GENERAL ELECTRIC

DOMESTIC TURNKEY PROJECTS

DESIGN SPECIFICATION

| | |
|---|---|
| BASIS FOR DESIGN OF DRYWELL CONTAINMENT VESSEL PENETRATIONS | |
| SPEC. NO. 22A2505 | REV. NO. 0 |
| SH NO. 0 | CONT ON SHEET 1 |

# BASIS FOR DESIGN OF DRYWELL CONTAINMENT VESSEL PENETRATIONS

ISSUED BY:

R. E. Keever
Technical Leader
Design Engineering

T. J. Pashos, Manager
Balance-of-Plant Engineering

APPROVED BY:

S. Naymark, Manager
Project Engineering

ISSUED 2/18/69

# BASIS FOR DESIGN OF DRYWELL CONTAINMENT VESSEL PENETRATIONS

The following criteria are intended to define certain loading conditions and allowable stress levels in the containment vessel in the areas adjacent to any and all penetrations.

A. Normal Operating and Design Accident Conditions

For normal operating and the design accident conditions (normal thermal expansion, dead loads, seismic loads; and thermal growth and pressure conditions resulting from loss of coolant within the drywell), the maximum allowable stress levels shall be:

1. General membrane stresses $\leq$ Sm
2. Local membrane stresses $\leq$ 1.5 Sm
3. Bending stresses $\leq$ 1.5 Sm

Where Sm is the allowable tensile stress for the material in question as specified in Section VIII of the ASME Boiler & Pressure Vessel Code.

B. Pipe Rupture Accident Conditions

For pipe rupture accident conditions (all loads specified in (A) except that the seismic load shall be two times normal seismic load, and all loads transmitted to shell via the penetration assemblies resulting from a pipe rupture either internal or external to drywell) it shall be shown that the containment is maintained in accordance with requirements of Table I, Page 3. An acceptable means of demonstrating this shall be:

1. Calculated stresses* limited to:
   a. Local membrane stresses $\leq$ 1.5 Sm
   b. Local membrane + secondary membrane + secondary bending $\leq$ 3 Sm
2. In lieu of calculated stresses noted above, appropriate load-deflection tests confirming ability of containment to withstand pipe rupture loads will be acceptable.

*The stress levels indicated in (A) and (B) above are in accordance with ASME Boiler & Pressure Vessel Code, Section III. It should be noted that limiting the stresses to 3 Sm will result in a maximum stress level equal to 75% of the ultimate strength ($\sigma_{ULT}$) of the material since Sm = 25% $\sigma_{ULT}$.

ISSUED: 2-18-69

Analysis of pipe rupture loads shall include the effect of jet reaction loads and jet impingement loads, but the two loads should not be applied simultaneously to a single penetration. These loads are defined as:

1. Jet reaction load - a reaction load acting on a process line due to rupture of line.
2. Jet impingement load - a load acting on a process line resulting from rupture of an adjacent line.

The jet reaction load resulting from either a circumferential pipe break or a longitudinal pipe break shall be taken as the product of the internal pressure of the line and the flow area of the line. The break shall be assumed to occur at a point which will result in the maximum loading on the containment shell.

The jet impingement force at its origin (at the point of pipe rupture) shall be taken as the product of the internal pressure and the flow area of the ruptured line. To determine the effective impingement force on an adjacent line, the following factors shall be considered:

1. A longitudinal break is assumed to be in the form of a rectangle whose length is equal to twice the inside diameter of the pipe. The cross sectional area of a longitudinal pipe break shall be equal to the internal cross sectional area of the ruptured line.
2. As the coolant leaves the pipe, a portion of the water flashes to steam resulting in an angular expansion of the two-phase mixture as a function of distance from the break. The included angle of the spreading two-phase mixture is to be taken as 45°.
3. As the two-phase mixture strikes an adjacent pipe, the curvature and size of the pipe and the length of pipe being struck by the mixture shall be taken into account in calculating the resultant jet impingement force on the pipe.

Application of factors in "2" and "3" above will result in attenuation of the initial jet force (at the break) as a function of distance from the break and size and curvature of the pipe being impinged upon.

Shell stresses resulting from pipe rupture loads shall be calculated using the "Bijlard" method as set forth in Welding Research Council (WRC) Bulletin No. 107.

