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3.0 STRESS ANALYSES

The flawed location is in the transition cone to upper shell weld of the steam generator. For this location, the governing stress components are due to internal pressure and thermal transients. For the purpose of evaluating the observed flaws, it was necessary to determine through-wall stress distributions due to applied pressure and limiting thermal transients. The analyses used both theoretical and finite element methods, as discussed below.

The resulting stress distributions were used in fracture mechanics evaluations to determine predicted flaw growth rates and to determine the structural adequacy of the shell with the as-grown flaws, as presented in Section 4.

3.1 Pressure Stress

Since the observed flaw indications are circumferentially oriented, the axial component of pressure stress is of interest in evaluating the flaws. For a capped cylinder under internal pressure, Reference 4 gives a theoretical solution for axial stress. This results in:

$$\sigma_{axial} = \frac{qb^2}{a^2-b^2} = 8589\ psi$$

where: q = internal pressure = 800 psi
b = inside radius = 79.5"
a = outside radius = 83.12"

Because the affected region is in the transition cone to upper shell junction, bending stresses are also expected due to the geometric discontinuity. A two-dimensional axisymmetric finite element analysis of the component was performed to assess the pressure bending effects. The model is shown in Figure 2. The

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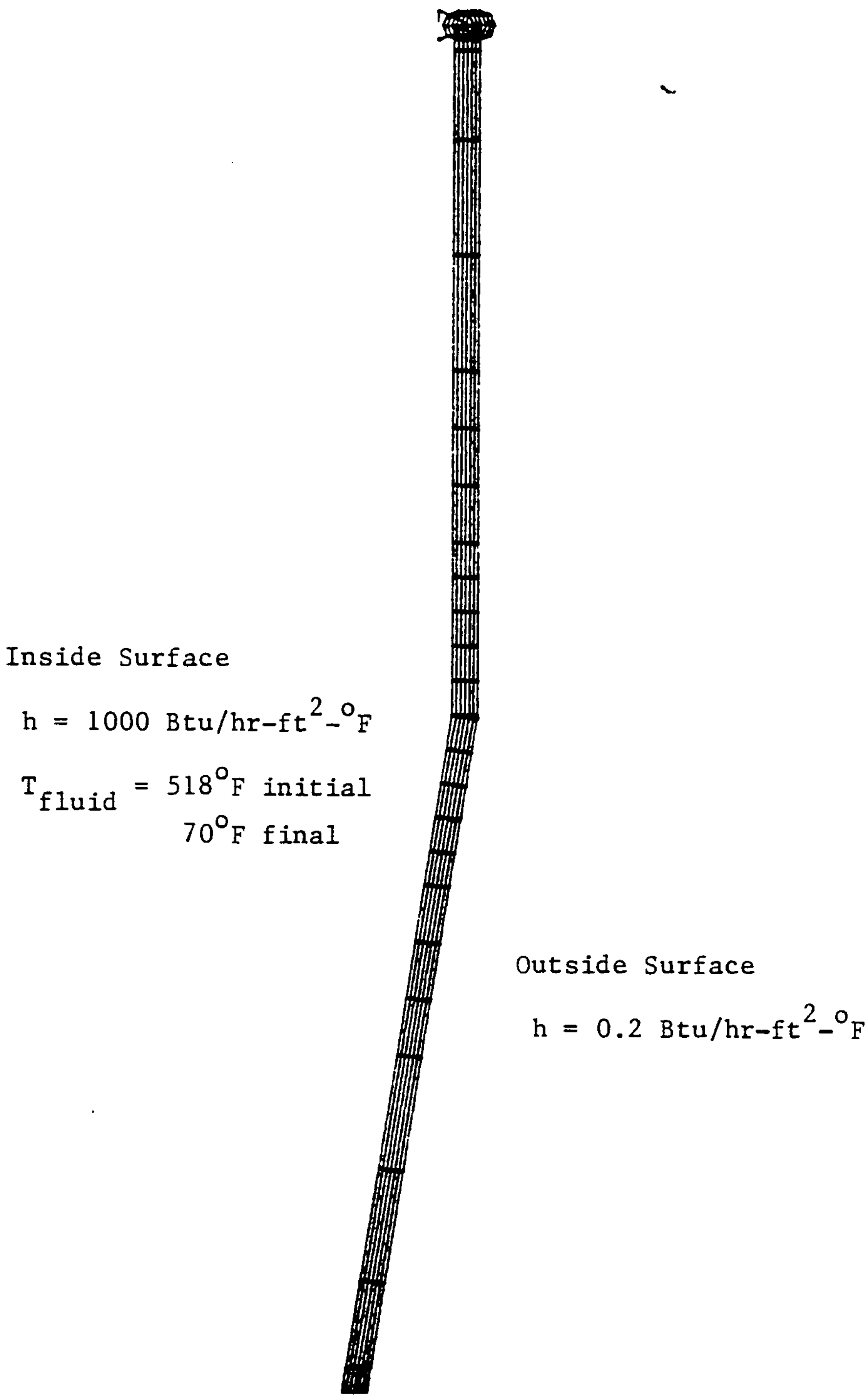

