
Safety Evaluation Report

related to the operation of
Salem Nuclear Generating Station,
Unit No. 2

Docket No. 50-211

Public Service Electric and Gas Company, et al.

**U.S. Nuclear Regulatory
Commission**

Office of Nuclear Reactor Regulation

May 1981



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1.0 INTRODUCTION AND GENERAL DISCUSSION

1.1 Introduction

In October 1974, the U. S. Atomic Energy Commission (AEC) issued its Safety Evaluation Report (SER) regarding the application by the Public Service Electric and Gas Company (PSE&G or licensee) for licenses to operate the Salem Nuclear Generating Station, Units 1 and 2. Since then, the Nuclear Regulatory Commission (NRC) has issued Supplements 1 through 5 which documented the resolution of several outstanding issues in further support of the licensing activities. Further review of the Unit 2 operating license application resulted from a number of studies performed following the accident at the Three Mile Island Unit 2 (TMI-2) reactor plant.

On April 18, 1980, a fuel loading and low power testing license was issued for Salem Unit 2 based, in part, upon requirements established for the TMI-2 accident. Initially, the license permitted fuel loading and zero power testing. The license was subsequently amended: Amendment No. 2, dated August 22, 1980, permitted the licensee to perform the low power test program identified in Section 8.16 of Appendix A to the license at power levels not to exceed 5 percent of rated core thermal power.

The purpose of this supplement is to further update our Safety Evaluation Report by providing (1) our findings from additional audits of the licensee's equipment qualification program; (2) our evaluation and status of the licensee's fire protection program; and (3) our evaluation and status of the licensee's Emergency Preparedness. These matters were discussed at a Commission briefing held on April 28, 1981.

Each of the following sections of this supplement is numbered the same as the corresponding section of the Safety Evaluation Report and Supplements No. 1-5, except Section 22.0 which addresses TMI-2 requirements and Section 23.0 which presents our conclusions.

Each section is supplementary to and not in lieu of the discussion in the Safety Evaluation Report and Supplements No. 1-5 thereto, except where specifically noted. Appendix A is a continuation of the chronology of principal actions related to the processing of the application. Appendix G contains a NRC review team's report of findings from an on-site review of PSE&G's cable separation study. Appendix H contains a letter from the Federal Emergency Management Agency (FEMA) on the subject of FEMA's findings and determinations of the status of State and local emergency preparedness for Salem Unit 2.

3.0 DESIGN CRITERIA-STRUCTURES, COMPONENTS EQUIPMENT AND SYSTEMS

3.11 Environmental Design of Engineered Safety Features Equipment

In Section 3.11 of SER Supplement No. 5, we stated that an additional audit, at PSE&G offices and the publication of the Safety Evaluation Report would complete the staff's evaluation of the licensee's environmental qualification program.

By letter, dated March 6, 1981, we transmitted to PSE&G the primary results of our review of environmental qualifications of safety-related electrical equipment at Salem Unit 2. This review identified a number of potential equipment deficiencies involving a lack of proper documentation, inadequate justification of assumed environmental conditions following an accident, and/or inadequate environmental testing of equipment such that conformance to DOR guidelines could not be demonstrated. PSE&G was required to respond within 10 days of receipt of the report with a written statement supporting the safe operation of their facility taking into account the NRC staff's preliminary list of deficiencies. PSE&G responded by letter dated March 19, 1981, that appropriate corrective actions which the staff identified had been taken and concluded that Salem 2 could operate in a safe manner.

The NRC technical review has been completed. A Safety Evaluation Report has been prepared which confirms the preliminary results forwarded to PSE&G on March 6, 1981, and identifies no outstanding items which require immediate corrective action. This SER requires PSE&G to provide, within 90 days, documentation of the missing qualification information which demonstrates that such equipment meets the DOR guidelines or NUREG-0588 or commit to a corrective action (requalification, replacement, relocation, and so forth) consistent with the requirements to establish qualification by June 30, 1982. If the latter option is chosen, the licensee must provide specific justification for operation until such corrective action is complete.

In this SER, the staff concludes that conformance with the above requirements and satisfactory completion of the corrective actions by June 30, 1982 will ensure compliance with the Commission Memorandum and Order of May 23, 1980. The staff further concludes that there is reasonable assurance of safe operation of this facility pending completion of these corrective actions.

9.0 AUXILIARY AND EMERGENCY SYSTEMS

9.7 Fire Protection System

In Appendix E to Supplement 4 of the Safety Evaluation Report, dated April 1980, we presented our Fire Protection Safety Evaluation Report for Salem Units 1 and 2. In that Supplement report we stated that the applicant committed to provide an alternate shutdown method for our review that would be independent of the relay and switchgear rooms. We also stated that the applicant committed to perform a fire interaction analysis on all redundant systems and components necessary for safe cold shutdown which are separated only by distance and are within 20' of each other. Where additional protection and/or separation are required to assure a safe shutdown condition, the applicant committed to:

- (1) achieve a minimum of 20 ft. separation between divisions;
- (2) provide a one-hour rated barrier to separate one train from the other; or
- (3) provide an alternate shutdown method that is independent of the interaction areas.

By letter dated November 5, 1979, the applicant made these commitments, stated his criteria for the fire interaction analysis, and provided preliminary descriptions of the type of modifications he proposed. The applicant also stated that additional information would be provided to the staff when the analyses and the design changes were finalized.

The staff required that the interim results of PSE&G's fire interaction analysis be reviewed prior to issuance of a full power license. To expedite this action a NRC fire protection review team was assembled for the purpose of conducting an on-site review of PSE&G's fire interaction analysis (cable interaction study) for Salem Units 1 and 2. The objectives of this team were to: (1) make a finding on the adequacy of PSE&G's fire interaction study and the program used to implement the results of that study; and (2) make a finding on the adequacy of the corrective actions implemented as a result of the fire interaction program. These findings would be limited to the adequacy of the fire protection measures on a short term basis. The adequacy of the measures on a long term basis would be covered by the staff in its review of the licensee's compliance with the requirements of Appendix R to 10 CFR Part 50.

The on-site fire protection review of the fire interaction study was conducted from April 30, 1981 to May 7, 1981. The team's report is attached as Appendix G to this Supplement. The team concluded that "the fire protection measures are adequate for continued operation of Unit 1 and for issuance of a (full power) license with appropriate license conditions for Unit 2 . . ." The license conditions resulting from this review are listed at the conclusion of this section.

In Section III, "Additional Considerations," of its report, the NRC review team acknowledged that the findings from the review may impact previous commitments made by PSE&G. PSE&G was requested: (1) to re-examine its cable wrap schedule and provide the NRC with a new date for completion of wrapping which would include the additional areas identified by the team; (2) to re-examine its schedule for responding to NRC Generic Letter 81-12 (Attachment A) and provide the NRC with a new date for that response; and (3) to re-evaluate its schedule for overall program verification and to propose a new schedule by letter to the Office of Inspection and Enforcement. By letter dated May 14, 1981, PSE&G addressed the above considerations and provided a proposed schedule for completion of these items. The staff has reviewed the proposed schedule and finds that the adjustments are appropriate to enable PSE&G to incorporate the review team's findings into PSE&G's fire protection program. The revised schedule is reflected in the license conditions listed at the end of this section.

In its letter dated May 14, 1981, PSE&G requested one exception from the schedule specified in the review team's report. Due to material ordering problems, PSE&G cannot support a near term installation of emergency lighting. PSE&G has proposed that until all emergency lighting has been installed: (1) a continuous fire watch would be established in the relay room; and (2) sufficient dedicated portable battery powered lighting would be provided for the operating personnel necessary to achieve cold shutdown. Since loss of all lighting can be postulated only with a fire in the relay room, the staff finds that PSE&G's proposal provides adequate protection on an interim basis until all emergency lighting is installed.

During the course of the staff's on-site review, one area in the 480/230 VAC switchgear room on elevation 84' in the Auxiliary Building was identified in which a single postulated 20-foot diameter fire could potentially fail all instrument channels, including the independent safe shutdown instrumentation provided for alternative shutdown. The review team concluded that this presented an immediate safety concern. Accordingly, the Office of Inspection and Enforcement obtained, and documented in correspondence dated May 5, 1981, a licensee commitment to take immediate corrective actions. This commitment is reflected in the license conditions listed at the conclusion of this section.

The results of the on-site review were based upon approximately a fifty percent audit of the licensee's fire interaction analysis. All identified deficiencies were related back to specific basic assumptions and criteria used by the licensee in the fire interaction analysis. To ensure that all additional related deficiencies, if any, are identified and corrected the licensee will be required to review his fire interaction analysis in light of the NRC review team's findings; to report the results of this review to the NRC; and to correct all additional deficiencies by July 31, 1981. As part of our evaluation of PSE&G's compliance with Appendix R, the staff will evaluate PSE&G's final documented fire interaction analysis.

On November 19, 1980, the Commission published an amendment to its regulations which required Salem Unit 1 to comply with Sections III.G, III.J, and III.O of Appendix R to 10 CFR Part 50. As indicated in Supplement 5 to our SER, dated January 1981, the applicant committed, by letter dated December 1, 1980 to implement in Salem Unit 2 any changes required for Salem Unit 1 to comply with Appendix R requirements.

By letter dated March 19, 1981, the applicant requested several exemptions from the requirements of Appendix R. Our review of these exemption requests for Salem 1 and 2 is being delayed pending receipt of the final design descriptions of the modifications made to provide fire protection for shutdown systems and the alternative shutdown capability.

