NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Hope Creek Generating Station	05000354	1 OF 12

TITLE (4)

Condition Alone That Could Have Prevented the Removal of Residual Heat - Safety Auxiliaries Cooling System (SACS) Deficiencies.

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
8	16	96	96	-- 022 --	02	01	31	97		05000
									FACILITY NAME	DOCKET NUMBER
										05000

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)			
POWER LEVEL (10)	100	20.2201(b)	20.2203(a)(2)(v)	50.73(a)(2)(i)(B)	50.73(a)(2)(viii)
		20.2203(a)(1)	20.2203(a)(3)(i)	X 50.73(a)(2)(ii)	50.73(a)(2)(x)
		20.2203(a)(2)(i)	20.2203(a)(3)(ii)	50.73(a)(2)(iii)	73.71
		20.2203(a)(2)(ii)	20.2203(a)(4)	50.73(a)(2)(iv)	OTHER
		20.2203(a)(2)(iii)	50.36(c)(1)	X 50.73(a)(2)(v)	Specify in Abstract below or in NRC Form 366A
		20.2203(a)(2)(iv)	50.36(c)(2)	50.73(a)(2)(vii)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
James Priest, Lead Engineer - Licensing and Regulation	(609) 339-5434

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
	YES (If yes, complete EXPECTED SUBMISSION DATE).	X NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On 8/16/96, Engineering identified that the existing plant configuration may not support actions permitted by the Safety Auxiliaries Cooling System (SACS) Technical Specifications and a four hour report was made in accordance with 10CFR50.72(b)(2)(iii). On 8/22/96, as part of a continuing review of this issue, additional concerns relative to the bases for the allowable out-of-service times (AOTs) for service water (SSWS), the SACS, and the "C" and "D" diesel generators (EDGs) were identified, and an additional four hour report was made in accordance with 10CFR50.72(b)(2)(iii). On 10/25/96, as a result of investigation into the SACS/SSWS/EDG AOT issues, it was 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 that loop could trip as a result of a protective feature. In accordance with 10CFR50.72(b)(1)(ii), a one hour report was made concerning this issue. These events were the result of inadequate reviews of the SSWS and SACS design bases during various activities (i.e., procedure revisions and license change request development). Compensatory administrative controls and plant modifications have been made to ensure the operability of the SACS, SSWS and EDGs under all postulated scenarios.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Hope Creek Generating Station	05000354	96	-- 022 --	02	2 OF 12

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

PLANT AND SYSTEM IDENTIFICATION

General Electric - Boiling Water Reactor (BWR/4)
Safety Auxiliaries Cooling System - EIIS Identifier {CC}
Station Service Water System - EIIS Identifier {BI}
Emergency Diesel Generators - EIIS Identifier {EK}

IDENTIFICATION OF OCCURRENCE

Discovery dates: 08/09/96, 08/16/96, 08/22/96 and 10/25/96
Dates determined to be reportable: 08/16/96, 08/16/96, 08/22/96 and 10/25/96
Problem Reports 960808084, 960808104, 960822213, 960823098, 961001148 and 961025213

CONDITIONS PRIOR TO OCCURRENCE

Plant was in OPERATIONAL CONDITION 1 (POWER OPERATION) at 100% of rated thermal power.

DESCRIPTION OF OCCURRENCE

Description of Systems

The Safety Auxiliaries Cooling System (SACS) is a redundant closed loop cooling water system consisting of two pumps and two heat exchangers per loop that provides cooling to safety related equipment required for shutdown of the reactor during design basis events. The Station Service Water System (SSWS) is also a two loop system consisting of two pumps and two SSWS/SACS heat exchangers per loop and transfers the heat loads from the SACS heat exchangers to the Ultimate Heat Sink (UHS).

SACS Operability With Cross-Connected Loads

On 8/16/96, as part of an ongoing Engineering Assurance Configuration Baseline Document (CBD) review of the SACS design and licensing basis (initiated as a corrective action for an event described in LER 95-037-00), Engineering personnel identified that the existing plant configuration may not support actions permitted by the Technical Specifications (TS). Specifically, Action a.2 of TS 3.7.1.1 specifies the realigning of at least one affected emergency diesel generator (EDG) to the operable SACS subsystem if one of the two SACS subsystems is inoperable. Existing procedures have also allowed the transfer of additional loads cooled by the SACS. Engineering concluded that, for postulated accident conditions, the SACS may

DESCRIPTION OF OCCURRENCE (Continued)

be incapable of supporting the required component heat loads in the realigned configuration. In accordance with the requirements of 10CFR50.72(b)(2)(iii), a four hour report was made concerning this issue.

