LICENSING REVIEW RESULTS

FOR FSAR CHAPTER 8

(ELECTRIC POWER)

RELATED TO THE

OPERATION OF

THE SNUPPS PLANTS

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8.0 ELECTRIC POWER

8.1 INTRODUCTION

8.1.1 REVIEW OF ELECTRIC POWER SYSTEMS

The review of the electric power systems for the SNUPPS plants has been a continuing process for over seven years. Design documents are reviewed internally by the designer, by the SNUPPS Staff, and by the SNUPPS Utilities. The SNUPPS Technical Committee meets regularly to discuss and evaluate design matters. The NRC reviewed the SNUPPS electric power systems during the CP stage of licensing and issued favorable Safety Evaluation Reports. There have been no significant changes in the design of the electric power systems since the time of the NRC's review of the PSAR. The electric power systems were again considered in detail during the preparation and review of the SNUPPS FSAR and the Callaway and Wolf Creek FSAR Site Addenda. The authors of this report were appointed by SNUPPS Management to review Chapter 8 of the FSARs and to act as surrogates for the NRC for the OL stage of licensing review. This latest review culminated in a formal two-day meeting held in Gaithersburg, Maryland on December 9-10, 1980 in which FSAR material was reviewed and system designers were questioned. The NRC Staff observed and participated in this meeting. This report provides a summary of results of this eight-man review. In addition to documenting the results of our review, this report is intended to be of assistance to the NRC in the preparation of their OL-stage SER. In general we confirmed the results of the previous reviews in that the electric power systems meet the applicable regulations, guides, and standards and that construction of the systems in accordance with the stated criteria and documentation will assure that the systems will perform satisfactorily. We did find several areas where additional evaluation is required or when additional information is necessary in the FSAR. These matters are listed below.

This report is organized in a manner similar to NRC SERs and to the standard format for safety analysis reports. Section 8.2.1 discusses the review of the offsite power systems for the Callaway plant. The detailed safety analysis and one of the bases for our review of this section is Section 8.2 of the Callaway FSAR Site Addendum. Section 8.2.2 is a similar report for the offsite power systems for the Wolf Creek plant and is based on Section 8.2 of the Wolf Creek FSAR Site Addendum. Section 8.3.1 discusses onsite AC power systems and Section 8.3.2 discusses onsite DC power systems. These sections correspond to identically numbered sections in the SNUPPS FSAR and both Site Addenda. The onsite power systems consist of a standardized portion within the SNUPPS power block and a nonstandardized portion outside of the power block. The electrical power systems within the power block and the Class IE nonstandard site portions are described in Section 8.3 of the SNUPPS FSAR. The non-Class IE onsite electrical power systems outside of the power block are described in Section 8.3 of each Site Addendum.

Specifically excluded from our review of the electric power systems were the seismic and environmental qualification programs, diesel generator support systems, fire protection, technical specifications, and other matters that are primarily addressed in FSAR chapters other than Chapter 8.

8.1.2 DISCUSSION

The Union Electric Company (owners of the Callaway plant) system consists of interconnected hydroelectric and fossil-fuel plants supplying electric energy over a 345/161/138-kilovolt transmission system. This system is also an integral part of the midwest interconnected utility grid, with interconnections to Central Illinois Public Service Company, Electric Energy Inc., Illinois Power Company, Kansas City Power & Light Company, Iowa-Illinois Gas & Electric Company, Iowa Southern Utilities, Missouri Public Service Company, Arkansas-Missouri Power Company, Associated Electric Cooperative, Inc., Public Service Company of Oklahoma, Tennessee Valley Authority, Southwestern Power Administration, and Central Electric Power Cooperative. UE is also a member of the Mid-America Interpool Network (MAIN) organization, one of nine Electric Reliability Councils.

The owners of Wolf Creek are Kansas Gas and Electric Company (KG&E) and Kansas City Power & Light Company (KCPL). The Southwest Power Pool is the regional reliability council of which KG&E and KCPL are members. It is made up of 38 member systems, extending throughout an area covering the states of Arkansas, Louisiana, Kansas, Oklahoma and portions of Mississippi, Missouri, New Mexico and Texas. The Southwest Power Pool is highly interconnected with transmission lines of many voltages, including 345 and 500-kilovolt.

