GENE-E21-00143
Class III
Revision I

ECCS Suction Strainer
Hydraulic Sizing Report

March 31, 1998

Prepared for:

OYSTER CREEK NUCLEAR GENERATING STATION

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PROPRIETARY INFORMATION NOTICE

IMPORTANT NOTICE REGARDING

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Please read carefully

ABSTRACT

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1.0 Introduction

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1.1 *Background*

In the event of a Loss of Coolant Accident (LOCA) in a BWR Nuclear Power Plant, drywell insulation and debris can be transported into the suppression pool which provides a supply of water to the Emergency Core Cooling System (ECCS). This insulation, when combined with corrosion products and other debris, can migrate to and block strainers installed on suction lines supplying the ECCS pumps. In July 1992, an ECCS suction strainer became blocked with mineral wool insulation at the Barseback 2 plant in Sweden due to insulation dislodged by the discharge of a relief valve in the drywell. The displaced mineral wool insulation eventually migrated into the suppression pool and clogged the strainer, causing cavitation of the spray pumps (Ref. 8.2). In January 1993, during a scheduled outage at Perry Nuclear Power Plant, it was observed that an ECCS Residual Heat Removal Suction Strainer became clogged (Ref. 8.2). These events led the NRC to require BWR owners to indicate how they would guard against such events in the future.

1.2 BWR Owners' Group Responses

In response to the NRC's concern, the BWR Owners' Group, using GE as Project Manager, implemented a program to develop a long-term solution to the strainer blockage issue. The BWROG developed and tested alternate ECCS suction strainer designs as a possible means to mitigate the strainer clogging problem. The BWROG efforts led to generation of the Utility Resolution Guidance (URG) document for ECCS Suction Strainer Blockage (NEDO-32686).

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2.0 Summary and Conclusions

The GE strainer has several advantages over the standard disc strainer, such as increased surface area and lower hydraulic losses for a strainer of comparable size.

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The detail design calculations are contained in the Design Record File, Reference 8. 1. Reference 8.4 was also used for the hydraulic sizing calculations. The Oyster Creek strainer sizing input and output spreadsheets are included as Appendix B.

3.0 Design Inputs

3.1 Plant Specific Configuration

Prior to initial sizing calculations, the plant specific configuration must be set up. The majority of this information is supplied by the utility, with verification completed by GE. These inputs include the following:

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3.2 Single Failure Mode Criteria

Critical to the design of the strainer is the application of DBA and single failure criteria. By selecting an appropriate failure mode that best simulates the events occurring after a postulated LOCA event, the most limiting design conditions can be selected.

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3.3 Debris Loading

As discussed above, equally important to the design of the strainer is the application of the various debris loads that could be experienced during the LOCA. The BV,,RROG has developed the methodology for sizing new ECCS suction strainers. References 8.2 and 8.3 outline the basic methodology for designing GE optimum stacked disk strainers. Typical debris consists of:

- Fibrous Debris
- Corrosion Products
- Reflective Metal Insulation
- Dirt and Dust
- Paint Chips/Zinc Oxide
- Rust
- Sand
- Calcium Silicate
- Other debris

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4.0 Overview of Analysis Technique

4.1 Introduction

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6.0 Oyster Creek Sizing Results and Discussions.

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7.0 Conclusions

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8.0 REFERENCES

8.1 ***Proprietary Information Withheld***

8.2 Reference 2: NEDO-32686, "*Utility Resolution Guidance for ECCS Suction Strainer Blockage ", Volume I, prepared by the BWROG ECCS Suction Strainer Committee, Appendix A: Passive Strainer Head Loss Prediction with Fibrous Debris.*

8.3 Reference 3: NEDO-32686, "*Utility Resolution Guidancefor ECCS Suction Strainer Blockage ", Volume I, prepared by the BWROG ECCS Suction Strainer Committee, Appendix B: Calculation ofstrainer RMI Capacity.*

