GE Nuclear Energy

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June 18, 1993

Docket No. STN 52-001

Chet Poslusny, Senior Project Manager
Standardization Project Directorate
Associate Directorate for Advanced Reactors
and License Renewal
Office of the Nuclear Reactor Regulation

Subject: Submittal Supporting Accelerated ABWR Schedule - **Suppression Pool Strainer (New Issue #42)**

Dear Chet:

Enclosed is a SSAR markup addressing the Suppression Pool Strainer Issue #42. This information will be included in Amendment 30, scheduled for transmittal to the NRC on July 8, 1993.

Please provide a copy of this transmittal to George Thomas.

Sincerely,

Jack Fox

Jack Fox
Advanced Reactor Programs

cc: Alan Beard (GE)
Norman Fletcher (DOE)
Frank Paradiso (GE)
Umesh Saxena (GE)
Bill Taft (GE)

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of channels, recording of parameters, instrument range and accuracy and post-accident monitoring equipment is discussed in Section 7.5.

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## 6.2.2 Containment Heat Removal System

### 6.2.2.1 Design Bases

The containment heat removal system, consisting of the suppression pool cooling mode and the wetwell and drywell spray features are integral parts of the RHR system. The purpose of this system is to prevent excessive containment temperatures and pressures, thus maintaining containment integrity following a LOCA. To fulfill this purpose, the containment cooling system meets the following safety design bases:

(1) The system limits the long-term bulk temperature of the suppression pool to 97.2°C when considering the energy additions to the containment following a LOCA. These energy additions, as a function of time, are provided in the previous section.

(2) The single-failure criterion applies to the system.

(3) The system is designed to safety grade requirements including the capability to perform its function following a Safe Shutdown Earthquake.

(4) The system maintains operation during those environmental conditions imposed by the LOCA.

(5) Each active component of the system is testable during normal operation of the nuclear power plant.

### 6.2.2.2 Containment Cooling System Design

The containment cooling system encompasses several of the RHR operating modes, which are the low pressue flooder (LPFL) mode, the suppression pool cooling mode, and the containment spray modes (drywell and wetwell). Containment cooling starts as soon as the LPFL injection flow begins. The suppression pool cooling mode cools the containment. The containment sprays cool the drywell and wetwell by condensing steam and the condensate running back into the suppression pool. All water that leaves the suppression pool is cooled by the RHR heat exchangers during the three operational modes indicated above. For each of the three loops, water is drawn from the suppression pool, pumped through a RHR heat exchanger and injected into the reactor vessel for the LPFL mode. Also, for each of the three loops for the suppression pool cooling mode, water is drawn from the suppression pool, pumped through a RHR heat exchanger and delivered to the suppression pool. On two of the loops (B&C), a portion of the water returned to the suppression pool may be passed through wetwell spray headers. These two loops also have a manual feature for providing drywell spray. Water from the RCWS is pumped through the heat exchanger shell side to exchange heat with the processed water. Three cooling loops are provided, each being mechanically and electrically separate from the other to achieve redundancy. A piping and instrumentation diagram (P&ID) is provided in Section 5.4. The process diagram, including the process data, is provided for all design operating modes and conditions.

All portions of the containment cooling system mode are designed to withstand operating loads and loads resulting from natural phenomena. All operating components can be tested during normal plant operation so that reliability can be assured. Construction codes and standards are covered in Subsection 5.4.7.

The low pressure flooder (LPFL) mode is automatically initiated from ECCS signals or manually initiated. The suppression pool cooling mode is started manually or automatically. The RHR system must be realigned for suppression pool cooling by the plant operator after the reactor vessel water level has been recovered. The RHR pumps are already operating. Suppression pool cooling is initiated in any of the three loops by manually closing the LPFL injection valve and opening the pool return valve. In the event that a single failure has occurred, and the action which the plant operator is taking does not result in system initiation, then the operator will place the other totally redundant system into operation by following the same initiation procedure. If the operator chooses to utilize the containment sprays, he must close the LPFL injection valves open spray valves. The drywell spray mode may

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Containment design features as related to debris formation have an important relationship to the ECCS's ability to provide containment cooling. A primary source of debris in containment is the thermal insulation. If insulation is dislodged and enters the wetwell, it can cause plugging of the ECCS suction strainers, which can impede ECCS performance and containment cooling.

