fixtures Near Combustible Material. Fixtures shall be so constructed, or installed, or equipped with shades or guards that combustible material will not be subjected to temperatures in excess of 90°C (194°F).

410-6. Fixtures Over Combustible Material. Lampholders installed over highly combustible material shall be of the unswitched type. Unless an individual switch is provided for each fixture, lampholders shall be located at least 8 feet above the floor, or shall be so located or guarded that the lamps cannot be readily removed or damaged.

410-7. Fixtures in Show Windows. Externally wired fixtures shall not be used in a show window.

Exception: Fixtures of the chain-supported type may be externally wired.

Chapter 1. General

ARTICLE 100 — DEFINITIONS

Scope. Only definitions of terms peculiar to and essential to the proper use of this Code are included. In general, only those terms used in two or more Articles are defined in Article 100. Other definitions are included in the Article in which they are used but may be referenced in Article 100.

Part A of this Article contains definitions intended to apply wherever the terms are used throughout this Code. Part B contains definitions applicable only to the Parts of Articles covering specifically installations and equipment operating at over 600 volts, nominal.

A. General

AC General-Use Snap Switch: See under "Switches."

AC-DC General-Use Snap Switch: See under "Switches."

Accessible: (As applied to wiring methods.) Capable of being removed or exposed without damage to the building structure or finish, or not permanently closed in by walls, ceilings, or finish of the building. (See "Concealed" and "Exposed.")

Accessible: (As applied to equipment.) Admitting close approach because not guarded by locked doors, elevation, or other effective means. (See "Readily Accessible.")

Ampacity: Current-carrying capacity of electric conductors expressed in amperes.

Anesthetizing Location: See Section 517-2.

Appliance: Utilization equipment, generally other than industrial, normally built in standardized sizes or types, which is installed or connected as a unit to perform one or more functions such as clothes washing, air conditioning, food mixing, deep frying, etc.

Appliance, Fixed: An appliance which is fastened or otherwise secured at a specific location.

Appliance, Portable: An appliance which is actually moved or can easily be moved from one place to another in normal use.

Appliance, Stationary: An appliance which is not easily moved from one place to another in normal use.

Appliance Branch Circuit: See "Branch Circuit, Appliance."

Approved: Acceptable to the authority having jurisdiction.

Approved for the Purpose: Approved for a specific purpose, environment, or application described in a particular Code requirement.

Askarel: A generic term for a group of nonflammable synthetic chlorinated hydrocarbons used as electrical insulating media. Aska-

rels of various compositional type, the gases produced, while consisting primarily of hydrogen chloride, can include others depending upon the askarel type.

Attachment Plug (Plug Cap) (C): A receptacle, establishes connection between attached flexible cord and the contact receptacle.

Automatic: Self-acting, operated by some impersonal influence such as current strength, pressure, temperature, etc. ("Nonautomatic.")

Bare Conductor: See under "Conductors."

Block (City, Town, or Village):

Bonding: The permanent joint or connection of a metallically conductive path which has sufficient capacity to conduct safely any current that may be expected.

Bonding Jumper: A reliable electrical connection between metal parts.

Bonding Jumper, Circuit: The conductor in a circuit to maintain required continuity.

Bonding Jumper, Equipment: The conductor connecting portions of the equipment grounded to the equipment.

Bonding Jumper, Main: The conductor connecting the circuit conductor and the equipment grounded to the equipment.

Branch Circuit: The circuit conductor and the equipment protected by the device protecting the circuit and the equipment. (See Section 240-9 for thermal cutouts.)

Branch Circuit, Appliance: A branch circuit having one or more outlets to which appliance is connected to have no permanently connected appliance.

Branch Circuit, General Purpose: A branch circuit having a number of outlets for lighting and utilization equipment.

Branch Circuit, Individual: A branch circuit having one utilization equipment.

Branch Circuit, Multiwire: A branch circuit having two or more ungrounded conductors having the same phase-to-phase voltage, and an identified grounded conductor which is connected to the neutral point of the ungrounded conductors.

Branch-Circuit Selection Current:

Building: A structure which stands on a permanent foundation and adjoining structures by fire walls or approved fire doors.

Storage and Handling of Liquefied Petroleum Gases at Utility Gas Plants (NFPA No. 59-1968).