Figure 7. Finite Element Model for Thermal Stress Analysis

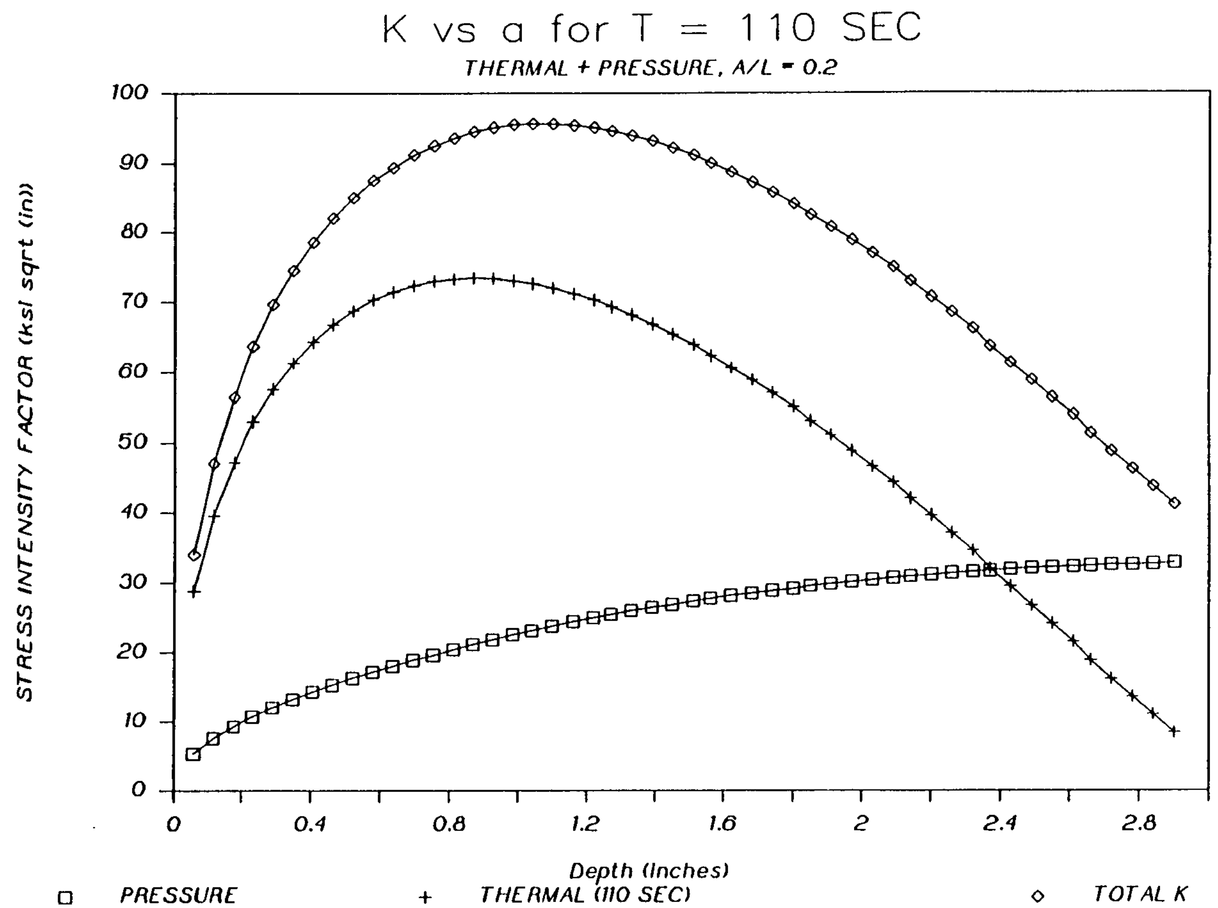

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Figure 10. K vs. A for Pressure and Thermal Stress Cases ($a/\ell = 0.2$)