U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Docket No:	50-354
License Nos:	NPF-57
Report No.	50-354/97-06
Licensee:	Public Service Electric and Gas Company
Facility:	Hope Creek Nuclear Generating Station
Location:	P.O.Box 236 Hancocks Bridge, New Jersey 08038
Dates:	November 12, 1996 - May 25, 1997
Inspector:	D. Moy, Reactor Engineer, DRS S. Klein, Reactor Engineer, DRS L. Dudes, Reactor Engineer, DRS
Approved by:	Eugene Kelly, Chief System Engineering Branch Division of Reactor Safety

EXECUTIVE SUMMARY

Hope Creek Nuclear Generating Station
Report No. 50-354/97-06

Engineering

- The Hope Creek service water system self-assessment met the objectives of NRC Temporary Instruction 2515/118, "Service Water System Operational Performance Inspection (SWSOPI)."

- The SWSOPI team focused on substantive topics and produced findings associated with heat exchanger and valve testing, strainer design reliability, operational considerations, and the 10 CFR 50.59 process. The scope of the self-assessment was expanded beyond the service water system to include the safety auxiliaries cooling system. A total of 206 questions were generated during the course of the effort, and these resulted in over 65 Action Requests formally incorporated into the PSE&G corrective action process.

- The SWSOPI and response teams were adequately staffed and technically competent. The SWSOPI team maintained objectivity and independence throughout the assessment. The Engineering Department Manager and the Vice President of Nuclear Engineering were appropriately apprised of the SWSOPI team's progress, and provided oversight and support for the self-assessment.

- The response team and line organizations effectively responded to the SWSOPI team's findings, and operability/reportability concerns were addressed promptly.

- Enforcement discretion was exercised concerning failure in 1987 to perform a 10 CFR 50.59 safety evaluation for a change in the normal configuration of the safety auxiliaries cooling system. **(NCV 97-06-02)**

- The SWSOPI self-assessment complemented other recent independent activities, such as a Safety Review Group inspection and a Configuration Baseline Document pilot evaluation, resulting in improved design/configuration control.

Report Details

Introduction

On September 5, 1996, Public Service Electric & Gas Company (PSE&G) notified the NRC that it would perform a service water (SW) system self-assessment as an alternative to an NRC inspection pursuant to Temporary Instruction (TI) 2515/118, "Service Water System Operational Performance Inspection (SWSOPI)." The SW self-assessment team and a dedicated response team began their activities with an entrance meeting on November 12, 1996, with PSE&G management. The onsite activities of the SW self-assessment team were monitored by NRC Region I under Inspection Procedure 40501, "Licensee Self-Assessments Related to Team Inspections." The inspectors periodically observed portions of the self-assessment over the period November 1996 - May 1997. During this oversight period, the inspectors evaluated the scope and depth of the self-assessment including independence, the process for identifying and resolving operability concerns, corrective actions, and management support and oversight.

E1 Conduct of Engineering

E1.1 Service Water System Self-Assessment

a. Inspection Scope (TI2515/118 & IP 40501)

The inspectors reviewed PSE&G's commitments in accordance with Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment." The inspectors also monitored the onsite activities of the service water self-assessment. The inspectors evaluated the scope and depth of the self-assessment including the team's objectivity and independence, and the commitment of personnel to the inspection progress.

b Observation and Findings

Scope and Depth

The self-assessment included both the service water system (SWS) and the safety auxiliaries cooling system (SACS), and consisted of 6-weeks of active SWS inspection, and 5-weeks of inspection for SACS.

A check list of inspection attributes for design, operation, maintenance, engineering, and corrective action was used by the licensee to facilitate its review. By attending several of the team meetings and reviewing their findings, the inspector verified the team's execution of the inspection requirements of TI 2515/118, including an evaluation of the design and licensing basis requirements for the systems.

The assessment team originated 207 questions which resulted in 46 observations related to the service water and safety auxiliary cooling systems. The principal SWSOPI team findings addressed the following topics: (1) 10 CFR 50.59 safety evaluations; (2) configuration and design control; (3) single failure analysis; (4) monitoring of SWS strainer degradation; and (5) heat exchanger thermal performance testing.

Objectivity & Independence

The team included one contractor and five PSE&G personnel under the direction of an experienced PSE&G team leader. Team members were dedicated to the assessment team, and dispositioned the findings from an objective point of view. Typically, the team findings were discussed in detail, and then accepted by the team. In all cases observed by the inspector, the assessment team members maintained both independence and objectivity equivalent to that for an NRC team inspection.

The response team also was staffed with personnel who were relieved of their normal duty assignments. The response team was led by a PSE&G manager who was knowledgeable concerning service water system design requirements. The Engineering Department Manager and the Vice President of Nuclear Engineering were appropriately apprised of the SWSOPI team's progress, and provided oversight and support for the self-assessment.