SACS deficiencies described above are related to initial plant pre-operational testing of the SACS that was inconsistent with the SACS design basis. Other contributing factors were a SACS pump in service testing (IST) limit that did not properly account for instrument inaccuracies and lack of consideration of the effects of loss of instrument air (LIA) on the system configuration. With respect to the startup testing, the system was flow balanced with only the EDG coolers and EDG room coolers realigned and without consideration for the potential LIA or pump degradation. Testing in this manner did not ensure that the flow distribution throughout the SACS was adequate to support the realignment of loads from the redundant SACS loop (i.e., the Emergency Core Cooling System (ECCS) room coolers, and the Filtration Recirculation and Ventilation System (FRVS) units).

As a result of these concerns, administrative controls were established to ensure that the EDGs, ECCS, FRVS and other SACS loads would not be realigned until the SACS was determined to be capable of supporting these cross connected loads. At the time of discovery of this issue, the system was not in a cross-connected configuration; and therefore, there was no existing operability issue. Administrative controls, based on engineering analysis, have been subsequently revised to permit realignment of specific equipment if one loop of SACS becomes inoperable. Engineering analysis concluded that these actions are within the heat removal capability of the operable SACS loop, provided compensatory actions were implemented prior to realignment.

SSWS/SACS/EDG Allowable Out-of-Service Times

On 8/22/96, as part of Engineering's continuing review, potential concerns relative to the bases for the allowable out-of-service times (AOTs) for the SSWS, the SACS and the "C" and "D" EDGs were identified. These AOTs were approved in Amendment 75 to the TS and were based upon engineering evaluations of the heat removal capability of the SSWS and the SACS in post LOCA/LOP scenarios. These evaluations demonstrated that adequate heat removal could be provided by either two SSWS/SACS pumps in one loop or with one SSWS/SACS pump in each independent loop. Justification for the extended AOTs for SSWS, SACS, and the "C" and "D" EDGs were based, in part, on the ability to accommodate up to two active failures (beyond design basis) in the SSWS or SACS systems.

DESCRIPTION OF OCCURRENCE (Continued)

Specifically, Engineering identified the following potential concerns with the evaluation used to support Amendment 75: 1) operating procedures may not ensure that flow paths and flow rates are consistent with assumptions; 2) recent adjustments to SSWS/SACS heat exchanger throttle valves may affect SSWS pump run out if the system is in the specific configuration identified in the evaluation (i.e., one pump per loop) (See LER 354/96-09-00); 3) the engineering evaluation assumed flow through the discharge to the cooling tower rather than the more conservative overboard discharge path (See LER 354/96-015-00); and 4) the potential for SACS pump run out was not considered for cross-connected loads and LIA. As a result of this issue, on 8/22/96, a four hour report was made in accordance with 10CFR50.72(b)(2)(iii).

Opening of RHR Heat Exchanger Valves

On 10/25/96, as part of the continuing investigation into the SACS/SSWS issues, station personnel concluded that plant procedures have permitted the plant to operate in a configuration where SACS may not be available to support mitigation of the consequences of an accident. Specifically, when the plant was operated in a configuration where the RHR heat exchanger valve was open on the standby SACS loop (as directed by plant procedures), that SACS loop could not sustain a pump failure and perform its design function. If a SACS pump failure were to occur in the standby SACS loop, the remaining pump could trip due to a pump protective feature (i.e., high flow pump trip), leaving the SACS supported loads in that loop (i.e., EDGs and ECCS room coolers) with no cooling flow. When this information was provided to the operating shift, immediate actions were taken to close the aforementioned RHR heat exchanger SACS supply valve and administrative controls were implemented to maintain SACS operation within its design basis. In accordance with 10CFR50.72(b)(1)(ii), a one hour report was made for this issue.

ANALYSIS OF OCCURRENCE

The following provides information from the investigation of the above events.

