# U.S. NUCLEAR REGULATORY COMMISSION **REGION V**

# EA 90-121

Report Nos. 50-528/90-25, 50-529/90-25, 50-530/90-25

Docket Nos. 50-528, 50-529, 50-530

License Nos. NPF-41, NPF-51, NPF-74

· Licensee: Arizona Public Service Company P. O. Box 52034 Phoenix, Arizona 85072-2034

Facility Name: Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2 and 3

Inspection at: Palo Verde Site, Wintersburg, Arizona

Inspection Conducted: May 16-18 and June 14-15, 1990

Inspectors:

- A. Johnson, Enforcement Officer
- R. Huey, Chief, Engineering Section C. Ramsey, Reactor Inspector T. Chan, NRR Project Manager

Other Personnel: M. Blume, Regional Attorney Approved by: R. Huey, Chief Date Signed **Engineering Section** 

**Inspection Summary:** 

Inspection during the period May 16-18 and June 14-15, 1990 (Report Nos. 50-528/90-25, 50-529/90-25 50-530/90-25)

<u>Areas Inspected</u>: A special, announced inspection by NRC inspectors to further assess licensee corrective actions for safe shutdown emergency lighting system deficiencies. Inspection Procedure Nos. 30703, 92701 and TI 2515-61 were used as quidance for the inspection.

### Results:

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General Conclusions and Specific Findings:

Ø Additional management attention is required in the fire protection In particular, additional attention is needed to assure: area.

\* Reliable emergency lighting for post-fire safe plant shutdown. .

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- Proper implementation of the quality assurance program for all emergency lighting system components.
- \* Adequate review of safe shutdown procedures contained in the Pre-Fire Strategies Manual, and
- \* Prompt reporting of violations of the fire protection program which would have adversely affected the ability to achieve and maintain safe shutdown in the event of a fire.

#### Significant Safety Matters:

The reliable performance of emergency lighting required by 10CFR50, Appendix R and the proper implementation of quality assurance measures associated with emergency lighting are significant safety matters.

#### Summary of Violations:

This inspection identified five apparent violations of NRC requirements:

- \* Failure to provide reliable emergency lighting with minimum 8 hour battery power supplies for post-fire safe plant shutdown.
- \* Failure to properly implement the quality assurance program for emergency lighting and other fire protection program activities.
- \* Failure to conduct proper reviews of safe shutdown procedures contained in the Pre-Fire Strategies Manual every 12 months to ensure that any necessary changes are made.
- \* Failure to adhere to FSAR governing code design requirements for outdoor use of emergency lighting in wet or damp locations.
  - \* Failure to report violations of the fire protection program which would have adversely affected the ability to achieve and maintain safe shutdown in the event of a fire.

# Open Items Summary:

Two unresolved items were closed. Three unresolved items were determined to be apparent violations, two new violations and one new open item were identified.



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# DETAILS

#### 1. Persons Contacted

# Arizona Public Service (APS) Corporation

#W. Conway, Executive Vice President, Nuclear #\*J. Bailey, Vice President, Nuclear Safety & Licensing #E. Simpson, Vice President, Nuclear Engineering & Construction #J. Levine, Vice President, Nuclear Production #B. Ballard, Director, Quality Assurance #\*J. Allen, Director, Nuclear Engineering & Construction #\*E. Sterling, Manager, Nuclear Engineering #P. Caudill, Manager, Site Services \*D. Smyers, Electrical Engineering #\*F. Garrett, Fire Protection Engineer, Risk Management \*M. Hypse, Lead, Nuclear Engineering/Elect. \*J. Samuels, Electrical Engineering #\*R. Bernier, Lead Engineer, Licensing

#### Southern California Edison

**#J.** Draper, Site Representative

#### Newman & Holtzinger, PC

#A. Gutterman, Attorney

Snell & Wilmer

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**#S.** Thornton, Attorney

- \* Denotes those personnel in attendance at the exit meeting May 17, 1990
- # Denotes those personnel in attendance at the exit meeting on June 15, 1990.

The inspectors also held discussions with other licensee and contractor personnel during the course of the inspection.

- 2. Licensee Actions on Previous Inspection Findings
  - A. <u>(Closed) Unresolved Item 528/90-02-01: "Inadequate Emergency</u> Lighting Design Implementation".

This item is administratively closed based on the discussion provided in paragraphs 3.A. and 4. of this report.

(Closed) Unresolved Item 528/90-02-02: "Failure to Implement Quality Assurance Program for Emergency Lighting System".

This item is administratively closed based on the discussion



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provided in paragraph 3.B. of this report.

C. <u>(Closed) Unresolved Item 528/90-02-03</u>: "Post-Fire Safe Shutdown Procedure Adequacy".

This item is administratively closed based on the discussion provided in paragraph 3.C. of this report.

D. <u>(Closed) Unresolved Item 528/90-02-04</u>: "Operator Training in Post-Fire Safe Shutdown".

This item involved a concern that licensed and non-licensed operators were directed to perform manipulations of equipment by the Pre-Fire Strategies Manual to achieve safe shutdown, for which the operators had not been trained.

The inspectors concluded that this item is closed based on the licensee's verification that, with 29 minor exceptions, all of the actions contained in the Pre-Fire Strategies Manual are included in Procedure No. 4XAO-XZZ44 (Shutdown From Outside the Control Room) or other Emergency Operating Procedures (EOP's). Thus, all required actions are included in the Annual Procedure Review for operators. Regarding the 29 operator actions that are not included in Procedure No. 4XAO-XZZ44 or other EOP's, the licensee determined that no special training is required for the operators to perform these actions.

On this basis, this item is considered closed.

E. <u>(Closed) Unresolved Item 528/90-02-06: "Emergency Lighting</u> <u>Illumination Levels".</u>

This item involved a concern about the adequacy of emergency lighting illumination levels in the Control Room and at the Remote Shutdown Panel.

During the May 16-18 meeting, the licensee explained that the illumination level acceptance criteria for these areas specified in the FSAR is 6 foot candles (in peripheral areas) and 3 foot candles (at control board instruments). The licensee stated that the current illumination levels meet the requirements committed to in the FSAR and are acceptable based on the following:

- 1. The licensee's Control Room and Remote Shutdown Panel emergency illumination study shows measured illumination levels to be approximately 10 foot candles in the Control Room and Remote Shutdown Panel areas.
- 2. Those areas where levels are less than 10 foot candles are the result of a licensee performed human factors analysis for glare which concluded that the illumination levels should be reduced.
- 3. The licensee performed an additional walkdown of emergency lighting illumination levels in all areas required for safe

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shutdown using engineering and operations personnel, and determined that the illumination levels were satisfactory without the use of "enhancement lighting."

4. The improper orientation of one emergency lighting unit lamp installed in the stairwell outside of the Unit 3 Control Room appeared to be an isolated case. The proper orientation of the lighting unit lamps is required to be verified during the performance of quarterly and annual PM tasks.

On this basis, this item is considered closed.

## 3. Results of NRC Followup on Emergency Lighting System Issues

During a meeting with NRC inspectors on May 16-18, 1990, the licensee addressed the several concerns identified in NRC Inspection Report 50-528/90-02. Each of the NRC concerns was specifically responded to by a licensee prepared meeting agenda document, dated May 16, 1990 (Attachment 1 to this report). The licensee used this document as a guide for conducting the meeting with the NRC inspectors on May 16-18. Each of the unresolved items in Inspection Report 50-528/90-02 has been resolved as discussed in this report.

# A. Inadequate Emergency Lighting System Design Implementation

This item involved the NRC inspectors concern that the Appendix R emergency lighting units installed at Palo Verde were not in compliance with the Facility Operating Licenses. The applicable NRC regulatory requirements covering emergency lights are specifically described in Appendix A to this report. NRC Inspection Report 528/90-02 addressed a principle concern that the high failure rate of installed emergency lights indicated that the units had not been properly designed or maintained to ensure their reliable operation when called upon in the event of a fire. The report also addressed concerns associated with the marginal load capacity of the batteries for several of the emergency lighting units, especially during operation in high temperature environments.

During a meeting with the NRC inspectors on May 16-18, 1990, the licensee stated that, although several of the lighting units were of marginal capacity and were experiencing higher than desired failure rates (e.g. Holophane and Emergi-Lite units), the emergency lighting system was adequate and in compliance with the requirements of the plant Operating License. During the meeting, licensee representatives summarized their overall position on the reliability of the emergency lighting system by stating that the total failures for all Appendix R emergency lighting represented only an approximate 5% failure over the last 30 months of plant operation.

The NRC inspectors did not agree with the licensee's conclusions. In particular, the inspectors noted that the licensee's characterization of the emergency light reliability, based on a failure rate of 5%, appeared to be deficient in at least two important respects: (1) it did not include failures for all

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types of Appendix R lights and (2) it spread the failures over the entire population of emergency lights, rather than recognizing that most of the failures were related to specific types of lights and plant locations. In this regard, the inspectors noted that a large number of the failures appeared to involve the Emergi-Lite, Holophane and Exide lighting units. Since these lighting units are the principle sources of emergency lighting for several important areas in the MSSS, Auxiliary Building, Control Building and Control Room, high failure rates of these units can have a significant adverse impact on the ability to achieve safe plant shutdown in the event of a fire.

In response to the NRC inspector's concern, during meetings with the NRC on June 14-15, the licensee provided the results of a review of the performance of all Palo Verde emergency lighting units since 1987. The NRC concluded that this review confirmed the NRC concern that the Emergi-Lite, Holophane and Exide lighting units were experiencing high rates of failure, without appropriate engineering evaluation or corrective action being taken by the licensee. The licensee review identified the following emergency light failure information:

1. Between 1987 and 1990, the Holophane emergency lighting units in the Auxiliary and Control Buildings failed as follows:

<u>Unit 1:</u> 4 of 4 units (100%) failed in 1988, 3 of 4 units (75%) failed in 1989, and 3 of 4 units (75%) failed in 1990.