KG&E and KCPL are also members of the MOKAN Pool, which is made up of nine companies in the Kansas and western Missouri area. The other seven companies are Central Kansas Power Company, Western Power Division and Central Telephone and Utilities Corportation, Empire District Electric Company, Kansas Power and Light Company, Missouri Public Service Company, St. Joseph Light and Power Company, and Sunflower Electric Cooperative.

The onsite power system at each site location is provided with preferred (offsite) power from the offsite system through two independent and redundant sources of power. One preferred circuit from the switchyard supplies power to a three-winding startup transformer. This startup transformer feeds two medium-voltage 13.8-kilovolt busses and a 13.8/4.16-kilovolt ESF transformer. The second preferred (offsite) circuit is connected to the second 13.8/4.16-kilovolt ESF transformer. Each transformer normally supplies its associated member voltage 4.16-kilovolt Class IE bus.

The two non-Class IE 13.8-kilovolt busses supply power to the non-safety-related auxiliary loads of each unit. The 13.8-kilovolt buses are also connected to a three-winding unit auxiliary transformer, in addition to the startup transformer. The unit auxiliary transformer is connected to the main generator through an isolated phase bus duct.

Two 4.16-kilovolt non-Class IE buses are supplied power from two 13.8-kilovolt buses through two 13.8/4.16-kilovolt station service transformers.

Non-Class IE low-voltage 480-volt loads are supplied power from two 13.8-kilovolt buses through 480-volt load centers and 480-volt motor control centers.

The onsite power system for each unit is divided into two separate load groups, each load group consisting of an arrangement of buses, transformers, switching equipment, and loads fed from a common power supply. Power is supplied to auxiliaries at 13.8-kilovolt, 4.16-kilovolt, 480-volt, 480/277-volt, 208/120-volt, 120-volt AC, 250-volt DC, and 125-volt DC.

The onsite standby power system includes the Class IE AC and DC power for equipment used to maintain a cold shutdown of the plant and to mitigate the consequences of a DBA.

Class IE AC system loads are separated into two load groups which are powered from separate ESF transformers or two independent diesel generators (one per load group). Each load group distributes power by a 4.16-kilovolt bus, 480-volt load centers, and 480-volt motor control centers.

The Class IE DC system provides four separate 125-volt DC battery supplies per unit for Class IE controls, instrumentation, power, and control inverters.

8.1.3 EVALUATION

The bases for our acceptance and the detailed results of our review are addressed in Sections 8.2 and 8.3 of this report. However, our general approach was to review the information against the recommendations and referenced guides and standards of the NRC's Standard Review Plan.

The areas requiring additional information and/or evaluation are listed below and are discussed in the section of this report indicated in parenthesis.

1. Additional FSAR discussion is required concerning conformance to IEEE-384 regarding separation between tray and conduit and between redundant safety group crossovers. (Section 8.3.1.1)

2. Confirmation is required in the FSAR to state that separation between Class IE and non-Class IE cables/circuits inside cabinets is the same as if both were Class IE. (Section 8.3.1.1)

3. An FSAR clarification is required concerning the plans to fuse certain low voltage control circuits. (Section 8.3.1.1)

4. Long-term overcurrent protection for the pressurizer heaters must be provided. (Section 8.3.1.2)

5. An FSAR statement concerning the effects of design basis events or other high energy line breaks on any separation group is required. (Section 8.3.1.2)

6. Clarification concerning which of the Class IE power systems are included on the bypass indicating panel is needed. (Section 8.3.1.2)

7. The load carrying capacity of the startup transformer needs to be clarified in the FSAR. (Section 8.3.1.2)

8. The FSAR should be modified to show the routing of non-Class IE cables from the startup transformer to the redundant load groups. (Section 8.3.1.2)

9. Additional description of the degraded grid voltage relays is necessary. (Section 8.3.1.2)

10. The lowest voltage of loads considered in the analysis for optimization of transformer tap settings should be stated and justified. (Section 8.3.1.2)

11. A design change in the load-shedding circuits must be evaluated and implemented or additional justification for the present design is required. (Section 8.3.1.2)

