September 10, 2004

Mr. A. Christopher Bakken, III
President and Chief Nuclear Officer
PSEG Nuclear LLC - N09
P. O. Box 236
Hancocks Bridge, NJ 08038

SUBJECT: HOPE CREEK NUCLEAR GENERATING STATION - NRC INSPECTION REPORT 05000354/2004009

Dear Mr. Bakken:

On July 30, 2004, the U. S. Nuclear Regulatory Commission (NRC) completed an engineering team inspection at the Hope Creek Nuclear Generating Station. The enclosed report documents the inspection findings which were discussed on July 30, 2004, with Mr. D. Garchow, Mr. J. Hutton and other members of your staff during an exit meeting.

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and the conditions of your operating license. The inspection involved field walkdowns, examination of selected procedures, calculations and representative records, and interviews with station personnel.

The report documents two NRC identified findings of very low safety significance (Green), one of which was determined to involve a violation of an NRC requirement. However, because of the very low safety significance and because it has been entered into your corrective action program, the NRC is treating this issue as a Non-Cited Violation (NCV) consistent with Section VI.A of the NRC Enforcement Policy. If you contest the NCV in this report, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001; with copies to the Regional Administrator, Region I; the Director, Office of Enforcement, United States Regulatory Commission, Washington, DC 20555-0001; and the NRC Resident Inspector at Hope Creek.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter and its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web-site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

/RA/

Lawrence T. Doerflein, Chief
Systems Branch
Division of Reactor Safety

Docket No. 50-354
License No. NPF-57

Enclosure: Inspection Report 05000354/2004009;
w/Attachment: Supplemental Information

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U.S. NUCLEAR REGULATORY COMMISSION

REGION I

Docket No:	05000354
License No:	NPF-57
Report No:	05000354/2004009
Licensee:	PSEG LLC
Facility:	Hope Creek Nuclear Generating Station
Location:	P.O. Box 236 Hancocks Bridge, NJ 08038
Dates:	July 12 - 17 and July 26 - 30, 2004
Inspectors:	F. Arner, Senior Reactor Inspector, Division of Reactor Safety, (DRS), Team Leader A. Della Greca, Senior Reactor Inspector, DRS C. Cahill, Senior Reactor Inspector, DRS D. Werkheiser, Reactor Inspector, DRS T. Cerne, NRC Consultant M. Patel, Reactor Inspector, Division of Reactor Projects, (DRP), Trainee A. Patel, Reactor Inspector, DRP, Trainee
Approved by:	Lawrence T. Doerflein, Chief Systems Branch Division of Reactor Safety

Enclosure

Summary of Findings

IR 05000354/2004-009; 07/12/2004 - 07/30/2004; Public Service Electric Gas Nuclear LLC, Hope Creek Nuclear Generating Station, Safety System Design and Performance Capability.

This inspection was conducted by six regional inspectors and one NRC consultant. The inspection identified two Green findings, one of which was also a non-cited violation. The significance of most findings is indicated by their color (Green, White, Yellow, or Red) using Inspection Manual Chapter (IMC) 0609, “Significance Determination Process” (SDP). Findings for which the SDP does not apply may be “Green” or be assigned a severity level after NRC management review. The NRC’s program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, “Reactor Oversight Process,” Revision 3, dated July 2000.

A. NRC-Identified Findings

Cornerstone: Mitigating Systems

- Green. The team identified that the basis for a reactor core isolation cooling (RCIC) system operability determination (CROD) and its associated follow-up assessment (CRFA) was not supported with technically correct information for evaluating a nonconformance to the original design performance specifications. Specifically, the RCIC turbine/pump speed control system response as described in the licensee’s CROD / CRFA was incorrect and did not accurately reflect the actual system capability as described in the licensee’s available vendor documentation and calibration procedures.

  This finding was more than minor because the error in the assumption that the turbine control system would compensate for pump degradation resulted in a nonconservative assessment of equipment capabilities. The issue affected the equipment performance attribute of the mitigating systems cornerstone objective of ensuring the capability of the RCIC system with respect to performing its licensing bases function identified in the Updated Final Safety Analysis Report (UFSAR). The finding was determined to be of very low safety significance because it did not represent an actual loss of safety function of the RCIC system. (Section 1R21)

- Green. The team identified a finding of very low safety significance (Green) associated with a technically invalid high pressure coolant injection (HPCI) system analysis. The design analysis utilized an inaccurate design input relative to the capability of the turbine to increase speed above the maximum rated design value. This resulted in an invalid basis for determining that HPCI could inject its design flowrate against the assumed licensing basis vessel backpressure. The issue was determined to be a non-cited violation (NCV) of 10 CFR 50, Appendix B, Criterion III.

The finding was more than minor because it was associated with the mitigating system cornerstone attributes of design control and equipment performance and affected the objective of ensuring the capability of the HPCI system in performing its licensing basis function. The finding screened to very low safety significance (Green) in SDP Phase 1, because it did not result in an actual loss of system safety function. The team identified that a contributing cause of the finding was related to the cross-cutting area of Problem Identification and Resolution. PSEG missed several prior opportunities to identify and resolve this design issue. (Section 4OA2)

B. Licensee-Identified Violations

None

Report Details

1. REACTOR SAFETY

Cornerstones: Initiating Events, Mitigating Systems, and Barrier Integrity

1R21 Safety System Design and Performance Capability (IP 71111.21)

a. Inspection Scope

The team reviewed the design and performance capability of the Reactor Core Isolation Cooling (RCIC) system, the supporting 250 volt dc electrical system, and selected portions of the Residual Heat Removal (RHR) system. The inspection included a sample of supporting/supported components for the selected systems. The team reviewed the design basis documents, the Updated Final Safety Analysis Report (UFSAR), Technical Specifications, design changes and calculations, and other supporting documents (e.g., system health reports) to ensure that the systems could be relied upon to meet their functional requirements. In addition, the team used risk insights relative to the selected systems to focus inspection activities on components and procedures that would mitigate the effects of postulated events.