<u>Unit 2</u>: 3 of 4 units (75%) failed in 1987, 1 of 4 units (25%) failed in 1988, 4 of 4 units (100%) failed in 1989, and 3 of 4 units (75%) failed in 1990.

<u>Unit 3</u>: 1 of 4 units (25%) failed in 1987, 2 of 4 units (50%) failed in 1988, 3 of 4 units (75%) failed in 1989, and 1 of 4 units (25%) failed in 1990.

#### NOTE

Since many of the above failures resulted from tests conducted after "pre-conditioning", as discussed later in this report, there could have been more failures if the lighting units had been tested in their as-found condition.

 Between 1987 and 1990, the Main Control Room emergency lighting units (powered by Exide battery/inverter units in the Control Buildings) failed as follows:

Unit 1: 2 of 2 units (100%) failed in 1987, 2 of 2 units (100%) failed in 1988, and 1 of 2 units (50%) failed in 1989.

Unit 2: 1 of 2 units (50%) failed in 1988, and 2 of 2 units (100%) failed in 1989.



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Unit 3: 1 of 2 units (50%) failed in 1987, 1 of 2 units (50%) failed in 1988, and 2 of 2 units (100%) failed in 1989.

 During 1990, the Main Steam Support Structure (MSSS) and Turbine Plant Emergi-Lite emergency lighting units failed as follows:

Unit 1: 4 of 16 (25%) failed in 1990.

Unit 2: 5 of 16 (31%) failed in 1990.

Although the licensee assured the inspectors that the failure data provided during the June 14-15 meeting was correct, subsequent NRC inspector review of the data indicated several errors and inconsistencies. For example: in four instances, Unit 3 Control Building Exide unit failures were incorrectly specified as Holophane unit failures; in four instances, Unit 1 Turbine Building Emergi-Lite units were incorrectly specified as Dual-Lite units; and, in two instances, Unit 2 Control Building Exide units were not correctly specified as to the type of failure (e.g. bulb failure rather than battery failure). As a result of this review, the inspectors requested that the licensee reevaluate the emergency light failure data and resubmit complete and accurate information.

On June 29, 1990, the licensee submitted revised emergency light failure data. The revised data corrected the NRC noted errors and also revised the failure data for several other lighting units. In particular, the revised licensee review identified the following emergency light failure information:

 Between 1987 and 1990, the Holophane emergency lighting units in the Auxiliary and Control Buildings failed as follows:

Unit 1: 4 of 4 units (100%) failed in 1988, 1 of 4 units (25%) failed in 1989, and 1 of 4 units (25%) failed in 1990.

Unit 2: 3 of 4 units (75%) failed in 1987, 1 of 4 units (25%) failed in 1988, 4 of 4 units (100%) failed in 1989, and 3 of 4 units (75%) failed in 1990.

Unit 3: 2 of 4 units (50%) failed in 1988, 3 of 4 units (75%) failed in 1989, and 1 of 4 units (25%) failed in 1990.

 Between 1987 and 1990, the Main Control Room emergency lighting units (powered by Exide battery/inverter units in the Control Buildings) failed as follows:

Unit 1: 1 of 2 units (50%) failed in 1987, 2 of 2 units (100%) failed in 1988, and 1 of 2 units (50%) failed in 1989.

Unit 3: 2 of 2 units (100%) failed in 1989.

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 During 1990, the Main Steam Support Structure (MSSS) and Turbine Plant Emergi-Lite emergency lighting units failed as follows:

Unit 1: 5 of 16 (31%) failed in 1990.

Unit 2: 5 of 16 (31%) failed in 1990.

Although the revised emergency light failure data indicates a slightly lower rate of lighting unit failure than that originally provided to the NRC inspectors, it still appears clear that a significant and excessive number of the Appendix R emergency lighting units in the MSSS, Auxiliary Building, Control Building and Control Room have not demonstrated reliable performance.

Failure to provide reliable emergency lighting as required by the Facility Operating License to support safe shutdown in the event of a fire is considered to be an apparent violation of Facility Operating License Nos. NPF-41, NPF-51 and NPF-74 (50-528/90-25-01).

B. Failure to Implement Quality Assurance Program for the Emergency Lighting System

This item involved the NRC inspectors concern that the licensee had not properly implemented the requirements of the Palo Verde Quality Assurance program, as it applied to Appendix R emergency lighting units. NRC Inspection Report 50-528/90-02 cited numerous examples of instances in which appropriate quality assurance measures were not properly implemented.

During the meeting with the NRC inspectors on June 14-15, the licensee stated that the Quality Assurance Program does not apply to the emergency lighting system. The licensee maintained that the Quality Assurance Program only applied to Fire Protection water suppression systems, gaseous suppression systems and hangers as shown in FSAR Table 3.2-1.

The NRC inspectors did not agree with the licensee conclusion. The inspectors concluded that the Facility Operating Licenses clearly require that the Quality Assurance Program be applied to emergency lighting. The applicable regulatory requirements governing the quality assurance program as applied to the emergency lighting systems are included in Appendix A of this report.

#### **1.** Inspection Findings

The inspectors found that prior to the licensee's initiation of Quality Deficiency Report (QDR) No. 89-QB-003 in August 1989, which upgraded certain fire protection systems and components in the Site Information Management System (SIMS) to a "Quality Augmented" (QAG) classification, the licensee's Operations Quality Assurance Criteria Manual had not been applied to all fire protection program activities.



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Licensee QA program administrative implementing procedures No. 01AC-0AP01, Revision 0, Section 2.1.2 and No. 01AC-0AP02, Revision 0, Sections 2.3, 2.5.1 and 3.2.1 specify that the detail QA implementing procedures conform to the requirements of the FSAR.

Components required to be included in the QA program are governed by the licensee's Procedure No. 81AC-OCCO6. At the time of this inspection, emergency lighting lamp fixtures, high charge lamps, AC power lamp LED's, batteries, PC boards, transformers, test switches, time delay units, DC ammeters, fuses, mineral oil, etc., were classified as Non-Quality Related (NQR), and were not governed by Procedure No. 81AC-OCCO6. Therefore, the inspector concluded that the quality of the design, procurement, installation and testing of the emergency lighting system had not been verified in accordance with applicable requirements of the Operations Quality Assurance Criteria Manual.

The inspectors noted that the licensee's failure to properly implement the required quality assurance program for the emergency lighting system appears to have contributed to the following deficiencies.

a. <u>Inadequate Corrective Actions for Emergency Lighting System</u> <u>Failures</u>

The licensee did not implement appropriate corrective actions for the numerous emergency lighting unit failures described in paragraph 3.A above, as required by Section 16.4.7 of the APS Operations Quality Assurance Manual. Specifically, the licensee did not appropriately evaluate the numerous, documented emergency lighting system failures and did not implement appropriate corrective action to preclude recurrence of those failures.

b. Inadequate Testing of Emergency Lighting Units

The licensee did not adequately test emergency lighting units to demonstrate conformance with design and system readiness requirements as required by the Facility Operating Licenses for Units 1, 2, and 3.

All of the emergency lighting 8 hour discharge test procedures reviewed by the inspectors (i.e. Unit 1 Work Order (WO) No. 00383996, Unit 2 WO No. 00414259 and Unit 3 WO No. 00410539) specified pre-conditioning (i.e. addition of electrolyte, or replacement of batteries whose electrolyte levels had fallen below acceptable levels, upward adjustment of float voltage, and charging the batteries for up to 24 hours) prior to performing the 8 hour discharge tests. According to the licensee, these are the only procedures that have ever been used to perform 8 hour discharge testing during plant operation.

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Based upon the demonstrated high failure rate (discussed in paragraph 3.A, above) and the practice of "pre-conditioning" the lighting units prior to testing, the inspector concluded that the tests did not provide assurance that the as-found lighting units were ready and capable of performing their intended function when required during an emergency.

#### c. Inadequate Preventive Maintenance Intervals

The licensee failed to recognize that the numerous emergency lighting unit failures established a clear trend and indicated a compelling need to conduct more frequent preventive maintenance on the lighting units.

At the time of the inspection, the licensee's preventive maintenance frequency for the lighting units was based on vendor recommendations for the batteries operating at the ambient 77 degree F temperature where the battery design yields maximum operating efficiency and not on actual field conditions and field experience.

The inspector found that based on information from the emergency lighting system battery vendors, no empirical data currently exists which supports the adequacy of battery power supplies to conform to design requirements under the high temperature conditions in which the lighting units are installed at Palo Verde. Thus, there was no established basis for determining a predictive or preventive maintenance frequency to ensure reliability of the battery power supplies other than the vendor recommendations and facility experience in using the units under actual field conditions. The inspector concluded that the licensee failed to recognize that actual field conditions differed extensively from vendor assumptions and that the excessive failure history clearly indicated that preventive maintenance was needed more frequently.

Based on historical failure data, the preventive maintenance tasks at Palo Verde do not appear to have been scheduled with a frequency adequate to preclude the numerous recurrent failures discussed above.

Failure to implement the required quality assurance program for the emergency lighting system is considered to be an apparent violation of Facility Operating License Nos. NPF-41, NPF-51 and NPF-74 (50-528/90-25-02).