12. An analysis that demonstrates sufficient battery capacity at the lowest anticipated battery room temperature is required. (Section 8.3.2.1)

13. An FSAR change is required to correctly document Class IE DC loads. (Section 8.3.1.2)

14. Additional evaluation is required to determine if local pockets of hydrogen gas could form in explosive concentrations in the battery rooms. (Section 8.3.2.2)

15. The battery cell differential temperature testing plans in the FSAR should be clarified. (Section 8.3.2.2)

8.2 OFFSITE POWER SYSTEMS

8.2.1 OFFSITE POWER SYSTEMS - CALLAWAY

8.2.1.1 Discussion

Offsite AC power sources for the Callaway plant include three 345-kilovolt transmission lines. This offsite power system provides two full capacity, immediate-access, physically independent sources of AC power for plant startup and shutdown.

The 345-kilovolt switchgear is arranged in a modified breaker-and-a-nalf configuration. The 345-kilovolt system is protected from lightning and switching surges by lightning-protective equipment and by overhead static lines. The entire transmission system is designed to withstand the loading requirements for environmental conditions prevalent in the area related to terrain, soils, wind, temperature, lightning and floods. Review of Union Electric's historical outage rate indicates that transmission grid availability has been demonstrated to have a very high degree of reliability.

The design of the 125-volt DC systems for the switchyard provides two independent DC sources. This system meets all requirements for physical and electrical independence from each other and from the preferred power source.

Regarding reliability and operating flexibility, the transmission system is designed to allow any transmission line to be cleared without affecting other lines, any circuit breaker to be isolated for maintenance without interrupting power or protection, and any circuit on a section of bus to be isolated in case of a short circuit without interrupting service.

Union Electric has conducted grid stability analyses for the assumed conditions of (a) loss of largest generating unit on the system, (b) loss of any 345-kilovolt unit, and (c) 3 phase faults on 345-kilovolt lines, including stuck breaker conditions. The results demonstrated the grid will continue to provide uninterrupted synchronous AC current to the plant site switchyard.

Control room instrumentation presenting information on the status of preferred power system has been verified. Control room operator maintains automatic control of plant site switchgear breakers negating possible problems with the remote automatic load dispatch system.

Review of the Callaway test program indicates that the 345-kilovolt circuit breakers will be inspected and tested on a periodic basis. All testing can be accomplished without removing the generators, transformers, and transmission lines from service.

8.2.1.2 Evaluation

The offsite power system includes the independent power sources from the grid, transmission lines, transmission line towers, transformers, switchyard, switchyard control systems, and battery systems. The review of the offsite power system for the Callaway plant covered single line diagrams, schematic diagrams, and descriptive information. The review also included the design criteria and design bases for the offsite power systems and analyses of the manner in which the systems conform to the design criteria.

The basis for acceptance in our review was a demonstration of sound engineering design and conformance of the design, design criteria, and design bases to the NRC's regulations and guides and to industry standards. We determined that the Callaway offsite power system meets the requirements of General Design Criteria 17 and 18, the recommendations of Regulatory Guide 1.32, and the Standard Review Plan recommendations including SRP Table 8-1. We also determined that the system meets applicable industry standards and has been thoroughly evaluated by the utility. We therefore conclude that the Callaway offsite power system is acceptable.

8.2.2 OFFSITE POWER SYSTEMS - WOLF CREEK

8.2.2.1 Discussion

Offsite AC power sources for the Wolf Creek plant include four 345-kilovolt transmission lines and one 69-kilovolt transmission line. This offsite power system provides two full capacity, immediate-access, physically independent sources of AC power for plant startup and shutdown.

Each of the immediate-access sources supplies one of the two Class IE buses through an ESF transformer. In the 69-kilovolt switchyard, two 69/13.8-kilovolt transformers are installed with the 13.8-kilovolt side connected to an ESF transformer by an underground circuit. These transformers are operated in parallel to assure adequate voltage for the total ESF loads when starting. During the course of our review it was determined that the Wolf Creek design did not contain any provisions for control room indication of non-parallel operation of these transformers or features to physically prevent non-parallel operation. Subsequently, it was decided to provide alarms in the control room to indicate if the transformers are not operating in parallel. The other ESF transformer is connected to the 13.8-kilovolt side of the 345/13.8-kilovolt startup transformer. The startup transformer is connected to the 345-kilovolt switchyard by an overhead line. A second overhead 345-kilovolt circuit connects the main transformers to the 345-kilovolt switchyard. These two overhead lines are separated and supported by independent structures such that a structural collapse of one will not effect the other 345-kilovolt line.

