GE Nuclear Energy

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

April 9, 1993

MFN No. 052-93
Docket STN 52-004

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Richard Borchardt, Acting Director
Standardization Project Directorate

Subject: **NRC Requests for Additional Information (RAIs) on the Simplified Boiling Water Reactor (SBWR) Design**

Reference: Transmittal of Requests for Additional Information (RAIs) for the SBWR Design, Letter from J. W. Thompson to P. W. Marriott January 28, 1993

The reference requested additional information on the SBWR Design. As part of the response to this request, GE is submitting responses to the following RAIs:

1) RAIs No. RES. 1 through RES. 8

Sincerely,

P. W. Marriott, Manager
Safety & Licensing
M/C 444, (408) 925-6948

Enclosure: RAI Responses

LTRBK 93-20

bcc: J. C. Baechler
R. H. Buchholz
S. A. Delvin
D. M. Gluntz
R. J. McCandless
A. S. Rao
G. M. Sweden
SBWR File MC-781

LTRBK 93-20

RAI Number: RES.1 **Responsible Engineer:** MALTE, B.

What is the basic PCCS capacity (per unit) produced by steam condensation in the tubes (no flow from drywell to pressure suppression pool via the PCCS vent line, no noncondensable gas in the drywell atmosphere, and IC or PCCS pool temperature at its initial value)? What is the drywell pressure associated with this basic capacity?

GE Response: RES.1

The PCCS condensers were sized on the basis of saturated conditions in the IC/PCC pool. For pure saturated steam, the heat removal rate of the PCCS condenser at a drywell pressure of 350 kPa (50.7 psia) and pool temperature of 100°C (212°F) is 10 MW

The basic PCCS capacity has also been calculated for a pool temperature of 50°C (122°F) and a drywell pressure of 350 kPa. The heat removal rate at these conditions is calculated to be 23.9 MW

Applicable Section No.	Tier 1?	Text Revision?	Amendment Number
6.2.2	No	No	

Response Document

RAI Number: RES.2 **Responsible Engineer:** MALTE, B.

How does the basic PCCS capacity defined in Question RES.1 decrease as IC/PCCS pool temperature increases over the range from its initial temperature to saturation temperature?

GE Response:

See response to RES.1.

Applicable Section No.	Tier 1?	Text Revision?	Amendment Number
6.2.2	No	No	

Response Document

RAI Number: RES.3 **Responsible Engineer:** MALTE, B.

How does the basic PCCS capacity defined in Question RES.1 increase as the drywell-to-suppression chamber differential pressure increases from 1.05 psid (initiating flow through the vent line) to 2.30 psid (initiating flow through the upper row of horizontal vents)?

GE Response:

The PCCS capacity was determined for pure steam at a drywell pressure of 350 kPa and drywell-to-suppression chamber differential pressures of 7.5, 15.4, and 23.4 kPa (1.09, 2.23, and 3.39 psid). For an IC/PCC pool temperature of 50°C, the PCCS condenser has sufficient capacity so that over the range of differential pressures considered the heat removal rate does not vary. The heat removal rate is 23.9 MW

For a pool temperature of 100°C, the heat removal rate increases with differential pressure. The PCCS capacity is:

10.0 MW @ ΔP = 7.5 kPa
10.6 MW @ ΔP = 15.4 kPa
10.7 MW @ ΔP = 23.4 kPa.

Applicable Section No.	Tier 1?	Text Revision?	Amendment Number
6.2.2	No	No	

Response Document

RAI Number: RES.4 **Responsible Engineer:** MALTE, B.

How does the basic PCCS capacity defined in Question RES.1 decrease as the noncondensable gas fraction at the PCCS inlet increases?

GE Response: RES.4

The variation of the heat removal rate of the PCCS condenser with inlet noncondensable gas mass fraction was determined for a drywell pressure of 350 kPa and a drywell-to-suppression chamber pressure differential of 15.4 kPa. The results for IC/PCC pool temperatures of 50 and 100°C are given in Tables 1 and 2, respectively. The corresponding results are shown in Figure 1.