By letter dated April 22, 1981, the licensee committed to comply with Appendix R Section III.L with respect to alternative shutdown capability and to provide the information we required to complete our review by May 19, 1981. As a result of PSE&G's efforts to support the staff's recent on-site fire protection review, PSE&G has requested and we have approved an extension of this schedule to July 17, 1981 for an interim response and to August 17, 1981 for the final submittal.

In SER Supplement No. 5, we stated that the alternate shutdown capability to achieve hot shutdown from outside the control room is now operational. This statement was in error. As stated above, the applicant has not yet formally submitted a description of this capability. However, this matter was reviewed by the on-site team. By letter dated September 4, 1980, PSE&G reported the status of the design modifications to provide an alternate shutdown capability. This report included the statement, "Currently, equipment and procedures exist for achieving hot shutdown from outside the Control Room." Subsequently we have found that the capability referred to did not include adequate consideration of fire damage, which necessitated the license conditions listed at the end of this section.

At present, we are developing a program for evaluating Appendix R exemption requests for all operating plants. We will be completing our evaluation of these fire protection program aspects at Salem Units 1 and 2 as part of that program.

In Supplement No. 5 to the Salem Unit 2 SER, we also stated that an action item yet to be completed was the wrapping of several cable trays with a mineral wool blanket to give a 1-hour fire barrier between divisions separated by less than 20 ft. We concluded that it was reasonable to wait until March 20, 1981, to wrap these cable trays. By letter dated April 22, 1981, the licensee informed us that the wrapping of cable trays was delayed because they were unable to obtain adequate quantities of the mineral wool from the vendor. The licensee stated that as of April 22, 1981 they would have 40% of all trays wrapped and that the wrapping would be 100% complete by June 15, 1981. A further delay in final cable wrapping until July 31, 1981, was requested by PSE&G in a letter dated May 14, 1981 in order to incorporate into its program the findings from the NRC review. We have concluded that the licensee is making a reasonable effort to complete this item and their schedule is acceptable. The full power license will be conditioned with a requirement to complete this item by July 31, 1981.

We find that the fire protection program for the Salem Nuclear Generating Station is adequate at the present time, meets the requirements of GDC-3, and with the licensee's commitments and scheduled modifications, meets the guidelines contained in Appendix A to BTP 9.5-1. Until the committed fire protection system improvements are operational, we consider the existing fire detection and suppression systems; the existing barriers between fire areas; improved administrative procedures for

control of combustibles and ignition sources; the trained onsite fire brigade; the capability to extinguish fire manually; and the fire protection technical specifications provide adequate protection against a fire that would threaten safe shutdown.

On this basis we conclude that Salem Unit 2 is acceptable for full power operation subject to license conditions listed below which will assure the timely completion of required modifications.

Full power license conditions:

1. Prior to exceeding five percent rated thermal power, PSE&G shall:
 - a. Wrap the primary feeds for 125 volt DC control power to the 4160 volt, 460 volt and 230 volt switchgear located above the 4160 volt switchgear at elevation 64.
 - b. Take the following corrective action for deficiencies associated with the alternative shutdown capability:
 - (1) Coordinate operating procedures to ensure application of the appropriate alternative method when dictated by plant circumstance or conditions.
 - (2) Provide direction to the Senior Shift Supervisor as to when control room evacuation is dictated; provide direction as to which procedures, keys, operator aids, and equipment will be required in the new control location; and provide a discussion of shift organization and personnel deployment for remote operation.
 - (3) Provide for pre-staging of the special equipment or tools required by local operating procedures. These items include hand tools, pneumatic jumpers, prepared electrical jumpers, and diesel control power cables.
 - (4) Provide a means to maintain system status once local operation has been initiated and to restore normal function to disturbed control systems.
 - (5) Provide guidance for ensuring or verifying adequate shutdown margin when outside the control room.
 - (6) Provide a means to obtain direct temperature information from the hot and cold legs during cooldown as part of the alternate shutdown procedures.

- (7) Install adequate measures to ensure that effective communications with alternative shutdown control stations can be established.
 - (8) Increase minimum staffing level, on shift, to include the following individuals; 2 Senior Reactor Operators, 4 Nuclear Control Operators, 10 Equipment/Utility Operators, the Shift Technical Advisor, and one maintenance electrician.
2. PSE&G shall install adequate 8 hour emergency lighting, independent of plant power systems, at all locations which may be required to be manned during the alternate shutdown procedure as well as at all avenues of entrance to and egress from those areas. The emergency lighting shall be installed prior to exceeding fire percent power or a continuous fire watch shall be established in the relay room and sufficient dedicated portable battery powered lighting will be provided for the operating personnel necessary to achieve cold shutdown.
 3. By July 31, 1981, PSE&G shall:
 - a. Modify or extend existing barriers in 4160 volt switchgear room in order to protect redundant control and power cables currently located above the fire barrier;
 - b. Provide a one-hour barrier for the cable trays associated with the turbine-driven auxiliary feedwater pump in the auxiliary feedwater pump room;
 - c. Provide a one-hour barrier around one of the redundant cables associated with power, instrumentation, and control for the diesel generators (located in the proximity of the diesel generators) where separation is less than 20 feet.
 - d. Provide smoke detectors in the area of the power feeds to redundant diesel generators in the 4 ft. wide hallway near the waste gas tanks.
 - e. Wrap redundant cables supplying power to the 4 kv switchgear from the diesel generators in the 4 kv switchgear room where separation is less than 20 feet.
 - f. Wrap redundant cables supplying power from 230 volt switchgear to the battery chargers where separation is less than 20 feet.
 - g. Raise barriers separating equipment needed for shutdown so that the top of the barrier is above the top of the redundant raceways or wrap both redundant raceways in the following areas: 460-230 volt switchgear, 125 volt D-C switchgear, the valve motor control centers located in the electrical penetration area, and the pressurizer heater buses located in the electrical penetration area.

- h. Extend barriers in an "L" shape configuration for the following equipment: the 4160 volt switchgear, 460-230 volt switchgear, the 125 V DC switchgear, the valve motor control centers, and the pressurizer heater buses.
 - i. Wrap one of the redundant power cables from the diesel generators located in the fuel oil storage tank room.
 - j. Provide one hour fire barrier for the 207 panel or the turbine driven auxiliary feedwater control cabinet.
 - k. Provide a one hour fire barrier for the remote shutdown panel.
 - l. PSE&G shall review its Fire Interaction analysis for any additional areas impacted by the assumptions and criteria identified in the NRC review team's report as being inconsistently applied or with which the team did not concur. PSE&G shall report the results of this review to the NRC and complete all additional corrective actions by July 31, 1981.
4. By June 5, 1981, PSE&G shall re-route the alternate shutdown power feed in order to provide protection for this cable from a fire affecting the normal instrument trains. Until this modification is complete a continuous fire watch shall be stationed in the elevation 84 switchgear room. During the period when new leads are being landed, and no power feed to the alternate shutdown instruments is available, an additional fire watch shall be stationed continuously in the Relay Room.
5. By July 15, 1981, PSE&G complete final engineering verification of the fire protection analysis and corrective actions.
6. During the performance of Startup Procedure SUP 82.5, Shutdown From Outside Control Room, PSE&G shall satisfactorily demonstrate the following additional operations:
- a. Local start of diesel generator using alternative control power source.
 - b. Local operation of 4 KV breaker.
 - c. Local start of the containment fan cooler unit.
 - d. Local operation of a motor operated and an air operated valve.
 - e. Local control of charging.
7. Prior to July 31, 1981, PSE&G shall complete all required cable wrapping.

The Office of Inspection and Enforcement will monitor the licensee's progress and verify the completion of the open fire protection action items identified in the license conditions specified above.

ATTACHMENT A
TO
SECTION 9.7 OF
SUPPLEMENT 6



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

February 20, 1981

TO ALL POWER REACTOR LICENSEES WITH PLANTS
LICENSED PRIOR TO JANUARY 1, 1979

SUBJECT: FIRE PROTECTION RULE (45 FR 76602, NOVEMBER 19, 1980) -
Generic Letter 81-12

Paragraph 50.48(b) of 10 CFR Part 50, which became effective on February 17, 1981, requires all nuclear plants licensed to operate prior to January 1, 1979 to meet the requirements of Sections III.G, III.J and III.O of Appendix R to 10 CFR Part 50 regardless of any previous approvals by the Nuclear Regulatory Commission (NRC) for alternative design features for those items. This would require each licensee to reassess all those areas of the plant "... where cables or equipment, including associated non-safety circuits, that could prevent operation or cause maloperation due to hot shorts, open circuits or shorts to ground or (sic) redundant trains of systems necessary to achieve and maintain hot shutdown conditions are located within the same fire area outside of primary containment ..."* to determine whether the requirements of Section III.G.2 of Appendix R are satisfied. If not, the licensee must provide alternative shutdown capability in conformance with Section III.G.3 or request an exemption if there is some justifiable basis.