The ABWR design includes the necessary provisions to prevent debris from impairing the ability of the RCIC, HPCF, and RHR systems to perform their required post-accident functions. Specifically, the ABWR does the following:

The design is resistant to the transport of debris to the suppression pool;

The SPCU system will provide early indication of any potential problem;

The ECCS suction strainers meet the current regulatory requirements unlike the strainers at the incident plants.

The equipment installed in the drywell and wetwell minimize the potential for generation of debris.

In addition to the ABWR design features, the control of the suppression pool cleanliness is a significant element of minimizing the potential for strainer plugging. The COL applicant will review the issue of maintaining the suppression pool cleanliness and propose to the NRC staff an acceptable method for assuring that the suppression pool cleanliness is maintained. Methods shall be considered for removing, at periodic intervals, sedament and floating or sunk debris from the suppression pool that the SPCU does not remove. See subsection 6.2.7.3 for COL license information.

Refer to Appendix 6C for additional information on ~~mention of~~ ABWR design features.

Included in the leak rate test summary report will be, a report detailing the containment inspection, a report detailing any repairs necessary to pass the tests, and the leak rate test results.

#### 6.2.6.5 Special Testing Requirements

The maximum allowable leakage rate into the secondary containment and the means to verify that the inleakage rate has not been exceeded, as well as the containment leakage rate to the environment, are discussed in Subsections 6.2.3 and 6.5.1.3.

## 6.2.7 COL License Information

#### 6.2.7.1 Alternate Hydrogen Control

A comparison of costs and benefits will be provided for alternate hydrogen control in accordance with Subsection 6.2.5.

#### 6.2.7.2 Administrative Control Maintaining Containment Isolation

The COL applicant will maintain the primary ontainment boundary by administrative controls in accordance with Subsection 6.2.6.3.1.

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### 6.2.7.3 Suppression Pool Cleanliness

The COL applicant will propose for NRC staff review, acceptable methods to maintain suppression pool cleanliness in support of preventing ECCS suction strainer plugging in accordance with Subsection 6.2.1.8 and Appendix 6C.

Appendix 6C

## Containment Debris Protection for ECCS Strainers

NRC Bulletin No. 93-02, "Debris Plugging of Emergency Core Cooling Suction Strainers," references NRC guidance and highlights the need to adequately accommodated debris in design by focusing on an incident at the Perry Nuclear Plant. GE reviewed the concerns addressed by NRC Bulletin 93-02 and has reviewed the design of the ABWR for potential weaknesses in coping with the bulletin's concerns. GE has determined that the ABWR design is more resistant to these problems for a number of reasons as discussed in the following.

The ultimate concern raised by the Perry incident was the deleterious effect of debris in the suppression pool and how it could impact the ability to draw water from the suppression pool during an accident. The ABWR design has committed to following the guidance provided in Reg Guide 1.82, Rev. 1 (Water Sources for long-term Recirculation Cooling following a Loss of Coolant Accident) and the ABWR is designed to inhibit debris generated during a LOCA from preventing operation of the Residual Heat Removal (RHR), Reactor Core Isolation Cooling (RCIC) and High Pressure Core Flooder (HPCF) systems.

The type of insulation material to be used has not yet been determined. However, the newer insulating systems (NUKON) are packaged in large blankets which are encased to prevent the release of small particles. Fine fibers of NUKON are created only as the result of a LOCA's high pressures steam-water jet. If one of these blankets were to reach the wetwell it would prevent small particles from matting out on the ECCS suction strainers in an overall uniform manner that could plug the strainer. In addition, it should also be recognized that the ABWR has substantially reduced the amount of piping in the drywell relative to earlier designs and consequently the quantity of insulation required. Furthermore, there is no equipment in the wetwell spaces that requires insulation or other fibrous materials. The ABWR design conforms with the guidance provided by the NRC for maintaining the ability for long-term recirculation cooling of the reactor and containment following a LOCA.