Applicable Section No.	Tier 1?	Text Revision?	Amendment Number
6.2.2	No	No	

RES.4 Figure 1

Response Document

Table 1

PCCS Performance as a Function of Inlet Gas Mass Fraction
for IC/PCC Pool Temperature = 50°C

Inlet Gas Mass Fraction	PCC Capacity Watts
0.0	2.39e7
.011	1.60e7
.044	1.41e7
.086	1.27e7
.167	1.10e7
.244	9.63e6
.316	8.40e6
.384	7.30e6
.448	6.32e6
.509	5.43e6
.567	4.63e6
.622	3.91e6
.675	3.26e6
.725	2.66e6
.772	2.10e6
.818	1.58e6
.862	1.09e6
.903	6.57e5
.943	2.82e5
.981	1.30e4

P_{DW} = 350 kPa

$\Delta P_{DW/WW}$ = 15.4 kPa

Table 2

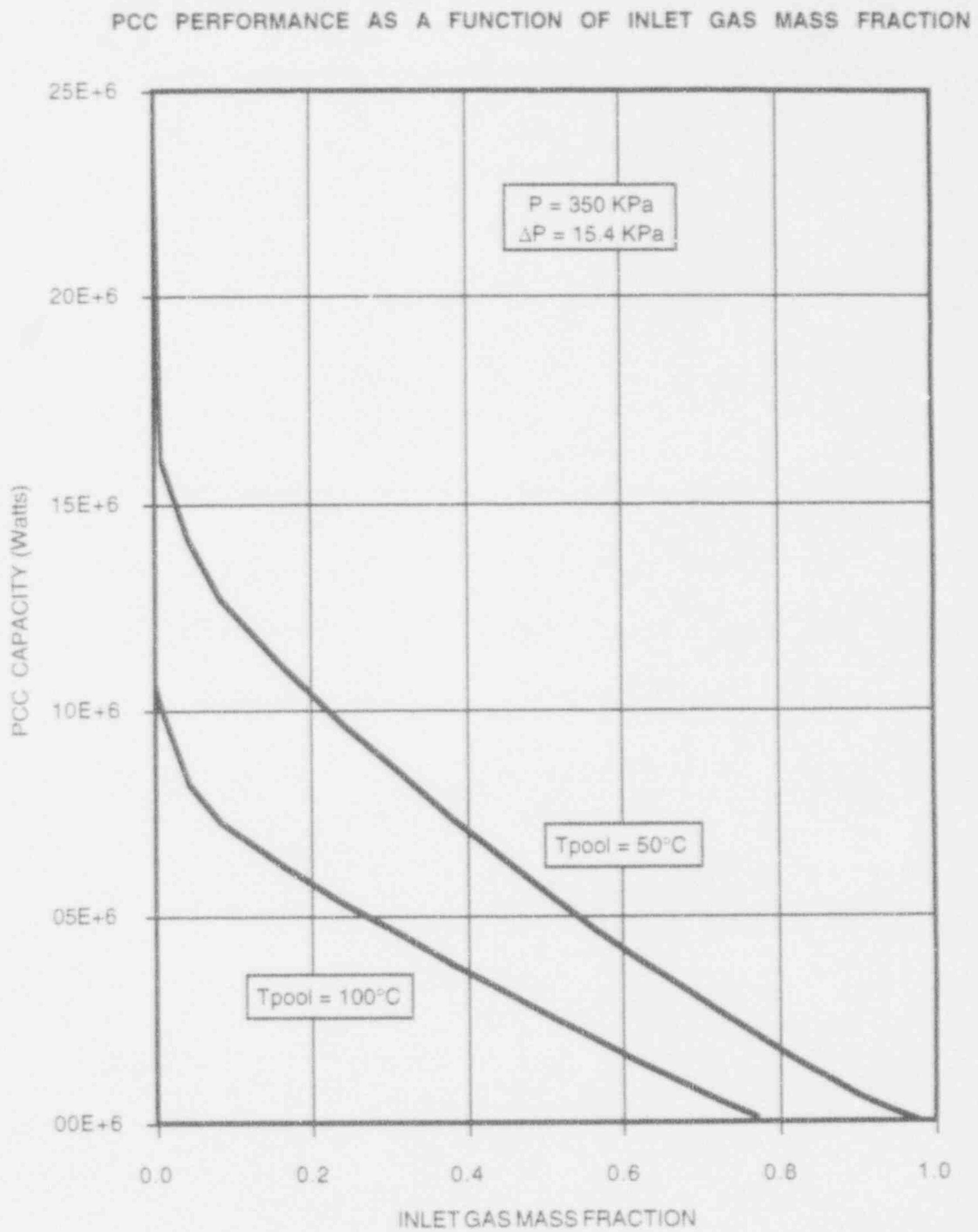
PCCS Performance as a Function of Inlet Gas Mass Fraction
for IC/PCC Pool Temperature = 100°C