Regarding the RHR system, the team focused on the low pressure coolant injection (LPCI) and suppression pool cooling (SPC) subsystems, while checking specific design details of the suppression chamber spray, containment spray, shutdown cooling, and alternate decay heat removal modes of operation. The team reviewed the system interactions among the various RHR modes of operation, particularly where the design specified a transfer to the LPCI lineup upon receipt of an accident signal. RHR component performance (including selected pumps, valves, heat exchangers, strainers, orifices, and instrumentation) was evaluated with respect to design requirements during normal plant operations and accident scenarios. In addition, the team reviewed the applicable system procedures which control alignment and operational activities during normal evolutions, and abnormal and emergency scenarios. The team reviewed operations and surveillance test procedures, and the training lesson plans to evaluate the consistency between the assumptions made in the design and the expected system response. The team also conducted plant walkdowns to check specific RHR system field configuration and lineup details with respect to the approved design drawings, system modifications, and engineering changes. In addition, the material condition of the RHR subsystems and components was assessed.

The team interviewed various plant personnel responsible for system status, licensing bases controls, and the implementation of modifications to verify the adequacy of programs and procedures addressing the design basis considerations in system alignments and work control practices. Several RHR design change packages were reviewed along with the supporting calculations (e.g., RHR pump net positive suction head calculations, RHR system hydraulic analysis related to replacement strainers) to validate not only that the design inputs to the system modifications were accurate, but also that the analytical results and conclusions reflected acceptable RHR system performance and a configuration consistent with the system lineup.

The team reviewed surveillance test procedures and test results, including inservice testing (IST), for the RHR system. The system operability status during surveillance activities (e.g., the full flow testing of the RHR pumps for the LPCI mode) was discussed with cognizant operations personnel. Additionally, design requirements for the periodic time response testing of RHR valves that are required to change position after receipt of an LPCI signal were discussed with operations and design engineering personnel to ensure proper understanding of the constraints on full system availability and transient (e.g., water hammer) considerations. The team also reviewed the RHR piping keep-fill system, including the related jockey pump operations, system pressure and alarm instrumentation, and operator actions. Selected RHR system modifications (e.g., loop crosstie header installation for alternate decay heat removal) and the supporting calculations were checked for compliance with the relevant design bases criteria, and also for potential adverse impact upon other RHR safety related and accident response functions.

The team performed a review of selected parameters (e.g., ultimate heat sink temperature, containment isolation valve response, thermal relief valve actuation setpoints) affecting design inputs and systems and components supporting the RHR system to verify that the system configuration was consistent with the design bases. The timing constraints of the emergency diesel generator start and loading requirements were checked for consistency with the design basis accident sequence documented in UFSAR Table 6.3-1. Also, where overlap testing was used to verify proper system setpoints and component operability (e.g. 450 psig reactor pressure interlock/permissive for the LPCI injection valves), the surveillance procedures were reviewed and system engineering and operations personnel were interviewed to verify that the segmented overlap tests confirmed component operability.

The Hope Creek simulator was also visited and control board checks were conducted with the simulator instructors to verify simulator fidelity with specific plant controls. Discussions with operators and training personnel were used to confirm that proper emphasis was placed upon system/component design and accident response assumptions in the training scenarios, as well as to determine the technical adequacy and clarity of the procedures being used by the licensed operators. Design bases documents for the RHR system were also reviewed to check for proper integration into operations and surveillance procedures, and training plans. Specific design features reviewed included LPCI discharge piping keep-fill, suppression pool cooling, and alternate decay heat removal. The team also reviewed the capability of the operators to perform certain Abnormal/EOP directed actions, given expected plant conditions and the availability of time that is assumed for the design-basis accident requiring LPCI response.

The team reviewed selected components associated with the 250 vdc system. These components included batteries, chargers and switchgear. The capability of the DC electrical systems to provide reliable power to operate the HPCI and RCIC systems for accident and transient conditions was reviewed in detail. These reviews included verification that selected design requirement and commitments contained in the UFSAR, design documents, industry standards, and vendor information had been established and were being maintained. Documents reviewed included drawings, calculations, engineering analyses, accident analyses and design changes. The team reviewed associated component electrical testing as well as control circuit logic testing. Selected instrumentation calibration and functional tests were also reviewed. Operating experience information, including vendor information in the form of service information letters (SILs), was reviewed to ensure that Hope Creek properly evaluated and incorporated applicable recommendations. Procedures, calculations and engineering evaluations associated with a station blackout event were also reviewed.

The team performed field walkdowns of the accessible DC electrical system equipment to assess the material condition and verify that the installed configuration was consistent with design drawings, operating procedures, and other design information. The team assessed the adequacy of environmental protection measures to ensure that temperature sensitive components, such as batteries, would perform their safety functions. The team reviewed the last completed surveillance tests, the operator workaround list, system engineer tracking/trending data, health reports, temporary modifications, work order backlog, and corrective action database to assess the overall health of the system.

With respect to the electrical portions of the systems, the team reviewed the control wiring diagrams of the RHR pump motors and RCIC turbine controls to verify that their operation and automatic initiation, when applicable, were in conformance with the design bases documents and UFSAR descriptions. The review was performed to verify that the control of valves critical to the correct operation of the systems was as specified in the design bases documents. Additionally, the team reviewed the condensate storage tank (CST) level setpoint calculations to ensure that an adequate water volume was available to the pumps and that the swap-over of the suction source from the CST to the suppression pool did not impair their ability to perform their safety function. The team reviewed alternating current and direct current power distribution single line diagrams and the protective relay/breaker/fuse coordination studies to ensure that a fault or single failure of an electrical component or source did not impair the ability of the systems to perform their specified safety function. The team also confirmed that sufficient instrumentation had been provided to initiate automatic functions and to monitor the operation of the systems during and following a plant abnormal event.

The team reviewed the load flow analysis and the emergency diesel generator (EDG) loading calculation to verify that the loads addressed had been correctly identified in the calculation and to assure that the EDGs were capable of meeting the load requirements under worst-case conditions. Through a review of the voltage drop calculation, the team also verified that adequate voltage was provided to the safety-related loads during normal, abnormal and emergency loading conditions. The team reviewed the environmental qualification of motors and valves within the scope of the inspection to verify they would be capable of performing their safety function, following an accident, in the environment stated in the specification for environmental service conditions. In addition, the team reviewed selected electrical design modifications related to RHR and RCIC to confirm that changes were reasonable and did not impact the original design bases of the system.