For protection against static electricity hazards, see Recommended Practice on Static Electricity (NFPA 77-1972).

All conduit referred to herein shall be threaded with a standard conduit cutting die that provides $\frac{3}{4}$ -inch taper per foot. Such conduit shall be made up wrench tight to minimize sparking when fault current flows through the conduit system. Where it is impractical to make a threaded joint tight, a bonding jumper shall be utilized.

500-2. Special Precaution. Articles 500 through 503 require a form of construction of equipment and of installation that will insure safe performance under conditions of proper use and maintenance.

It is important that inspection authorities and users exercise more than ordinary care with regard to installation and maintenance.

The explosion characteristics of air mixtures of hazardous gases, vapors, or dusts vary with the specific material involved. For Class I locations, Group A, B, C, and D, the classification involves determinations of maximum explosion pressure, maximum safe clearance between parts of a clamped joint in an enclosure and the minimum ignition temperature of the atmospheric mixture. For Class II locations, Groups E, F, and G, the classification involves the tightness of the joints of assembly and shaft openings to prevent entrance of dust in the dust-ignition-proof enclosure, the blanketing effect of layers of dust on the equipment that may cause overheating, electrical conductivity of the dust, and the ignition temperature of the dust. It is necessary, therefore, that equipment be approved not only for the class, but also for the specific group of the gas, vapor, or dust that will be present.

For purposes of testing and approval, various air mixtures (not oxygen enriched) have been grouped on the basis of their hazardous characteristics and facilities have been made available for testing and approving equipment for use in the following atmospheric groups:

For Groups A, B, C, and D, see Table 500-2.

Group E: Atmospheres containing metal dust, including aluminum, magnesium and their commercial alloys, and other metals of similarly hazardous characteristics.

Group F: Atmospheres containing carbon black, charcoal, coal or coke dust which have more than 8 percent total volatile material (carbon black per ASTM D1620, charcoal, coal and coke dusts per ASTM D271) or atmospheres containing these dusts sensitized by other materials so that they present an explosion hazard.

Group G: Atmospheres containing flour, starch, or grain dust.

Certain chemical atmospheres may have characteristics that require safeguards beyond those required for any of the above groups. Carbon disulfide is one of these chemicals because of its low ignition temperature, 100°C (212°F), and the small joint clearance required to arrest its flame. For a complete list noting properties of flammable liquids, gases, and solids, see Fire-Hazard Properties of Flammable Liquids, Gases, and Volatile Solids (NFPA No. 325M-1969).

(a) Approval for Class and Properties. Equipment shall be approved not only for the class of location but also for the explosion properties of the specific gas, vapor, or dust that will be present. In addition, equipment shall not have exposed any surface that operates at a temperature in excess of the ignition temperature of the specific gas, vapor, or dust.

The characteristics of various atmospheric mixtures of hazardous gases, vapors, or dusts depend on the specific hazardous material involved.

(b) Marking. Approved equipment shall be marked to show the Class, Group, and operating temperature, or temperature range, based on operation in a 40°C ambient, for which it is approved.

The temperature range, if provided, shall be indicated in identification numbers, as shown in Table 500-2(b).

Identification numbers marked on equipment nameplates shall be in accordance with Table 500-2(b).

Exception No. 1: Equipment of the nonheat-producing type, such as motion boxes, conduit, and fittings and equipment of the heat-producing type having a maximum temperature not more than 100°C (212°F), shall not be required to have a marked operating temperature or temperature range.

Exception No. 2: Fixed lighting fixtures marked for use in Class I Division 2 locations only, need not be marked to indicate the Group.

For purposes of testing and approval, various atmospheric mixtures (not oxygen enriched) have been grouped on the basis of their hazardous characteristics, and facilities have been made available for testing and approving equipment for use in the atmospheric groups listed in Table 500-2. Since there is no consistent relationship between explosion properties and ignition temperature, the two are independent requirements.

(c) Temperature. The temperature marking specified in (b) above shall not exceed the ignition temperature of the specific gas or vapor to be encountered.

For information regarding ignition temperatures of gases and vapors, see Fire-Hazard Properties of Flammable Liquids, Gases, Volatile Solids (NFPA No. 325M-1969).