ISSUED [illegible]
2-18-69

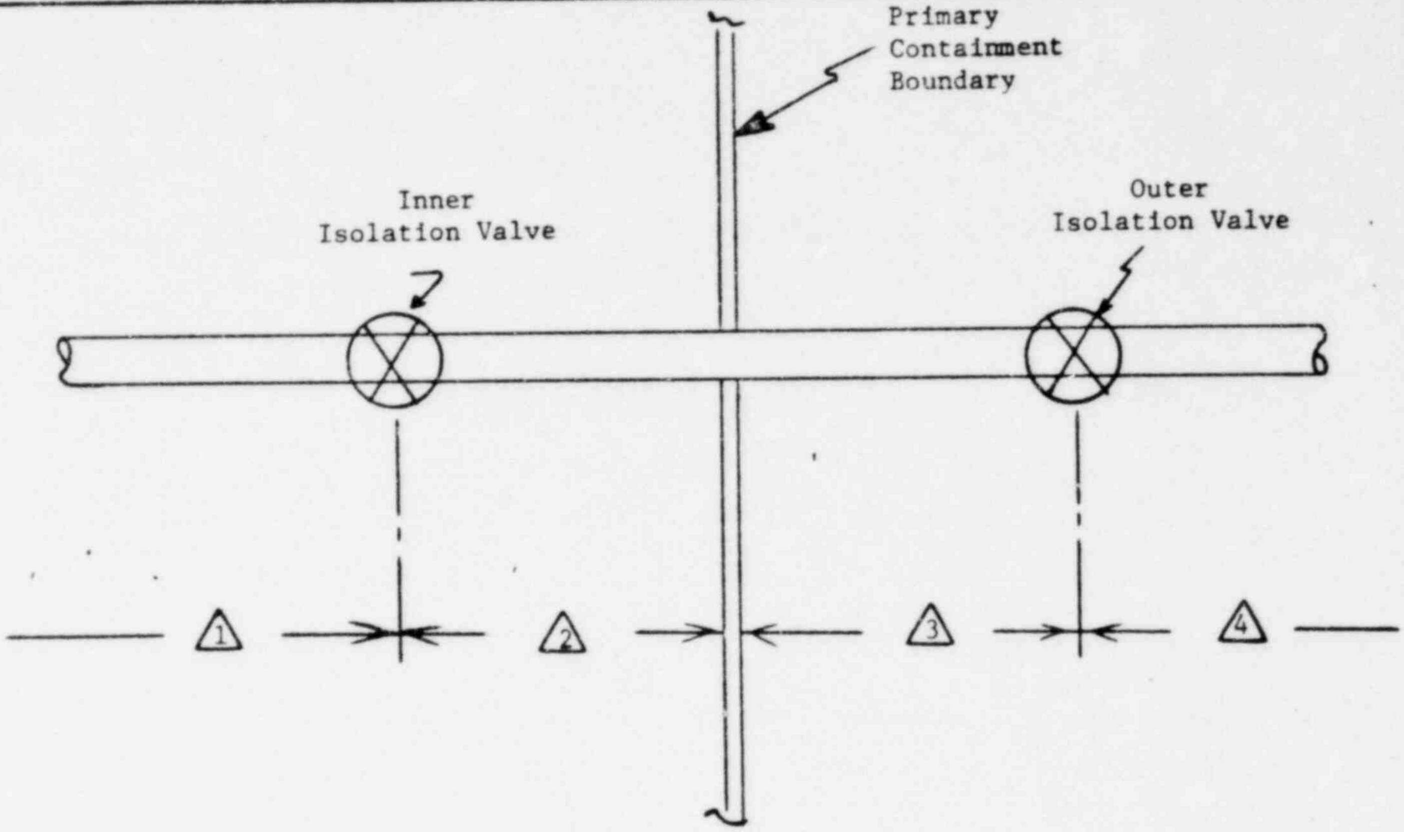


TABLE I

| Break Region | Type of Break | Component Integrity Necessary to Assure Containment |
|---|---|---|
| 1 | Long.<br>Circ. | Inner Isolation Valve<br>or<br>Outer Isolation Valve Plus<br>Primary Containment Boundary |
| 2 | Long.<br>Circ. | Inner Isolation Valve<br>or<br>Outer Isolation Valve Plus<br>Primary Containment Boundary |
| 3 | Long.<br>Circ. | Inner<br>Isolation<br>Valve |
| 4 | Long.<br>Circ. | Inner Isolation Valve<br>or<br>Outer Isolation Valve |