The team utilized risk achievement worth information along with the significance determination process phase two worksheets to select components within the RCIC system to review in-depth. The RCIC turbine and pump were selected for detailed review. Reviews included the results from quarterly pump test runs along with design considerations relative to maintaining components operational after system initiation. Consideration was given to inadvertent isolation of the system when not desirable such as in events which would result in high ambient temperatures or elevated turbine exhaust backpressures. Other critical components reviewed included the RCIC injection motor operated valve, the RCIC turbine steam inlet valve, and various components related to the Turbine control system where failure would result in the loss of the turbine/pump function. System modifications, procedures and various design related calculations were reviewed to ensure the system was capable of achieving its safety function during transient and accident scenarios. System operability reviews were selected for review to ensure the technical basis for operability conclusions were supported and valid. Additionally, maintenance procedures including preventive maintenance work instructions were reviewed to ensure consistency with vendor technical manual requirements.

b. Findings

Introduction. The team identified that an operability determination (CROD) and its associated follow-up assessment (CRFA) were not supported with technically correct information for concluding that RCIC remained operable for a nonconforming condition with UFSAR design specifications. This finding was determined to be of very low safety significance based on a revised operability review which determined that there was not an actual loss of safety function of the RCIC system.

Description. Prior to this inspection, PSEG determined that the RCIC pump performance had degraded below UFSAR described design specifications (i.e. could not support rated flow of 600 gpm against maximum assumed SRV backpressure with the rated turbine speed) and determined that the RCIC system was operable but non-conforming as defined in NRC Generic Letter (GL) 91-18. PSEG entered this issue into their corrective action program (Notification 20193031, 6/11/2004) and performed an operability determination (Order 70039742-10: CROD, 6/11/2004) for initial support of this declaration. A follow-up assessment was performed (Order 70039742-30: CRFA, 6/17/2004) to support the elements of the CROD.

The team questioned the validity of a statement contained in the CROD and its supporting CRFA which in-part formed the basis for operability of the RCIC system. Specifically, Section IV of the CROD (and Section III of the CRFA) specifically stated or implied that an additional speed increase (beyond the maximum RCIC turbine speed of 4500 rpm) would compensate for any potential pump degradation and that the control system will not inhibit the turbine-pump speed required to develop the required flow against the maximum UFSAR described backpressure. The team determined that this assumption demonstrated a flawed understanding of the turbine control system response.

The RCIC pump is driven by a ‘GS’ type Terry Steam Turbine with a maximum rated speed of 4500 rpm. The turbine is controlled and governed by an electronic-hydraulic-mechanical control system that includes the following subsystems: flow controller, speed controller (EG-M), and actuator (EG-R). The flow controller converts pump discharge flow to a milliampere signal for the speed controller. The turbine governor system receives flow controller signal input and converts it into hydraulic-mechanical motion to position the turbine governor valve relative to the milliamp signal. The system is calibrated so that the maximum specified milliamp output signal from the flow controller corresponds to the turbine rated high speed set point and the minimum specified milliamp output signal corresponds to the turbine low speed set point. As pump flow is developed and reaches the set point of the flow controller, the flow controller output signal to the turbine governor will integrate to where constant rated pump flow is obtained. This should occur below rated speed of the turbine for any given steam condition. This type of control system is commonly used on both RCIC and HPCI turbines.

In response to the team’s questions, PSEG performed a review of the system’s design specifications and calibration set-up procedure, and held discussions with the equipment vendors. PSEG subsequently acknowledged in a notification report that they had used an invalid technical assertion that additional turbine speed increase (beyond the maximum RCIC turbine limit of 4500 rpm) would compensate for any potential pump degradation. Based on this, PSEG determined that the RCIC system given the current pump performance data would not provide rated flow 600 gpm against the maximum UFSAR described design backpressure (first SRV mechanical setpoint plus tolerance). PSEG evaluated this condition with a revision to the CROD and CRFA (Order 70039742-80: CROD, 7/13/2004; Order 70039742-90: CRFA, 7/19/2004) and determined that RCIC remained operable but non-conforming considering existing pump performance and the Hope Creek design which includes an automatic low-low set function for SRVs ‘P’ and ‘H’. This design feature would change system head curves such that a rated flow of 600 gpm would still be achievable for the various transient and accident scenarios.

Analysis. The performance deficiency associated with this finding is the failure to have a technically correct basis for determining operability of an RCIC system nonconforming condition. The standard not met is identified in PSEG’s operability procedure, SH.OP-AP.ZZ-0108 (Q), “Operability Assessment and Equipment Control Program,” which states that assessments should base determinations on the best information available. The team determined that applicable vendor and calibration procedure information was readily available with regard to system operation.

This finding is greater than minor because the error in the assumption that the turbine control system would compensate for pump degradation results in a non conservative assessment of equipment capabilities. The issue affects the equipment performance attribute of the mitigating systems cornerstone objective of ensuring the capability of the RCIC system with respect to performing its licensing basis capability identified in the UFSAR. Additionally, the team noted that the flawed understanding of the turbine control system could lead to a more significant safety concern. Section 4OA2 of this report describes an impact on identifying HPCI inoperability due in part because of the misunderstanding of this common issue to both systems.

This finding is of very low safety significance because based on existing pump performance data and crediting the function of the SRV's at lower pressure settings, there was no actual loss of the RCIC safety function. The licensee entered this issue into their corrective action program (Notification 20196649, 7/13/2004) and initiated actions to review their operability/follow-up assessment process, and evaluate actions to restore the system to conformance with the UFSAR design commitments. No violation of regulatory requirements occurred. (**FIN 50-354/04-09-01**)

4OA2 Problem Identification and Resolution

a. Inspection Scope

The team reviewed a sample of corrective actions associated with the reactor core isolation cooling, 250 volt dc, residual heat removal and the high pressure coolant injection systems, as identified in the documents reviewed section. The review was performed to verify that PSEG was identifying issues at an appropriate threshold, and taking appropriate corrective actions. The team's selection of items to review focused on design related issues which may have an effect on the design bases capabilities of the systems. The team also reviewed corrective actions associated with a non-cited violation identified during a December 2002 safety system design inspection of the HPCI system.