Paragraph 50.48(c)(5) requires that any modifications that the licensee plans in order to meet the requirements of Section III.G.3 of Appendix R must be reviewed and approved by the NRC. This paragraph also requires that the plans, schedules and design descriptions of such modifications must be submitted by March 19, 1981. To expedite our review process and reduce the number of requests for additional information with regard to this review, we are enclosing two documents which specify the information that we will require to complete our reviews of alternative safe shutdown capability. Enclosure 1 is "Staff Position Safe Shutdown Capability". This document was originally sent to you in late 1979. Section 8 specifies the information required for staff review. If you have already submitted any of the information required, you need only reference that previous submittal. Enclosure 2 indicates the additional information needed to ensure that associated circuits for alternative safe shutdown equipment is included in your reassessment and in our review. If you made no modifications that were required to provide alternative safe shutdown capability and if your reassessment concludes that alternative safe shutdown capability in accordance with the provisions of Section III.G.3 is not necessary, you do not have to provide the information requested by these Enclosures.

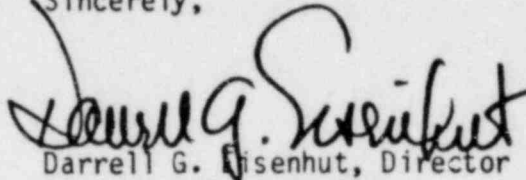
*Quoted from Section III.G.2 of Appendix R to 10 CFR Part 50. Note that the "or" preceding "redundant trains" is a typographical error and should read "of redundant trains".

Finally, we request that as part of your submittal of plans and schedules for meeting the provisions of Paragraphs (c)(2), (c)(3) and (c)(4) of 10 CFR 50.48 as required by Paragraph 50.48(c)(5), you include the results of your reassessment of the design features at your plant for meeting the requirements of Sections III.G, III.J and III.O of Appendix R to 10 CFR Part 50.

This detailed information need not accompany the design description that must be submitted by March 19, 1981. However, we request that it be submitted as soon as possible, but no later than May 19, 1981.

This request for information was approved by GAO under a blanket clearance number R0071 which expires September 30, 1981. Comments on burden and duplication may be directed to the U. S. General Accounting Office, Regulatory Reports Review, Room 5106, 441 G Street, N. W., Washington, D. C. 20548.

Sincerely,



Darrell G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation

Enclosures:

1. Staff Position
2. Request for Additional Information

cc w/enclosures:
See next page

STAFF POSITION
SAFE SHUTDOWN CAPABILITY

Enclosure 1

Staff Concern

During the staff's evaluation of fire protection programs at operating plants, one or more specific plant areas may be identified in which the staff does not have adequate assurance that a postulated fire will not damage both redundant divisions of shutdown systems. This lack of assurance in safe shutdown capability has resulted from one or both of the following situations:

- * Case A: The licensee has not adequately identified the systems and components required for safe shutdown and their location in specific fire areas.
- * Case B: The licensee has not demonstrated that the fire protection for specific plant areas will prevent damage to both redundant divisions of safe shutdown components identified in these areas.

For Case A, the staff has required that an adequate safe shutdown analysis be performed. This evaluation includes the identification of the systems required for safe shutdown and the location of the system components in the plant. Where it is determined by this evaluation that safe shutdown components of both redundant divisions are located in the same fire area, the licensee is required to demonstrate that a postulated fire will not damage both divisions or provide alternate shutdown capability as in Case B.

For Case B, the staff may have required that an alternate shutdown capability be provided which is independent of the area of concern or the licensee may have proposed such a capability in lieu of certain additional fire protection modifications in the area. The specific modifications associated with the area of concern along with other systems and equipment already independent of the area form the alternate shutdown capability. For each plant, the modifications needed and the combinations of systems which provide the shutdown functions may be unique for each critical area; however, the shutdown functions provided should maintain plant parameters within the bounds of the limiting safety consequences deemed acceptable for the design basis event.

Staff Position

Safe shutdown capability should be demonstrated (Case A) or alternate shutdown capability provided (Case B) in accordance with the guidelines provided below:

1. Design Basis Event

The design basis event for considering the need for alternate shutdown is a postulated fire in a specific fire area containing redundant safe shutdown cables/equipment in close proximity where it has been determined that fire protection means cannot assure that safe shutdown capability will be preserved. Two cases should be considered: (1) offsite power is available; and (2) offsite power is not available.

2. Limiting Safety Consequences and Required Shutdown Functions

- 2.1 No fission product boundary integrity shall be affected:
 - a. No fuel clad damage;
 - b. No rupture of any primary coolant boundary;
 - c. No rupture of the containment boundary.
- 2.2 The reactor coolant system process variables shall be within those predicted for a loss of normal ac power.
- 2.3 The alternate shutdown capability shall be able to achieve and maintain subcritical conditions in the reactor, maintain reactor coolant inventory, achieve and maintain hot standby* conditions (hot shutdown* for a BWR) for an extended period of time, achieve cold shutdown* conditions within 72 hours and maintain cold shutdown conditions thereafter.

* As defined in the Standard Technical Specifications.

3. Performance Goals

- 3.1 The reactivity control function shall be capable of achieving and maintaining cold shutdown reactivity conditions.
- 3.2 The reactor coolant makeup function shall be capable of maintaining the reactor coolant level above the top of the core for BWR's and in the pressurizer for PWR's.
- 3.3 The reactor heat removal function shall be capable of achieving and maintaining decay heat removal.
- 3.4 The process monitoring function shall be capable of providing direct readings of the process variables necessary to perform and control the above functions.
- 3.5 The supporting function shall be capable of providing the process cooling, lubrication, etc. necessary to permit the operation of the equipment used for safe shutdown by the systems identified in 3.1 - 3.4.
- 3.6 The equipment and systems used to achieve and maintain hot standby conditions (hot shutdown for a BWR) should be (1) free of fire damage; (2) capable of maintaining such conditions for an extended time period longer than 72 hours if the equipment required to achieve and maintain cold shutdown is not available due to fire damage; and (3) capable of being powered by an onsite emergency power system.
- 3.7 The equipment and systems used to achieve and maintain cold shutdown conditions should be either free of fire damage or the fire damage to such systems should be limited such that repairs can be made and cold shutdown conditions achieved within 72 hours. Equipment and systems used prior to 72 hours after the fire should be capable of being powered by an onsite emergency power system; those used after 72 hours may be powered by

offsite power.

- 3.8 These systems need not be designed to (1) seismic category I criteria; (2) single failure criteria; or (3) cope with other plant accidents such as pipe breaks or stuck valves (Appendix A BTP 9.5-1), except those portions of these systems which interface with or impact existing safety systems.

4. PWR Equipment Generally Necessary For Hot Standby

(1) Reactivity Control

Reactor trip capability (scram). Boration capability e.g., charging pump, makeup pump or high pressure injection pump taking suction from concentrated borated water supplies, and letdown system if required.

(2) Reactor Coolant Makeup

Reactor coolant makeup capability, e.g., charging pumps or the high pressure injection pumps. Power operated relief valves may be required to reduce pressure to allow use of the high pressure injection pumps.

(3) Reactor Coolant System Pressure Control

Reactor pressure control capability, e.g., charging pumps or pressurizer heaters and use of the letdown systems if required.

(4) Decay Heat Removal

Decay heat removal capability, e.g., power operated relief valves (steam generator) or safety relief valves for heat removal with a water supply and emergency or auxiliary feedwater pumps for makeup to the steam generator. Service water or other pumps may be required to provide water for auxiliary feed pump suction if the condensate storage tank capacity is not adequate for 72 hours.

(5) Process Monitoring Instrumentation

Process monitoring capability e.g., pressurizer pressure and level, steam generator level.

(6) Support

The equipment required to support operation of the above described shutdown equipment e.g., component cooling water service water, etc. and onsite power sources (AC, DC) with their associated electrical distribution system.

5. PWR Equipment Generally Necessary For Cold Shutdown*

(1) Reactor Coolant System Pressure Reduction to Residual Heat Removal System (RHR) Capability

Reactor coolant system pressure reduction by cooldown using steam generator power operated relief valves or atmospheric dump valves.

(2) Decay Heat Removal

Decay heat removal capability e.g., residual heat removal system, component cooling water system and service water system to removal heat and maintain cold shutdown.

(3) Support

Support capability e.g., onsite power sources (AC & DC) or offsite after 72 hours and the associated electrical distribution system to supply the above equipment.

* Equipment necessary in addition to that already provided to maintain hot standby.

6. BWR Equipment Generally Necessary For Hot Shutdown

(1) Reactivity Control

Reactor trip capability (scram).

(2) Reactor Coolant Makeup

Reactor coolant inventory makeup capability e.g., reactor core isolation cooling system (RCIC) or the high pressure coolant injection system (HPCI).

(3) Reactor Pressure Control and Decay Heat Removal

Depressurization system valves or safety relief valves for dump to the suppression pool. The residual heat removal system in steam condensing mode, and service water system may also be used for heat removal to the ultimate heat sink.

(4) Suppression Pool Cooling

Residual heat removal system (in suppression pool cooling mode) service water system to maintain hot shutdown.

(5) Process Monitoring

Process monitoring capability e.g., reactor vessel level and pressure and suppression pool temperature.

(6) Support

Support capability e.g., onsite power source (AC & DC) and their associated distribution systems to provide for the shutdown equipment.

7. BWR Equipment Generally Necessary For Cold Shutdown*

At this point the equipment necessary for hot shutdown has reduced the primary system pressure and temperature to where the RHR system may be placed in service in RHR cooling mode.

(1) Decay Heat Removal

Residual heat removal system in the RHR cooling mode, service water system.

(2) Support

Onsite sources (AC & DC) or offsite after 72 hours and their associated distribution systems to provide for shutdown equipment.

* Equipment provided in addition to that for achieving hot shutdown.

