

NUCLEAR SAFETY EVALUATION  
Reference NOD-QP-3

ID No. CID 920473/02  
(from 9.1)

SECTION A

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10 CFR 50.59 Applicability Screening

9.1 Activity Identification

Procedure Change No. NA affecting Procedure NA

Modification Request No. NA Design  Installation [ ] Testing [ ]

Temporary Modification No. NA Engineering Change Notice No. NA

Other CID 920473/02

Document Title: Insufficient Containment Spray ~~Net~~ Pump Net Positive Suction Head.

Nuclear Safety Evaluation Conclusion

[ ] This activity is not a 10 CFR 50.59 activity, because it:

- Does not change the facility as described in the USAR.
- Does not change procedures as described in the USAR.
- Does not involve conducting tests or experiments not described in the USAR.
- Does not affect Nuclear Safety in a way not previously evaluated in USAR.

This activity is being done pursuant to 10 CFR 50.59.

This safety evaluation must be reviewed by SARC; ref Tech. Spec. 5.5.2.7.  
This activity must be reported in the annual report; ref 10 CFR 50.59, Item b, Paragraph 2.

[ ] This activity involves an Unreviewed Safety Question. The activity must be canceled, or revised and re-evaluated, or NRC authorization is required prior to implementation; ref 10 CFR 50.59, Item c.

We hereby certify that this Nuclear Safety Evaluation is complete and accurate to the best of our knowledge.

Prepared by Gary D. Ruhl <sup>JON RESSLER 8-3-92 1345</sup>  
Date 6/12/92 Time 1615  
Print Name

Gary D. Ruhl <sup>JDR 2426</sup>  
Signature Extension 2441

Reviewed by B. J. VAN SANTI <sup>BJV 8-3-92 15:45</sup>  
Date 6/15/92 Time 10:30  
Print Name

B. J. Van Sant  
Signature Extension 2437

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9.2 What (specifically) is being done?

USAR Section 6 is being updated to revise the Net Positive Suction Head (NPSH) calculations for the recirculation mode in accordance with recent revision to the plant design basis to reflect as-built conditions. This includes crediting the available NPSH with sump subcooling head where previously this credit was not allowed.

9.3 Why is this being done (briefly)?

LER 92-016 includes corrective action to update the USAR based on as-built hydraulic analysis results which indicate that available NPSH calculations for the recirculation mode of containment spray (CS) require crediting sump subcooling head to meet the pump required NPSH.

9.4 Does the activity involve a change to the Technical Specifications?

NO - This activity meets the requirements of current Technical Specifications. The following sections were reviewed: 2.3,  
2.4

Continue with 9.5

YES - Technical Specification Section \_\_\_\_\_ must be revised prior to performing this activity.

Exit this procedure and continue with NOD-QP-7.

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9.5 Does the activity involve a change in the facility?

NO - Go to 9.6

YES - Is this aspect of the facility described in the USAR?

List USAR Sections reviewed: \_\_\_\_\_

NO - Go to 9.6

YES - list USAR Sections \_\_\_\_\_

Does the USAR description require any changes or revisions due to this activity?

NO - continue with 9.6

YES - 10 CFR 50.59 applies to this activity

Section B of the Nuclear Safety Evaluation must also be completed.

Continue with 9.6

9.6 Does the activity involve changes to procedures?

NO - Go to 9.7

YES - Are related procedures (including definitions or descriptions of activities or controls over functions) outlined, summarized, completely described, or implied in the USAR?

List USAR Sections reviewed: \_\_\_\_\_

NO - Go to 9.7

YES - list USAR Sections \_\_\_\_\_

Does the USAR description require any changes or revisions due to this activity?

NO - Continue with 9.7

YES - 10 CFR 50.59 applies to this activity

Section B of the Nuclear Safety Evaluation must also be completed

Continue with 9.7

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9.7 Does the activity involve tests or experiments?

NO - Go to 9.8

YES - Is the test/experiment one which has been previously anticipated in the USAR?

YES list USAR Sections \_\_\_\_\_  
\_\_\_\_\_

Go to 9.8

NO - (i.e., it is not described in the USAR; including one-of-a-kind tests or new system configurations)

Could this test/experiment degrade the margins of safety during normal operations or anticipated transients, or could it degrade the adequacy of structures, systems or components to prevent accidents or mitigate accident conditions?

NO - \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- Continue with 9.8

YES - 10 CFR 50.59 applies to this activity  
Section B of the Nuclear Safety Evaluation must also be completed.

Continue with 9.8

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9.8 Could the activity adversely affect nuclear safety?

NO - Explain \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- Go to Nuclear Safety Evaluation Conclusion or continue with Section B of the Nuclear Safety Evaluation, if required.

YES - How Revision to the USAR NPSH calculations could result in a design basis such that the associated CS pumps do not have adequate available NPSH. With insufficient NPSH available, the pumps could cavitate and fail prematurely to deliver required flow. Worst case failure would be loss of CS post RAS which could impact the containment peak pressure.