Additionally, the team reviewed a selection of condition report operability determinations (CRODs), and condition report follow-up actions (CRFAs) to verify that problems were identified, documented, and effectively resolved.

b. Findings

HPCI System Capability Analysis

Introduction. The team identified a finding of very low safety significance (Green) associated with a technically invalid HPCI system analysis. The design analysis utilized an inaccurate design input relative to the capability of the turbine to increase speed above the maximum rated design value. The issue was determined to be a non-cited violation (NCV) of 10 CFR 50, Appendix B, Criterion III.

Description. In December 2002, the NRC completed a Hope Creek design inspection which included the HPCI system (NRC Inspection Report 50-354/2003-002). An NCV was issued (NCV 50-354/2003-002-04) for inadequate acceptance limits for the HPCI quarterly operability surveillance test. The concern also identified that PSEG calculations were non-conservative with respect to ensuring the system could meet design requirements. The NRC team noted during review of this issue that PSEG subsequently had performed calculation BJ-0023, “HPCI Full Flow Test Required Pressure,” revision one, dated July 11, 2003. This analysis focused on determining the High Pressure Coolant Injection (HPCI) pump differential pressure required to satisfy technical specification requirements and assure injection capability of 5600 gallons per minute (gpm) against the highest assumed reactor backpressure. The team noted the analysis utilized a backpressure value of 1135 psia which was consistent with the UFSAR pressure range described for system operation.

The team determined that PSEG had utilized an incorrect design input within BJ-0023 which turned out to be critical to the assumption that the system could inject at the rated flowrate against design basis vessel backpressure. Specifically, the analysis referenced the system operating procedure (HC.OP-IS.BJ-0001) as allowing a maximum turbine-pump speed of 4500 rpm and therefore believed that using a lower value of 4350 rpm provided conservatism to accommodate potential internal pump leakage. The hydraulic analysis used a maximum speed of 4350 rpm along with pump affinity laws to demonstrate that HPCI could achieve rated flow against 1135 psia.

The team determined that PSEG had failed to recognize that an actual limitation existed on turbine speed, which was based on vendor documentation and controller calibration speed settings. The team questioned how the system would be able to operate in accordance with PSEG’s analysis when it was calibrated such that the maximum turbine speed would be on the order of 4150 rpm. The team determined that the capability of HPCI to achieve its design bases flowrate would be challenged with regard to maximum licensing bases assumed backpressures associated with SRV mechanical lift setpoints including tolerance. During their review of the issue, PSEG determined that the pump would not develop sufficient head to inject 5600 gpm against a vessel pressure of 1135 psia. Additionally, PSEG discovered that the 1135 psia pressure was non conservative due to a licensing change made in 1995 which changed SRV setpoint tolerances from 1% to 3%. PSEG utilized the current pump performance data, the maximum turbine speed setting of 4150 rpm, and the revised maximum vessel backpressure of 1156 psia and determined the system would develop a flowrate of a nominal 4700 gpm which indicated a shortfall on the order of 16% from the design flowrate.

HPCI was declared inoperable on July 16, 2004, and a 14 day technical specification limiting condition of operation was entered due to the inability to demonstrate via calculation or test data that the system could perform at the assumed level in the accident analysis. A PSEG project team performed a rigorous investigation which identified that the original sizing of restricting orifices installed in each of the HPCI discharge paths (core spray and feedwater lines) increased system friction losses and reduced the margin and capability of the system to supply accident analysis assumed flowrates. The installed orifices were determined to constitute over three quarters of the total system pressure drop. PSEG performed a design change package and resized the orifices to allow the system to achieve its design flowrate capability against 1156 psia at the maximum design turbine speed of 4150 rpm. The team reviewed the methodology associated with the design package and determined that the actions taken were reasonable with respect to restoring operability and the original design basis capability of the system. HPCI was declared operable on July 28, 2004.

Analysis. The performance deficiency was a failure to utilize proper design inputs (maximum HPCI turbine speed assumption) within an HPCI design calculation. This resulted in an invalid basis for determining that HPCI could inject its design flowrate against the assumed maximum licensing basis vessel backpressure. The finding was more than minor because it was associated with the mitigating system cornerstone attributes of design control and equipment performance and affected the objective of ensuring the capability of the HPCI system in performing its licensing basis function.

The finding screened to very low safety significance (Green) in SDP Phase 1, because it did not result in an actual loss of system safety function. While the team noted that the worst case licensing basis backpressure of 1156 psia would have resulted in a shortfall of the design flowrate, the Hope Creek design includes two SRVs (H & P) which will automatically actuate at low-low pressure setpoints of 1017 and 1047 psig respectively. This design feature, while not credited in the UFSAR assumed pressure range for HPCI operation, would reduce the actual backpressure experienced for transients and accidents to allow the HPCI system to achieve its safety function.

The team noted that there were several missed opportunities to identify that the HPCI system was not capable of performing its design flowrate at the conservative accident analysis pressure of 1156 psia, and was indicative of a cross cutting weakness in the Engineering organizations Problem Identification and Resolution. Specifically, engineering personnel had opportunities to identify the issue during the July 2003 calculation of record including the independent design verification performed. Furthermore, Notification 20193794 which was initiated in June 2004 due to a self assessment performed prior to this inspection, again failed to recognize the invalid design assumption in the calculation.

Enforcement. 10 CFR Part 50, Appendix B, Criterion III, requires design control measures be in place that provide for verifying or checking the adequacy of the design. Contrary to the above, verification of design adequacy was not sufficient to identify invalid input data and thereby prevented the opportunity to correct the inadequate calculation. Additionally, the invalid analysis prevented the identification that HPCI could not inject its rated flowrate against the maximum accident assumed SRV backpressure. However, because the violation was of very low safety significance (Green) and PSEG entered the deficiency into their corrective action system (Notification 20197067), this finding is being treated as a non-cited violation consistent with Section VI.A of the NRC Enforcement Policy. **(NCV 50-354/04-09-02)**

4OA4 Cross Cutting Aspects of Findings

Section 4OA2 of this report describes a finding regarding an inadequate HPCI design analysis which involved PI&R as a causal factor in not identifying the issue due to several missed opportunities.

4OA5 Other

1. (Closed) URI 50-354/2003-002-05 Adequacy of HPCI suction sources relative to lube oil temperature

During the December 2002 safety system design inspection, NRC staff identified a concern relative to lube oil temperature requirements and the procedures for controlling the HPCI suction sources. The issue was left unresolved pending PSEG completion of additional analysis and procedure reviews.