8. Information Required For Staff Review

- (a) Description of the systems or portions thereof used to provide the shutdown capability and modifications required to achieve the alternate shutdown capability if required.
- (b) System design by drawings which show normal and alternate shutdown control and power circuits, location of components, and that wiring which is in the area and the wiring which is out of the area that required the alternate system.
- (c) Demonstrate that changes to safety systems will not degrade safety systems. (e.g., new isolation switches and control switches should meet design criteria and standards in FSAR for electrical equipment in the system that the switch is to be installed; cabinets that the switches are to be mounted in should also meet the same criteria (FSAR) as other safety related cabinets and panels; to avoid inadvertent isolation from the control room, the isolation switches should be keylocked, or alarmed in the control room if in the "local" or "isolated" position; periodic checks should be made to verify switch is in the proper position for normal operation; and a single transfer switch or other new device should not be a source for a single failure to cause loss of redundant safety systems).
- (d) Demonstrate that wiring, including power sources for the control circuit and equipment operation for the alternate shutdown method, is independent of equipment wiring in the area to be avoided.

- (e) Demonstrate that alternate shutdown power sources, including all breakers, have isolation devices on control circuits that are routed through the area to be avoided, even if the breaker is to be operated manually.
- (f) Demonstrate that licensee procedure(s) have been developed which describe the tasks to be performed to effect the shutdown method. A summary of these procedures should be submitted.
- (g) Demonstrate that spare fuses are available for control circuits where these fuses may be required in supplying power to control circuits used for the shutdown method and may be blown by the effects of a cable spreading room fire. The spare fuses should be located convenient to the existing fuses. The shutdown procedure should inform the operator to check these fuses.
- (h) Demonstrate that the manpower required to perform the shutdown functions using the procedures of (f) as well as to provide fire brigade members to fight the fire is available as required by the fire brigade technical specifications.
- (i) Demonstrate that adequate acceptance tests are performed. These should verify that: equipment operates from the local control station when the transfer or isolation switch is placed in the "local" position and that the equipment cannot be operated from the control room; and that equipment operates from the control room but cannot be operated at the local control station when the transfer or isolation switch is in the "remote" position.
- (j) Technical Specifications of the surveillance requirements and limiting conditions for operation for that equipment not already covered by existing Tech. Specs. For example, if new isolation and control switches are added to a service water system, the existing Tech. Spec. surveillance requirements on the service water system should add a statement similar to the following:

"Every third pump test should also verify that the pump starts from the alternate shutdown station after moving all service water system isolation switches to the local control position."
- (k) Demonstrate that the systems available are adequate to perform the necessary shutdown functions. The functions required should be based on previous analyses, if possible (e.g., in the FSAR), such as a loss of normal a.c. power or shutdown on a Group I isolation (BWR). The equipment required for the alternate capability should be the same or equivalent to that relied on in the above analysis.

- (1) Demonstrate that repair procedures for cold shutdown systems are developed and material for repairs is maintained on site.

REQUEST FOR ADDITIONAL INFORMATION

1. Section III.G of Appendix R to 10 CFR Part 50 requires cabling for or associated with redundant safe shutdown systems necessary to achieve and maintain hot shutdown conditions be separated by fire barriers having a three-hour fire rating or equivalent protection (see Section III.G.2 of Appendix R). Therefore, if option III.G.3 is chosen for the protection of shutdown capability cabling required for or associated with the alternative method of hot shutdown for each fire area, must be physically separated by the equivalent of a three-hour rated fire barrier from the fire area.

In evaluating alternative shutdown methods, associated circuits are circuits that could prevent operation or cause maloperation of the alternative train which is used to achieve and maintain hot shutdown condition due to fire induced hot shorts, open circuits or shorts to ground.

Safety related and non-safety related cables that are associated with the equipment and cables of the alternative, or dedicated method of shutdown are those that have a separation from the fire area less than that required by Section III.G.2 of Appendix R to 10 CFR 50 and have either (1) a common power source with the alternate shutdown equipment and the power source is not electrically protected from the post-fire shutdown circuit of concern by coordinated circuit breakers, fuses or similar devices, (2) a connection to circuits of equipment whose spurious operation will adversely affect the shutdown capability, e.g., RHR/RCS Isolation Valves, or (3) a common enclosure, e.g., raceway, panel, junction box, with alternative shutdown cables and are not electrically protected from the post-fire shutdown circuits of concern by circuit breakers, fuses or similar devices.

For each fire area where an alternative or dedicated shutdown method, in accordance with Section III.G.3 of Appendix R to 10 CFR Part 50, is provided by proposed modifications, the following information is required to demonstrate that associated circuits will not prevent operation or cause maloperation of the alternative or dedicated shutdown method:

- A. Provide a table that lists all equipment including instrumentation and support system equipment that are required by the alternative or dedicated method of achieving and maintaining hot shutdown.
- B. For each alternative shutdown equipment listed in 1.A above, provide a table that lists the essential cables (instrumentation, control and power) that are located in the fire area.
- C. Provide a table that lists safety related and non-safety related cables associated with the equipment and cables constituting the alternative or dedicated method of shutdown that are located in the fire area.
- D. Show that fire-induced failures of the cables listed in B and C above will not prevent operation or cause maloperation of the alternative or dedicated shutdown method.
- E. For each cable listed in 1.B above, provide detailed electrical schematic drawings that show how each cable is isolated from the fire area.

2. The residual heat removal system is generally a low pressure system that interfaces with the high pressure primary coolant system. To preclude a LOCA through this interface, we require compliance with the recommendations of Branch Technical Position RSB 5-1. Thus, this interface most likely consists of two redundant and independent motor operated valves. These two motor operated valves and their associated cable may be subject to a single fire hazard. It is our concern that this single fire could cause the two valves to open resulting in a fire-initiated LOCA through the subject high-low pressure system interface. To assure that this interface and other high-low pressure interfaces are adequately protected from the effects of a single fire, we require the following information:
 - A. Identify each high-low pressure interface that uses redundant electrically controlled devices (such as two series motor operated valves) to isolate or preclude rupture of any primary coolant boundary.
 - B. Identify the device's essential cabling (power and control) and describe the cable routing (by fire area) from source to termination.
 - C. Identify each location where the identified cables are separated by less than a wall having a three-hour fire rating from cables for the redundant device.
 - D. For the areas identified in item 2.C above (if any), provide the bases and justification as to the acceptability of the existing design or any proposed modifications.

22.0 TMI-2 REQUIREMENTS

22.1 Introduction

In a letter dated June 26, 1980, we advised all applicants for construction permits and operating licenses of the Commission's guidance regarding the requirements to be met for current operating license applications. The requirements are derived from NRC's Action Plan (NUREG-0660) and are found in NUREG-0694, "TMI-Related Requirements for New Operating Licenses."

The requirements discussed in NUREG-0694 were listed in four categories: those required for fuel loading and low power testing; those required for full-power operation; those requiring internal NRC action; and those required to be implemented by a certain date.

Subsequently, by letter dated October 31, 1980, a compilation of those TMI-related items that have been specifically approved by the Commission for implementation was issued to all licensees and applicants. This letter transmitted NUREG-0737, "Clarification of TMI Action Plan Requirements," which included information about schedules, applicability, method of implementation review, submittal dates, and clarification of technical positions.

Requirements for fuel loading and low power testing were addressed in Part II of Supplement No. 4 to the Salem Nuclear Generating Station Unit 2 Safety Evaluation Report. Supplement 5 addressed full power requirements and dated requirements of NUREG-0694 as clarified and supplemented by NUREG-0737. This supplement provides an updated status of the full power requirements for item III.A.1.1. Upgrade Emergency Preparedness.

The applicable full power requirement is discussed below and follows the numbering sequence used in NUREG-0694 and NUREG-0737. The staff's review of the issues described in this section are based on the explicit requirements contained in NUREG-0694 as updated in NUREG-0737.

22.2 Full Power Requirements

III. Emergency Preparations and Radiation Protection

III.A.1.1 Upgrade Emergency Preparedness

Position

Provide an emergency response plan in compliance with NUREG-0654, Rev.1 (November 1980) "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants." NRC will give substantial weight to FEMA findings on offsite plans in judging the adequacy against NUREG-0654. Perform an emergency exercise to test the integrated capability and a major portion of the basic elements existing within emergency preparedness plans and organizations.

This requirement shall be met before issuance of a full-power license.

Discussion and Conclusions

Based upon our review, as documented in this section, of the licensee's plans and procedures, the NRC and FEMA evaluation of the joint exercise, and our review of the FEMA findings, we find that the state of onsite and offsite emergency preparedness provides reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency.

a. Emergency Plan Preparation

The applicant has corrected the deficiencies in the emergency plan which were previously identified in Appendix F to Supplement 5 of the Salem Safety Evaluation Report.

Based on our review, we conclude that the Salem emergency plan, together with the commitment from the licensee in their letter dated May 7, 1981 meets the planning standards in 10 CFR 50.47, the requirements of Appendix E to 10 CFR 50, and the guidance set forth in NUREG-0654/FEMA-REP-1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," Revision 1, November 1980.

The applicant's letter of May 7, 1981 commits to the following conditions:

- (1) Provide meteorological and dose assessment remote interrogation capability to meet the criteria of Appendix 2, NUREG-0654, Revision 1 as follows: (a) a functional description of upgraded capabilities by January 1, 1982, (b) installation of hardware and software by July 1, 1982 provided that NRC approval is received by four months prior to that time and (c) full operational capability by October 1, 1982.