Has this effect been previously evaluated in the USAR?

YES - discussed in USAR Section \_\_\_\_\_

- Continue with Nuclear Safety Evaluation Conclusion

NO - 10 CFR 50.59 applies to this activity

Continue with Section B of the Nuclear Safety Evaluation

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SECTION B

Unreviewed Safety Question Determination

10.1.1 Identify Plant Specific Design, Operating and Technical Documents		
<u>Document Title</u>	<u>ID Number</u>	<u>Revision</u>
<u>Containment Spray DBD</u>	<u>SDBD-CS-131</u>	<u>R3</u>
<u>USAR Volume 3</u>	<u>Section 6</u>	<u>R5</u>
<u>Technical Specifications</u>	<u>Section 2.4</u>	
<u>Eval. of CS Pump NPSH Accounting for Sump Subcooling</u>	<u>ADD-CE calc. 0-MECH-CALC-021</u>	<u>RD</u>
10.1.2 Identify Applicable NRC Documents/Industry Standards		
<u>Title</u>	<u>ID Number</u>	<u>Revision</u>
<u>AEC Safety Guide</u>	<u>1. <del>5</del> <sup>6</sup> <sub>2</sub> 6/15/92</u>	<u>0</u>
10.1.3 Identify Related Drawings		
<u>Title</u>	<u>ID Number</u>	<u>Revision</u>
<u>SI + CS P4ID</u>	<u>E23866-210-130</u>	<u>55</u>
<u>SI-3A,B,C, Pump Curves</u>	<u>Cartridge 93 Frame</u>	<u>D368</u>
10.2 List safety functions the affected structures or components perform: <u>The CS pumps cool containment post LOCA to ensure pressure in containment does not exceed 60 psi by supplying water from the STRWT and post RAS from the containment sump.</u>		
List applicable accidents for which these safety functions are required: <u>LOCA</u>		

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10.3 System Interactions Analyses			
<u>Criteria</u>	<u>Applicable</u>	<u>Criteria</u>	<u>Applicable</u>
Fire Protection	[ ]	Structural Impact	[ ]
Electrical Equipment Qualifications	[ ]	Separation Criteria	[ ]
High Energy Line Break Review	[ ]	Single Failure Criteria	[ ]
Seismic Interaction and Qualification	[ ]	Possibility of Operator Error	[ ]
Electrical Systems Analysis	[ ]	Heavy Loads	[ ]
Human Factors Review	[ ]	Impact on HVAC	[ ]
Security Review	[ ]	System/Component Performance	<input checked="" type="checkbox"/>
Environmental Radiological Release	[ ]	Natural Phenomena	[ ]
Materials Compatibility	[ ]	Installation of Temporary Modifications	[ ]
Containment Integrity	<input checked="" type="checkbox"/>	Testing of Temporary Modifications	[ ]
Control Room Habitability	[ ]	Other: _____	[ ]
Missile Protection	[ ]		

Discussion of Applicable Systems Interactions Analyses

(Include Attachment Sheet as needed) *No physical or operational changes are involved with the proposed activity of crediting sump subcooling in the recirculation mode NPSH available calculations. Adequate NPSH is available under the new design basis which credits only 25% of the available sump subcooling head. System/component performance<sup>B-2</sup> is not effected. No other systems interactions apply.*

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10.4 Could the proposed activity increase the probability of occurrence of an accident previously evaluated in the USAR? YES [ ]  
NO

Explain: No changes are being made to the existing design or operation of equipment which could increase the probability of occurrence of an accident.

10.5 Could the proposed activity increase the consequences of an accident previously evaluated in the USAR? YES [ ]  
NO

Explain: The revision to the design basis available NPSH for the CS pumps in recirculation mode does not alter the consequences of an accident since adequate NPSH is shown to be available. System interactions are discussed in SAO 92-02.

10.6 Could the proposed activity increase the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the USAR? YES [ ]  
NO  (see attached sheet 11 of SAO 92-02) 8/15/92 15:45

Explain: Operation of the plant is not being revised. The design basis revision indicates that adequate NPSH is available for proper CS pump operation and, therefore, the probability of occurrence of a malfunction of equipment important to safety is not increased.

10.7 Could the proposed activity increase the consequences of a malfunction of equipment important to safety previously evaluated in the USAR? YES [ ]  
NO

Explain: The consequences of a malfunction of equipment important to safety is not effected. The CS pumps will function as designed to supply >2000 GPM spray post-RAS since adequate NPSH is shown to be available, for all modes of system operation

based on containment transient <sup>B-3</sup> analysis results.



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10.8 Could the proposed activity create the possibility of an accident of a different type than any previously evaluated in the USAR? YES [ ]  
NO

Explain: The CS pumps will perform their safety related function as evaluated in the USAR. No plant physical or operational changes will be made and therefore the possibility of an accident of a different type is not created.