Implementation of Generic Letter 89-13

The SWSOPI team found that the licensee had implemented most of its commitments made in response to GL 89-13. However, the team identified some missed commitments or weaknesses. Independent NRC evaluation of these issues (and resultant PSE&G actions) is as follows:

- Trending of As-Found Conditions

  In response to GL 89-13, the licensee committed to develop a formal inspection program to address silt accumulation and erosion/corrosion. The response stated that the long term inspection frequency would be established upon completion of a piping replacement project and based on piping inspection results. The inspector verified that SWS intake structure silt surveys were tracked by Tasks No. 213816 through No. 213819. Procedure HC.MD-PM.EA-0002 provides the instructions needed to perform silt surveys with a step included to record as-found conditions in the intake bays. In accordance with analysis report HC-EA-PMCR96082, the periodicity of the silt survey was changed from 12 months to 6 months. The change was based on silt survey results from 1987 to 1993.

The licensee initiated Action Request No.961223174 and Condition Report No. 961122111 to address a lack of trending of SACS heat exchanger differential pressure data. PSE&G submitted an update of the commitments made in response to GL 89-13 (LR-N97411, dated August 1, 1997) stating that the heat exchanger testing program at Hope Creek follows the alternate action for frequent regular maintenance.

During the next two refueling outages (RF07 and RF08), all four safety auxiliaries cooling system (SACS) heat exchangers are now planned to be inspected, cleaned, and a baseline tube-side pressure drop recorded. Between refueling outages, service water pressure drop across the heat exchanger will be routinely monitored to detect the onset of macrofouling. Based on the results from these inspections, an appropriate frequency for future SACS heat exchanger inspections will then be established. The inspector independently noted that, in the context of heat exchanger reliability, the SWSOPI team found that the licensee was implementing an effective program to control biofouling. The progress of SACS heat exchanger inspections and trending of performance will be followed in future NRC inspection. **(IFI 97-06-01)**

- Heat exchanger performance capability monitoring

The SWSOPI team found that: (1) equations used in the SACS heat exchanger test procedure were not treated formally as calculations; (2) the SACS test procedure did not conform to the guidelines established by the Electric Power Research Institute (EPRI); (3) discrepancies existed in the analytical methods used in SACS design documents and test procedures.

EPRI heat exchanger performance monitoring guidelines, EPRI NP-7552, Section 5.3, Test Conditions, state that test data should be taken for a minimum of 30 minutes at five minute intervals, and that the heat exchanger inlet temperatures should not vary more than +/-0.2°F per five minute interval prior to or during the test. Failure to meet these guidelines would increase the uncertainty of the heat exchanger monitoring measurements. The assessment team found that procedure HC.SE-PR.EG-0001(Q), "Safety and Auxiliary Cooling System Annual Biofouling Monitoring," did not meet the EPRI guidelines and did not prescribe an acceptable performance test. The team recommended that the procedure be revised to comply with the EPRI document. Action request 961223174 was generated to document the problem. The NRC inspector verified that the procedure revision was implemented and concluded that the licensee's corrective action was appropriate.

Corrective Actions

The inspector found that the licensee promptly dispositioned the questions raised by the assessment team. Many of the items were reviewed and resolved during the team's onsite activities. Corrective actions for the remaining issues were placed in the licensee's corrective action tracking program. The inspector observed effective cooperation between assessment team personnel and the response team in addressing team findings. At the time of assessment team exit meeting, 46 observations and 65 action requests were generated. In the majority of cases, commitments were made to correct the problems. The technical issues identified by the assessment team also received prompt assessment for operability and reportability consideration. The inspector found that the licensee properly categorized and tracked the self-assessment team's findings.

PSE&G Final SWSOPI Report

The inspector reviewed the SWSOPI final assessment report, dated July 18, 1997, and found it to be comprehensive. The report documented the results of the self-assessment and provided detailed descriptions of findings and weaknesses. Observations and findings related to configuration control and calculation quality were evident; relative to calculations, the report included an observed strength regarding the quality and detail of recent calculations. The report concluded that the majority of the planned or completed actions in response to GL 89-13 were adequate, but noted some missed commitments, process weaknesses, and opportunities for improvement.

Overall, the inspector noted that the team found that the station service water and safety auxiliaries cooling systems were capable of performing their intended functions. However, the team was unable to confirm the thermal and hydraulic performance requirements of Technical Specification Section 3.7.1.3, in that the temperature limit (88.6°F) was not conservative, and sufficient supporting design analyses were not currently available. The inspector determined that the licensee had previously addressed this issue in Licensee Event Reports (LERs) 96-015 and 96-022. A Licensing Change Request and proposed technical specification changes were subsequently submitted to the NRC to resolve these issues. The team did review current administrative limits imposed upon intake structure tidal water level, ultimate heat sink temperature, as well as other design measures already taken, and observed that these interim actions adequately ensured SWS and SACS capability.