Inlet Gas Mass Fraction	PCC Capacity Watts
0.0	1.06e7
.011	1.00e7
.044	8.19e6
.086	7.27e6
.167	6.16e6
.244	5.27e6
.316	4.51e6
.384	3.80e6
.448	3.14e6
.509	2.54e6
.567	1.98e6
.622	1.47e6
.675	9.82e5
.725	5.45e5
.772	1.61e5

P_{DW} = 350 kPa

$\Delta P_{DW/WW}$ = 15.4 kPa

Figure 1


PCC PERFORMANCE AS A FUNCTION OF INLET GAS MASS FRACTION
25E+6
20E+6
15E+6
10E+6
05E+6
00E+6
PCC CAPACITY (Watts)
P = 350 KPa
ΔP = 15.4 KPa
Tpool = 50°C
Tpool = 100°C
0.0
0.2
0.4
0.6
0.8
1.0
INLET GAS MASS FRACTION

RAI Number: RES.5 **Responsible Engineer:** MALTE, B.

What are the expected sensitivities (if any) to the composition of the noncondensable gas?

The effect on tube condensation of steam in the presence of noncondensable gases. Tests were performed with air and helium, which act similarly to nitrogen and hydrogen, respectively. The results indicate that has been studied in the reference for the same mole fraction, air reduces the rate of heat transfer more than helium. While for the same mass fraction, helium reduces the rate of heat transfer more than air. The difference between the effects of helium and air decrease with increasing noncondensable mass fraction.

REFERENCE: "The effects of noncondensable gases on steam condensation under forced convection conditions", Siddique, M. PhD. dissertation, MIT, 1992.

Applicable Section No.	Tier 1?	Text Revision?	Amendment Number
6.2.2	No	No	

Response Document

RAI Number: RES.6 Responsible Engineer: MALTE. B.

What is the thickness of the gravity-driven cooling system pool walls at the interface with the drywell atmosphere? Per SSAR Section 3.8.3.1, these are "made of stainless steel plates or carbon steel plates lined with stainless steel cladding and backed up with vertical and horizontal steel structural framing system."

GE Response:

The thickness of the GDCS pool walls at the interface with the drywell is 16 mm (5/8 in) carbon steel with additional stainless steel cladding.

Applicable Section No.	Tier 1?	Text Revision?	Amendment Number
3.8.3.1	No	No	

Response Document

RAI Number: RES.7 **Responsible Engineer:** MALTE, B.

What is the thickness of the (water-cooled) drywell head?

GE Response:

The thickness and description of the (water-cooled) drywell head is as follows:

The drywell head consists of a 2:1 ratio, semi-elliptical vessel head welded to a vertical right cylinder with a flange welded to the bottom of the cylinder. The mating flange is welded to a vertical right cylinder which projects from the diaphragm floor. The semi-elliptical head is 40mm thick, the vertical right cylinders are 50mm thick and the flanges are 100mm thick by 250mm wide.

Applicable Section No.	Tier 1?	Text Revision?	Amendment Number
3.8.1.3	No	No	

Response Document

RAI Number: RES.8 **Responsibie Engineer:** MALTE, B.

What is the thickness of the fines in the pressure suppression chamber airspace? Per SSAR Section 3.8.3.1, these "project down 1.0 m (3'-3") below the 0.6 m (2'-0") thick floor....The radial plate, with a flange plate at the bottom, forms the support beam to the floor system." Figure 21.1.2-2 Sheet 9 (Reactor Building, Plan at Elevation 16000) shows that there are 24 of these fins.

GE Response:

The thickness of the fins which project below the diaphragm floor is 25 mm (1 in) The dimensions of the flange plate at the bottom of the fins is 540 mm x 38 mm (21 in x 1-1/2 in)

Applicable Section No.	Tier 1?	Text Revision?	Amendment Number
3.8.3.1	No	No	

Response Document