- (2) Provide substantiation that the back-up source of meteorological information from the NWS Office, Greater Wilmington Airport adequately characterizes the site conditions with respect to wind direction and wind speed by July 1, 1981.
- (3) Provide substantiation that uncertainties associated with plume trajectory prediction, associated with the occurrence of sea-land breeze circulations within the plume exposure pathway zone, are compatible with the planned recommendations for protective actions that would be based upon such projections by July 1, 1981.

The Federal Emergency Management Agency (FEMA) has provided interim findings (Appendix H) on the State and local emergency response plans. FEMA found based on a joint exercise, site specific to the Salem Nuclear Plant, that the stated objectives of the exercise were generally achieved even though the scenario had some limitations; and, that the deficiencies noted in the exercise can be readily corrected with additional SOPs, drills and training. In summary FEMA concluded that the deficiencies which currently exist in the state of Radiological Emergency Preparedness in the States of New Jersey and Delaware should not preclude the two states from coping with an accident at the Salem Nuclear Plant.

b. Emergency Plan Implementation

We have examined the implementation of the emergency plan and the applicant's actions in response to the deficiencies identified in a NRC letter from B. Grier to R. Eckert dated April 7, 1981. By letter of April 24, 1981, the applicant committed to correct each of the aforementioned deficiencies by May 15, 1981 with the exception of the training program documentation, which will be completed within 120 days. Based on further discussions with the applicant in a meeting on April 23 and 24, 1981, and on their commitment letter of April 24, 1981, we have reasonable assurance that deficiencies will be corrected by May 15, 1981 with the exception noted above. The staff does not consider the documentation of the training program as a required item to achieve an adequate state of emergency preparedness. We consider that the current state of training is adequate to perform the essential functions that may be required in the event of a radiological emergency. Based upon our review and the licensee's commitment, we conclude that the applicant has satisfied the Emergency Preparedness requirements specified for completion prior to the issuance of a full power license. The applicant's current state of Emergency Preparedness provides reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency.

23.0 CONCLUSIONS

Based on our evaluation of the application as set forth in our Safety Evaluation Report issued in October, 1974 and Supplement Nos. 1-5 and our evaluation as set forth in this supplement, we conclude that the operating license can be issued to allow power operations at full rated power (3411 megawatts thermal) subject to license conditions.

We conclude that the construction of the facility has been completed in accordance with the requirements of Section 50.57(a)(1) of 10 CFR Part 50, and that construction of the facility has been monitored in accordance with the inspection program of the Commission's staff.

Subsequent to the issuance of the operating license for full rated power for Salem Nuclear Generating Station Unit 2, the facility may then be operated only in accordance with the Commission's regulations and the conditions of the operating license under the continuing surveillance of the Commission's staff.

We conclude that the activities authorized by the license can be conducted without endangering the health and safety of the public, and we reaffirm our conclusions as stated in our Safety Evaluation Report and its supplements.

APPENDIX A

CONTINUATION OF CHRONOLOGY
OF RADIOLOGICAL SAFETY REVIEW

January 21, 1981	Letter from licensee concerning emergency plan evacuability study
January 23, 1981	Letter from licensee providing test and schedule information concerning environmental qualification of safety-related equipment.
January 26, 1981	Letter from licensee forwarding "Environmental Qualification Review Report," Revision 1, Volume 1 (proprietary and non-proprietary).
January 29, 1981	Letter from licensee discussing modifications and remedial actions with regard to masonry walls.
January 30, 1981	Issuance of Supplement No. 5 to Safety Evaluation Report
February 3, 1981	Letter to licensee forwarding pages omitted from December 22 transmittal concerning control of heavy loads.
February 4, 1981	Letter from licensee requesting exemption from proposed technical specifications concerning testing of snubbers.
February 6, 1981	Letter from licensee transmitting, "Instrumentation for Detection of Inadequate Core Cooling" (proprietary and non-proprietary).
February 6, 1981	Letter from licensee providing information on reactor vessel level indicating system.
February 9, 1981	Letter to licensee advising that proposed audible alarm level is acceptable.
February 9, 1981	Letter from licensee forwarding New Jersey Radiological Emergency Response Plan.
February 10, 1981	Letter from licensee transmitting monthly operating report for January 1981.
February 10, 1981	Letter from licensee requesting extension of license expiration date.
February 10, 1981	Letter to licensee concerning seismic qualification of auxiliary feedwater systems

February 11, 1981 Letter from licensee requesting extension to March 16 for submittal of Training and Qualification Plan.

February 18, 1981 Letter to licensee concerning post-TMI requirements for Emergency Operations Facility

February 20, 1981 Letter to licensee concerning "BWR Feedwater Nozzle and Control Rod Drive Return Line Nozzle Cracking," NUREG-0619

February 23, 1981 Letter from licensee transmitting Revision 3 of "Environmental Qualification Review Report," Volumes 1 & 2 (proprietary and non-proprietary)

February 25, 1981 Letter to licensee concerning emergency procedures and training for station blackout events.

February 26, 1981 Issuance of Amendment 5 to DPR-75 to extend term of license to April 18, 1983.

February 27, 1981 Letter to licensee transmitting request for additional information.

March 5, 1981 Letter to licensee concerning functional criteria for emergency response facilities.

March 6, 1981 Letter to licensee forwarding preliminary results of environmental qualification of safety-related electrical equipment.

March 10, 1981 Letter to licensee transmitting clarification of staff's handling of proprietary information on environmental qualification of Class IE electrical equipment.

March 13, 1981 Letter from licensee forwarding Submittal 2 of Security Training and Qualification Plan.

March 13, 1981 Letter from licensee transmitting Annual Financial Report for 1980.

March 16, 1981 Letter to licensee advising that cable tray fire barrier is acceptable.

March 19, 1981 Letter from licensee concerning environmental qualification of safety related electrical equipment.

March 19, 1981 Letter from licensee advising of proposal for compliance with 10 CFR Part 50, Appendix R concerning fire protection.

March 24, 1981 Letter from licensee transmitting revised pages for Security Training and Qualification Plan.

March 24, 1981 Letter to licensee transmitting request for additional information on fire protection.

March 26, 1981 Meeting with licensee to discuss proposed technical specifications.

March 27, 1981 Letter to licensee concerning proposed license condition on protection against loss of auxiliary feedwater pump suction flow.

March 27, 1981 Letter to licensee requesting best estimate of monthly cost, including costs for replacement energy and capital expense, to maintain unit in inactive status while awaiting full power license.

April 2, 1981 Letter from licensee transmitting information concerning its compliance with Regulatory Guide 1.97.

April 3, 1981 Letter from licensee in response to March 27, 1981 letter regarding costs of replacement energy and capital expense.

April 7, 1981 Letter to licensee forwarding required actions resulting from emergency planning appraisal.

April 13, 1981 Meeting with licensee to discuss Salem's compliance with 10 CFR Part 50, Appendix R.

April 14, 1981 Letter from licensee transmitting LER 81-03/03L

April 16, 1981 Letter from licensee transmitting updated Q list.

April 16, 1981 Letter to licensee transmitting request for information on control system failures.

April 20, 1981 Letter from licensee providing confirmation of implementation dates for upgraded Emergency Response Facilities.

April 21, 1981 Letter to licensee requesting that inservice inspection boundary diagrams be sent to Battelle Pacific Northwest Laboratory.

April 22, 1981 Letter from licensee concerning compliance with Appendix R - Item III.L

April 23, 1981 Letter from licensee concerning containment minimum pressure setpoint.

April 24, 1981 Letter from licensee confirming actions to be taken in response to emergency planning appraisal.

April 24, 1981	Letter from FEMA to NRC transmitting FEMA findings on Salem emergency preparedness.
April 29, 1981	Letter from licensee transmitting Annual Reports for 1980
May 1, 1981	Letter from licensee forwarding "Startup Test Report"
May 4, 1981	Letter from licensee concerning shift manning.
May 5, 1981	Letter to licensee confirming fire protection actions to be taken by licensee.
May 5, 1981	Letter to licensee requesting response to emergency planning open action items.
May 7, 1981	Letter from licensee confirming actions to be taken for emergency planning.
May 11, 1981	Meeting with licensee to review its cable interaction study.
May 12, 1981	Letter from licensee transmitting updated "Q" list.
May 14, 1981	Letter from licensee providing response to NRC staff fire protection review.

APPENDIX G

REVIEW OF PSE&G's
CABLE SEPARATION STUDY



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

MAY 11 1981

Docket Nos.: 50-272/311

APPLICANT: Public Service Electric & Gas Company

FACILITY: Salem, Units 1 and 2

SUBJECT: SUMMARY OF MEETINGS AND SITE VISIT TO REVIEW THE PSE&G CABLE
INTERACTION STUDY

A series of meetings were held from April 30, 1981 to May 6, 1981 at the Salem Station to review PSE&G's cable interaction study. An exit interview was held on May 7, 1981 to discuss the findings of the review. These findings are found in the attached report.

A handwritten signature in cursive script that reads "Janis Kerrigan".