This inspection followed up this concern through a review of PSEGs HPCI lube oil cooler performance analysis, “H-1-BJ-MDC-1997," dated June 29, 2004. The team found the analysis used reasonable inputs and assumptions to determine nominal expected temperatures during transients where higher suction source temperatures would be expected. The team also reviewed the last completed test results for the quarterly HPCI flow surveillance test which showed lube oil temperatures within normal expected ranges. The team reviewed Order 70028584 associated with the concerns regarding HPCI lube oil temperature limits and found the review to be thorough with appropriate evaluation of the associated transients and accidents which would result in suction from the suppression pool at elevated temperatures.

The team determined that procedures appropriately addressed the concern with instruction to provide suction from the condensate storage tank and if necessary, bypass the high torus level suction transfer to remain on the lower temperature source. Emergency Operating Procedure EOP-101, “Reactor Pressure Vessel Control,” and the system operating procedure were reviewed and found to adequately describe actions required to swap the suction source back to the condensate storage tank (CST) if required. Additionally, cautions were provided that elevated suction temperatures may result in equipment damage, such that operators would maintain awareness of the need to monitor this condition. Based on the review of the above, the team considered this issue closed. No violations of NRC requirements were identified.

4OA6 Exit Meeting Summary

The inspectors presented the inspection results to Mr. D. Garchow and Mr. J. Hutton and other members of PSEG at the conclusion of the inspection on July 30, 2004. Proprietary information examined during the inspection was identified and returned to the licensee at the conclusion of the inspection. The inspectors verified that the inspection report does not contain proprietary information.

ATTACHMENT 1

SUPPLEMENTARY INFORMATION

KEY POINTS OF CONTACT

PSEG

S. Afarian	RHR System Engineer
M. Bergman	RCIC System Engineer
J. Duffy	Design Engineer
J. Flannagan	Vibration Program Engineer
K. Fleischer	Supervisor, Design Electrical Engineering
M. Lazar	System Engineer (RCIC)
F. Ricarto	Design Electrical Engineer
H. Berrick	Licensing Response Team Lead
M. Conroy	Maintenance Rule Program Manager
M. Crawford	RHR Design Engineer
G. Daves	Acting System Engineering Manager
J. Dower	Operations Training Supervisor
J. Hinkle	Operations Engineer
T. Macewen	Operations Engineer
J. Reid	Operations Training Leader
G. Schmelz	Simulator Instructor
H. M. Swartz	Simulator Support Group Supervisor

LIST OF ITEMS OPENED AND CLOSED

Opened and Closed

FIN 05000354/2004009-01	Invalid technical bases for RCIC nonconformance
NCV 05000354/2004009-02	Inadequate HPCI design analysis

Closed

URI 50-354/2003-002-05	Adequacy of HPCI suction sources relative to lube oil temperature

LIST OF DOCUMENTS REVIEWED

Design and Licensing Basis Documents

NRC Generic Letter No. 91-18, Rev. 1, Information to Licensees Regarding NRC Inspection Manual Section on Resolution of Degraded and Nonconforming Conditions.
NRC Information Notice 97-90, Use of Non-conservative Acceptance Criteria in Safety-Related Pump Surveillance Tests.
NRC Inspection Report No. 50-354/04-002
NRC Inspection Report No. 50-354/03-002
NUREG/CR-4564, Operating Experience and Aging-Seismic Assessment of Battery Chargers and Inverters
Regulatory Guide 1.3, Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants, Rev. 2, February 1977
DE-CB.BC-0036(Q), Rev. 1, Configuration Baseline Document for RHR System
Design Installation and Test Specification (Bechtel 10855-D3.35), RHR, Rev. 9
Design Specification (General Electric 22A4305), RHR, Rev. 3

UFSAR Sections

3.9.2.2.2, Thermal Expansion Testing of Non-NSSS Piping
6.3, Emergency Core Cooling System
15.9, Plant Nuclear Safety Operational Analysis
Table 6.2-16, Containment Penetrations
Table 6.3-1, Operational Sequence of ECCS for Design Basis Accident

Technical Specifications

Amendment No. 124 - Condensate Storage Tank Low Level Setpoint Change, Dated March 6, 2000
Section 3/4.3.3 Emergency Core Cooling System Actuation Instrumentation
Section 3/4.5.1 Emergency Core Cooling Systems ECCS - Operating
Section 3/4.5.2 Emergency Core Cooling Systems ECCS - Shutdown
Section 3/4.4.9, Residual Heat Removal
Section 3/4.5.3, Suppression Chamber
Section 3/4.6.2.2, Suppression Pool Spray
Section 3.4.6.2.3, Suppression Pool Cooling
Section 3/4.6.3, Primary Containment Isolation Valves
Section 3/4.7.1.3, Ultimate Heat Sink

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M-08-0(Q), Condensate & Refueling Water & Storage P&ID, Sh. 1 & 2
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M-50-1(Q), RCIC Pump Turbine P&ID, Rev. 28
M-51-1(Q), Residual Heat Removal P&ID, Sh. 1 & 2

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HC.OP-AB.RPV-0009, Shutdown Cooling, Rev. 1
HC.OP-AR.ZZ-0004, Overhead Annunciator Window Box A6, Rev. 12
HC.OP-AR.ZZ-0005, Overhead Annunciator Window Box A7, Rev. 13
HC.OP-SO.BC-0001, RHR System Operation, Rev. 36
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HC.OP-SO.PK-0001, 125 VDC Electrical Distribution System Operation, Rev. 14
HC.OP-SO.PJ-0001, 250 VDC Electrical Distribution System Operation, Rev. 6
HC.OP-SO.BD-0001 (Q), RCIC Operation, Rev. 25
HC.OP-SO.BJ-0001 (Q), HPCI Operation, Rev. 23
SH.OP-AP.ZZ-0107, Shift Turnover Responsibilities, Rev. 7
SH. OP-AP.ZZ-0108, Operability Assessment and Equipment Control Program, Rev. 14