No two 345-kilovolt transmission lines cross each other. One of the four 345-kilovolt lines crosses the 69-kilovolt line at a location four and one-half miles south of the plant. In the course of our review, it was determined that the Wolf Creek FSAR Site Addendum needed to be clarified to show this one crossing.

The 345-kilovolt switchyard includes a breaker-and-a-half arrangement for each circuit. Each 345-kilovolt breaker has two trip coils on separate DC control circuits. The 69-kilovolt switchyard has a separate DC control circuit. The switchyard DC control system is independent of the DC power systems of the SNUPPS power block. The switchyard circuit breakers and transmission line protective relays can be tested and inspected without removing the transformers or transmission lines from service. Control of the 345-kilovolt generator breakers and the 13.8-kilovolt breakers in the 69-kilovolt switchyard is accomplished from the control room. Indication of all switchyard breakers is in the control room.

A load flow and stability analysis has been conducted. This analysis shows, for both transient and steady state cases, that the Wolf Creek offsite power system has the following capabilities:

1. The system can successfully withstand loss of the Wolf Creek plant when fully loaded.

2. With all 345-kilovolt lines in service and the Wolf Creek plant fully loaded, the system can successfully withstand the loss of any one 345-kilovolt line from the Wolf Creek substation under three-phase fault conditions with the fault cleared in normal clearing sequence.

3. With all 345-kilovolt lines in service and the Wolf Creek plant fully loaded, the system can successfully withstand the loss of any two elements caused by a single-phase fault being cleared by back-up breaker operation in back-up clearing sequence.

4. Any one 345-kilovolt line, when energized from the remote end, can successfully carry the total engineered safety feature load should it become necessary to do so.

5. The 69-kilovolt line from the Athens substation to the Wolf Creek site can successfully carry the total engineered safety feature load should it become necessary to do so.

The KG&E and KCPL transmission systems historical outage rates were evaluated and found to compare favorably with utility industry experience.

8.2.2.2 Evaluation

The offsite power system includes the independent power sources from the grid, transmission lines, transmission line towers, transformers, switchyard, switchyard control systems, and battery systems. The review grid, transmission lines, transmission line towers, transformers, switchyard, switchyard control systems, and battery systems. The review of the offsite power system for the Wolf Creek plant covered single line diagrams, schematic diagrams, and descriptive information. The review also included the design criteria and design bases for the offsite power systems and analyses of the manner in which the systems conform to the design criteria.

We determined that the Wolf Creek FSAR Site Addendum needed to be updated to show the one crossing of the 69-kilovolt line and a 345-kilovolt line. Adequate independence and separation exist even with this crossing. In addition, the design of the two 69/13.8-kilovolt transformers needed to be modified to alarm or physically prevent non-parallel operation of the transformers. Subsequent to our review meeting the Wolf Creek owners decided to provide the control room alarm. Both of these FSAR changes (i.e. the transmission line crossing and the new control room alarm) were included in Revision 1 to the Wolf Creek FSAR Site Addendum.

The basis for acceptance in our review was a demonstration of sound engineering design and conformance of the design, design criteria, and design bases to the NRC's regulations and guides and to industry standards. We determined that the Wolf Creek offsite power system meets the requirements of General Design Criteria 17 and 18, the recommendations of Regulatory Guide 1.32, and the Standard Review Plan recommendations including SRP Table 8-1. We also determined that the system meets applicable industry standards and has been thoroughly evaluated by the utility. We therefore conclude that the Wolf Creek offsite power system is acceptable.