Janis Kerrigan, Project Manager
Licensing Branch No. 3
Division of Licensing

Enclosure:
As stated

MAY 11 1981

REPORT
ON
PSE&G
CABLE
SEPARATION
STUDY

J. Kerrigan
G. Meyer
L. Norrholm
R. Pallino
J. Knox
J. Behm
B. Mann

REVIEW OF PSE&G CABLE SEPARATION STUDY

As part of the overall fire protection review, the staff reviews the cable separation study performed by the licensee to confirm that there is reasonable assurance that a single fire would not destroy the redundant components of systems necessary for shutdown.

In order to expedite the conduct of this review for the Salem Station, a team of people was sent to the plant. The team consisted of:

- 1) Janis Kerrigan, team leader
- 2) Gary Meyer, Project Manager for Unit 2
- 3) Lief Norrholm, Senior Resident Inspector
- 4) Ralph Pallino, Regional Inspector
- 5) John Knox, NRC staff electrical expert
- 6) Jim Behm, fire protection consultant
- 7) Bernie Mann, NRC staff systems expert

The objectives of the team were to:

- 1) make a finding on the adequacy of the cable separation study and the program used to implement the results of that study, and
- 2) make a finding on the adequacy of the corrective actions implemented as a result of the cable interaction program. These findings should concentrate on the adequacy of the fire protection measures on an interim basis. The adequacy of the measures on a long term basis will be covered by the staff in its review of the licensee's compliance with App. R.

I. Evaluation of Program Implementation

In order to evaluate the adequacy of the implementation of the licensee's fire protection program, we followed a number of systematic review steps. Those steps and our conclusions are presented below.

First, we evaluated whether the systems considered and identified by the licensee in his program are adequate to bring the plant to hot shutdown, to maintain hot shutdown for either short or long time periods, and to bring the plant to cold shutdown. Based on discussions with the licensee, we conclude that there is reasonable assurance that the systems identified exceed the minimum number required to maintain hot shutdown and to bring the plant to safe cold shutdown given a design bases fire.

Second, we evaluated whether the equipment and cables associated with each system were identified and are of a sufficient number to assure system functionability. Based on a 50 percent audit, piping and instrument drawings and discussions with the applicant, we conclude that there is reasonable assurance that equipment and cables have been identified that exceed the minimum number required to assure system functionability.

Third, we evaluated whether the licensee adequately identified the routing of cables throughout the plant. Based on a 50 percent audit, discussions with the licensee, computer printouts of cable routing schedules, physical

equipment and raceway layout drawings, and actual cable, raceway tracing during plant walkthroughs, we conclude that there is reasonable assurance that cable routing was adequately identified.

Fourth, we evaluated whether the licensee's program identified the specific equipment and cables requiring protection from a design basis fire. Based on a 50 percent audit, discussions with the applicant, and plant walk throughs, we conclude that there is reasonable assurance that equipment and cables requiring additional protection were identified.

The final step of the licensee's program (overall program verification) has not yet, been completed. OIE will monitor the licensee's progress in this area.

The team therefore concludes that the cable separation program for the Salem Station is acceptable.

II. Adequacy of Corrective Actions

In order to accomplish our second objective, which was to evaluate the adequacy of the corrective actions taken, the team performed an extensive field audit. Based on that audit, the team found that for many areas of the plant the fire protection measures implemented at the Station met or exceeded NRC requirements. However, we did find that some additional fire protection measures would be required in some areas.

In reaching our findings, we were able to trace the particular fire protection measures implemented back to the basic assumptions and criteria used by the licensee. (See Table 1). We then divided these criteria into 5 basic categories:

- 1) Criteria that had no impact on our review and therefore the acceptability of these criteria was not addressed by the team. (Criteria 2,9,12).
- 2) Criteria which the team agrees with and which the team found no examples of the criteria not being met. (Criteria 3, 6, 7, 8A, 11, 13, 14c).
- 3) Criteria which the team agrees with and which the team found examples of the criteria not being met (Criterion 1). The team understands that the final program verification is not complete, and we realize that at least some of the examples would have been picked up. For items in this category, the team found that additional fire protection measures would be necessary.
- 4) Criteria with which the team did not agree. The team concluded that the fire protection measures implemented using the criteria in this category were not adequate and that additional fire protection measures would be necessary. (Criteria 4, 8b, 14a, 14b).

- 5) One criterion (10) which dealt with areas of the plant which require alternate shutdown capability.

A. Category 1 Criteria

In regard to Criterion 2, "The intensity of the postulated fire decreases with height provided that no combustibles are present within the zone of influence," Criterion 9, "Cable-initiated fires are not credible," and Criterion 12, "An exposure fire inside containment is not credible," we conclude that these criteria had no impact on this evaluation. Thus their acceptability will not be addressed in this report.

B. Category 2 Criteria

In regard to Criterion 3, "If horizontal filled cable trays are present within and/or above the 20 foot diameter zone of influence of the fire, the zone of influence is extended out, in a cone shape configuration to include these combustibles," Criterion 6, "Cable will burn, but does not support combustion. Therefore, there is assumed to be no further propagation of fire along a horizontal cable tray once the fire source is removed," Criterion 7, "Conduit, although not considered to be combustible, was also not considered to provide a fire barrier to its enclosed cables," Criterion 8A, "The primary fire suppression system in an affected area is assumed to fail," Criterion 11, "Manual fire-fighting techniques only are required for the control room since the control room is constantly manned," Criterion 13, "All auxiliary feedwater trains will be protected that are within the 20 foot zone of influence of the fire," Criterion 14.c, "A 1 1/2 hour barrier on ventilation ducts that go through a three hour barrier separating redundant system is an adequate protective measure", we agree with the criteria, found no examples of non-compliance with these criteria during our review and thus, conclude

that there is reasonable assurance that the licensee has met these criteria.

C. Category 3 Criteria

1. Criterion 1

In regard to Criterion 1, "The design basis fire has a 20 foot diameter zone of influence and has a zone of influence that extends from the floor to the ceiling," we agree with this criterion but as a result of our review we found several areas in which the licensee did not apply this criterion. (A list of these areas is contained in Table 2.) Two examples of this are:

Example a: Two trains of the primary 125 DC control power to the 4160 volt, 460 volt and 230 volt switchgear are located within 20 feet of their redundant counterpart above the 4160 volt switchgear at elevation 64. The licensee indicated that the backup feed to the switchgear could be used in the event of fire, however, we found that both the primary and backup feeds are located within 20 feet so that redundant trains would be affected. The team concludes that the primary feeds to the switchgear need to be wrapped. The wrap for Unit 2 should be installed before exceeding five percent power and the wrap for Unit 1 should be installed within two weeks.

Example b: During the course of the staff's onsite review, one area in the 480/230 VAC Switchgear Room on elevation 84' in the Auxiliary Building was identified in which a single postulated 20-foot diameter fire could potentially fail all instrument channels, including the independent safe shutdown instrumentation provided for alternate shutdown. The review team concluded that this presented an immediate safety concern.

Accordingly, the Office of Inspection and Enforcement obtained, and documented in correspondence dated May 5, 1981, a licensee commitment to take immediate corrective actions. These actions included:

- a. Re-routing of the alternate shutdown power feed in order to provide protection for this cable from a fire affecting the normal instrument trains. This will be completed by June 5, 1981 for Units 1 and 2.
- b. Immediate stationing of a dedicated, continuous fire watch in the 84' elevation switchgear room until the modification described above is completed.
- c. During the period when new leads are being landed, and no power feed to the alternate shutdown instruments is available, an additional fire watch will be stationed continuously in the Relay Room.
- d. The final engineering verification of the fire protection analysis and corrective actions, which will confirm no similar mis-routings, will be completed by June 5, 1981.

The Office of Inspection and Enforcement will confirm these actions.

For other examples falling under this category (see table 2), the team conclusion is that modifications should be completed in accordance with the licensee's cable wrap schedule.

D. Category 4 Criteria

In regard to Criteria 4, 8.b, 14.a, and 14.b, we do not agree with the criteria and conclude that the fire protection measures implemented using the criteria are not adequate and that additional fire protection should be required. The basis for our not agreeing and the additional protection necessary is discussed below.

1. Criterion 4

The licensee has assumed that an exposure fire, which originates on the floor, will only have a flame height of from two to four feet. Also if this fire is located against one side of the fire partition barrier the licensee has assumed that there will be no horizontal heat transmission across the top of the eight foot barrier. We disagree with the licensee's assumptions for the following reasons:

1. Transient combustibles may be stacked against the fire partition which could produce a flame front which exceeds the height of the barrier. This is especially true with flammable liquids in which a flame front of from 10 to 12 feet may be expected. Such a flame height will expose redundant safety trains above the barrier if they are within the zone of influence of the fire.
2. Heat transfer will occur across the top of the fire partition well as extending outward. Also, heat will start spreading outward from its source at the ceiling level thereby by-passing the 8 foot high barrier located on the floor. Therefore, the redundant safety system on the other side of the barrier can be exposed to the same fire.

3. A related concern about this criterion is that the length of the installed barriers do not preclude water used in fighting the fire manually from affecting redundant equipment.

During the team audit, several areas were identified in which the licensee applied criterion 4 (See in Table 2). The team concludes that corrective action for all areas in which criterion 4 was applied to components needed for shutdown should be completed in accordance with the licensee's cable wrap schedule. One example of an area in which criterion 4 was applied is discussed below. The corrective action is also discussed.

Example: In the 4160 volt switchgear room, redundant control and power cables are located above the fire barrier separating the switchgear units.

For the reasons stated above, the team concluded that the existing barriers need to be modified or extended and that the redundant cabling above the barrier needs to be protected in order to minimize the likelihood of affecting redundant equipment by either the fire itself or by water used in fighting the fire manually. These modifications should be completed on the licensee's cable wrap schedule.