SACS Operability With Cross-Connected Loads

The concern with cross-connecting SACS loads is the result of deficiencies within the original design and construction documents. While it was recognized in the original system specification that cross-connecting loads would be required, original system calculations did not account for all potential cross-connected loads. In addition, the calculations did not

ANALYSIS OF OCCURRENCE (Continued)

account for loads resulting from LIA. As a result of the errors in the original calculations, the startup test procedure failed to provide verification of system capability with the allowed cross-connected loads or LIA. The startup test also failed to provide verification of system capability with pump degradation. Finally, the SACS pump IST limits did not include instrument inaccuracies. These errors were carried through various procedure revisions since plant startup. In addition, subsequent procedure revisions have allowed cross-connecting of additional loads beyond those specified in the design documents (e.g., fuel pool heat exchangers, PCIG compressor coolers).

Since the potential to operate in a condition alone that could have prevented the fulfillment of a safety function needed to remove residual heat had existed, this LER is being transmitted in accordance with the requirements of 50.73(a)(2)(v).

SSWS/SACS/EDG Allowable Out-of-Service Times

On July 27, 1994, a license amendment application to extend AOTs for SSWS/SACS/EDGs was submitted to the NRC for approval. The request was based on engineering analyses completed on June 27, 1994 and July 1, 1994. These evaluations included specific conditions that needed to be established to assure successful completion of system safety functions. However, the operator actions credited in the engineering evaluation were not fully established in procedures.

The engineering evaluation did not assume worst case conditions for the one pump per loop configuration and did not account for the overboard discharge path of SSWS (See LER 354/96-15-00 for details on the overboard discharge issue). When the SSWS/SACS throttle valves were re-positioned to an appropriate setting in March 1996 (See LER 354/96-009-00), the impact on the evaluation supporting Amendment 75 was not included in the calculation of the new valve positions. The potential to run out the SSWS pumps as a result of the proper settings was not adequately considered. When the re-positioning of the valves was subsequently evaluated relative to the Amendment 75 evaluation, implementation of an administrative limit on the river water level became necessary.

The calculation errors and procedure inadequacies resulted in a condition alone that could have prevented the fulfillment of the safety functions needed to remove residual heat. This LER is therefore being transmitted in accordance with the requirements of 50.73(a)(2)(v).

ANALYSIS OF OCCURRENCE (Continued)

Opening of RHR Heat Exchanger Valves

In 1987, Revision 4 to the SACS operating procedure, HC.OP-SO.EG-0001(Q) was approved. This revision directed the RHR heat exchanger to be placed in service on the standby SACS loop (the loop not supporting the Turbine Auxiliaries Cooling System) during normal operation. This procedure change was made to provide a minimum flow path for the SACS pump that is kept running in the standby loop. Although the UFSAR depicts both RHR heat exchanger valves as normally closed, the review for this procedure revision did not adequately recognize the change being made to the facility and an appropriate 10CFR50.59 safety evaluation was not performed to support this procedure revision.

The original SACS design (as described in the UFSAR) required that two SACS loops with at least one pump in each loop each be operable in the first ten minutes of a design basis accident (DBA) (the Emergency Core Cooling System injection phase). Calculation EG-20 and the SACS Design, Installation and Test Specifications assumed that the RHR heat exchanger valves are normally closed. However, EG-20 did note that one valve may be open under abnormal or testing conditions while at power (i.e., utilizing suppression pool cooling while at power). However, no impact on SACS operability was noted in EG-20 for these conditions, and as a result, no restrictions were placed on operation in this manner within the Technical Specifications or were described in the UFSAR.

Additionally, the original SACS design calculations apparently did not consider the effects of a DBA when RHR is transitioned to the shutdown cooling mode. Specifically, plant procedures require shutdown cooling to be placed in service during HOT SHUTDOWN; however, if a LOCA is postulated during this configuration, one loop of SACS could be lost with a single SACS pump failure. Therefore, whenever the RHR heat exchanger valve was placed in the open position and average reactor coolant temperature was greater than 200 degrees F, a potential existed for the associated SACS loop (required to mitigate the consequences of a DBA) to become inoperable following a single failure.

This issue has been determined to be reportable under the provisions of 10CFR50.73(a)(2)(ii).

APPARENT CAUSE OF OCCURRENCE

The following are the causes for the identified issues:

SACS Operability With Cross-Connected Loads

The plant configuration could not support the actions allowed by the TS and the operating procedures relative to realigning loads from an inoperable loop to the operable loop because the startup testing did not properly flow balance the SACS system. In addition, subsequent procedure changes were made that allowed additional cross-connected loads. These changes were made without adequate review. Finally, the SACS pump IST limits did not consider instrument inaccuracies.

The cause of the inadequate flow balance was a lack of a thorough design and test procedure review. This was the result of a lack of design/licensing basis knowledge by the preparers and reviewers of the design calculation and the startup test procedure.