The team made five recommendations related to update of GL 89-13 commitments, flow balancing or re-benchmarking of the SACS, and programmatic standards for design control and safety evaluations. The team also reviewed aspects of past self-assessment efforts for the SWS and SACS, including a Configuration Baseline Document pilot review and a Safety Review Group initiative.

c. Conclusions

The Hope Creek service water system self-assessment met the objectives of NRC Temporary Instruction 2515/118, "Service Water System Operational Performance Inspection (SWSOPI)." The SWSOPI and response teams were adequately staffed, and maintained objectivity and independence throughout the assessment. PSE&G management were kept apprised of the SWSOPI team's progress. For the specific issues reviewed, the inspector found that the licensee's response team and the line organization effectively responded to the SWSOPI team's findings, and promptly addressed operability/ reportability concerns. PSE&G's final SWSOPI report presented a complete description of the issues identified during the self-assessment.

E8 Miscellaneous Engineering Issues

E8.1 (Closed) Unresolved Item 50-354/96-09-02: Safety auxiliary cooling system (SACS) design deficiency.

On August 16, 1996, as part of an ongoing engineering assurance configuration baseline document (CBD) review of the SACS design and licensing basis, the licensee identified that the existing plant configuration may not support actions required by the Technical Specifications (TS). Specifically, Action a.2 of TS 3.7.1.1 specifies the alignment of at least one affected emergency diesel generator (EDG) to the operable SACS subsystem if one of the two SACS subsystems is inoperable. On October 25, 1996, the licensee determined that with one SACS pump inoperable and the SACS supply valve to the RHR heat exchanger connected to that loop open, the remaining SACS pump in the loop could trip as a result of a protective feature (high flow pump trip).

This condition resulted from inadequate review of a 1987 operating procedure revision that opened the RHR heat exchanger outlet valve in the standby SACS loop. Plant operating procedures also permitted the cross-connection of additional cooling loads to the standby SACS loop. The licensee concluded that under certain accident conditions, the SACS may be incapable of cooling the required components in that configuration.

In 1987, SACS operating procedure HC.OP-SO.EG-0001(Q) was revised to place the RHR heat exchanger in the standby SACS loop in service during normal operation. The change was made to provide a minimum flow path for the running SACS pump in the standby loop. Although the Final Safety Analysis Report (FSAR) depicts both RHR heat exchanger SACS outlet valves as normally closed, the licensee did not recognize the 1987 procedure revision as a change to the facility, and a 10 CFR 50.59 safety evaluation was not performed.

During a design basis loss of coolant accident coincident with a loss of offsite power and a single active failure of one SACS pump in the standby loop, the high flow caused by opening the RHR heat exchanger outlet valve would trip the remaining pump and result in loss of the standby loop. In this configuration, only two of the four EDGs would be available to power the emergency core cooling system (ECCS) injection pumps. However, for the first ten minutes of the postulated accident, the plant design and licensing bases credit three EDGs to meet the short-term requirements of ECCS injection phase. Thus, the condition resulted in a reduction of a margin of safety for Hope Creek. However, the licensee's analysis showed that the fuel design temperature limits would not have been approached as a result of the reduced injection flow.

This licensee-identified finding preceded the SWSOPI self-assessment. The NRC initially addressed the licensee's preliminary findings concerning SACS in Inspection Report 50-354/96-09, dated December 5, 1996. PSE&G issued two licensee event reports (LER) regarding SACS design deficiencies. The inspector reviewed LERs 96-022-01 and 96-022-02, dated November 25, 1996 and January 31, 1997, respectively. The inspector evaluated interim measures to isolate certain loads and concluded that those meassures acceptably restored system operability.

After additional information regarding SACS pump runout performance characteristics was obtained from the pump supplier, the flow set point on the protective trip device was increased to a point at which both normal operating and design basis accident cooling loads would not result in an inadvertent loss of a SACS loop. The licensee then revised the system operating procedure to again permit the previous alignment of the SACS system.

The licensee also established the following long-term commitments:

(a) SACS design flow calculations will be revised to account for cross-connected loads
(b) SACS will be flow balanced, accounting for all possible cross-connected loads
(c) SACS operating configurations will be reconciled with the design and licensing basis

As of the end of the SWSOPI, PSE&G was in the process of finalizing SACS system flow calculations. The inspector verified that the remaining commitments were being tracked adequately and were scheduled for completion by December 16, 1997.