10.9 Could the proposed activity create the possibility of a malfunction of equipment important to safety of a different type than any previously evaluated in the USAR? YES [ ]  
NO

Explain: Malfunction of the CS pumps due to inadequate NPSH is not evaluated in the USAR. The design basis revision indicates that adequate NPSH is available with credit of subcooling head based on containment transient analysis data. Therefore, the possibility of a malfunction of equipment important to safety of a different type could not be created.

10.10 Does the proposed activity reduce the margin of safety as defined in the basis for any Technical Specification? YES [ ]  
NO

Explain: The USAR Section 6.2-1 and AEC Safety Guide I do not define subcooling as the basis of a Margin of Safety. The Safety Guide is a suggested methodology for calculating NPSH available. The original USAR analysis follows this methodology; however, it is acceptable to calculate NPSH available by other methods. The Technical Specification requirements for the pumps deal with operability and do not

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address a margin of safety for the available NPSH. Since adequate NPSH is available, the operability and thus margin of safety is not reduced.

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10.11 Summarize USAR changes which are needed or attach marked-up copy of affected pages: \_\_\_\_\_

See attached marked-up pages.

10.12 Annual report of 10 CFR 50.59 changes, tests and experiments. Provide a brief description of the activity: \_\_\_\_\_

This activity involves revising the design basis calculation of available NPSH for the SE pumps in recirculation mode.

This includes update of the USAR to reflect the new design basis to include sump subcooling head credit for the available NPSH.

Summarize the safety evaluation: This activity is being done pursuant to 10CFR 50.59 but does not degrade Nuclear Safety because the available NPSH is not a margin of safety for the Technical Specifications and the physical and operational aspects of the systems are not effected.

- Go to the Nuclear Safety Evaluation Conclusion

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ATTACHMENT SHEET

9.8

No physical deficiencies are present as a result of not meeting the requirements of the current licensing basis to use AEC criteria Safety Guide 1.1 for calculating pump NPSH. While normal engineering practice allows for subcooling in calculating the NPSHa, the AEC criteria conservatively directed that this not be credited to build in an inherent safety margin and eliminate the possibility of a inadequate suction head.

Based on the available NPSH from subcooling it is apparent that in the event of a LOCA a significant margin for NPSHa exists by the use of actual sump temperatures (Ref. C-E letter O-MPS-91-120 dated 8/23/91). The pumps are currently lacking less than three feet of static head and have available more than 20 feet of head from subcooling (Based on EA-FC-90-94).

**SAFETY GUIDE 1**

**NET POSITIVE SUCTION HEAD FOR  
EMERGENCY CORE COOLING AND CONTAINMENT HEAT REMOVAL SYSTEM PUMPS**

**A. Introduction**

Proposed General Design Criterion 41 requires that the emergency cooling and containment heat removal systems be capable of accomplishing their required safety functions assuming partial loss of installed capacity. In current designs the ability to accomplish these safety functions reliably depends in part on the proper performance of system pumps which, in turn, depends on the conditions under which the pumps must operate. One of these conditions is suction pressure. This guide describes a suitable relationship between increases in containment pressure caused by postulated loss of coolant accidents and the net positive suction head (NPSH) of emergency core cooling and containment heat removal system pumps which may be used to implement General Design Criterion 41.

**B. Discussion**

A significant consideration related to emergency core cooling and containment heat removal systems is the potential for degraded pump performance which could be caused by a number of factors, including inadequate NPSH. If the NPSH available to a pump is not sufficient, cavitation of the pumped fluid can occur. This cavitation may reduce significantly the capability of the system to accomplish its safety functions.

It is important that the proper performance of emergency core cooling and containment heat removal systems be independent of calculated increases in containment pressure caused by postulated loss of coolant accidents in order to assure reliable operation under a variety of

possible accident conditions. For example, if proper operation of the emergency core cooling system depends upon maintaining the containment pressure above a specified minimum amount, then too low an internal pressure (resulting from impaired containment integrity or operation of the containment heat removal systems at too high a rate) could significantly affect the ability of this system to accomplish its safety functions by causing pump cavitation. In addition, the deliberate continuation of a high containment pressure to maintain an adequate pump NPSH would result in greater leakage of fission products from the containment and higher potential offsite doses under accident conditions than would otherwise result.

Changes in NPSH for emergency core cooling and containment heat removal system pumps caused by increases in temperature of the pumped fluid under loss of coolant accident conditions can be accommodated without reliance on the calculated increase in containment pressure. Adequate NPSH can be assured by locating pumps at suitable elevations with respect to the storage volumes connected to their suction sides, by using multistage or booster pumps, by a combination of these methods, or by other techniques.

**C. Regulatory Position**

Emergency core cooling and containment heat removal systems should be designed so that adequate net positive suction head (NPSH) is provided to system pumps assuming maximum expected temperatures of pumped fluids and no increase in containment pressure from that present prior to postulated loss of coolant accidents.