Item C-12: Primary System Vibration Assessment

DESCRIPTION

Historical Background

Structural damage to the primary system, including the reactor pressure vessel and internals, associated piping and steam generator tubing in PWRs, can be caused by vibrations of sufficient magnitude. These vibrations can be either flow-induced or the result of operation of the pumps to which primary system piping is attached. There have been a number of instances where components internal to the reactor coolant pressure boundary have come loose as the result of flow-induced vibration and been carried through the primary system by the coolant flow. This NUREG-0471[1] item is related to New Generic Issue 7, "Failures Due to Flow-Induced Vibration," contained in Section 1 of this report. The analysis of this item takes into consideration Item B-73 in this Section.

Safety Significance

Vibration could be an early indication of possible problems. Excessive core barrel movement, caused by flow- induced vibration, may lead to many detrimental effects including damage to reactor internals and interference with control rod movement. Problems resulting from excessive core barrel movement have been encountered in at least one plant.

Structural damage due to flow-induced vibration of steam generator tubing has also been encountered. Anti- vibration bars are currently utilized to minimize tube vibration. However, fretting has occurred due to deficient design and material selection for the anti-vibration bars.

Piping systems are also susceptible to forced vibration as a result of pump vibration during operation. If a natural frequency of the connected piping is very nearly the same as the driving frequency of the pump, there is then the possibility, depending on the amplitude of vibration, for fatigue fai1ures in the system particularly at the nozzle where the stresses will be highest.

Possible Solution

A possible solution would be to develop criteria for instrumentation for monitoring excessive vibration inside the reactor vessel. Then, industry would be required to include instrumentation to meet the criteria. Any detected vibration would be assessed and may lead to modifications in the design of system components.

CONCLUSION

MEB has taken the position that current guidelines in SRP[2] Section 3.9.2, combined with staff positions on loose parts monitoring (Regulatory Guide 1.133)[3] provide sufficient basis for resolution of this issue.[4] The SRP[5] requirements include acceptance of a vendor's prototype plant results along with the startup

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[1] NUREG-0471, "Generic Task Problem Descriptions (Categories B, C, and D)," U.S. Nuclear Regulatory Commission, June 1978.
[2] NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, (1st Ed.) November 1975, (2nd Ed.) March 1980, (3rd Ed.) July 1981.
[3] Regulatory Guide 1.133, "Loose-Part Detection Program for the Primary System of Light-Water- Cooled Reactors," U.S. Nuclear Regulatory Commission, September 1977, (Rev. 1) May 1981. [8106120320]
[4] Memorandum for T. Speis from R. Vollmer, "Schedules for Resolving and Completing Generic Issues," February 1, 1983. [8401170076]
[5] NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, (1st Ed.) November 1975, (2nd Ed.) March 1980, (3rd Ed.)

program which satisfies Regulatory Guide 1.20,[6] Rev. 2.

Although operating plants have experienced a number of vibration problems, these have been detected by inservice inspections and other visual examinations. The MEB has been solving these problems on a case-by- case basis, which is the only practical course.

Based on the existing requirements described above, this issue has been RESOLVED.

July 1981.

[6] Regulatory Guide 1.20, "Comprehensive Vibration Assessment Program for Reactor Internals during Preoperational and Initial Startup Testing," U.S. Nuclear Regulatory Commission, December 1971, (Rev. 1) June 1975, (Rev. 2) May 1976. [7907100101]