8.3 ONSITE POWER SYSTEMS

8.3.1 AC POWER SYSTEMS

8.3.1.1 Discussion

The onsite AC power system for the SNUPPS plants consists of a Class IE system and a non-Class IE system. The non-Class IE system distributes power at 13.8-kilovolts, 4.16-kilovolts, 480-volts, 480/277-volts, and 208/120-volts to non-safety loads. The Class IE system distributes power at 4.16-kilovolts, 480-volts, 208/120-volts, and 120-volts to safety related loads. The Class IE system can be powered from two, independent offsite sources or, alternatively, by two, independent onsite sources. Class IE AC loads are divided into two load groups, each having access to one independent onsite or one independent offsite source.

Two ESF transformers, each powered by an independent, offsite source provide power to two 4.16-kilovolt, Class IE busses. Each ESF transformer and its source are sized to adequately supply safety related and non-safety related loads connected to its bus.

There will be no sharing of the onsite power sources between units on the multi-unit site. There are no provisions for automatically connecting one Class IE load group to the other Class IE load group or for automatically transferring loads between the groups. The offsite power supply for one load group can supply the other load group by means of a manual transfer. Interlocks are provided to prevent parallel operation of the redundant offsite sources or the onsite sources.

Regulatory Guide 1.75 and IEEE-384 were used as the design basis for physical independence of Class IE systems. Details of compliance to Regulatory Guide 1.75 are in the SNUPPS FSAR Section 8.1.4.3. It was determined that additional FSAR discussion is necessary concerning compliance with IEEE-384 regarding separation between tray and conduit and between redundant safety group crossovers. In addition clarification is required in the FSAR that separation between Class IE and non-Class IE cables inside cabinets will be the same as if both were Class IE. These FSAR changes have been prepared and are planned for submittal in Revision 3 to the SNUPPS FSAR.

Interlocks are provided to prevent automatic closure of a diesel generator supply breaker to an energized or faulted bus. Redundant load shedding circuits are provided to shed selected loads from the 4.16-kilovolt Class IE busses for a loss or degradation of the offsite power supply voltage. In order to complete our evaluation of the independence of the offsite and onsite power systems, we need additional information concerning the precautions and allowable modes of parallel operation of the two sources.

The standby, onsite power supply for each load group is a diesel generator complete with its own accessories and fuel systems. The diesel generators are electrically isolated from each other. Physical separation for fire and missile protection is provided since the diesels are located in separate rooms of a seismic Category I structure. Each diesel generator is rated at 6201 KW for continuous operation. The capacity of the generators is sufficient to start and carry all safety-related LOCA or cold shutdown loads within the voltage and frequency guidelines of Regulatory Guide 1.9. The characteristics of the loads have been conservatively established. The test program for the diesel is in compliance with Regulatory Guides 1.6 and 1.9. The plan for periodic diesel testing is in accordance with Regulatory Guide 1.108.

Two separate penetration areas are provided for all cables that must pass through the containment wall. Separation group independence is maintained with these two areas. The electrical penetration assemblies conform to IEEE 317-1976. Compliance to Regulatory Guide 1.63 is discussed in detail in SNUPPS FSAR Section 8.1.4.3. In that write-up a clarification is needed concerning the plans to fuse certain low voltage control circuits. This FSAR change has been prepared and is planned for submittal in Revision 3.

IEEE-415 deals with pre-operational testing and therefore was not specifically addressed in this review of Chapter 8. IEEE-420 was not specifically referenced in the SNUPPS electrical design, rather IEEE-279, -323,-344,-384, other industry standards, and general good design practice have been applied as the criteria for the SNUPPS electrical design.

8.3.1.2 Evaluation

The SNUPPS FSAR and Site Addenda were reviewed in accordance with Standard Review Plan 8.3.1. System redundancy, conformance with the single failure criterion, independence of offsite and onsite power sources, and the standby power system adequacy were reviewed.

Our review included the design and capabilities of the various devices used for electrical isolation. The qualification documentation for these devices will not be included in the FSAR but are available for review if required.

The design was reviewed against the requirements of GDC 17 and the recommendations of Regulatory Guide 1.53 and IEEE-379 for compliance with the single failure criterion. Also included was a review of the SNUPPS model in the control room, spreading rooms, and electrical distribution areas. The model illustrated how safety related cabling, cable trays, and conduit are identified and physically separated. The physical separation criteria, use of associated, non-Class IE circuits, and cable tray identification schemes were reviewed and found to be acceptable. Physical arrangement drawings, electrical schematics, and the SNUPPS model were reviewed to determine adequate physical separation.