#### 2. Additional Inspector Observations

The inspector considered that the licensee missed an opportunity to effect meaningful corrective action and provide a more reliable emergency lighting system. Although the Containment emergency lighting units are not required for safe

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shutdown, they are the same model and type of Dual Lite emergency lighting units installed in the MSSS's, Auxiliary Buildings, Control Buildings and Diesel Generator Buildings, which have experienced some failures. The following problems, identified by the licensee, provided an opportunity to effect corrective action for similar lighting units installed as safe shutdown units under similar high temperature conditions.

To address emergency lighting units installed in high temperature and high humidity environments of the plant (i.e. Containment and MSSS), and battery electrolyte evaporation problems, PCR Nos. 87-13-QD-004 and 87-13-QD-007 were initiated to replace these units with an inverter system. However, the PCR's were cancelled on December 11, 1987 and March 23, 1988, respectively, with justification which included the following: (1) high cost of battery replacements, (2) all Containment Building emergency lighting passed the 8 hour burn test in October 1987, and (3) the resolution to EER Nos. 86-0D-007 and 87-QD-004 was adequate to mitigate the high ambient temperature problems (requiring modification of the Containment Building battery chargers to permit adjustment of the float voltage, addition of mineral oil to battery electrolyte, replacement of lamp heads with extra high temperature plastic as needed, and cleaning batteries while performing PM tasks).

According to the licensee, the resolution to the Containment high temperature and emergency lighting battery electrolyte evaporation problem was not applied to emergency lighting units outside of Containment that are required for safe shutdown. The licensee maintained that EER Nos. 85-QD-022 and 86-QD-034 were initiated to modify the emergency lighting system battery chargers that are required for safe shutdown in the Control Buildings, Auxiliary Buildings, Diesel Generator Buildings, MSSS and Turbine Buildings to permit adjustment of the float voltage to the batteries for reasons other than high temperature.

The inspectors disagreed with the licensee technical resolution of the above matters for the following reasons:

- (a) Adjustment of float voltage required modification of the unit and adjusting a sealed potentiometer. However, the Dual-Lite battery vendor's letter to the licensee dated May 4, 1990 states in part, "To adjust any sealed pots in the field compromises the strict calibration requirements placed on our equipment. We have no way to monitor your calibration of equipment nor verify the type of procedure you're using to adjust this equipment. To adjust the equipment incorrectly in the field will effect life expectancy and performance of our unit, therefore voiding all warranties."
- (b) Based on the disposition to EER No 87-QD-004 for Containment emergency lighting electrolyte evaporation

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problems, a licensee representative acknowledged during the inspection that, in at least one instance, mineral oil was added to required safe shutdown emergency lighting batteries to inhibit electrolyte evaporation. The Dual-Lite battery vendor's letter to the licensee dated October 24, 1989 states in part, "Nickel-Cadmium cells are normally shipped from the manufacturer with approximately 5 mm of mineral floating on top of the cells. It should not be necessary to add any oil to the cells unless they were dumped for some reason. To do so may cause buildup in the cells that may affect performance".

The Dual-Lite battery vendor's letter to the licensee dated April 30, 1990 states in part, "When Nickel-Cadmium batteries are shipped, depending on the manufacturer, some manufacturers float approximately a 1/8 inch of mineral oil on the surface of the electrolyte to help reduce evaporation. This process is only done on Nickel-Cadmium cells and will cause permanent damage to Lead batteries".

The inspector concluded that the licensee did not adequately pursue the advisability of the above EER disposition with the vendor, otherwise the prohibition would have been understood. The inspector considers that this is an example of incomplete technical work.

# C. <u>Post-Fire Safe Shutdown Procedure Adequacy</u>

This item involved an NRC inspector's concern that the Pre-Fire Strategies Manual had not been reviewed since the original licensing of Unit 1 in December 1984, to determine the adequacy of operator actions specified to achieve safe shutdown. The applicable regulatory requirements governing periodic review of the Pre-Fire Strategies Manual are contained in Appendix A to this report.

The Pre-Fire Strategies Manual operator actions appeared to be inconsistent with the Outside Control Room Fire Spurious Actuation Study (Studies 01-NS-110, 02-NS-110 and 03-NS-110) for Fire Zones 47A and 42B (LPSI Train A pump room and Train B LPSI and containment spray pump rooms).

At the time of the inspection, the licensee acknowledged that the Pre-Fire Strategies Manual directed operators to locally operate switches and valves in areas which may not be accessible to the operators in the event of a fire. Some changes were made at the direction of the Fire Protection Supervisor, but the manual was not a controlled document. The first formal review and update by engineering was performed on April 18, 1988 (167-02213/ECS/JDO) at the request of the Site Fire Department, as part of the resolution of CAR #CE-86-0203. The licensee stated that the update is complete with the exception of the Spurious Evaluation Concern Section.

The inspectors acknowledged the licensee's statements and summarized the specific NRC inspectors concerns as follows:



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- 1. At the time of the inspection, the Pre-Fire Strategies Manual had not been reviewed every 12 months as required by Technical Specification 6.8.2 and the licensee's Procedure No. 01AC-OAP-2, to determine the adequacy of operator actions specified to achieve post-fire safe shutdown for fires occurring outside of the Control Room.
- 2. At the time of the inspection, the Pre-Fire Strategies Manual contained incorrect directions for operator actions to preclude spurious actuation of Train A and Train B components in Fire Zones 47A and 42B. The equipment required operator action and was located in the same area as the postulated fire. It was not clear whether the operators were required to enter these areas during the fire to accomplish the manual actions, or wait until the fire had been extinguished.
- 3. In addition to Fire Zones 47A and 42B identified by the inspector, the licensee identified 14 other areas where the Pre-Fire Strategies Manual directed operators to enter areas which may not have been accessible due to fire, smoke and combustion products.
- 4. Apparently, a formal engineering review of the Pre-Fire Strategies Manual was performed in April 1988. However, this review only addressed firefighting concerns. An engineering review of operator actions specified by the Spurious Actuation Studies, and the review every 12 months as required by Procedure No. 01AC-0AP02, had not been performed.

The failure to perform an annual review of the Pre-Fire Strategies Manual is considered to be an apparent violation of Technical Specification 6.8.2 (50-528/90-25-03).

4. <u>Failure to Adhere to FSAR Governing Code Design Requirements for Outdoor</u> <u>Use of Emergency Lighting in "Wet or Damp Locations."</u>

This item involved the NRC inspector's concern that Appendix R Emergi-Lite units that were installed in the MSSS Breezeway (an outdoor "damp" location) were not tested and approved for use in outdoor "wet or damp" locations, as required by Article 410-4 of NFPA 70-1975 and the facility Operating License. Thus, the capability of the lighting units to perform their intended function in this environment during an emergency had not been demonstrated. The applicable NRC regulatory requirements for emergency lighting systems are specifically described in Appendix A to this report.

In response to the NRC inspector's concern, during the May 16-18, 1990 meeting, the licensee stated that the Palo Verde Emergi-Lite emergency lighting units were designed and tested for outdoor use by the manufacturer. The licensee also stated that a letter dated May 1, 1989, obtained from the QC Manager of Emergi-Lite, confirmed that the Emergi-Lite equipment purchased at Palo Verde had been designed and tested to meet the NEMA 4X weatherability requirements.



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The licensee also stated that the vendor had no supporting test results for the statements made in the May 1, 1989 letter to the licensee. Accordingly, the inspectors requested that the licensee obtain supporting test results from the vendor or otherwise. Further, the inspectors noted that licensee EER No. 89-QD-007 documented deficiencies associated with the design of the Emergi-Lite units, and concluded that the units were poorly constructed and were not tested and approved for outdoor use.

The licensee disposition of EER No. 89-QD-007 applied RTV to the lighting fixtures. However, the inspectors considered that this action did not achieve compliance with the weatherability requirements of governing code NFPA 70, which provides that the lighting units shall be "Approved for the Purpose", and marked "Suitable for Wet or Damp Locations".

At the conclusion of the May 16-18 meeting, the licensee acknowledged that despite the vendor's May 1, 1989 letter, there was no supporting test data to confirm that the Emergi-Lite units installed at Palo Verde have been tested to meet the weatherability requirements of Article 410-4 of NFPA 70-1975.

The licensee further acknowledged during this meeting that according to the vendor's literature, the only available test data supporting the design and construction of the Emergi-Lite emergency lighting units is the data from Underwriters Laboratories Inc., who tested and approved the units for ordinary indoor use only. In fact, as a basic safety precaution under "Important Safeguards", the vendor's literature dated April 24, 1989, states in part, "Do Not Use Outdoors."

Subsequently, during the June 14-15 Meeting, the licensee maintained that the Emergi-Lite emergency lighting units were designed, constructed, and qualified for outdoor use. In particular, the licensee stated that the Emergi-Lite KS series emergency lighting units are contained in NEMA 4X cabinets which by NEMA standards is defined, according to the licensee, as "Either indoor or outdoor use to provide a degree of protection against falling rain, splashing water and hose directed water; undamaged by the formation of ice on the enclosure." The licensee considered that because the outdoor lighting units are located inside the NEMA 4X enclosures, the lighting units are in essence installed indoors.

The inspectors disagreed with the licensee's position and noted that:

- 1. The Emergi-Lite emergency lighting units and NEMA 4X cabinets installed outdoors in the MSSS Breezeway were not tested and approved for outdoor use as a "complete unit" by an independent nationally recognized testing laboratory or otherwise.
- 2. The lighting unit design, as tested and approved by Underwriters Laboratories Inc., was altered by the licensee's enclosure of the lighting units in NEMA 4X cabinets.
  - 3. The licensee had not performed a sufficient evaluation of the combined adverse effects of altering the design of the units by

enclosing them in the NEMA 4X cabinets (i.e. increased temperature due to the NEMA 4X cabinet enclosure).

