GE Nuclear Energy

General Electric Company
175 Curtner Avenue, San Jose, CA 95125

December 16, 1993

MFN No. 236-93
Docket STN 52-004

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington DC 20555

Attention: Richard W. Borchardt, Director
Standardization Project Directorate

Subject: Transmittal of Responses to NRC Questions

References: Letter, M. Malloy to P. W. Marriott, "Request for Additional Information (RAI) Regarding the Simplified Boiling Water Reactor (SBWR) Design", November 15, 1993

Attached please find GE's responses to the questions and comments received from the Staff and its Purdue University contractor during the October 1, 1993 meeting and transmitted in the reference letter.

Sincerely,

D. L. Foreman for

J. E. Leatherman
SBWR Certification Manager
MC-781, (408)925-2023

cc: M. Malloy, Project Manager (NRC) (2 attachments)
F. W. Hasselberg, Project Manager (NRC) (1 attachment)

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ATTACHMENT A

Requests for Information by Purdue University

PURDUE UNIVERSITY

SCHOOL OF NUCLEAR ENGINEERING

Additional Required Informations From GE About Prototype SBWR System

1. We need information on various system parameters for blowdown phase at 150 psi. We are interested in the thermalhydraulic paramters at 150 psi. After MSL break, information on vessel liquid level (time dependent level due to swelling), quality, void fraction and exact decay heat power levels will be useful. (Note that a similar question was put to GE in our previous list of questions No. 7, but an error was made at that time in asking for parameters at 150 sec).

2. Please provide us with a diagram that defines all water levels as defined by GE (Levels 1-9) in the RPV for all accident scenarios.

3. Regarding question #2 in our previous list of questions, the loss coefficient for GDCS and Equalization Line Squib Valves was given to us in terms of 'psi'. Should this be 'psid', and if so, where it is measured?

4. We would like to request further explanation in regards to Questions #3a and #3e in our previous list of questions to GE. This is in regards to the design of the headers and separators in the ICS and PCCS, and their associated loss coefficients. We need detailed design drawings of the PCCS and ICS condenser units and modules, as well as the noncondensable line vents in the lower headers. We are unable to locate this information in any of the drawings that have been sent to us. The calculation of the loss coefficient using the Crane Technical Paper neccesitates the assumption of single-phase flow in the condenser tubes. How is this issue approached by GE since the upper header will have steam and noncondensables, the condenser tubes will have two-phase mixture, and the lower header will contain stratified two-phase mixture of condensate and noncondensables?

5. We would like to request more information on the spray units in the suppression pool and containment. Specifically, we need information on spray nozzle diameter and mean droplet diameter or Sauter mean daimeter if availble.

6. What type of quick-operating valves were used for the ADS system (SRVs and DPVs) in GIST facility. Information is needed on the valve type : solenoid, pneumatic or electric actuated ball or other type of valve and vendor information.

7. We need information on type of pump used for the feed water line? Is the volumetric flow rate in the auxiliary line connecting to the FWL kept at constant rate, during the vessel depressurization from 150psi to the lowest pressure (reached at 8-10 hours)?

8. *Reminder:* Please also provide answers to the questions put in the previous list of questions on GIST facility and its heaters.

ABBREVIATIONS

ADS	automatic depressurization system
DPV	depressurization valve
FWL	feedwater line
GDCS	gravity-driven cooling system
GIST	gravity-driven cooling system integral systems test
ICS	isolation condenser system
MSL	main steam line
PCCS	passive containment cooling system
RPV	reactor pressure vessel
SRV	safety relief valve

ATTACHMENT B

GE Answers to Purdue University Questions

Note: All answers are based on currently available data. In many cases the data are preliminary and are subject to change during the SBWR design certification process.

1. **Thermal hydraulic parameters at RPV pressure of 150 psia after MSL break inside containment**

Assume FW pump trip and reactor scram at time zero.

- Water level: (two phase)

  Chimney 16.1 m
  Downcomer 18.0 m

- Void Fraction:

  Lower plenum 0.28
  Channel 0.68
  Bypass 0.69
  Chimney 0.72
  Steam dome 1.0
  Downcomer 0.74

- Time to 150 psia: 270 sec

- Quality @ dome: 1.0

- Power @ 270 sec.: 5.19×10^7 watts

2. **RPV water levels**

Provided in the table below are the elevations of the RPV water levels. The plant safety analytical limits and the nominal trip setpoints are the elevations from the vessel bottom at reference zero.