The cause of the procedure changes that allowed additional cross-connected loads was a poorly performed review of the procedure change as a result of a lack of safety awareness, reliance on past operating experience, and a lack of adequate interface between Operations and Engineering.

The cause of the failure to account for instrument inaccuracies was that the IST program did not require it. In addition, the preparer and reviewers of the calculation which established the IST limits did not recognize a need to account for inaccuracies.

All of the above errors occurred in the mid-1980s during the process of initial pre-operational system testing.

SSWS/SACS/EDG Allowable Out-of-Service Times

The concerns relative to the basis for the extended SSWS/SACS/EDG AOTs were the result of failure to track and follow-up on actions necessary to assure consistency with the engineering evaluation that supported Amendment 75 as well as a failure to evaluate the impact of subsequent issues on the Amendment 75 engineering evaluation.

The causes of the failure to track and follow-up on actions were: 1) inattention to detail and inadequate communication on the part of involved personnel; and 2) weaknesses in the process for developing a license change request (LCR) and implementing the associated amendment.

APPARENT CAUSE OF OCCURRENCE (Continued)

The causes of the failure to evaluate the impact of subsequent issues on the Amendment 75 engineering evaluation were inattention to detail and lack of a questioning attitude on the part of the preparer and reviewer of the revised calculations that implemented the re-positioning of the throttle valves.

Opening of RHR Heat Exchanger Valves

The apparent cause of the deficient SACS operating procedure was attributed to an inadequate review of the design and licensing basis of the SACS when developing the procedure change. A contributing factor was the inadequate original design basis information concerning SACS operability when the RHR heat exchanger valve is in service to support testing, abnormal operation or a normal shutdown.

ASSESSMENT OF SAFETY CONSEQUENCES

SACS Operability With Cross-Connected Loads and SSWS/SACS/EDG Allowable Out-of-Service Times

There were no actual safety consequences associated with these issues. However, if a LOP/LOCA were to occur coincident with worst case design basis conditions, SSWS/SACS performance would be degraded such that SACS and/or the suppression chamber operational limits would have been exceeded and the time to reach cold shutdown conditions would have been increased. The probability of this is low since it would require that the following exist concurrently: 1) a LOP/LOCA, 2) high river water temperature, 3) low river water level, and 4) worst case IST inaccuracies.

Opening of RHR Heat Exchanger Valves

There were no actual safety consequences associated with this event. The potential safety consequences, assuming a LOCA/LOP occurred coincident with a single active failure of a SACS pump in the standby loop when the RHR valve is open, are described in the following paragraph.

Operation in this configuration would result in having only one SACS loop available, leaving two EDGs to power the ECCS injection pumps and FRVS (which is sufficient for long term DBA mitigation). However, for the first ten minutes of the DBA, the design and licensing bases credit three EDGs

ASSESSMENT OF SAFETY CONSEQUENCES (Continued)

(as a result of applying single failure criteria) to meet the short-term requirements of both ECCS and FRVS during the ECCS injection phase. In evaluating the safety significance of this issue, PSE&G has qualitatively assessed the results of previously performed General Electric analyses (Sensitivity Studies for SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis for Hope Creek Generating Station, dated February, 1992, and Hope Creek Generating Station SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis, dated August, 1993) of DBA scenarios with reduced ECCS flow rates.

Although this event did result in a reduction of a margin of safety for Hope Creek, the potential for fuel damage was minimal in that fuel design limits would not have been approached. However, in this scenario, only 75%, or three out of a postulated four, of the FRVS units will be available to recirculate the Reactor Building air for the first ten minutes following a LOCA signal. This would result in a degradation in the cooling provided by FRVS to limit the expansion and temperature of the Reactor Building air following a LOCA and impact secondary containment operability.

PREVIOUS OCCURRENCES

A review of the LERs for the past two years indicated that LERs 95-037, 96-009 and 96-015 represent prior similar occurrences. These LERs document events where SACS was operated outside of its design basis. These events involved a discrepancy between calculated system parameters and actual system conditions. The events described in this LER were identified during a pre-planned review of the SACS design and licensing basis and are the result of corrective actions described in LER 95-037.

CORRECTIVE ACTIONS

Due to the current Engineering work scope, several of the corrective action due dates have been revised to reflect the current schedule for completion.