4. The licensee had not sufficiently evaluated the potential for the MSSS Breezeway outdoor "damp" location to cause short circuiting of the lighting unit electrical components.

5. For various reasons, the Emergi-Lite emergency lighting units installed outdoors in the MSSS Breezeway have experienced high failure rates, demonstrating the lighting unit design was not adequate to provide reliable 8 hour illumination during an emergency.

Failure to provide emergency lighting of approved design for outdoor use to support safe shutdown is considered to be an apparent violation of Facility Operating License Nos. NPF-41, NPF-51 and NPF-74 (50-528/90-25-04).

The licensee stated that in order to ensure more reliable operation of emergency lighting units in the future, the following actions were being taken:

- 1. Preventive maintenance on Emergi-Lite units was being increased from quarterly to monthly. The licensee also indicated that the replacement of these with larger capacity, more reliable units would be completed by August 31, 1990.
- 2. Preventive maintenance on Dual-Lite units in high temperature areas (Turbine plant, Main Steam Support Structure and Diesel Generator rooms) was being increased from quarterly to monthly. The licensee stated that they would take action to specifically trend temperature and other important battery parameters for these units in the future.
- 3. Marginal capacity Holophane units were being replaced with larger capacity units. The licensee stated the replacement of all Holophane units would be completed by October 31, 1990.
- 4. Periodic capacity tests would be performed on emergency lighting system batteries in order to ensure that the batteries are capable of continued reliable operation between periodic discharge tests. The licensee stated that these capacity tests would be implemented within six months of the May 18 meeting.

# 5. Failure to Notify the NRC of Violations

The plant Technical Specifications provide specific requirements for reporting Fire Protection Program violations which would have adversely affected safe plant shutdown in the event of a fire. The applicable regulatory requirements governing reportability of violations of the Fire Protection Program are contained in Appendix A to this report.

The apparent violations discussed in Paragraphs 3.A, 3.B and 3.C of this report have not been reported to the NRC by the licensee. In addition to

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the apparent violations discussed in this report, Violation 530/90-08 describes another example of an apparent reportable condition. As noted in that violation, a work order was initiated on January 7, 1990, after the failure of Inverter No. 3EQBN004, which supplies power to emergency lighting fixture Nos. 3EQBN004A, B, C and D. These lighting fixtures are required for operation of ECCS "Train B" switchgear at load centers PHBM34, PHBM36 and PHBM38. The load centers contain switchgear for "Train B" LPSI shutdown cooling valves, "Train B" Containment spray control valves, safety injection tank isolation valves, and "Train B" Class 1E battery charger supply breakers, and are required to be manipulated by plant operators in order to achieve and maintain safe shutdown in the event of fire. In the event of a loss of offsite power, essential lighting cannot be supplied to the Auxiliary Building using fire protected "Train B" onsite power supplies (e.g. essential lighting for these areas is only provided for by "Train A" power supplies, which are not fire protected). The only available lighting would have been supplied by emergency lighting Unit No. 3EQBN004. On this occasion, lighting unit 3EQBN004 was inoperable for more than 30 days, but the condition was not reported to the NRC by the licensee.

On another occasion, the licensee's EER No. 88-QB-003 documented the failure of the same lighting unit (3EQBN004) in August 1988, and the unit remained inoperable for more than 30 days. Although this condition represented a condition that compromised the ability to achieve and maintain safe shutdown in the event of a fire, it was not reported to the NRC by the licensee.

Failure to report violations which would have adversely affected the ability to achieve and maintain safe shutdown in the event of a fire is considered to be an apparent violation of Technical Specification 6.9.3 (50-528/90-25-05).

# 6. <u>Emergency Lighting System Vendor Technical Manuals</u>

The inspectors performed a partial review of the licensee's system for updating emergency lighting system vendor technical manual. According to the licensee, when information updates are received from the vendors by Nuclear Engineering, it is immediately entered into a computerized data base. Hard copies and procedural changes (if necessary) are provided to plant personnel within an average of 30 days. If needed, plant personnel can access the computerized data base to obtain the information sooner.

The inspector's review of the appropriateness of the technical content of emergency lighting vendor technical manuals used in the field, and manual updates from the vendors over the past five years is not yet complete. This will be evaluated by the Region V during a subsequent inspection.

This is considered an Open Item (50-528/90-25-06).

### 7. Exit Interview

Exit meetings were held with the licensee's staff on May 17 and June 15, 1990. The items of concern in this report were discussed at that time. The licensee acknowledged the scope and content of the inspection findings.

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# APPENDIX A TO INSPECTION REPORT 528/90-25

 As referrenced in paragraphs 3.A and 4 of Inspection Report 528/90-25, the following provisions establish, in part, the requirements for providing reliable emergency lighting units for support of safe plant shutdown in the event of a fire:

> License No. NPF-41, Condition 2.C(7) for Palo Verde Unit 1, License No. NPF-51, Condition 2.C(6) for Palo Verde Unit 2 and License No. NPF-74, Condition No. 2.F for Palo Verde Unit 3, provide in part:

"APS shall implement and maintain in effect all provisions of the approved fire protection program as described in the Final Safety Analysis Report (FSAR) for the facility, as supplemented and amended, and as approved in the SER through Supplement 11, subject to the following provision: APS may make changes to the approved fire protection program without prior approval of the Commission only if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of fire."

FSAR Appendix 9B, Table IV.J, requires emergency lighting units with at least 8-hour battery power supplies in all areas needed for operation of safe shutdown equipment and in access and egress routes thereto (all lighting units that are the basis for this violation and those that follow are required by Table IV.J).

FSAR Appendix B, Safety Design Basis Eighteen, states in part: "Emergency lighting systems shall be provided in accordance with the guidance provided in NRC Branch Technical Position (BTP) APCSB 9.5-1...Batteries for emergency lighting shall be rated for a minimum of 8 hours...Applicable codes and regulations of...the National Fire Codes of the National Fire Protection Association...have been used as guidance in the development of the plant fire protection system.

NRC BTP APCSB 9.5-1, Appendix A, recommends suitable fixed emergency lighting with 8-hour minimum battery power supplies for safe shutdown equipment and in access and egress routes thereto. In response to this recommendation, FSAR Table 9B.3-1(D-5) states, in part: "Lighting and two way voice communications are provided. See FSAR Sections 9.5.2 and 9.5.3...."

FSAR Section 9.5.3.1.3 states: "Design and installation of the plant lighting systems use the guidance provided by the National Electrical Code (NFPA No. 70-1975/ANSI C1-75)" (hereinafter cited as "NFPA").

NFPA Article 410-4 requires that emergency lighting fixtures and equipment installed in "wet or damp locations" be "approved for the purpose," and be marked "Suitable for Damp Locations." Damp



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locations include "partially protected locations under canopies, marquees, roofed open porches and the like...."

NFPA Article 100 defines "Approved" as "acceptable to the authority having jurisdiction," and "Approved for the Purpose" as "approved for a specific purpose, environment or application described in a particular Code requirement."

NRC BTP APCSB 9.5-1 defines "Approved" as "tested and accepted for a specific purpose or application by a nationally recognized testing laboratory."

2. As referrenced in paragraph 3.B of Inspection Report 528/90-25, the following provisions establish, in part, the requirements for implementing Quality Assurance Program control's for Appendix R emergency lighting systems:

License No. NPF-41, Condition 2.C(7) for Palo Verde Unit 1, License No. NPF-51, Condition 2.C(6) for Palo Verde Unit 2, and License No. NPF-74, Condition No. 2.F for Palo Verde Unit 3, provide in part:

APS shall implement and maintain in effect all provisions of the approved fire protection program as described in the Final Safety Analysis Report (FSAR) for the facility, as supplemented and amended, and as approved in the SER through Supplement 11, subject to the following provision: APS may make changes to the approved fire protection program without prior approval of the Commission only if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of fire.

FSAR Table 9B.3-1(C) requires the development and implementation of a Quality Assurance Program to satisfy the guidance of BTP 9.5-1 for design, procurement, installation, testing, and administrative controls for the fire protection program for safety related areas. The table sets forth eleven criteria, including those requiring adequate corrective actions and test controls.

BTP 9.5-1 defines the term "Fire Protection Program" as "the integrated effort involving all components, procedures, and personnel utilized in carrying out all activities of fire protection. It includes system and facility design, fire prevention, fire detection, annunciation, confinement, suppression, administrative controls, fire brigade organization, inspection and maintenance, training, quality assurance, and testing."

FSAR Section 17.2.2.2 provides: "the Operations QA program, as described in the Operations Quality Assurance Criteria Manual, shall be applied to fire protection program activities associated with those fire protection systems and equipment used or installed in areas housing safety related equipment, and other areas where an unsuppressed fire could potentially damage safety-related structures, systems or components."



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The original Palo Verde SER dated November 1981 provides that the licensee will implement the fire protection program consistent with the provisions of the NRC staff's guidance in "Nuclear Plant Fire Protection Functional Responsibilities, Administrative Controls and Quality Assurance," dated August 29, 1977, including those provisions concerning quality assurance. Supplement 6 of this staff guidance recommends a quality assurance program that applies, among other things, to emergency lighting.

a. The following Quality Assurance Program controls are specifically applicable to corrective actions:

APS Operations Quality Assurance Manual, Criterion 16, Revision No. 5, Section 16.4.7, "Corrective Action," implements FSAR Table 9B.3-1(C.8), and requires appropriate evaluation to determine the cause and prevent recurrence of failures that have an effect on, or influence safe operation of the plant in an adverse manner. Under Section 16.4.8, a documented evaluation is required to support any decision to permit the use of installed equipment that is nonconforming.

b. The following Quality Assurance Program controls are specifically applicable to testing:

FSAR Table 9B.3-1(C.5) requires that a test program be established to assure that testing is performed and verified by inspection and audit to demonstrate conformance with design and system readiness requirements. APS Operations Quality Assurance Manual, Revision No. 5, Criterion 14, implements the provisions of FSAR Table 9B.3-1(C.5).