8.4 ***Proprietary Information Withheld***

8.5 ***Proprietary Information Withheld***

9.0 APPENDICES

9.1 ***Appendix A:** GE ECCS Suction Strainer Sizing Procedures*

***Appendix B**: ECCS Strainer design input and output*

GE ECCS Suction Strainer Sizing
Head Loss Calculation Methodology with fiber insulation

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Definition of the variables and the associated symbols

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Inputs for ECCS Suction Strainer Design

APPENDIX B

Plant: **OC**
Design/Load Case:
Calculation Date: *9/23/97*

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OC Appendix B

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Change to the Licensing Basis

Attachment IV

Answer to Questions 2 - 4

Question 2:

It was noted that the core spray flow docketed in response to Generic Letter 97-04 was 4250 gpm. However, in the Request for a Change to the Licensing Basis, the flow was identified to be 4350 gpm. Explain the difference.

Response 2:

The original calculation used to support the Generic Letter submittal did identify a core spray main pump flow of 4250 gpm, once a booster pump had been removed from service. At the time of the submittal, the calculation had been completed, but the design verification of the calculation was still in progress. Subsequent to the submittal, the design verification of the main pump flow was completed and revealed that the actual flow was 4350 gpm. As this new number was more conservative that the original submittal, no updated response to the Generic Letter was required. However, when the Request for a Change to the Licensing Basis was submitted, the correct, design verified, value of 4350 gpm was submitted.

Question 3:

Provide a detailed description of the bounding case, including the postulated worst case single failure.

Response 3:

The bounding case assumes a large break in a recirculation line below the lowest drywell grating. This maximizes both debris generation and transport to the suppression pool. The containment initial conditions are such that the containment pressure response to the accident is minimized and the suppression pool temperature response is maximized. The full capability of the core (main and booster pumps injecting) and containment spray systems are assumed to be in operation within the first minute of the accident. This maximizes strainer debris loading rates and suction piping system head loss. Consistent with operating procedures, one of the two containment spray pumps is used to reduce the drywell pressure, the other is used to cool the suppression pool. When the drywell pressure drops to 1.25 psig the system in drywell spray mode is aligned to cool the suppression pool.

At the ten-minute point in the accident one of the core spray booster pumps is manually removed from service to ensure adequate NPSH. At the one-hour point the remaining core spray booster pump is manually removed from service to ensure adequate NPSH. At this point credit is no longer taken for containment pressure of 1.25 psig in evaluating the NPSH margin.

When the design criteria for the new suction strainers were developed, a number of sensitivity studies were performed. These studies were intended to identify key issues associated with the head loss to the ECCS pumps. From these studies, it was concluded that the maximum strainer flow situations were bounding. As a result, the design basis scenario for the suction strainer was associated with maximum flow through the strainer (Case 8 in our August 3, 1998 submittal). It must be noted that this case does not result in the maximum suppression pool temperature, which historically had been used as the bounding case for net positive suction head assessments.

As the maximum flow condition provides the design basis for the suction strainer, the single failure associated with the scenario was not that associated with restricting flow to the core (i.e. diesel generator failure). A diesel generator failure does not result in maximum flow conditions. For the Oyster Creek Nuclear Generating Station, the most limiting core spray pump for suction head loss is the backup pump NZ01C. The NZ01C pump is the backup for pump for NZ01A. NZ01A is the primary pump in the loop, and if it starts, the NZ01C pump will not be run. Therefore, the worst postulated single failure assumed in the design of the suction strainers is the loss of core spray main pump NZ01A.

Question 4:

Provide the Net Positive Suction Head requirements for the Containment Spray pumps as a function of flow.

Response 4:

Containment Spray Pump Flow	Required NPSH[1]
3850 gpm	18 ft.
4200 gpm	21 ft

[1] Reference: Oyster Creek Final Safety Analysis Report; Figure 6.2-15.

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Change to the Licensing Basis

Attachment V

Question 5:

Provide the Calculations for Case 8 and Case 9