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HC.IC-SO.PJ-0003, 18 Month 250 Volt Battery Charger Service Test Using BCT-2000, Rev. 4
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HC.OP-FT.BC-0002, D ECCS Jockey Pump - DP228 - Functional Test, Rev. 8
HC.OP-IS.BC-0001, AP202 A RHR Pump In-Service Test, Rev. 29
HC.OP-IS.BC-0101, RHR Subsystem A Valves- IST, Rev. 22
HC.OP-IS.BC-0102, RHR Subsystem B Valves- IST, Rev. 30
HC.OP-IS.BC-0103, RHR Subsystem C Valves - IST, Rev. 20
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HC.OP-IS.BC-0105, RHR System Valves - Cold Shutdown -IST, Rev. 21
HC.OP-ST.BC-0001, RHR System Piping and Flow Path Verification - Monthly, Rev. 11
HC.OP-ST.BC-0004, LPCI Subsystem A ECCS Time Response Functional Test - 18 months, Rev. 11
HC.OP-ST.BC-0005, LPCI Subsystem B ECCS Time Response Functional Test - 18 months, Rev. 11
HC.OP-ST.BC-0006, LPCI Subsystem C ECCS Time Response Functional Test - 18 months, Rev. 10
HC.OP-ST.BC-0007, LPCI Subsystem D ECCS Time Response Functional Test - 18 months, Rev. 8
HC.OP-ST.BC-0009, RHR Heat Exchanger Flow Measurement - 18 month, Rev. 2

Completed Surveillance Tests

HC.IC-CC.BD-0006(Q), RCIC Division 2 Channel E51-N035A, E51-NO35E Condensate Storage Tank Level, Rev. 19, dated 7/17/03
HC.IC-DC.ZZ-0102(Q), Bailey SQRT Extractor Calibration, Type 750 (Style 1 & 2), dated 8/2002, 3/2004
HC.IC-LC.FC-001(Q), Loop Calibration RCIC Turbine Speed Control System, dated 8/2002, 3/2004
HC.IC-ST.PJ-0001(Q), 60 Month Surveillance and Performance Discharge Test of 250 Volt Batteries Using BCT-2000, Rev. 8 - Test of 10-D-431, dated 5/2/03

HC.IC-ST.PK-0001(Q), 60 Month Surveillance and Performance Discharge Test of 125 Volt Batteries Using BCT-2000, Rev. 10 - Test of 1A-D-411, dated 10/29/01
HC.IC-ST.PK-0002(Q), 18 Month Surveillance and Service Test of 125 VDC Batteries Using BCT-2000, Rev. 10 - Test of 1A-D-411, dated 4/18/03
HC.IC-ST.PK-0003(Q), 18 Month 125 Volt Battery Charger Service Test Using BCT-2000, Rev. 12 - Test of 1A-D-413, dated 9/17/03
HC.IC-ST.PK-0003(Q), 18 Month 125 Volt Battery Charger Service Test Using BCT-2000, Rev. 12 - Test of 1A-D-414, dated 1/10/03
HC.OP-FT.BD-002(Q), RCIC Time Response Test, dated 6/12/2004
HC.OP-IS.BC-0001(Q), AP202 ‘A’ RHR Pump IST, dated 6/2004
HC.OP-IS.BC-0002(Q), CP202 ‘C’ RHR Pump IST, dated 6/2004
HC.OP-IS.BC-0003(Q), BP202 ‘B’ RHR Pump IST, dated 5/2004
HC.OP-IS.BC-0004(Q), DP202 ‘D’ RHR Pump IST, dated 4/2004
HC.OP-IS.BC-0101(Q), RHR Subsystem ‘A’ Valves – IST, dated 6/2004
HC.OP-IS.BD-001(Q), RCIC Pump Operability, dated 2/2002, 6/2004
HC.OP-IS.BD-002(Q), RCIC Operability, dated 1/2000, 6/2004
HC.OP-IS.BD-101(Q), RCIC Valve Operability, dated 6/2001, 6/2004
HC.OP-IS.BJ-001(Q), HPCI Pump Operability, Rev. 41 dated 4/27/2004
HC.OP-IS.BJ-001(Q), HPCI Pump Operability, Rev. 42 dated 7/06/2004
HC.OP-SO.BC-0001(Q), RHR System Operation, dated 6/2004
HC.OP-ST.BC-0005(Q), LPCI Subsystem ‘B’ ECCS Time Response Functional Test, dated 4/2003
HC.OP-ST.BC-0007(Q), LPCI Subsystem ‘D’ ECCS Time Response Functional Test, dated 4/2003
HC.OP-ST.BC-0009(Q), RHR Heat Exchanger Flow Measurement, dated 4/2003
HC.MD-GP.ZZ-0015(Q), Battery Equalizing Charge, Rev. 16 - Test of 1A-D-411, dated 4/21/03
HC.MD-GP.ZZ-0015(Q), Battery Equalizing Charge, Rev. 16 - Test of 10-D-431, dated 5/1/03
HC.MD-ST-PJ-0002(Q), 250 Volt Quarterly Battery Surveillance, Rev. 18 - Test of 10-D-431, dated 5/2/03
HC.MD-ST-PK-0002(Q), 125 Volt Quarterly Battery Surveillance, Rev. 21 - Test of 1A-D-411, dated 4/17/03 and 7/17/03

<u>Drawings</u>

Anchor/Darling Valve Company drawing, 1-BC-HV-F024A, Ref. No. 10855-P301(Q) 448-5
Hayward Tyler Pump drawings for RHR pumps 1CP228 & 1DP228, Ref. No. 10855-M82 (Q)
C8070146G, 862 System, RHR Pump Control HS-4416A & E11-S64A, Rev. 10
C8078501D, 862 System, RHR System Alarms & Status, Rev. 6
D8070136F, 862 System, Pump AP202 Motor Status, Rev. 0
D8077561E, 862 System, Lamp Voltage Buffering System for RHR System, Ch. A, Rev. 5
E-0001-0(Q), Single Line Diagram, Station, Rev. 20
E-0002-1(Q), Single Line Meter and Relay Diagram, Power System, Sh. 1, Rev. 12
E-0006-1(Q), Single Line Meter and Relay Diagram, 4.16 kV Class 1E Power System, Sh. 1 & 2
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E-0012-1(Q), Single Line Meter and Relay Diagram, 120 VAC Instrumentation & Misc. Systems, Sh. 1 - 5