FSAR Section 9.5.3.4 requires that the emergency lighting system be inspected and tested periodically to ensure operability of the automatic switches and other components in the system. The test procedures are required to measure appropriate design parameters to demonstrate system design and readiness requirements.

3. As referrenced in paragraph 3.C of Inspection Report 528/90-25, the following provisions establish, in part, the requirements for review of Post-Fire Safe Shutdown Procedures:

Technical Specification 6.8.2 requires that programs and procedures of Specification 6.8.1 be reviewed periodically as set forth in administrative procedures. Specification 6.8.1 requires that written procedures be implemented governing the Fire Protection Program. APS Administrative Procedure No. 01AC-0AP02, section 3.6.6, implementing the Fire Protection requirements of Technical Specification 6.8.2, requires that the Pre-Fire Strategies Manual be reviewed at least once every 12 months to determine whether any changes are necessary.

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Technical Specification 6.9.3 for Palo Verde Units 1, 2 and 3, provides that: "Violations of the requirements of the Fire Protection Program described in the FSAR which would have adversely affected the ability to achieve and maintain safe shutdown in the event of a fire shall be reported in accordance with 10 CFR 50.73.

License No. NPF-41, Condition 2.C(7) for Palo Verde Unit 1, License No. NPF-51, Condition 2.C(6) for Palo Verde Unit 2, and License No. NPF-74, Condition No. 2.F for Palo Verde Unit 3, provide in part: "APS shall implement and maintain in effect all provisions of the approved fire protection program as described in the Final Safety Analysis Report (FSAR) for the facility, as supplemented and amended, and as approved in the SER through Supplement 11, subject to the following provision: APS may make changes to the approved fire protection program without prior approval of the Commission only if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of fire."

FSAR Section 9.5.3.1.1 (Safety Design Basis Two) provides that: "The lighting system, comprised of normal, emergency, and essential subsystems, shall be designed so that a single failure of any subsystem or electrical component of a subsystem, assuming loss of offsite power, cannot terminate the system's ability to illuminate areas occupied during a reactor shutdown or emergency."

"APS shall implement and maintain in effect all provisions of the approved fire protection program as described in the Final Safety Analysis Report (FSAR) for the facility, as supplemented and amended, and as approved in the SER through Supplement 11, subject to the following provision: APS may make changes to the approved fire protection program without prior approval of the Commission only if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of fire."

FSAR Appendix 9B, Table IV.J, requires emergency lighting units with at least 8-hour battery power supplies in all areas needed for operation of safe shutdown equipment and in access and egress routes thereto.



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# CONCERN 1:

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 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.

(E.l.a, p. 4)

# DISCUSSION:

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The specific article of the National Electrical Code (NFPA 70-1975) which covers these emergency lighting units is Article 700.

Article 700-3 states that all equipment shall be "approved" for use on emergency lighting systems.

However, the NEC states in Article 700 that other applicable articles of this code shall apply. If we classify these emergency lighting units as "lighting fixtures", Article  $4\phi0$  may be used as guidance.

Article 410-4 states that fixtures installed in wet locations shall be "approved for the purpose". The following is the APS interpretation of these articles and our compliance:

- a) The definition of "approved for the purpose" as defined in the NEC Article 100 is "Approved for a specific purpose, environment or application described in a particular Code requirement.
- b) The definition of "approved" as defined in NEC Article 100 is "Acceptable to the authority having jurisdiction".
- c) The authority having jurisdiction in our case is the NRC.
- d) The BTP 9.5.1 describes an acceptable emergency light as :

"Fixed, self-contained lighting consisting of fluorescent or sealed-beam units with individual eight-hour minimum battery power supplies should be provided in areas that must be manned for safe shutdown and for access and egress routes to and from all fire areas."

Where the BTP requires approval or testing by an outside organization it specifically states that requirement in the BTP. For instance, SCBA's require approval by the NIOSH, as specifically stated in the BTP, Section 4.d.(7). 1.1

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In summary, neither BTP nor the NEC require emergency lights to be tested or approved by any outside organization to demonstrate compliance with design requirements. APS Engineering used vendor data and engineering judgement to confirm the acceptability of the units in the applications for which they were designed.



#### CONCERN 2:

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.

(E.1.a, p. 4)

# DISCUSSION:

There are four emergency lighting vendors which supply Appendix "R" required lighting in various applications throughout PVNGS. These applications, including the worst case temperature environment from UFSAR Table 9.4.2, are as follows:

Vendor	<u>Buildings</u>	UFSAR Temperature
Dual-Lite	All Areas	122 F (Turbine Bldg) 140 F (DG Bldg/DG running)
Holophane	Control Auxiliary	104 F (Aux Bldg)
Emergi-Lite	MSSS Breezeway	120 F (MSSS)
Exide	Control Room	85 F (Battery rooms)

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#### Dual-Lite .

The Dual-Lite emergency lights are wall mounted, self-contained, battery powered emergency lighting units. These units are located in every building at PVNGS. They are used in both 8-hour and 1-1/2 hour applications.

The Dual-Lite units have two 7.2 watt heads and operate at 6-volts. This equates to a 2.4 amp load over the 8-hour discharge period or a required 19.2 amp-hour capacity at the 8-hour discharge rate.

Each emergency lighting unit has a long-life Nickel-Cadmium battery. There are three manufacturers of the batteries used in Dual-Lite units, these manufacturers are Sab-Nife, ALCAD and Varta.

The Dual-Lite warranty states that the batteries are not to be used in ambients above 110 F. However, correspondence from Dual-Lite and the battery vendors for Dual-Lite have demonstrated that adequate capacity and life is available even at the higher ambient temperatures.



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Sab-Nife: The Sab-Nife batteries are model EDE-30. From vendor data, the EDE-30 has a capacity of 32 amp-hours at the 8-hour rate. From the manufacturer curves, the available capacity at 122 F and at 140 F is 100%. Hence sufficient capacity exists to supply the 19.2 amp-hour load. The battery life, also from the curves, at a continuous 122 F is 12 years.

ALCAD:

The ALCAD batteries are model VB-5. These batteries are Nickel Cadmium with a 40.8 amp-hour capacity at the 8-hour discharge rate. The vendor has provided a curve that shoes at 122 F, 85% capacity is available and at 140 F, 75% capacity is available. Since there is 53% margin in design capacity, the higher temperatures are not considered a problem. T

At a continuous temperature of 122 F, from vendor curves, life reduction of 40% can be expected. The design service life of the battery at 80 F is 25 years. Hence, at 122 F the service life of the battery is expected to be 15 years.

Varta:

Varta has their engineering offices located in Germany, therefore communication with Varta has been difficult. However, it is known that Varta batteries are also Nickel-Cadmium, similar to those supplied by the other two vendors. The capacity at 77 F at the 8-hour discharge rate is 38 amphours. Hence, as is the case with the other vendors, there is considerable margin between the battery design capacity and the load requirements.

#### Emergi-Lite

Emergi-Lite wall mounted units are used in the MSSS at the 140' elevation for the ADV's and in the Turbine Building Breezeway (the access/egress path for the MSSS).

Each Emergi-Lite unit is supplied with a sealed Polytemp Nickel-Cadmium battery manufactured by SAFT and is warranted for 15 years. These batteries are designed specifically to give long life under high temperature environments.

SAFT has recently provided APS a curve showing that at a continuous temperature of 120 F, the cell life of the battery would be four to five years. This capacity, per SAFT, would be capable of delivering 8-1/2 hours total run time at 120 F.

In addition, the Emergi-Lite chargers are temperature compensated to automatically adjust float voltages for high temperatures. This will avoid over-charging of the batteries and hence extend the life.



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# Holophane

In the Control Building and Auxiliary Building where a broader source of light was needed to illuminate switchgear and relay panels, a modular AC power stations are used. These power stations supply numerous fluorescent fixtures from each power station. The units each contain their own leadacid battery enclosed in a separate compartment of the power station.

In the Auxiliary Building, these units are exposed to a worst case temperature of 104 F. Recent correspondence from the vendor has shown that at that higher temperature, continuously, with an uncompensated charger, as used at Palo Verde, the expected life of the battery is 1.4 years.

This is the absolute worst case, since we know in actual application the temperatures are not near this value continuously year round.

The Holophane batteries are maintenance free, lead-acid type batteries with a warrantee based on battery temperature.

It should be noted that the capacity of these batteries would increase at higher temperatures.

#### <u>Exide</u>

The Exide units have their batteries located in the Class 1E battery rooms. Since this is a very controlled environment with an absolute maximum temperature of 85 F. The temperature concern is not a factor.



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# CONCERN 3:

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.

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(E.l.a, p. 4)

# **DISCUSSION:**

Refer to Concern 1 and Concern 2 discussion.



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CONCERN 4:

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.

(E.l.a, p. 4)

# DISCUSSION: `

The Emergi-Lite emergency lighting units are designed and tested for outdoor use by the manufacturer.

The Emergi-Lite KS series emergency lighting unit is contained in a NEMA 4X cabinet which by NEMA standards is defined as:

Either indoor or outdoor use to provide a degree of protection against falling rain, splashing water and hose-directed water; undamaged by the formation of ice on the enclosure.