Formerly the temperature limit of each Group was assumed to be the lowest ignition temperature of any material in the Group, i.e., 280°C for Group D, 180°C for Group C.

To avoid revising this limit as new gases are added (see hexane in Group D and acetaldehyde in Group C), temperature will be specified in future markings.

The ignition temperature for which equipment was approved prior to this requirement shall be assumed to be as follows:

- Group A—280°C (536°F)
- Group B—280°C (536°F)
- Group C—180°C (350°F)
- Group D—280°C (536°F)

Maximum surface temperatures for equipment in Class II hazardous locations are covered in Section 502-1.

500-3. Specific Occupancies. Articles 510 through 517 cover garages, aircraft hangars, gasoline dispensing and service stations, bulk storage plants, finishing processes, and health care facilities.

500-4. Class I Locations. Class I locations are those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures. Class I locations shall include those specified in (a) and (b) below.

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NUREG-75/087
MAY 9, 1976

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Revision of Section 9.5.1

STANDARD REVIEW PLAN FOR THE REVIEW OF SAFETY ANALYSIS REPORTS FOR NUCLEAR POWER PLANTS

LWR EDITION

OFFICE OF NUCLEAR REACTOR REGULATION
U.S. NUCLEAR REGULATORY COMMISSION

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SEP 29 1976

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4. Definitions

For the user's convenience, some of the terms related to fire protection are presented below with their definitions as used in this BTP.

Approved - tested and accepted for a specific purpose or application by a nationally recognized testing laboratory.

Automatic - self-acting, operating by its own mechanism when actuated by some impersonal influence such as a change in current, pressure, temperature or mechanical configuration.

Combustible Material - material that does not meet the definition of noncombustible.

Control Room Complex - the zone served by the control room emergency ventilation system (see SRP Section 6.4, "Habitability Systems").

Fire Area - that portion of a building or plant that is separated from other areas by boundary fire barriers.

Fire Barrier - those components of construction (walls, floors and their supports), including beams, joists, columns, penetration seals or closures, fire doors and fire dampers that are rated by approving laboratories in hours of resistance to fire and are used to prevent the spread of fire.

Fire Stop - a feature of construction that prevents fire propagation along the length of cables or prevents spreading of fire to nearby combustibles within a given fire area or fire zone.

Fire Brigade - the team of plant personnel assigned to firefighting and who are equipped for and trained in the fighting of fires.

Fire Detectors - a device designed to automatically detect the presence of fire and initiate an alarm system and other appropriate action (see NFPA 72E, "Automatic Fire Detectors"). Some typical fire detectors are classified as follows:

Heat Detector - a device that detects a predetermined (fixed) temperature or rate of temperature rise.

Smoke Detector - a device that detects the visible or invisible products of combustion.

BRANCH TECHNICAL POSITION CMBB 9.5-1

(Formerly BTP ASB 9.5-1)

GUIDELINES FOR
FIRE PROTECTION FOR NUCLEAR POWER PLANTS

2.E(1)(a) P. 1

room, it is necessary to employ other measures to prevent a fire from causing the loss of function of safety-related systems.

Within fire areas containing components of a safety-related system, special attention should be given to detecting and suppressing fires that may adversely affect the system. Measures that may be taken to reduce the effects of a postulated fire in a given fire area include limiting the amount of combustible materials, installing fire-resistant construction, providing fire rated barriers for cable trays, installing fire detection systems and fixed fire suppression systems, or providing other protection suitable to the installation. The fire hazard analysis will be the mechanism to determine that fire areas have been properly selected.

2.E(1)(a)

Suitable design of the ventilation systems can limit the consequences of a fire by preventing the spread of the products of combustion to other fire areas. It is important that means be provided to ventilate, exhaust, or isolate the fire area as required and that consideration be given to the consequences of failure of ventilation systems due to fire causing loss of control for ventilating, exhausting, or isolating a given fire area. The capability to ventilate, exhaust, or isolate is particularly important to ensure the habitability of rooms or spaces that must be attended in an emergency. In the design, provision should be made for personnel access to and escape routes from each fire area.

4. Definitions

For the user's convenience, some of the terms related to fire protection are presented below with their definitions as used in this BTP.

Approved - tested and accepted for a specific purpose or application by a nationally recognized testing laboratory.