2. Criterion 8b

The licensee has assumed that where redundant safety related conduit and/or cable trays are within a 20 foot zone of influence of the fire that an automatic suppression system is not necessary. We disagree with the licensee's assumptions. Within this zone of influence we expect one of the safety systems to fail as a result of the fire. We do not consider it acceptable

to leave a fire impinging on the only safety division remaining until the plant fire brigade responds and manually extinguishes the fire. In addition during the forty year life of the plant any modifications to the cable tray may lessen its fire resistance to an unacceptable level.

The NRC fire consultant recommended that primary suppression systems be automatic versus manual. One area in which a manual suppression system is used for the protection of redundant equipment is the 460 volt switchgear room. Other areas identified by the team are included in Table 2.

We find the manual suppression system acceptable on an interim basis. For the long term fix, we understand that the licensee has requested an exemption from the Appendix R requirement that the primary suppression system be automatic. We recommend that the NRC review of the exemption request consider the NRC fire consultant's recommendation for the Salem Plant.

3. Criterion 14a

The licensee has assumed that for an exposure fire which originates on the floor, a one hour fire rated barrier or partition between redundant safety related equipment and/or conduit - cable trays is sufficient to prevent damage to the one safety train. The licensee has also assumed that an automatic primary fire suppression system is not necessary since the fire brigade will respond in sufficient time to prevent loss of redundant safety trains.

The NRC fire consultant recommended that primary automatic suppression systems be installed where redundant cables are within the influence of

the 20 foot design basis fire and protected only by a 1-hour fire barrier wrap. We find the manual hose suppression acceptable on an interim basis. For the long term we understand that the licensee has requested an exemption from the Appendix R requirement that barriers and automatic suppression be installed. We recommend that the NRC review of the exemption request consider the NRC fire consultant's recommendation for the Salem plant.

4. Criterion 14b

The licensee has assumed that for specific areas protected by an automatic suppression system, the primary fire suppression system fails. The licensee has provided a redundant automatic suppression system for these areas.

We disagree with the licensee's assumptions that the redundant suppression system will react fast enough to prevent damage to safety related equipment and/or cable tray and conduit. The thermal lag of the sprinkler heads has a heat sink of sufficient magnitude to prevent their operation prior to damage to safety systems. This is true of all automatic sprinkler heads.

During the team audit, several areas were identified in which the licensee applied Criterion 14b (listed in Table 2). The team concludes that corrective actions for all areas in which Criterion 14b was applied to components needed for shutdown should be completed in accordance with the licensee's cable wrap schedule. One example of an area in which Criterion 14b was applied is discussed below. The corrective action is also discussed.

Example: In the auxiliary feedwater pump room redundant equipment and cables are separated by less than 20 feet and are protected by redundant automatic sprinklers. For the reasons stated above, the team concludes that a one-hour barrier should be provided for the cable trays associated with the turbine-driven auxiliary feedwater pump. This corrective action should be completed in accordance with the licensee's cable wrap schedule.

E. Category 5 Criterion

Criterion 10 states that "Relay room cable and equipment and cables in the vicinity of the ceiling of the 460 V switchgear room cannot be passively protected, and, therefore, an alternate shutdown system is required for those areas."

The team agrees with this assumption. An evaluation of the interim acceptability of the licensee's alternate shutdown system follows.

PSE&G has adopted a basic approach to shutdown in the event of fire which involves maintaining operational control from the unit control room as long as it remains habitable. For those plant areas in which a single postulated fire could affect control or operability of redundant equipment, alternative means, through local operation of available equipment, are provided in order to achieve cold shutdown. These alternative means can be applied whether control is maintained in the control room or is transferred to another location in the event, considered unlikely by the licensee, that occupancy of the control room becomes impossible.

PSE&G uses standard functional operating procedures (Operating Instruction I-3.8, Maintaining Hot Standby, Operating Instruction I-3.6, Hot Standby to Cold Shutdown) and Emergency procedures (Emergency Instruction 4.9, Blackout) augmented by Appendices which detail alternative methods of system operation. Explicit instructions for alternative operational methods are provided in a single document, indexed by system, which provides specific local operating procedures for each valve, motor, or component which may be required to be operated in order to achieve cold shutdown or to correct a mis-operation precipitated by fire damage. Each type of local operating instruction was reviewed by the team to confirm technical adequacy. Actual operation of a 4 KV motor, a 460 V motor, a motor operated valve, and an air operated valve were demonstrated using these procedures. Local start of a diesel generator was reviewed for technical adequacy based on a drawing review. Demonstration of this capability was deferred until PSE&G completes a design change in progress to provide alternate control power at each diesel control center. The procedure presently requires pulling temporary cable to provide this alternative.

The team concluded that PSE&G has available sufficient operational information to achieve cold shutdown in any postulated fire which could affect equipment availability or control. The team also concluded that poor organization of the procedures and lack of preplanning were evident which would result in significant lost time were these procedures implemented as currently written.

Accordingly, the team concludes that the following aspects of the alternate shutdown procedure should be required to be corrected prior to Unit 2 operation above 5% rated thermal power. In addition based on the licensee's procedural practices and the commonability of these procedures, these corrective actions should be taken for Unit 1 concurrently. The aspects of the alternate shutdown

procedure that should be corrected are:

- The lack of coordination in the procedures to ensure application of the appropriate alternative method when dictated by plant circumstance or conditions.
- The lack of direction to the Senior Shift Supervisor as to when control room evacuation is dictated, and lack of definition as to which procedures, keys, operator aids, and equipment will be required in the new control location; the lack of discussion of shift organization and personnel deployment for remote operation.
- Most local operating instructions require the use of special equipment or tools. These items are specifically identified in the procedure but have not been pre-staged in a defined location. These items include hand tools, pneumatic jumpers, prepared electrical jumpers, and diesel control power cables.
- No mechanism is provided to maintain system status once local operation has been initiated. No provision to restore normal function to disturbed control systems has been defined.
- No indication of reactor flux level is provided for the dedicated alternate shutdown system. Accordingly, guidance for ensuring or verifying adequate shutdown margin when outside the control room should be provided.
- Dedicated alternate shutdown instrumentation does not include loop or core temperature. For hot standby operation, the licensee plans to use steam generator saturation pressure information to infer primary temperature. In order to achieve cooldown, direct temperature information from the hot and cold legs should be required and can be achieved, if not otherwise available, by installation of temporary instrumentation to the detector lead in the penetration area.
- Only the portable radio/repeater communications systems is identified as immune to the effects of an exposure fire in the relay room. It was determined

during the review that use of a hand-held portable radio to control activities in the plant from the hot shutdown station is extremely difficult due to ambient noise. We conclude that adequate measures should be implemented to ensure that effective communications with that station can be established.

- A single exposure fire in the Relay Room can precipitate a total loss of station lighting. We conclude that adequate 8 hour emergency lighting, independent of plant power systems should be installed at all locations which may be required to be manned during the alternate shutdown procedure as well as at all avenues of entrance to and egress from those areas.
- In order to account for personnel requirements to support unaffected unit operation, the fire brigade, and alternate shutdown functions on the affected unit, 18 shift members were identified. Minimum staffing requirements presently do not include all of the following individuals; 2 Senior Reactor Operators, 4 Nuclear Control Operators, 10 Equipment/Utility Operators, the Shift Technical Advisor, and one maintenance electrician. This staffing level is necessary, on shift, to support a workable alternate shutdown capability. This would necessitate adding an additional two people not currently on shift.

Completion of the above listed corrective actions should be verified by the Office of Inspection and Enforcement prior to Unit 2 operation above 5% rated thermal power.

In addition, in order to fully validate the licensee's capability to accomplish remote shutdown and cooldown, the team concludes that it is necessary for the licensee to perform a demonstration during the performance of Startup Procedure SUP 82.5, Shutdown From Outside Control Room. The following additional operations should be required during that test;

- Local start of diesel generator using alternative control power source.

- Local operation of 4 KV breaker
- Local start of the containment fan cooler unit.
- Local operation of a motor operated and an air operated valve.
- Local control of charging.

III. Additional Considerations

In a recent letter to NRC the licensee indicated that all cable wrap operations at Unit 2 would be completed in June 1981. In view of the teams findings which indicates additional barriers should be provided in certain areas, the licensee should re-examine the cable wrap schedule and provide the NRC with a new date for completion of wrapping which would include the additional areas identified by the team.

In a letter to NRC the licensee confirmed that response to Generic letter 81-12, "Fire Protection Rule," would be provided by May 19, 1981. The team recognizes that the licensee's staff interaction with the team and the findings of the team will impact the licensee's ability to meet that date. Therefore, the licensee should re-examine the schedule for responding to Generic Letter 81-12 and provide the NRC with a new date for that response.

In addition, OIE recently sent a letter to PSE&G which requires that overall program verification be completed by June 5, 1981. If the team findings have impacted this schedule, a letter should be sent to OIE indicating the licensee's proposed new schedule for completing this action.

IV. Summary

The team concludes that fire protection measures are adequate for continued operation of Unit 1 and for issuance of a license with appropriate license conditions for Unit 2 with the understanding that the corrective actions discussed above would be implemented on a schedule that would be subject to staff approval.