In conclusion, the licensee identified that the previous SACS configuration would not have supported the Hope Creek TS. The 1987 procedure change, for which no safety evaluation was performed, reduced the minimum complement of EDGs available in a design basis event. Had a complete safety evaluation been performed, as required, the reduction in the margin of safety could have been identified at that time. This failure to perform the safety evaluation constituted an apparent violation of 10 CFR 50.59(a). However, the inspector did not consider this failure (to recognize the change and perform an appropriate safety evaluation) to reflect present performance in this area. Upon identifying the problem, the licensee implemented adequate compensatory actions, performed a comprehensive root cause analysis of the condition, and initiated several actions to prevent recurrence. The inspector concluded that the SACS single failure vulnerability introduced by the valve lineup change in 1987 was relatively subtle, and was not likely to have been identified by routine licensee efforts such as surveillance or quality assurance activities. In addition, the licensee's discovery of the problems was an outfall, in part, of corrective actions for previous NRC enforcement actions pertaining to service water system design deficiencies. Thus, this licensee-identified and corrected violation will not be cited as the criteria of Section VII.B.3 of the NRC Enforcement Policy (NUREG 1600) were met. (**NCV 50-354/97-06-02**)

E8.2 Review of Updated Final Safety Analysis Report (UFSAR)

A recent discovery of a licensee operating its facility in a manner contrary to the updated final safety analysis report (UFSAR) description highlighted the need for a review that compares plant practices, procedures, and/or parameters to the UFSAR descriptions. While performing the inspection documented in this report, the inspector reviewed Sections 9.2.1 and 9.2.2 of the Hope Creek FSAR and verified that the wording was consistent with the observed activities and plant operating procedures.

V. Management Meetings

X1 Exit Meeting

The inspector met several times with licensee management during the conduct of the self-assessment to evaluate the assessment team's progress and the potential safety significance of the team's findings. Mr. E. M. Kelly, Chief of the System Engineering Branch, Division of Reactor Safety, attended the team's exit meeting held at Hope Creek Station on May 29, 1997. A final NRC exit meeting was held with PSE&G management and staff onsite on August 5, 1997. No proprietary information is disclosed in this inspection report.

PARTIAL LIST OF PERSONS CONTACTED

Public Service Electric and Gas company

G. Overbeck	Director, System Engineering
J. Hilditch	Supervisor Engineering BOP
S. Kobylarz	SWSOPI Team Leader
P. Lindsay	SWSOPI Team Member - Design
E. Johnson	SWSOPI Team Member - Operation
M. Woloszyn	SWSOPI Team Member - Operation
K. Ihnen	SWSOPI Team Member - Quality Assessment
R. DeNight	SWSOPI Team Member - Maintenance
W. Mokoid	SWSOPI Team Member - Quality Assurance
C. Bowman	SWSOPI Team Member - Contractor, Heat Exchanger Performance
J. DeFebo	SWSOPI Team Member - SWSOPI Team Supervisor
J. Priest	Licensing Engineer
M. Phillips	Operation Engineer
C. Gassell	Design Engineer
F. Vosbury	Response Team Member
M. Cirelly	Service Water System Engineer
D. LaMaotra	Response Team Leader

State of New Jersey

A. Kapsalopoulou	Nuclear Safety Inspector
T. Kolesnik	Nuclear Safety Inspector

U.S. Nuclear Regulatory Commission

E. Kelly	Chief, System Engineering Branch
S. Morris	Senior Resident Inspector
D. Moy	Reactor Engineer
S. Klein	Reactor Engineer
L. Dudes	Reactor Engineer

INSPECTION PROCEDURES USED

IP 40501	Licensee Self-assessment Related to Safety Issues Inspections
TI 2515/118	Service Water System Operational Performance Inspection (SWSOPI)

ITEMS OPENED, CLOSED, AND DISCUSSED

Closed

50-354/96-09-02	URI	SACS design deficiency

Open

50-354/97-06-02	NCV	Failure to perform 10 CFR 50.59 safety evaluation
50-354/97-06-01	IFI	SACS heat exchanger trending

LIST OF ACRONYMS USED

AR	Action Request
CBD	Configuration Baseline Document
EDG	Emergency Diesel Generator
ECCS	emergency Core Cooling System
EPRI	Electric Power research Institute
FSAR	Final Safety Analysis Report
GL	Generic Letter
LER	Licensee Event Report
MOV	Motor Operated Valve
NLR	Nuclear Licensing Report
NJSD/DEP	New Jersey State Department of Environmental Protection
RHR	residual Heat Removal System
SACS	Safety Auxiliary Cooling System
SWS	Service Water System
SWSOPI	Service water System Operational Performance
TI	Temporary Instruction
TS	Technical Specification