Automatic - self-acting, operating by its own mechanism when actuated by some impersonal influence such as a change in current, pressure, temperature, or mechanical configuration.

Combustible Material - material that does not meet the definition of noncombustible.

Control Room Complex - the zone served by the control room emergency ventilation system (see SRP Section 6.4, "Habitability Systems").

Exposure Fire - An exposure fire is a fire in a given area that involves either in situ or transient combustibles and is external to any structures, systems, or components located in or adjacent to that same area. The effects of such fire (e.g., smoke, heat, or ignition) can adversely affect those structures, systems, or components important to safety. Thus, a fire involving one train of safe shutdown equipment may constitute an exposure fire for the redundant train located in the same area, and a fire involving combustibles other than either redundant train may constitute an exposure fire to both redundant trains located in the same area.

Fire Area - that portion of a building or plant that is separated from other areas by boundary fire barriers.

ENGINEERING EVALUATION

SUBJECT: Alternatives to emergency lighting units located in the Turbine Breezeway, stairs K, and in the MSSS building at elevation 140'.

PROBLEM: The existing installed Emergi-Lite units have questionable workmanship. This led to concerns about the lifespan of the unit in the PVNGS high ambient temperature environment.

SOLUTION I: Replace the existing emergency lighting units with new units that can withstand the jobsite environment for the specified time.

EVALUATION OF SOLUTION I: This solution is based on the specification that the emergency lighting unit can operate for eight hours at one hundred twenty degrees Fahrenheit. Forty-seven companies were considered of which thirteen produced similar products or were interested in looking into producing such a product. Of these thirteen, only two were willing to back their product with letters of certification. Unfortunately, these letters were not backed by sufficient test data. Several of the larger manufacturers have indicated that to their knowledge, no one in the emergency lighting industry is producing a product that can withstand one hundred twenty degrees Fahrenheit. This is because the industry uses the UL standard for operation of electronics which is one hundred five degrees Fahrenheit. This temperature is well below the summer temperatures in Phoenix making their units unacceptable for our application. Therefore, an emergency lighting unit is not available to fit our needs.

SOLUTION II: Place inverters in the Turbine Building and run branch circuits to emergency fixtures installed in the Turbine Breezeway, stairs K, and MSSS building elevation 140'.

EVALUATION OF SOLUTION II: If two inverters are used and the adjacent lights are staggered between the two, the problem of no light in the breezeway due to unit failure is minimized. Furthermore, by placing the inverters in a cooler environment within the turbine building prevents the problem of high temperatures on the electronics of the inverter. A walkdown on 8/23/89 confirmed that there is sufficient space for the inverters within the switchgear room of the Turbine Building.

RECOMMENDATION: Replace the emergency lighting units located in the Turbine Breezeway, Stairs K, and MSSS elevation 140' with fixtures powered by inverters as discussed above.

2. ECI (a) P-1

UL 924

STANDARD SAFETY

EMERGENCY LIGHTING
AND
POWER EQUIPMENT



UNDERWRITERS
LABORATORIES
INC.

SA4.5 For the purpose of this investigation, all tests are to be conducted at an ambient temperature of $25 \pm 5^\circ\text{C}$ ($77 \pm 9^\circ\text{F}$). The measurements symbolized in Table SA4.1 are as follows:

I_c — Specified charge current range (maximum and minimum).

I_1 — Battery charger current during battery charge cycle.

I_2 — Battery current rating.

T_c — Temperature on battery case during charge cycle.

T_d — Temperature on battery case during discharge cycle.

V_c — Specified charger voltage range (maximum and minimum).

V_1 — Battery terminal voltage during charge cycle.

V_2 — Closed circuit voltage at battery terminals at end of discharge cycle.

SA4.6 The specified test sequence is to be repeated so that data can be collected at the maximum and minimum manufacturer-specified battery charger voltages or currents, or both.

SA4.7 After the test sequence has been completed, the tabulated values of temperature, voltage, and current are to be plotted as functions of time. These curves represent performance at both maximum and minimum charging rates and are to be retained as reference.

SA4.8 A substitute battery is acceptable without further testing if (1) the output voltage and current of the charger in the unit fall within the charging limits established for the substitute, and (2) the constant current discharge rating of the substitute battery is equal to or greater than the rated discharge current of the battery originally tested in the unit.