The diesel generators were evaluated against Regulatory Guide 1.9 and IEEE-38 and found to be acceptable.

A part of our review of the standby power supply concerned the load-shedding circuits (FSAR Section 8.3.1.1.3). Each incoming breaker is provided with one time delay undervoltage relay in series with the output of the 2-out-of-4 loss of voltage and degraded voltage logic. We suggested that a design change be considered that would upgrade this time delay relay to a 2-out-of-4 logic or move the relay to the incoming breaker closing circuit. This change is currently under evaluation. Either a design change or additional justification for the current design will be included in a future revision to the SNUPPS FSAR.

We determined that additional pressurizer heater protection against long-term overcurrent conditions is required. This design change will be documented in a future FSAR revision. In addition, the FSAR needs to be changed in the following areas:

1. to clarify that design basis events or other high energy line breaks will not affect any load group,

2. to indicate which power system components provide input to the bypass indicating panel,

3. to clarify the load carrying capacity of the startup transformer.

4. to show the routing of non-Class IE cables from the start-up transformers and ESF transformers to the redundant load groups,

5. to expand the discussion of degraded grid voltage relays, and

6. to state and justify the lowest voltage of loads considered in the analysis for optimization of transformer tap settings.

The SNUPPS FSAR changes associated with items 1 through 4 above have been prepared and are planned for submittal in Revision 3. Items 5 and 6 above require additional evaluation and will be documented in a future FSAR Revision.

We evaluated the AC power system failure mode and effects analysis (FSAR Table 8.3-4) and find that it accurately depicts that single failures of major components of the AC power system will not cause a loss of independence or redundancy.

The basis for acceptance in our review was a demonstration of sound engineering design and conformance of the design, design criteria, and design bases to the NRC's regulations and guides and industry standards. With the exception of those matters discussed above, we determined that the SNUPPS AC power systems meet the applicable criteria in the Standard Review Plan Table 8-1. We also determined that the system meets the applicable industry standards and has been thoroughly evaluated by the designers and the utilities. We therefore conclude that, subject to resolution of the above matters, the SNUPPS AC power systems are acceptable.

8.3.2 DC POWER SYSTEMS

8.3.2.1 Discussion

The DC power system for each SNUPPS unit consists of four independent Class IE 125-volt subsystems, two non-Class IE 125-volt subsystems, and one non-Class IE 250-volt subsystem as described in the SNUPPS FSAR Section 8.3.2. The DC power system is designed to provide reliable and continuous power for controls, instrumentation, inverters, and DC emergency auxiliaries.

Four independent Class IE DC power separation groups are provided. Each subsystem consists of one 125-volt battery, one battery charger, one inverter, and distribution switchboards. One spare battery charger and one spare inverter ar- rovided, electrically unconnected, to be moved into place should th ie a malfunction in the connected equipment.

Separation Groups 1 anc ovide control power for load groups 1 and 2, respectively. These se ion groups also provide vital instrumentation and control power or Channels 1 and 4, respectively, of the reactor protection and engineered safety features systems. DC Separation Groups 2 and 3 provide vital instrumentation and control power for Channels 2 and 3 respectively, of the reactor protection and engineered safety features systems.

The battery chargers for DC Separation Groups 1 and 3 are supplied 480-volt AC power from different Class IE load center buses of Load Group 1. Similarily, the battery chargers for DC Separation Groups 2 and 4 are supplied 480-volt AC power from different Class IE load centers of Load Group 2.

The two load centers can only be connected by a manual bus tie breaker operation. No ties exist between Load Groups therefore, no single failures in the interconnections between redundant load centers can cause automatic transferring of load centers or loads from the designated supply to its redundant counterpart. Thus paralleling of the DC power supplies is prevented.

The four batteries feed four separate 120-volt AC vital instrumentation buses through an inverter as the normal power source. A key interlocked slide switch provides an alternate source of 120-volt AC power to the vital instrumentation bus. The manually actuated key interlock switch, when placed in the alternate power position, opens the contacts to the battery power feed thereby preventing paralleling of the power supplies to the vital buses.