SACS Operability With Cross-Connected Loads

1. Upon confirmation of the startup test concerns, administrative controls were established to ensure that the plant was maintained within its design and licensing basis. Administrative controls will remain in effect until final resolution of these issues to ensure the continued operability of the SACS, SSWS and SACS supported equipment.

CORRECTIVE ACTIONS (Continued)

2. The applicable design calculations will be revised to account for cross-connected loads and to account for LIA. This will be completed by May 31, 1997.

3. SACS will be flow balanced, accounting for all possible cross-connected loads, LIA, and other acceptance criteria. This will be completed by December 16, 1997.

4. Engineering support personnel (ESP) received general training on the design and licensing basis. This training included management's expectations regarding maintenance of the design and licensing basis, techniques for improving a questioning attitude, and the need for fully recognizing and understanding a problem in order to correctly analyze it.

5. The technical standard for system flow balancing has been revised to include guidance on adding margin to system flow to allow for degraded conditions.

6. As described in LER 354/95-037-00, an Engineering Assurance CBD review of selected systems is ongoing. These reviews will verify that operating procedure steps are consistent with the design basis.

7. A decision will be made relative to the need for and method of accounting for instrument inaccuracies for pumps in the IST program. This will be completed by June 30, 1997.

8. A 10CFR50.59 reviewer personnel qualification program has been implemented. This program includes required initial and periodic refresher training and will ensure a minimum level of training and qualification for preparers, peer reviewers and approvers of 10CFR50.59 applicability reviews and safety evaluations.

SSWS/SACS/EDG Allowable Out-of-Service Times

1. Procedures have been revised to provide more specific guidance on maintaining SACS operability during post LOCA/LOP scenarios.

CORRECTIVE ACTIONS (Continued)

2. The engineering evaluation is in the process of being reviewed and, if required, will be revised to incorporate worst case design assumptions. This will be completed by May 31, 1997.

3. Engineering has evaluated the issue of SSWS pump run out in the one pump to two heat exchanger configuration with the existing throttle valve positions. The evaluation resulted in establishing an administrative limit on river water level upon which actions including shutdown must occur. The engineering evaluation supporting Amendment 75 will be revised to include the new data by May 31, 1997.

4. Engineering will determine the appropriate action (e.g., submit an LCR, implement a modification) to resolve the river water administrative limit by May 31, 1997.

5. The Probabalistic Safety Assessment (PSA) group will review the current SACS/SSWS PSA model to determine if any modification is needed. This will be completed by July 30, 1997.

6. The process for submitting a LCR and implementing the associated amendment has been revised to require specific accountabilities for tracking, reviewing, and implementing amendments.

7. The responsibilities of the initiators of engineering evaluations and calculations as defined in procedures will be stressed by engineering management during roll outs. This will be completed by March 30, 1997.

8. A heightened awareness of the design and licensing basis has been created at PSE&G through ESP training. ESP training is mandatory for engineering personnel. The 10CFR50.59 training also includes discussion of the design and licensing basis.

9. In response to the NRC's October 9, 1996 request for information regarding the adequacy and availability of design basis information, PSE&G will provide added confidence and assurance that Hope Creek is operated and maintained within the design bases and that any deviations are reconciled in a timely manner. This will be completed by March 8, 1997.

CORRECTIVE ACTIONS (Continued)

10. Investigation of personnel performance and delivery of appropriate corrective measures has been completed.

Opening of RHR Heat Exchanger Valves

1. As an initial corrective action, the SACS operating procedure was revised to state that the RHR heat exchanger valve must be maintained closed to ensure SACS operability.

2. New vendor test data on SACS pump capabilities indicated greater runout capacity than was previously assumed. Based on this data, a modification was implemented to lower the differential pressure setpoint trip for the SACS pumps, allowing greater flow from one pump. This change enabled one SACS pump in that loop to supply SACS loads including the RHR heat exchanger flow under post DBA conditions and enabled the RHR heat exchanger valves to be opened during normal plant operation. Resolution of the SACS operating configuration with the design and licensing basis has not yet been adequately dispositioned, but will be completed by March 31, 1997.

3. A heightened awareness of the design and licensing basis has been created at PSE&G through ESP training. ESP training is mandatory for engineering personnel. The 10CFR50.59 training also includes discussion of the design and licensing basis.

4. A 10CFR50.59 qualification program has been implemented. This program includes required initial and periodic refresher training and will ensure a minimum level of training and qualification for preparers, peer reviewers and approvers of 10CFR50.59 applicability reviews and safety evaluations.