However, the Perry incident was not the result of a LOCA but rather debris entering the Suppression Pool during normal operation. The arrangement of the drywell and wetwell/wetwell airspace on a Mark III containment (Perry) is significantly different from that utilized in the ABWR design. In the Mark III containment, the areas above the suppression pool water surface (wetwell airspace) are substantially covered by grating with significant quantities of equipment installed in these areas. In these areas are no real barriers to prevent small quantities of debris from falling into the suppression pool from the spaces located above the pool surface. This arrangement contributes to a much greater potential for debris to enter the suppression pool during outage activities as well as activities in the containment during power operation. Furthermore, access to the wetwell airspace (containment) of a Mark III is allowed during power operations. In contrast, on the ABWR the only connections to the suppression pool are 10 drywell connecting vents (DCVs) and access to the wetwell during power operations is prohibited. The DCVs will have horizontal steel plates located above the openings that will prevent any material falling in the drywell from directly entering the vertical leg of the DCVs. This arrangement is similar to that used with the Mark II connecting vent pipes. Vertically oriented trash rack construction will be installed around the periphery of the horizontal steel plate to intercept debris. The trash rack design shall allow for adequate flow from the drywell to wetwell. In order for debris to enter the DCV it would have to travel horizontally through the trash rack prior to falling into the vertical leg of the connecting vents. Thus the ABWR is resistant to the transport of debris from the drywell to the wetwell.

In the Perry incident, the insulation material acted as a sepia to filter suspended solids from the suppression pool water. The Mark I. II, and III containment's have all used carbon steel in their suppression pool liners. This results in the buildup of corrosion products in the suppression pool which settle out at the bottom of the pool until they are stirred up and resuspended in the water following some event (SRV lifting). In contrast the ABWR liner of the suppression pool is fabricated from stainless steel which significantly lowers the amount of corrosion products which can accumulate at the bottom of the pool.

Since the debris in the Perry incident was created by roughing filters on the containment cooling units a comparison of the key design features of the ABWR is necessary. In the Mark III design more than 1/2 of the containment cooling units are effectively located in the wetwell airspace. For the ABWR there are no cooling fan units in the wetwell air space. Furthermore the design of the ABWR Drywell Cooling Systems does not utilize roughing filters on the intake of the containment cooling units.

In the event that small quantities of debris enter the suppression pool, the Suppression Pool Cleanup System (SPCU) will remove the debris during normal operation. The SPCU is described in Section 9.5.9 and shown in Figure 9.5.1 of the ABWR SSAR. The SPCU is designed to provide a continuous cleanup flow of 250 $m^3$/hour (1100 gpm). This flow rate is sufficiently large to effectively maintain the suppression pool water at the required purity. The SPCU system is intended for continuous operation and the suction pressure of the pump is monitored and provides an alarm on low pressure. Early indication of any deterioration of the suppression pool water quality will be provided if significant quantities of debris were to enter the suppression pool and cause the strainer to become plugged resulting in a low suction pressure alarm.

The ECCS pump suction pool strainers for the ABWR will meet the requirements of Reg Guide 1.82, Rev. 1. The suction strainers at Perry did not meet the current regulatory requirements. The ABWR ECCS suction strainers will utilize a "T" arrangement with conical strainers on the 2 free legs of the "T". This design separates the strainers so that it minimizes the potential for a contiguous mass to block the flow to an ECCS pump. The ABWR design also has additional features not utilized in earlier designs that could be used in the highly improbable event that all suppression pool suction strainers were to become plugged. The alternate AC (Alternating Current) independent water addition mode of RHR allows water from the Fire Protection System to be pumped to the vessel and sprayed in the wetwell and drywell from diverse water sources to maintain cooling of the fuel and containment. The wetwell can also be vented at low pressures to assist in cooling the containment.

In summary the ABWR design includes the necessary provisions to prevent debris from impairing the ability of the RCIC, HPCF, and RHR systems to perform their required post-accident functions. Specifically, the ABWR does the following:

The design is resistant to the transport of debris to the suppression pool;

The SPCU system will provide early indication of any potential problem;

The ECCS suction strainers meet the current regulatory requirements unlike the strainers at the incident plants.

The equipment installed in the drywell and wetwell minimize the potential for generation of debris.

In addition to the ABWR design features, the control of the suppression pool cleanliness is a significant element of minimizing the potential for strainer plugging.