SA4.9 A substitute charger may be used if its output voltage and current permit it to be used with each battery that is recognized for use with the unit, and if it meets all other end use requirements.

SA4.10 Batteries, battery chargers, and loads complying with the applicable requirements identified elsewhere in this standard, and compatible with each other as specified in paragraphs SA4.8 and SA4.9, may be substituted without repetition of the complete battery discharge sequence described in Sections 37 and 43.

SA5. Sealed Battery Cell Pressure Relief Test

SA5.1 A sealed battery shall comply with Section 38.

SA6. Battery Vent Cap Test

SA6.1 A vented battery shall comply with Section 39.

MARKINGS

SA7. General

SA7.1 The battery shall be plainly and permanently marked with the manufacturer's name or trademark, month and year of manufacture, and a distinctive catalog number or the equivalent.

42. Temperature Test

42.1 The materials used in the construction of a unit shall not be affected adversely by the temperatures attained under any condition of intended operation.

42.2 A material will be considered as being adversely affected if it is subject to a temperature rise greater than that indicated in Table 42.1.

42.3 The values for temperature rise in Table 42.1 are based on an assumed ambient temperature of $25 \pm 15^\circ\text{C}$ ($77 \pm 27^\circ\text{F}$), and tests are to be conducted at an ambient temperature within that range.

42.4 Temperature readings may be obtained by thermocouples, and a temperature is considered to be constant when three successive readings, taken at intervals of 10 percent of the previously elapsed duration of the test but not less than 10-minute intervals, indicate no change.

42.5 Ordinarily the method of measuring the temperature of a coil or winding is the resistance method, but temperature measurements by either the thermocouple or resistance method can be used.

Exception: The thermocouple method is not to be used for a temperature measurement at any point at which supplementary insulation is used.

42.6 The thermocouple method consists of the determination of temperature by the application of thermocouples to the hottest accessible parts.

42.7 Thermocouples are to consist of wires no larger than No. 24 AWG (0.21 mm^2) and no smaller than No. 30 AWG (0.05 mm^2). It is the standard practice to use thermocouples consisting of No. 30 AWG iron and constantan wires and a potentiometer-type indicating instrument; such equipment is to be used whenever referee temperature measurements with thermocouples are necessary. The thermocouple wire shall comply with the requirements for special thermocouples as listed in the table of limits of error of thermocouples in Temperature Measurement Thermocouples, ANSI MC96.1—1975.

TABLE 42.1
MAXIMUM ACCEPTABLE TEMPERATURE RISES

Materials and Component Parts	$^\circ\text{C}$	$(^\circ\text{F})$
1. Rubber or thermoplastic insulation	35 ^a	63 ^a
2. Any point on a selenium rectifier	50 ^a	90 ^a
3. A silicon rectifier	75 ^a	135 ^a
4. Field wiring terminals ^b	50	90
5. Varnished-cloth insulation	60	108
6. Surfaces adjacent to or upon which the unit may be mounted in service	65	117
7. Fuse clips	30	54
8. Fiber used as electrical insulation	65	117
9. Wood or other combustible material	65	117
10. Class 105 insulation systems on windings of relays, solenoids, and the like	65 ^c	117 ^c
11. Transformer enclosure	65	117
12. Contacts	65	117
13. Connecting straps	65	117
14. Class 130 insulation systems on windings of relays, solenoids, and the like	85 ^c	153 ^c
15. Phenolic composition used as electrical insulation	125 ^a	225 ^a
16. On the embedding material of resistors	300	540
17. On bare resistor material	375	675
18. Capacitors		Rated temperature limit ^d
19. Sealing compound		" "

^a This limitation does not apply to an insulated conductor, a rectifier, or a material which has been investigated and is found effective for a higher temperature.

^b The temperature on a wiring terminal or lug is measured at the point most likely to be contacted by the insulation of a conductor installed as in actual service.

^c 10°C (18°F) higher in coil insulation if measured by the resistance method.

^d These are temperature limits, not temperature rises.

^e Unless a thermosetting material, the maximum sealing compound temperature, when corrected to a 25°C (77°F) ambient temperature, is 15°C (27°F) less than the softening point of the compound as determined in the Test for Softening by Ring and Ball Apparatus ASTM E28—1967.