GE Nuclear Energy

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

June 1, 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: **Supporting Information for Appendix 19F of the ABWR SSAR**

Dear Chet:

The subject information has been requested by H. Ashar of the NRC staff.

Please distribute to H. Ashar and G. Bagchi.

Sincerely,

Jeffrey C. Bachler for JNF

Jack Fox
Advanced Reactor Programs

cc: G. W. Ehlert
Norman Fletcher (DOE)

JF93-183

D050
1/1

ABWR CONTAINMENT LINER PLATE EVALUATION FOR SEVERE ACCIDENT CONDITIONS

1.0 The ability of the ABWR liner plate system to withstand the effects of design pressures and temperatures for normal and abnormal conditions in accordance with ASME code, has been demonstrated in Section 3.H.1.5.5.1 of the SSAR Appendix 3H.

The NRC staff however, has expressed concerns about the ability of the ABWR containment liner plate system to withstand a severe accident pressure (134 psig) plus thermal loads without tearing failure due to the stress concentration at discontinuities, similar to that observed in Sandia Containment tests (Reference 1).

An evaluation of the containment liner plate for ABWR has been performed to demonstrate that the liner plate has adequate margins to withstand the severe accident pressure of 134 psig together with the thermal loads. In this evaluation, a very conservative strain concentration factor of 33 at the discontinuities as observed in the Sandia Containment tests (Reference 1) has been used. The details of the evaluation are described in the following sections.

2.0 LINER PLATE SYSTEM

The ABWR containment liner plate system consists of ¼" thick plate made of ASME SA-516 Grade 70 steel. The liner plate is anchored into the concrete containment through WT 4 X 7.5 made of ASTM A-36 steel and welded to the liner plate. The following are the pertinent data of the ABWR containment liner plate system used for the evaluation.

- Concrete Containment:

Inside Radius = 14.5^M (571 in)

Thickness = 2.0^M (78.7 in)

Hoop Rebar: (1 - #18 @ 150 mm oc + 1 - #18 @ 450 mm oc on each face) = 1.8 in^2/in total on both faces

Vertical Rebar: (320 x 2 -#18 + 160 - #18 = 1.666 in^2/in total on both inside and outside faces)

- Steel Liner Plate:

  ¼" thick ASME SA 516 Grade 70

  Yield stress at 70°F = 38.0 ksi

  Yield stress at 500°F = 30.7 ksi

  Ultimate Uniaxial Strain at Fracture = 21%

  (Based on ASTM 516 Grade 70 minimum guaranteed elongation in 2")

- Liner Anchor:

  WT 4 X 7.5 spaced at 500 mm on center

  Yield stress at 70°F = 36.0 ksi (A36 steel)

3.0 EVALUATION

The following severe accident conditions are used for the evaluation of the ABWR containment liner plate.

A.	Containment Internal Pressure	=	134 psig
B.	Steam Jet Temperature	=	500°F
	Ambient Temperature	≈	100°F
	Rise in Temperature	≈	400°F

Due to the internal pressure, the liner plate has a tendency to elongate by virtue of hoop tension whereas it has a tendency to shorten due to compression on the inside face of the containment for elevated internal temperature. Thus, the combination of internal pressure and temperature loads on the liner plate has compensatory effects. The friction and the physical bond between the liner plate and concrete wall are conservatively neglected for the evaluation. The corresponding shrinkage strains, being small, are neglected, and the concrete is assumed to have zero tensile strength.

3.1 EVALUATION FOR INTERNAL PRESSURE LOADING

The hoop force due to the internal pressure of 134 psig on an internal radius of 14.5 m (571 in) is computed to be 76.5 kips per inch height of the containment. Assuming that this hoop force is resisted by the total hoop steel of 1.8 in^2 and liner plate area of 0.25 in^2 per inch height of the containment, the hoop stress is computed to be 37.3 ksi which gives the value of hoop strain of 0.13%.

This compares very closely with the strain values obtained from the "FINEL" analysis report which gave maximum strain of 0.126% (Ref.3). Assuming a very conservative estimate of strain concentration factor of 33 at the discontinuities on the Sandia Containment Test results (based on internal