E-0013-1(Q), Single Line Meter and Relay Diagram, 480 Volt Unit Substations 00B170 & 00B180, Sh. 1, Rev. 13
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E-0019-1, 480V MCC Tabulation, Class 1E - Aux Bldg - D/G Area, 10B411, 10B421, 10B431, and 10B441, Sh. 1 & 2
E-0019-2, 480V MCC Tabulation, Class 1E - Aux Bldg - D/G Area, 20B411, 20B421, 20B431, and 20B441, Sh. 1 & 2
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E-6234-0, Electrical Schematic Diagram Residual Heat Removal System RHR Pump Min Flow Bypass Valve, Sh. 11, Rev 5
E-6441-0, Electrical Schematic Diagram Class 1E 4.16KV Circuit Breaker Control RHR Pumps 1AP202, 1CP202, 1DP202, Sh 1 & 2
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M-50-1, RCIC Pump Turbine, Sh.1 Rev.19
M-51-1, Residual Heat Removal, Sh.1 Rev.32
M-51-1, Residual Heat Removal, Sh.2 Rev.32
10855-N1-E51-C001-23(1)-1, RCIC Pump Curve
10855-N1-E51-E001-21(1)-3, RCIC Pump
10855-N1-E51-E001-22(1)-3, RCIC Pump
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HC.OP-AB.ZZ-0135, Station Blackout, Loss of Offsite Power, Diesel Generator Malfunction, Rev. 23
HC.DE-PS.ZZ-0041(Q), HC Station Blackout Program
HC.IC-CC.BC-0001, RHR - Division 1 Channel E11-N658A, Rev. 6

HC.IC-SC.BC-0001, RHR - Division 1 Channel E11-N658A, Rev. 6
HC.MD-CM.BC-0003, ECCS Jockey Pump Overhaul, Rev. 7
HC.MD-PM.FC-0002(Q)- Reactor Core Isolation Cooling Turbine Oil Inspection
SH.MD-AP.ZZ-0023(Q), Scaffold Program, Rev. 5
SH.MD-DG.ZZ-0023(Q), Scaffold Erection, Modification & Dismantling Desk Top Guide, Rev. 3

Plans, Policies and Programs

Hope Creek Generating Station Inservice Testing Manual, Rev. 16
SH.OP-AP.ZZ-0108(Q), Operability Assessment and Equipment Control Program, Rev. 14
NOH01RHRSYS-01, Nuclear Training Center Lesson Plan for the RHR System, dated 7/11/02
SH.RA-AP.ZZ-0004, Snubber Program, Rev. 0

Calculations

AP-2(Q), Hope Creek Generating Station Condensate Storage Tank Volumes, Rev. 4
AP-0004(Q), Condensate Storage Tank - Level Setpoints, Rev 6
BC-0002, NPSH for RHR System Pumps (Suction from Suppression Pool), Rev. 4
BC-0023(Q), RHR Min Flow Orifice E11-D0001, Rev. 3
BC-0030(Q), ECCS Jockey Pump Net Positive Suction Head, Rev. 3
BC-0052(Q), Plant Cooldown Using One RHR Heat Exchanger, Rev. 2
BC-0055, HCGS RHR System Thermal Hydraulic Model, Rev. 4
BC-0056, RHR Hydraulic Analysis, Rev. 4
BD-01(Q), NPSH for RCIC System Pump (Suction from SP), Rev. 2
BD-03(Q), RCIC Pump Discharge Line Sizes, Rev. 4
BD-02(Q), NPSH for RCIC System Pump (Suction from CST), Rev. 2
BD-07(Q), RCIC Test Return, Rev. 2
BD-12(Q), Setpoint for RCIC (BD-PSL-4157), Rev. 1
BD-13(Q), Setpoints for RCIC, Rev. 4
BD-14(Q), RCIC Turbine/Pump Start Transient, Rev. 0
BD-19(Q), Shutoff Head for RCIC Pump OP203, Rev. 0
BD-20(Q), RCIC Jockey Pump System Capabilities, Rev. 0
BJ-23(Q), HPCI Full Flow Test Required Pressure, Rev. 1
D7.5, Hope Creek Generating Station Environmental Design Criteria, Rev. 19
E-1.4(Q), HC Class 1E 125 & 250 VDC Systems: Short Circuit & Voltage Drop Studies, Rev. 5
E-4.1, HC Class 1E 125 VDC Station Battery & Charger Sizing, Rev. 9
E-4.2(Q), Hope Creek Generating Station Class 1E DC Equipment and Components Voltage Study, Rev. 3
E-5.1(Q), HC Class 1E 250 VDC Station Battery & Charger Sizing, Rev. 7
E-7.4(Q), Class 1E 4.16 kV System, Rev. 3
E-7.7(Q), Class 1E 480 Volt System, Rev. 0
E-7.9(Q), 125 VDC & 250 VDC Class 1E System, Rev. 2
E-9(Q), Standby Class Diesel Generator Sizing, Rev. 6
E-15(Q), Load Flow Study, Rev. 7
E-45.001, Station Blackout II, 250V DC Battery, Rev. 0
H-1-BC-MEE-1835, LPCI Flow with RHR Pump Minimum Flow Valve Open, Rev. 0
H-1-BD-IST-4302, ECCS Jockey Pump Discharge Pressure, Rev. 0

H-1-BD-MDC-0923(002), MOV Capability for 1BD-HV-F013, Rev.1
H-1-FC-MDC-0940 (003), MOV Capability Assessment for 1FC-HV-F045, Rev. 1
SC-AP-0001, Condensate Storage Tank Low Level to HPCI, Rev. 3
SC-AP-0003, Condensate Storage Tank Low Level to RCIC, Rev. 6
SC-BC-0055, RHR Suppression Pool Spray Flow A to ERF, Rev. 6

Vendor Technical Manuals

EPRI NP-6909, Terry Turbine Controls Guide, Rev. 1
EPRI TR-105874, Terry Turbine Maintenance and Troubleshooting Guide, Rev. 2
GE SIL 351, HPCI/RCIC Turbine Control System Calibration, Rev. 2
GE SIL 623, HPCI/RCIC System Peak Pump Discharge Pressure During Surveillance Testing
GE SIL 640 RCIC/HPCI EGM Control Box Electrolytic Capacitor, Rev. 0
GE 21A9203, Purchase Specification for HPCI Pump Drive, Rev. 4
GE 21A9243, Purchase Specifications for RCIC Pump (Hope Creek), Rev. 0
GE 21A9243BF, Design Spec Data – RCIC Pump (Hope Creek), Rev. 4
GE 22A1354AS, Design Spec Data - RCIC System (Hope Creek), Rev. 14
PN1-E51-C001-0055(001), RCIC Pump, Rev. 4
PN1-E51-C002-0054(001), RCIC Governor and Control, Rev. 12
VTD PN1-E51-C002-0054 0001 rev. 13-Terry Steam Turbine Manual