A letter dated 5/1/89 obtained from the QC Manager of Emergi-Lite confirmed that the Emergi-Lite equipment purchased at PVNGS had been designed and tested to meet the NEMA 4X weatherability requirements.

The Emergi-Lite units contain sealed Nickel-Cadmium batteries as manufactured by SAFT America, Inc. The batteries are designed to support a wide temperature range.

The Emergi-Lite units have temperature compensated chargers which adjust charging current based on battery ambient temperature. This feature helps extend the life of the battery in elevated temperatures by preventing overcharging.

These emergency lights meet the requirements of BTP 9.5.1.

These lights are not required to be tested (See Concern 1). The temperature issue is addressed in Concern 2.

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# CONCERN 5:

Regarding Johnson Controls Model 6VHC-96, Dynasty GC 12V-100 and 12UPS-300 lead-acid and gel-cel 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 emergency lighting for loads in Units 1 and 2. According to the licensee's Procurement Specification No. 13-EM-041B, the battery cells are required to be of the proper rating to meet 125 percent of the battery load profile requirements at a minimum battery temperature without the battery voltage dropping below 1.75 volts per cell, to ensure adequate capacity at the end of the battery's useful life in accordance with U.L. Standard No. 924. The end of the battery's useful life is defined in the specification as the point where the battery has reached 80 percent of its 8 hour discharge rating.

(E.1.a, p. 4-5)

# DISCUSSION:

13-EM-041B is a Purchase Order number, not a Procurement Specification, and is not the Purchase Order for the Holophane UPS batteries. The Purchase Order for the Holophane UPS is 13-EM-036A. The 125% sizing criteria for the batteries is only imposed in Specification 13-EM-050, the specification for large station batteries. The 125% sizing criteria is not applicable to the Holophane UPS batteries and was not specified when the units were purchased. The Holophane UPS batteries meet the UL 924 guidance of supplying connected load for a minimum of 8 hours with the voltage not dropping below 87.5% of rated voltage.

The current battery type configurations are as follows:

#### <u>Unit 1</u>

1EQBN001 - All batteries are GLOBE 6VHC96 1EQBN002 - 2 batteries are DYNASTY GC12V100, the rest are GLOBE 6VHC96 1EQBN003 - All batteries are GLOBE 6VHC96 1EQBN004 - 1 battery is DYNASTY UPS 12-300, the rest are GLOBE 6VHC96

#### Unit 2

2EQBN001 - All batteries are DYNASTY UPS 12-300 2EQBN002 - All batteries are DYNASTY GC12V100 2EQBN003 - All batteries are DYNASTY UPS 12-300 2EQBN004 - All batteries are GLOBE 6VHC96 Unit 3

3EQBN001 - All batteries are GLOBE 6VHC96 3EQBN0.2 - All batteries are GLOBE 6VHC96 3EQBN001 - All batteries are GLOBE 6VHC96 3EQBN002 - All batteries are GLOBE 6VHC96

The ratings for each type of battery at an 8-hour discharge rate are GLOBE 6VHC96 96 amp-hour, DYNASTY UPS 12-300 88 amp-hour, and DYNASTY GC12V100 73 amp-hour.

To calculate the required battery amp-hour capacity for an 8-hour discharge, the following formula is used:

({[(Watts(load) / Inverter efficiency) / Nominal VDC] / Number of strings of batteries} x Discharge time) where:

Watts(load) - rated output load Inverter efficiency - 80.5% Number of strings of batteries - 4 Discharge time - 8 hours

Using 900 watts (rated connected output load for 1EQBN001) as an example, the result will be:

({[(900 / .805) / 24] / 4} x 8) - 93.17 amp-hour

Tabulating the amp-hour capacity using the same methodology for various output load is shown below:

Rated_Load	Minimum amp-hour capacity required
400 watts	41.40 amp-hour
500 watts	51.76 amp-hour
600 watts	62.11 amp-hour
700 watts	72.40 amp-hour
800 watts	82.80 amp-hour
900 watts	93.17 amp-hour

Using the information above and the rated output load connected, each UPS can be evaluated for compliance against the minimum amp-hour capacity for the type of battery installed.

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Tag Number	<u>Rated_Load</u>	<u>a-h required</u>	<u>a-h_installed</u>
1EQBN001**	900 watts	93.17 amp-hour	96 amp-hour
1EQBN002**	700 "	72.40 "	73 " *
1EQBN003**	900 . "	93.17 "	96 "
1EQBN004**	400 "	· 41.40 "	. 88 " *
2EQBN001**	600 watts	62.11 amp-hour	88 amp-hour
2EQBN002**	700 "	. 72.40 "	73 "
2EQBN003**	600 <b>"</b>	62.11 "	88 "
2EOBN004	400 "	41.40 "	96 "
3EQBN001**	900 watts	93.17 amp-hour	96 amp-hour
3EQBN002	700 "	72.40 "	96 "" '
3EQEN003	900 <b>"</b>	93.17 "	96 "
3EQBN004**	400 "	41.40 "	96 "

\* The least amp-hour capacity battery installed was assumed to be installed for all the batteries in the UPS.

\*\* Test results provided to verify adequacy.

As shown by the calculation performed, the batteries installed in the Holophane UPS is adequate to provide 8 hours of illumination without the voltage dropping below 87.5% of rated voltage, in accordance with UL 924 guidance.

# CONCERN 6:

Article 700-6 of NFPA 70-1975 and Section 37.1 of U.L. Standard No. 924 requires that the batteries have a capacity rating to supply and maintain not less than 87.5 percent of the nominal battery voltage for the total load of the circuit supplying emergency lighting. The load profile for lighting fixtures supplied by Battery Nos. QBN001 and QBN003 in Units 1 and 3 requires 86 amp/hours. However, all of these existing batteries in Unit 1 and two of the batteries in Unit 3, are only rated for 73 amp/hours (GC12V-100) and 88 amp/hours (12UPS-300). These batteries were replacements for the original batteries (6HVC-96), which had a 96 amp/hour rating.

(E.1.a, p. 5)

# **DISCUSSION:**

Refer to Concern 5 discussion.

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# CONCERN 7:

According to the battery vendor, the optimum temperature for maximum battery efficiency is 77 degrees F. At higher and lower temperatures, the battery capacity is decreased. The original batteries (6VHC-96) were designed to operate in an optimum temperature range of 60 degrees F to 85 degrees F.

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(E.1.a, p. 5)

# DISCUSSION:

Refer to Concern 2 discussion.

# CONCERN 8:

According to EER No. 89-QD-034, regarding Saft America Inc. emergency lighting batteries installed in the MSSS, which are also designed to operate in accordance with U.L. Standard No. 924, the batteries are provided with a disconnect switch, which will disconnect the lighting circuit at 87.5 percent of the nominal battery voltage.

(E.1.a, p. 5)

# DISCUSSION:

The Emergi-Lite batteries have a nominal voltage rating of 24 VDC. During discharge, the battery voltage is allowed to lower to 20 VDC. At 20 VDC, the charger is designed to cut-out to protect the battery from a potentially harmful deep discharge.

The EER 89-QD-034 requested a modification to the Emergi-Lite units to adjust the cut-out voltage down to a lower value or defeat this feature entirely. The emergency lighting units were cutting-out at a higher than design voltage of 23 VDC. The request of the EER was denied to avoid deep discharging of the batteries and a recommendation was made to return the charging boards, which were cutting-out at 23 VDC, to Emergi-Lite. This EER also referenced EER 89-QD-015, which essentially dealt with the same issue except it also asked for an evaluation of higher than 24 VDC charger voltages.

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The time versus voltage profile that was mentioned in the EER is in reference to the <u>discharge</u> characteristics of the battery. As the battery discharges over time the voltage will go down to the cut-out voltage of 20 VDC.

The Emergi-Lite units have sealed Nickel-Cadmium batteries, hence electrolyte evaporation is not a problem at higher charge rates.

# CONCERN 9:

Based on the total emergency lighting load profiles (86 amp/hours) for Battery Nos. QBN001 and QBN003 in Units 1 and 2, it does not appear that the original batteries (6VHC-96), or existing batteries (12 UPS-300) are capable of providing 125 percent of the battery load profile requirements at the optimum temperature for maximum battery efficiency, or at higher and lower temperatures, where the battery efficiency is lower.

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(E.1.a, p. 5)

# DISCUSSION:

Refer to Concern 1, 2, and 5 discussions.



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# CONCERN 10:

There does not appear to be sufficient margin in the GC 12-100 battery capacity to supply power to the lighting fixtures for 8 hours. Further, it appears that two of the batteries installed in Unit 2 with the lower load profiles have never been tested, and one other failed the 8 hour discharge test on March 6, 1990.

(E.l.a, p. 6)

# DISCUSSION:

The statement "... two of the batteries installed in Unit 2 with the lower load profiles have never been tested..." is a misinterpretation of the APS self-imposed testing report. The two UPS' in question, 2EQBN002 and 2EQBN003, were unavailable for testing for not passing the monthly acceptance criteria for open circuit voltage of a battery. The defective batteries were replaced and 8-hour discharge tests were performed and all acceptance criteria met. UPS 2EQBN001 did fail its 8-hour discharge test, the batteries were replaced and the 8-hour discharge test re-performed and all acceptance criteria were met.



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# CONCERN 11:

At the time of the inspection, it appeared that appropriate corrective actions had not implemented to preclude emergency lighting battery failures and recurrences as evidenced by emergency lighting battery failure data shown in a February 20, 1990 Failure Data Trending computer printout for the period 1988 through 1989, and a high volume of new battery usage as shown in a March 20, 1990 Procurement Materials. Management Information System computer printout for the period 1986 through 1990. During the period of May 1987 to October 1989, 70 of approximately 480 emergency lighting unit batteries had failed. Approximately fifty of the failed batteries were required to support safe shutdown. However, appropriate evaluation of the failures to determine cause and prevent recurrence apparently had not been initiated or documented.