TABLE 1

Licensee Assumptions or Criteria

1. The design basis fire has a 20 foot diameter zone of influence and has a zone of influence that extends from the floor to the ceiling
2. The intensity of the postulated fire decreases with height provided that no combustibles are present within the zone of influence.
3. If horizontal filled cable trays are present within and/or above the 20 foot diameter zone of influence of the fire, the zone of influence is extended out, in a cone shape configuration to include these combustibles.
4. The design basis fire originates from a transient combustible on the floor and is assumed to be 2-4 feet high. Heat will not be transmitted horizontally above the eight foot fire barrier. The zone of influence is truncated at the barrier.
6. Cable will burn, but does not support combustion. Therefore, there is assumed to be no further propagation of fire along a horizontal cable tray once the fire source is removed.
7. Conduit, although not considered to be a combustible, was also not considered to provide a fire barrier to its enclosed cables.
- 8a. The primary fire suppression system in an affected area is assumed to fail.
- 8b. An automatic primary fire suppression system does not have to be provided for redundant safety systems within a fire zone of influence of 20 feet.
9. Cable - initiated fires are not credible.
10. Relay room cable and equipment and cables in the vicinity of the ceiling of the 460 V switchgear room cannot be passively protected, and, therefore, an alternate shutdown system is required for those areas.

11. Manual fire-fighting techniques only are required for the control room since the control room is constantly manned.
12. An exposure fire inside containment is not credible. However, electrical penetrations will be protected by a radiant heat shield. In addition, fire protection is being provided for the RCPs.
13. All AFW trains will be protected that are within the 20 foot zone of influence of the fire.
14. One of the following protective measures is sufficient:
 - a) A one-hour fire barrier between redundant components within a fire area.
 - b) Redundant suppression systems.
 - c) A 1 1/2 hour barrier on ventilation ducts that go through a 3-hour barrier separating redundant systems.

TABLE 2

FURTHER EXAMPLES OF AREAS REQUIRING ADDITIONAL PROTECTION

1. Category 3, Criterion 1

- a. Redundant cables, associated with power, instrumentation, and control for the diesel generators (located in proximity of the diesel generators) were routed within 20 feet of their redundant counterpart. A one-hour barrier around one of the cables was not provided in accordance with the licensee's criteria. These cables should be wrapped in accordance with the licensee's criteria and cable wrap schedule.
- b. Smoke detectors are not provided in the area of the power feeds to redundant diesel generators in the 4 ft. wide hallway near the waste gas tanks. Smoke detectors should be installed on a schedule to be proposed by the licensee.
- c. Redundant cables supplying power to the 4 KV switchgear from the diesel generators are located within 20 feet of each other in the 4 KV switchgear room. These cables should be wrapped in accordance with the licensee's criteria and cable wrap schedule.
- d. Redundant cables supplying power from the 230 volt switchgear to the battery chargers are not wrapped and are within the 20 foot fire zone. These cables should be wrapped in accordance with the licensee's criteria and cable wrap schedule.

2. Category 4, Criterion 4

- a. Barriers separating equipment needed for shutdown should be raised so that the top of the barrier is above the top of the redundant raceways or both redundant raceways should be wrapped. One of the above corrective actions should be completed in accordance with the licensee's cable wrap schedule for the following areas: 460-230 volt switchgear, 125 volt D-C switchgear, the valve motor control centers located in the electrical penetration area, and the pressurizer heater buses located in the electrical penetration area.

- b. In order to minimize the effects of fire and water from fire hoses on redundant equipment, barriers should be extended in an "L" shape configuration and be installed in accordance with the licensee's cable wrap schedule.

Equipment identified during our review that require extended barriers include: the 4160 volt switchgear, 460-230 volt switchgear, the 125 V DC switchgear, the valve motor control centers, and the pressurizer heater buses.

3. Category 4, Criterion 8b

The following areas were identified during our review as having manual suppression systems for the protection of redundant equipment.

- a. electrical penetration area
- b. 460-230 volt switchgear room
- c. the deluge system for the fuel oil storage tank room
- d. the hall below the diesel generator rooms where redundant power feed to diesels cross
- e. 4160 volt switchgear room

We find the manual suppression acceptable on an interim basis, pending NRC staff review of the licensee's (Appendix R) exemption

4. Category 4, Criterion 14b

- a. Redundant power cables from the diesel generators located in the fuel oil storage tank room are separated by more than 20 feet but the fixed fire load of diesel fuel oil necessitates a larger than 20 foot separation. Thus, one of the redundant cables should be wrapped in accordance with the licensee's cable wrap schedule.
- b. A one hour fire barrier should be provided the 207 panel or the turbine driven auxiliary feedwater control cabinet in accordance with the licensee's cable wrap schedule.
- c. A one hour fire barrier should be provided for the remote shutdown panel in accordance with the licensee's cable wrap schedule.

APPENDIX H

FEDERAL EMERGENCY MANAGEMENT AGENCY LETTER

"Findings and Determination Relation to
the Status of State and Local
Emergency Preparedness for the
Salem Unit 2 Nuclear Plant"

Dated April 24, 1981



FEDERAL EMERGENCY MANAGEMENT AGENCY

Washington D.C. 20472

APR 24 1981

MEMORANDUM: Brian Grimes
US Nuclear Regulatory Commission

FROM: John E. Dickey *[Signature]*
Director, Radiological Emergency Preparedness
Division

SUBJECT: Findings and Determination Relating to the Status of
State and Local Emergency Preparedness for the Salem
Unit 2 Nuclear Plant.

This responds to your February 5 and March 10, 1981, requests for the above information.

No formal submission of REP Plans by either the State of New Jersey or the State of Delaware have been made to FEMA Regions in accordance with FEMA proposed Rule 44 CFR 350.7. Both States have, however, submitted draft REP Plans for review and comment by their respective Regional Assistance Committees (RAC).

New Jersey submitted a draft on January 16, 1981. RAC review comments were furnished to the State on February 25, 1981. Certain revisions to these plans were made and furnished to the RAC on March 27, 1981. The RAC is not finished reviewing the revisions because of an inadequate cross reference list. Delaware submitted a draft on December 29, 1980. RAC review comments were furnished to the State on February 23, 1981. Delaware has furnished a revised plan received in the FEMA Region on March 31, 1981, which addressed "short term" items. A later edition of the plans, dated April 1981 was received by the Region on April 6, 1981. It appears to address more of the RAC concerns first identified in February, however the RAC members have not completely evaluated the adequacy of the April revision.

Neither State has completely satisfied the requirement for a public meeting in accordance with 44 CFR 350.10. New Jersey held a public meeting on March 20, 1981; however notification to the public was not timely. Another public meeting is scheduled for April 29, 1981. Delaware has scheduled a public meeting on June 15, 1981.

A joint exercise site specific to the Salem nuclear plant was conducted on April 8, 1981, with participation by both States and the local governments within the 10 mile EPZ. The stated objectives of the exercise were generally achieved, even though the scenario had some limitations. While a number of deficiencies were noted, they can be readily corrected with additional SOPs, drills and training.

In summary the overall state of Radiological Emergency Preparedness in the States of New Jersey and Delaware have been significantly improved during the past year. While there is still a need for considerable improvement, the deficiencies which exist should not preclude the two States from coping with an accident at the Salem nuclear plant.

NRC FORM 335 (7-77)		U.S. NUCLEAR REGULATORY COMMISSION BIBLIOGRAPHIC DATA SHEET		1. REPORT NUMBER (Assigned by DDC) NUREG-0517 Supplement No. 6	
4. TITLE AND SUBTITLE (Add Volume No., if appropriate) Safety Evaluation Report Related to the Operation of Salem Nuclear Generating Station, Unit No. 2				2. (Leave blank)	
7. AUTHOR(S)				3. RECIPIENT'S ACCESSION NO.	
9. PERFORMING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code) Office of Nuclear Reactor Regulation U.S. Nuclear Regulatory Commission Washington, D.C. 20555				5. DATE REPORT COMPLETED MONTH YEAR May 1981	
12. SPONSORING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code) Same as 9. above				DATE REPORT ISSUED MONTH YEAR May 1981	
				6. (Leave blank)	
				8. (Leave blank)	
				10. PROJECT/TASK/WORK UNIT NO.	
				11. CONTRACT NO.	
13. TYPE OF REPORT			PERIOD COVERED (Inclusive dates)		
15. SUPPLEMENTARY NOTES Docket No. 50-311				14. (Leave blank)	
16. ABSTRACT (200 words or less) <p>Supplement No. 6 to the Safety Evaluation Report for the application filed by Public Service Electric and Gas Company, Philadelphia Electric Company, Delmarva Power and Light Company, and Atlantic City Electric Company for a license to operate the Salem Nuclear Generating Station, Unit No. 2 (Docket No. 50-311) located in Salem County, New Jersey has been prepared by the Office of Nuclear Reactor Regulation of the U. S. Nuclear Regulatory Commission. The purpose of this supplement is to further update the Safety Evaluation Report by providing (1) our findings from additional audits of the licensees' equipment qualification program, (2) our evaluation and status of the licensees' fire protection program, and (3) our evaluation and status of the licensees' emergency preparedness. Based on our evaluation of the application as set forth in the Safety Evaluation Report and its Supplements 1 - 6, we have concluded that Salem 2 can be operated in accordance with Facility Operating License DPR-75, and its Technical Specifications, without endangering the health and safety of the public.</p>					
17. KEY WORDS AND DOCUMENT ANALYSIS			17a. DESCRIPTORS		
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