Physical separation of Class IE equipment is met as each Separation Group battery has its own seismic Category I room and the charger and distribution system for the Separation Group are in a separate, adjacent seismic Category I room. Adequate separation was observed in our review of the SNUPPS model. Class IE cables and raceway are routed in accordance with Regulatory Guide 1.75 and IEEE-384 to meet separation and redundancy requirements.

The 125-volt DC Class IE battery loading cycle information is presented in FSAR Tables 8.3-1 and 8.3-2 and the to be revised Table 8.3-3 handed out in our December 9-10 review meeting. Table 8.3-3 of the SNUPPS FSAR will be revised in Revision 3 because the valve control in the turbine-driven train of the auxiliary feedwater system is considered a continuous battery load. The battery sizing was based upon a minimum battery room temperature of 77°F and a capacity of 25% greater than that required under the most severe loading conditions. We require an analysis to show sufficient battery capacity at the lowest battery room temperature to prevent having a Technical Specification requiring plant shutdown should the room temperature fall below 77°F. An FSAR change to address this matter has been prepared and is planned for submittal in Revision 3 to the SNUPPS FSAR.

Battery discharge tests have been performed in accordance with IEEE 415 and 308 and Regulatory Guides 1.32 and 1.41. The Class IE battery chargers are sized to restore the battery from the design minimum charge state to the fully charged state within 12 hours based upon the largest combined demands of all continuous loads.

All 125-volt Class IE DC power system equipment is designed and qualified at the maximum equalization voltage of 140 volts.

The preoperational and initial startup test programs for the DC power system are in accordance within Regulatory Guides 1.41 and 1.68. The periodic onsite testing program includes the battery capacity tests of IEEE 450 and Regulatory Guide 1.118.

Alarms and instruments are provided for each Class IE DC subsystem to give immediate operability status indication to the control room operators.

The qualification testing program to show the adequacy of the seismic design of the Class IE DC power system is not yet complete. Of particular interest is the seismic qualification of the terminal connections from the DC distribution system to the battery and between the two levels of cells in the battery rack. Subsequent to our December 9-10, 1980 meeting, it was confirmed that these matters are a part of the seismic test program. We need to review the entire qualification test package once the testing is complete to determine if the equipment meets the acceptance criteria.

8.3.2.2 EVALUATION

The DC power system includes the batteries, battery chargers, and distribution centers used to supply power to DC-operated equipment. The scope of review of the DC power system included single line diagrams, schematic diagrams, and descriptive information. The review included the design criteria and analyses of the adequacy of those criteria.

We reviewed the 125-volt Class IE DC power system to verify redundancy with regard to both power sources and the associated distribution system. We reviewed the system to assess the electrical and physical separation of redundant power sources, distribution systems, and connected loads.

We evaluated the DC power system failure mode and effects analysis (FSAR Table 8.3-4) and find it accurately depicts that single failures of major components of the DC power system will not cause a loss of independence or redundancy.

We were unable to determine if adequate ventilation of the battery rooms has been provided to preclude the formation of explosive concentrations of hydrogen gas. This evaluation is underway and will be documented in a future FSAR Revision.

We also require additional FSAR explanation of the method for performing the test to measure battery cell differential temperature. Battery testing, including cell temperature measurement, will meet IEEE-450; this fact will be clarified in SNUPPS FSAR Revision 3.

The methods SNUPPS employs to identify power system cables and raceways as safety-related equipment in the plant, and the indentification scheme used to distinguish between redundant cables and raceways are in accordance with Regulatory Guide 1.75 and are, therefore, acceptable.

The instrumentation and controls vital to the proper functioning of the Class IE DC power system are designed to the same criteria as the Class IE AC system is designed and are, therefore, acceptable.

The basis for acceptance in our review was a demonstration of sound engineering design and conformance of the design, design criteria, and design bases to the NRC's regulations and guides and to industry standards. With the exception of those matters discussed above, we determined that the SNUPPS DC power systems meet the applicable criteria in the Standard Review Plan Table 8-1. We also determined that the system meets the applicable industry standards and has been thoroughly evaluated by the designers and the utilities. We therefore conclude that, subject to resolution of the above matters, the SNUPPS DC power systems are acceptable.