(E.2, p. 6)

# **DISCUSSION:**

There were 79 incidences involving some type of corrective action per the Failure Data Trending (FDT) database since 1987. There were only 13 battery failures for Appendix R emergency lights and 12 battery for Non-Appendix R emergency lights. To compensate for component replacements under the PM program, the MMIS Material Activities Report dated March 20, 1990 was used to extract battery failures not identified in the FDT database for Dual-Lite supplied batteries. There were an additional 24 Appendix R battery failures and 12 Non-Appendix R battery failures. Of the 24 Appendix R battery failures, 15 were batteries used in the NEMA 4X7 Dual-Lite fixture which precipitated the issuance of DCP 1,2,3FE-QD-022 (Emergi-Lite units). The remaining 9 Appendix R failures per MMIS and the 13 battery failures in FDT represents only a 5% failure rate for 440 Appendix R emergency lighting units for a 30 month time period.

RCF EER are generated whenever the System Engineer identifies sufficient increase in failures. RCF EER 90-QD-002 was generated based on the fourth quarter FDT report due to the increase in failures of charging cards.



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# CONCERN 12:

EER No. 87-QD-004, dated January 28, 1987, identified and documented problems associated with batteries for the emergency lighting units as follows: "High temperatures inside Containment during operation cause loss of electrolyte in all fixtures; total loss in many, varying amounts in the rest. Salt accumulates on battery posts and vent caps and is discarded during PM cleaning. Continual repeated electrolyte loss with demin water replacement will cause premature battery failure". The same batteries (Dual-Lite Model EDE-30) used for Containment emergency lighting are used for safe shutdown emergency lighting in the Auxiliary Building, Control Building and Diesel Generator Building.

(E.2.a, p. 6-7)

# DISCUSSION:

EER 87-QD-004 identifies a concern with repeated replenishment of electrolyte by adding demineralized water to the batteries in Containment. Temperatures in containment and excessive float voltages are only some of the contributing factors of electrolyte loss. The major cause of electrolyte evaporation is the lack of quarterly PM's for the Containment emergency lighting. For emergency lights in Containment, PMs are currently performed only once per fuel cycle (during refueling outage). Access to Containment is restricted during plant operation for the performance of other than the cycle PM's. The time between the performance of the cycle PM's can vary from 1 year to 2 years. Varying amounts of electrolyte loss is expected with total loss of electrolyte expected if the last performance of the cycle PM's is over a year. Lights installed outside Containment are not subject to the same environment and have PM's performed on a quarterly basis. The performance of the PM's ensures that the light will perform its intended function. No battery plates have been uncovered for units outside of Containment if quarterly PM's were performed. The only exceptions were lights that were inadvertently left out of PM's (non-Appendix R lights).

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The quarterly PM's for outside Containment emergency lights are adequate to ensure that the lights are maintained in accordance with Dual-Lite's recommended maintenance criteria. The lights in Containment are not required for safe shutdown and have their cycle PM's performed during the refueling outage.

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# CONCERN 13:

The disposition of EER No. 87-QD-004 regarding the boiling and evaporation of Containment emergency lighting battery electrolyte apparently provided for float voltage adjustment, to a reduced battery float voltage, to an unspecified value. The modification to allow adjustment of the float voltage was apparently made, to Appendix R emergency lighting units installed outside of the containment. It appears that the modification was made to the lighting units without using the appropriate design change and maintenance work order processes. It further appears that the EER disposition was not provided with the appropriate engineering evaluation of the effects of reduced float voltage on the battery discharge capacity during emergency use.

(E.2.b, p. 7)

# DISCUSSION:



EER 87-QD-004 was not used for the adjustment of float voltages for lights outside of Containment. Quarterly and cycle PM tasks for the Dual-Lite fixtures provide the instructions on adjusting the float voltages. The values used in the PM's are in accordance with the vendor's tech. manual. Modifications to the lighting units to facilitate the adjustment required by the PM tasks was authorized by EER's 85-QD-022 and 86-QD-034.



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# CONCERN 14:

The disposition to EER No. 87-QD-004 also provided for replacement of the electrolyte in the batteries with distilled water, topped with mineral oil; again apparently without appropriate engineering evaluation of the effects of this disposition. It appears that mineral oil had, also, been added to lead-acid batteries installed in Appendix R applications, in addition to Nickel-Cadmium batteries. NRC discussions with battery vendors have indicated that the deposits of mineral oil on the plates of lead-acid batteries, and all battery cells, adversely affects battery capacity and performance, and is not approved. Given the temperature extremes in certain locations, there appears to be a high probability that mineral oil would be deposited on plates.

(E.2.c, p. 7)

# DISCUSSION:

Mineral oil was not added to any lead-acid batteries used for emergency lighting, Appendix R applications. The only lead-acid batteries currently installed are for the Control Room emergency lighting system (EQDNFO1 and EQDNF02). An inspection performed by EED verified that no mineral oil was added to the electrolyte in lead-acid batteries.

The cycle PM tasks for the Containment emergency lights contain the statement to add mineral oil. A review, of the PM tasks for emergency lights outside of Containment, determined that the PM's do not have a statement to add mineral oil to inhibit electrolyte evaporation.


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# CONCERN 15:

Certain batteries have demonstrated a continuing failure history (Failure Data Trending). For example, 15 percent (70 failures of approximately 480 Appendix R emergency lights installed in all 3 units) failed over a 30 month period (May 1987 to October 1989). The NRC is concerned that Appendix R emergency lighting preventive maintenance tasks have not been designed to optimally assure a continued capability of Appendix R lighting units to operate for the required eight hours. Furthermore, apparently, timely preventive maintenance completion has not been aggressively pursued because, in about 84 instances, the required annual capacity test and quarterly electrolyte level checks were overdue in Unit 3 as of March 23, 1990.

(E.2.d, p. 7)

#### DISCUSSION:

Refer to Concern 11 discussion for Failure Data Trending information.

PMs are developed based upon manufacturers' recommendations. Schedule dates are established based on the periodicity of the PM. PMs may be delayed past their due date without management approval under the following conditions:

Meets criteria for delaying specified in procedure 30AC-9MP02.

Does not exceed the grace period (25% of maintenance interval).

PMs can be delayed past their grace period with the written concurrence from the Maintenance Manager (or designee) on the Preventative Maintenance Task Disposition Report.

The grace period has been tabulated below for the different periodicity of PMs:

4W - + 7 days 12W - + 21 days 24W - + 42 days 48W - + 84 days 1Q - + 23 days 1M - + 8 days 1S - + 46 days 1A - + 92 days 1R - No firm due date, must be completed during the refueling outage (Ref. 3.7.1.2 of 30AC-9MP02)

Majority of the PMs have been performed prior to the due date or during the grace period, as allowed by procedure 30AC-9MP02. All Dual-Lite discharge PM tasks were performed prior to the overdue date (prior to end of grace period). Manpower restraint caused by having 3 units in an outage along with the Unit 3 Main Transformer event (January 1990) depleted the available manpower resources to perform emergency lighting PM tasks. Currently there are no PM tasks past their grace period (5/8/90).



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# CONCERN 16:

The licensee's EER No. 89-QD-034 documents excessive failures of MSSS installed emergency lighting when the battery input voltage was found to be greater than the rated 21 VDC. The batteries are required to operate at 24 VDC rated voltage. However, the EER disposition was apparently based on the erroneous reference to a time versus voltage profile which indicated that the excessive voltage had no adverse effect on the batteries, when, in fact, the excessive charging voltage is a direct contributor to electrolyte evaporation.

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(E.2.e, p. 8)

## DISCUSSION:

Refer to Concern 8 discussion.



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CONCERN 17:

It appears that prompt and technically sufficient evaluations and corrective actions of the considerable, observed emergency lighting deficiencies were not implemented.

(E.2.f, p. 8)

### DISCUSSION:

At the completion of the installation of the Emergi-Lite units per DCP's 1,2,3 FE-QD-022, each Emergi-Lite unit was tested for initial acceptance. Numerous failures were noted during this testing, as stated in the inspection report. Defective boards and a bad batch of batteries were the main cause of the failures. The defective boards and bad batteries were replaced and each light was successfully tested before the DCP was closed. Subsequent failures, mainly boards, required the frequency of the PM task to be revised from a quarterly PM to a monthly task.

See APS' response to NRC Inspection Report, Notice of Violation 50-530/90-08-02, dated April 20, 1990 (102-01674) and Plant Guideline 13 for the evaluation of prioritization of corrective maintenance for the emergency lighting system.

The Emergi-Lite units will be replaced per DCP 1,2,3 FE-QD-025, with Holophane centralized AC modular power stations (2 stations/unit).



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## CONCERN 18:

At the time of the inspection, it appeared that the Pre-Fire Strategies Manual had not been reviewed since the original licensing of Unit 1 in December 1984 to determine the adequacy of operator actions specified to achieve post-fire safe shutdown for fires occurring outside of the Control Room.

(E.3, p. 9)

#### DISCUSSION:

The Pre-Fire Strategies Manual is controlled by the Site Fire Department as it has been since its original development. Some changes were made at the direction of the Fire Protection Supervisor, but the manual was not controlled document. The first formal review and update by Engineering was performed on April 18, 1988 (167-02213/ECS/JDO) at the request of the Site Fire Department. This action was required as part of the resolution of CAR #CE-86-0203. The following summarizes actions taken with respect to the Pre-Fire Strategies Manual to close this CAR.