Design Change Packages

4EC-1006, Rev. 1, Modification of RHR Shutdown Cooling Valves Circuitry
4EC-3638, Rev. 1, MOV Control Circuit Modification per NRC IN 92-18
4HC-0150, Rev. 0, Installation of Administratively Control 1E Key Lock Isolation Switch in MCC 10B242082
4HC-0150, Rev. 0, Pkg. 2, Modification to Logic Configuration for the Bailey Overload/Power Fail Monitor Circuits
4HC-0311, Rev. 0, Elimination of Topaz Inverters from ECCS & RCIC Instrumentation Circuitry
4HM-0585, Rev. 0, RHR Test Return Valve Logic Change
80065877, Rev. 0, Replace GE AKR DC Breakers
80073096, Rev. 0. Modify HPCI Discharge Flow Orifice FO-5051 and FE-6813
GE Engineering Change Notice (NJ 68362) for the RHR System Design Spec., dated 11/14/85
Design Memorandum H-1-BCXX-CDM-0539-0 for DCR 4EC-1006, dated 5/13/87
DCP 4EC-1021 (package 7) for snubber 1-P-BC-023-H027 removal
DCP 4EC-3411, Crosstie Headers for Loops A-C & B-D, Rev. 0
DCP 4EC-3538, Replacement of ECCS Suction Strainers, Rev. 0
DCP 4EC-3656, Seven New Relief Valves Added To Containment Piping Segments, Rev. 0
DCP 4-HM-0585, Valve Operator Logic Change for BC-HV-F010A&B and F024A&B, Rev. 0

Work Orders

70038788
50045027, ST 18/MO Test - A RHR HX Performance Test, dated 4/12/03

Miscellaneous

CROD (Order 70030848) for RHR Flow ST.BC-0009, dated 4/15/03
CROD (Order 70038788) for Evaluation of LPCI Injection Rate, dated 4/27/04
CROD 20193031/70039742 – RCIC Operability, dated 7/2004
Engineering Evaluation H-1-GS-MEE-0514, Station Blackout Study for the Hope Creek Generating Station in Support of the NUMARC 87-00, Rev. 2
GE SIL No. 448, Maintenance and Lubricants for GE Type AK/AKR Circuit Breakers, Rev. 2
Motor Operated Valve Data Sheets, PSBP 315445 (049&050) for 1BCHV-F024A&B, Rev. 1
Safety Evaluation No. H-1-BCXX-ESE-0437, De-Termination of RHR Testable Check Bypass Valve Operation Solenoids, dated 7/16/86
Safety Evaluation No. H-1-BCXX-MSE-0687-0, Evaluation of NRC Information Notice 87-10, dated 8/6/87
Specification 10855-E-151, Technical Specification for the Battery Chargers for the Hope Creek Generating Station, Rev. 6
Simulator Action Request H-1996-298, Installation of DCP-4EC-3411, dated 8/20/96
Training Lesson 0301-000.00H-000069-13, DC Electrical Distribution, April 8, 1998
GE SIL No. 463, Process Instrument Noise, Rev. 1
Equipment Evaluation Summary Sheet EQH-069-001-EESS, Main Steam SRV Actuator, Rev. 3
Equipment Evaluation Summary Sheet J603-SV-001-EESS, Valcor Solenoid Valves, Rev. 12
Equipment Evaluation Summary Sheet M001-MTR-015, ECCS Motors, Rev. 3
Equipment Evaluation Summary Sheet P301-HV-004-EESS, Limitorque AC Motor Operator, Rev. 9
Equipment Evaluation Summary Sheet P301-HV-005-EESS, Limitorque DC Valve Actuator, Rev. 5
Equipment Evaluation Summary Sheet P302-HV-003-EESS, Limitorque AC Motor Operator, Rev. 8
Equipment Evaluation Summary Sheet P302-HV-004-EESS, Limitorque DC Valve Actuator, Rev. 6
Equipment Evaluation Summary Sheet P303A-HV-002-EESS, Limitorque DC Valve Actuator, Rev. 5
Equipment Evaluation Summary Sheet P303A-SV-004-EESS, Asco Solenoid Valve, Rev. 10
Analysis Report HC.FC*.ABR.11, RCIC Turbine and Governor Valve Mechanical EQ Tasks
Memorandum SCI-94-0776 from A. Blum to J. Nichols, Ref. RCM Analysis HC.FC*.ABR.11

<u>Notifications</u>

20011776	20142336	20193916	20193794	20195844
20012025	20143973	20190355	20196939	20196628*
20085623		20191220	20196961*	20196649*
20127956	20151876	20192736	20145033	20197067*
20130308	20161829	20192929	20194674	20197000*
20130865	20169830	20192948	20194676	20197078*
20132105	20181611	20193016	20194767	20197088*
20134556	20183752	20193014	20194919	20197496*
20134647	20184358	20193031	20195403	20198162*
20139736	20187753	20193176	20195507	20198399*
20141739	20187886	20193463	20195820	20198555*

20198558*	20028992	20197106*	20196782*	20196984*
20024029	80038583	20196878*	20196939*	
20026890				

(Note " * " = Generated as result of this inspection)

LIST OF ACRONYMS

CST Condensate Storage Tank
CRFA Condition Report Follow-Up Assessment
CROD Condition Report Operability Determination
EOP Emergency Operating Procedure
I&C Instrumentation and Control
LPCI Low Pressure Coolant Injection
HPCI High Pressure Coolant Injection
PSEG Public Service Electric & Gas
RCIC Reactor Core Isolation Cooling
RHR Residual Heat Removal
SIL Service Information Letter
SP Suppression Pool
SPC Suppression Pool Cooling
SRV Safety Relief Valves
UFSAR Updated Final Safety Analysis Report
VDC Voltage Direct Current