DETERMINATION OF SUPPORT SPACING TABLES USED IN THE DESIGN OF SAFETY CLASS NUCLEAR PLANT PIPING

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SUMMARY

It is normal practice in the design and layout of seismically qualified hot process pipe to first prepare isometric drawings, and then perform computerized flexibility analyses to determine thermal movements. These computer results for hot lines and dead weight spacing tables found in typical design codes for cold lines are then used to locate pipe supports and restraints. For safety class piping, it is necessary, however, to modify or supplement the dead weight support locations selected to resist seismic loadings applied to the piping system. This determination or verification of seismic design adequacy normally involves multidegree of freedom dynamic analyses procedures. These analyses cannot be completed until all supports which restrain the pipe are located, and often such analyses are iterative.

If these costly iterative dynamic analyses are to be minimized or avoided, it is necessary to develop approximate, simplified methods suitable for use by piping designers to quickly locate required seismic supports, whether they be of the movable, hydraulic, or inertia snubber type, or of a typical fixed U-bolt type.

This paper describes a procedure using the Equivalent Static Load Method, (U.S. Nuclear Regulatory Commission Standard Review Plans, Section 3.7.2.II.1.b., 1975), of support spacing tables and charts to carry seismic loads. It includes in addition to continuous straight pipe procedures those required for one and two bend geometry and tees.

The procedure used considers that there is typically a stress reserve available to carry seismic stresses.

For ASME Class 1:

$$T_s = 1.5S_m - 0.08S_m \text{ (Dead Weight)} - 0.5S_m \text{ (pressure)} = 0.92S_m \quad (1)$$

For ASME Classes 2 and 3:

$$T_s = 1.2S_h - 0.1S_h \text{ (Dead Weight)} - 0.5S_h \text{ (Pressure)} = 0.6S_h \quad (2)$$

where:

T_s = Stress available to carry seismic load

S_h and S_m = ASME Section III Allowable Stresses.

A number of examples are shown which illustrate the method and compare the results with rigorous multidegree of freedom dynamic analysis of piping systems. In addition, the paper investigates load considered in dynamic analysis on the load coefficients considered in the Equivalent Static Load Method.

There are a number of benefits from the use of these simplified seismic design charts and tables. The approximate, simplified methods described take about 10 to 20 percent of the time required for multidegree of freedom dynamic analyses, and significantly less trained engineering personnel can be utilized. In addition, the simplified procedures can be used for preliminary layout for all piping and for final design of cold lines and small or less critical pipes, and can be applied to the support of heating and ventilating ductwork, electric cable trays, and conduits.