- 1) The manual was established as a controlled document and distributed by Document Control.
- DCP and technical input and review checklists were revised to address impact to the manual and the Spurious Actuation Studies. These revisions were also incorporated into the new Plant Design Change Program (81DP-0DC03).
- 3) Procedure O1AC-OAPO2 was revised, requiring annual update of the manual.
- 4) Engineering reviews "Engineering Output Data" as part of the annual review.
  - NOTE: Last annual update by Engineering was requested on 6/8/89. Update is complete with the exception of the Spurious Actuation Evaluation Concerns Section.



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### CONCERN 19:

The Pre-Fire Strategies Manual operator actions appeared to be inconsistent with the Outside Control Room Fire Spurious Actuation Study (Studies 01-NS-110, 02-NS-110 and 03-NS-110) for Fire Zones 47A, 47B, 72, 73, 74A and 74B, regarding operator actions to interchange instrument air header pressure transmitters.

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(E.3, p. 9)

#### DISCUSSION:

The Spurious Actuation Study for fires outside the Control Room has a section called "Compensatory Measures" for each Fire Zone. These measures are not always necessarily local manual operator actions but may be Plant modifications such as installation of raceway fire barriers. The Pre-Fire Strategies Manual, which is based on the study, only describes manual operator actions.

For Fire Zones 47A and 47B, no manual actions or plant modifications are associated with interchange of instrument air header pressure transmitters.

In Zones 72, 73, and 74A of the Spurious Actuation Study a compensatory measure is called out to move the instrument air header pressure transmitters. This permanent plant modification was necessary because the "A" train transmitter was on the "B" side of the room and visa versa. This modification was made by DCP 10J-SG-129. Hence, since no operator action is required, the Pre-Fire Strategies Manual is correct by not describing this action. The Spurious Actuation Study, however, was not revised as a result of this DCP.

For Zone 74B the compensatory measures that require an operator to take manual actions are identical between the Spurious Actuation Study and Pre-Fire Strategies Manual.



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#### CONCERN 20:

At the time of the inspection, it appeared that licensed and non-licensed operators were directed to perform manipulation of equipment, by the Pre-Fire Strategies Manual, to achieve post-fire safe shutdown. It was not apparent that the personnel had been trained to perform the required actions.

(E.4, p. 9-10)

#### DISCUSSION:

An extensive training program was developed and provided to all licensed operators that may be assigned the task of Fire Team Advisor which covered a wide range of topics including the Pre-Fire Strategies Manual. The training included workshops specifically on the Spurious Actuation Evaluation Concerns Section. Practical exercises were conducted where students performed manual actions under impaired vision to manipulate electrical breakers and valves and maintain effective communications. These exercises were conducted with full protective equipment.

The Fire Team Advisor training was an "initial" training course with no plans or actions regarding recurrent training in the future. New operators will be provided the initial training prior to being assigned duties of Fire Team Advisor.

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With respect to non-licensed operators there is no specific training for Pre-Fire Strategies Manual identified actions.

Operations Procedure 4XAO-XZZ44, shutdown outside the Control Room is included in the Annual Procedure Review for all licensed operators. Job Performance Measures (JPM's) are administered for actions outside the Control Room. JPM's are administered on a common and random basis; therefore, a student could potentially receive only classroom training in a given year. <u>All but 29 of</u> the operator actions identified in the Pre-Fire Strategies Manual are included in Procedure 4XAO-XZZ44. These 29 actions have been reviewed by Operations and it has been determined that no specialized training is required for the operators to perform these actions.

Fire Team Advisor training was also provided during 1987, 1988 and 1989 by the Fire Department Training Officer.



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### CONCERN 21:

Regarding Fire Zones 47A, 47B, 72, 73, 74A and 74B, the Pre-Fire Strategies Manual directed operators to locally operate switches and values in areas which may not be accessible to the operators in the event of a fire. It was not clear whether operators were required to enter these areas during the fire to accomplish manual actions or to wait until the fire had been extinguished. In either case, it was not apparent that the appropriate personnel had been trained in safety and protective measures necessary to accomplish such actions.

(E.4, p. 9-10)

#### DISCUSSION:

During a review of the Pre-Fire Strategies Manual by the Corporate Fire Protection Engineer it was discovered that a local manual compensatory action was required within a zone that was affected by the fire (QDR-0125). Hence, this manual action could not realistically be taken credit for.

The activity identified in the QDR involved two Fire Zones which required the opening of a disconnect switch within an auxiliary relay cabinet in Fire Zones 47A and 42B to prevent the spurious opening of the reactor vent valves. A review of the Spurious Actuation Study for outside the control room revealed that the Pre-Fire Strategies Manual was consistent with the Study\_ Both were in error. The Spurious Actuation Study has been revised by Engineering to state an alternate location for removing power to the valve and hence preventing spurious actuation. An update to the Pre-Fire Strategies Manual has been performed.

In Zones 72, 73, and 74A of the Spurious Actuation Study, a compensatory measure is called out to move the instrument air header pressure transmitters. This permanent plant modification was necessary because the "A" train transmitter was on the "B" side of the room and visa versa. This modification was made by DCP 10J-SG-129. Hence, since no operator action is required, the Pre-Fire Strategies Manual is correct by not describing this action. The Spurious Actuation Study, however, was not revised as a result of this DCP.

The Spurious Actuation Study is currently under review by the EEP Fire Protection Design Basis Review Group. As a result of this an action has been scheduled to perform a complete engineering review of the spurious actuation studies.

#### CONCERN 22:

For a fire inside the Control Room, the licensee's Spurious Actuation Study 13-NS-109 requires operators to provide makeup to the Essential Chilled Water System, Essential Cooling Water System and Emergency Diesel Generator Surge Tanks by providing water from the Fire Water System. It was not apparent that operators had been trained to perform these actions.

(E.4, p. 9-10)

# DISCUSSION:

The manual actions associated with makeup water to the surge tanks are addressed in Procedure 4XAO-XZZ44. Appendix F, Section 2.2 and Appendix J, Section 2.0 address DG Jacket Water Surge Tank. Appendix J, Sections 3.0 and 4.0 address Essential Chilled Water Surge Tank and Essential Cooling Water Surge Tank respectively.

Operations Procedure 4XAO-XZZ44 is included in the Annual Procedure Review for all licensed operators. Job Performance Measurers (JPM's) are administered for actions outside the Control Room. JPM's are administered on a common and random basis. Therefore, a student could potentially receive only classroom training in a given year.

An extensive training program was developed and provided to all licensed operators that may be assigned the task of Fire Team Advisor which covered a wide range of topics including the Pre-Fire Strategies Manual. The training included workshops specifically on the Spurious Actuation Evaluation Concerns Section. Practical exercises were conducted where students performed manual actions under impaired vision to manipulate electrical breakers and valves and maintain effective communications. These exercises were conducted with full protective equipment.

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The Fire Team Advisor training was an "initial" training course with no plans or actions regarding recurrent training in the future. New operators will be provided the initial training prior to being assigned duties of Fire Team Advisor.

With respect to non-licensed operators there is no specific training for Pre-Fire Strategies Manual identified actions. None of the actions required to be performed are outside those actions normally expected to be performed by a non-licensed operator.



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### CONCERN 23:

The licensee's October 29, 1984 submittal to the NRC indicated that NUREG 0700 was used as the design basis for the control room and the remote shutdown panel emergency lighting illumination levels. NUREG 0700 requires a minimum of 10 foot candles in these areas. However, the licensee's acceptance criteria for the control room and the remote shutdown panel emergency lighting illumination levels is 6 foot candles in peripheral areas and 3 foot candles at control board instruments.

(E.6.a, p. 11)

#### **DISCUSSION:**

For inside the Control Room, APS used 6 foot candles in the horseshoe area and 3 foot candles on the panel areas. This commitment is as stated in UFSAR Section 14B. NUREG-0700 provides guidance for Control Room lighting illumination levels. The guidance provided in NUREG-0700 concerning Control Room emergency lighting is 10 foot candles. The referenced letter of October 29, 1984, states that the guidance of NUREG-0700 was used, as applicable, to perform the required DCRDR. No commitments were made in the letter concerning Control Room emergency lighting illumination levels.



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# CONCERN 24;

Thirteen lighting level readings were taken at various locations outside the control room in Unit 3 with a photometer (Spectra Photometer Model FC-200, Serial number 476, NRC Equipment Number 000393. with the next calibration due date of 7/26/90). The locations were the stairwell outside the control room, the essential chiller surge tank level and valves, the chiller room stairwell exit, and the Emergency Diesel Generator rooms. The photometer readings ranged from 0.03 to 0.75 foot-candles with an exception of 1.3 foot-candles at the emergency diesel control panel.

(E.6.b, p. 11)

# DISCUSSION:

For Appendix R lighting, APS used the guidance of Generic Letter 86-10, which states that illumination, levels shall be sufficient to perform the shutdown function. Emergency lighting has been walked down to confirm this.



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CONCERN 25:

Orientation of the lamps on a lighting unit in the stairwell outside the control room were found to be not directed toward the access/egress pathway.

(E.6.b, p. 11)

# DISCUSSION:

Incorrect lamp orientation noted during recent NRC inspection was an isolated occurrence due to construction work on the adjacent Unit 3 Operation Support Building. Adequate lighting for access/egress existed even though the lamps were not directed toward the access/egress pathway. Inspection team members were able to access/egress the stairwell.

Lamp orientation is verified when performing quarterly preventive maintenance (PM). Quarterly PM's provide instructions to orientate the lamps.



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