Reactor Vessel Water Level	Description	Plant Safety Analytical Limit (cm)	Nominal Trip Setpoint (cm)
0.5	Initiates GDCS Equalizing line	749.3	749.3
1	Low-low water level trip	1009.5	1042.3
2	Low water level trip	1409.5	1442.3
3	Low water level trip	1725.5	1733.3
4,5,6,7	Water level alarms	N/A	Note 1
8	High water level trip	1879.0	1871.3
9	FW pump trip	1936.4	Note 1

Note 1: The nominal trip setpoints for the water level alarms and FW pump trip will be determined later.

3. Loss Coefficient of GDCS Squib

$C_v \geq 876$ gpm/psid$^{0.5}$, measured across the valve length

4. Additional information on ICS and PCCS condensers

a. Noncondensable vent lines in lower headers

The following reference drawings, sent to NRC in transmittal MFN No. 168-93 (October 19, 1993), describe the two condensers:

2. SBW5280DMNX1105, PCCS Condenser Prototype General Arrangement
3. SBW5280DMNX1106, Isolation Condenser General Arrangement

For the Isolation Condenser, the vent line and nozzle are identified as items 23 and 25 on the IC General Arrangement Drawing (Drawing Reference 3). On Sheet 1 in the lower right hand corner, the vent nozzle can be seen on the figure listed as "Partial View from D". The nozzle is located on the top of the lower header, near the flange head. On Sheet 2, Detail "5" gives the dimensions of the nozzle.

For the PCCS condenser, the vent line is described in the PCCS Condenser Prototype General Arrangement (Drawing Reference 2). On Sheet 1 on the left hand side, the vent line is shown as an 8" schedule 40 pipe going into the lower header. Detail "C" and Section "W-W" on Sheet 2 give the dimensions of the vent line.

b. Loss coefficients

Both the IC and the PCC have design requirements for the maximum pressure loss through the units. The primary side pressure loss of the IC shall be limited to 20.68 kPa (3 psi) from the steam line penetration to the main drain line penetration (top of drywell top slab) at maximum expected steady state IC condensing capacity (140 % of normal capacity). The primary side pressure loss for the PCC condenser and vent line shall be limited to less than 850 mm of water at 71 °C. This requirement insures that the main horizontal vents between the drywell and wetwell remain submerged while the PCCS vents are open. Studies by the condenser designer and GE indicate that the reference designs for the SBWR will meet these requirements with margin.

Modeling of both the IC and PCC are done by the TRACG (GE's version of TRAC-BWR) computer code at GE. TRACG has the capability to calculate pressure loss for a mixture of steam and a non-condensable gas and for a two-phase mixture. User input to this calculation is based on a division of the condenser and its associated piping into "cells". Input parameters include the geometry of the cells and local single-phase hydraulic loss factors. The equations used to calculate pressure losses from these inputs are described in J.G.M. Andersen, et al., "TRACG Model Description," NEDE-32176P (Class 3), submitted to the NRC in February, 1993.

5. Containment and Suppression Pool Spray Nozzle Information

GE has not performed the detailed design of the containment spray system. This system is not a safety system for the SBWR. The level of detail on the spray nozzles, as asked by Purdue, is beyond the scope of the SBWR certification program. The system does have the design requirement that the spray pattern should give complete coverage in the gas spaces. To achieve that, the individual sprays from the nozzles will probably overlap to ensure coverage.

6. GIST ADS valves

GIST used pneumatic-actuated ball valves for the ADS system. Vender information from the valve is below:

Gemini Valve Inc.
1 Otter Court
Raymond, N.H. 03077

7. SBWR Feedwater System

There are three identical reactor feed pumps. These pumps are horizontal, centrifugal, single stage pumps, driven by adjustable speed synchronous motors. The SBWR does not have an auxiliary feedwater system, therefore the second part of this question is not applicable to the SBWR.

8. Previous GIST Questions

GE has responded to Purdue's earlier questions on GIST in a transmittal sent to the NRC on October 20, 1993 (MFN No. 170-93).