
Item B-19: Thermal-Hydraulic Stability (Rev. 1)

DESCRIPTION

Historical Background

The possibility of thermal-hydraulic instability in a BWR had been investigated by GE since the start-up of early BWRs. Analytical methods and codes were formulated on the basis of these early investigations to predict the stability characteristics of BWRs. Eventually, the licensing basis and analytical methods used by GE to evaluate the stability of BWRs were documented and presented in January 1977 in NEDO-21506.¹

Since 1977, significant effort has been expended on developing an understanding of BWR instability. Testing at operating BWRs has added to the information obtained from single channel and control rod oscillator tests in the early BWRs.² In addition, improved state-of-the-art thermal-hydraulic methods and fuel rod performance studies have permitted greater definition of the stability phenomenon and criteria for prevention of instability. Developments along these lines have resulted in updated methods and models for the assessment and evaluation of BWR stability limits for licensing purposes.³ However, recent data from a high-power-density foreign BWR unexpectedly indicated that scram protection based on the APRM signals would not necessarily prevent violation of the critical heat flux limits if local instabilities occur. As a result of these findings, the staff proposed the issuance of a Board Notification.⁴ This item was identified in NUREG-0471.⁵

At the request of the licensees, the NRC staff has reviewed two submittals and has recently approved TS changes for two BWRs to resolve the concerns related to the thermal-hydraulic stability in these plants.^{6,7}

Safety Significance

Hydrodynamic flow instabilities may occur in a BWR when two-phase flow exists in a channel with critical dimensions and particular flow parameters. The instability can cause power oscillations and lead to local violation of the critical heat flux.

Possible Solution

The proposed resolution is technical specifications that will restrict operation of the reactor in regions of potential thermal-hydraulic instability and/or provide for surveillance and corrective measures under conditions of marginal stability.

¹ NEDO-21506, "Stability and Dynamic Performance of the General Electric Boiling Water Reactor," General Electric Company, January 1977.

² Memorandum for D. Crutchfield from L. Rubenstein, "Staff Evaluation of GE Topical Report NEDE-24011 (GESTAR) Amendment 8," April 17, 1985. [8504290470]

³ XN-NF-691(P)(A) & Supplement 1, "Stability Evaluation of Boiling Water Reactor Cores Sensitivity Analyses & Benchmark Analysis," Exxon Nuclear Company, Inc., August 22, 1984.

⁴ Memorandum for D. Eisenhut from R. Mattson, "Board Notification—BWR Core Thermal Hydraulic Stability," February 27, 1984. [8403020299]

⁵ NUREG-0471, "Generic Task Problem Descriptions (Categories B, C, and D)," U.S. Nuclear Regulatory Commission, June 1978.

⁶ Memorandum for T. Novak from L. Rubenstein, "Susquehanna 1 and 2—Thermal Hydraulic Stability Technical Specification Change (TACS 55021 and 55022)," July 11, 1984. [8407170149]

⁷ Memorandum for G. Lainas from L. Rubenstein, "SER Input for Peach Bottom-3 Technical Specification Changes for Cycle 6 Operation with Increased Core Flows and Decreased Feedwater Temperatures (TACS #55123)," October 23, 1984. [8411010312]

CONCLUSION

Updated analytical methods and analyses based on the recent experimental results have been made available to address thermal-hydraulic instability concerns. These methods are being reviewed by the NRC staff to determine their acceptability for evaluating the stability of core designs and for delineating the power/flow regions of potential instability for which reactor operation will be restricted by appropriate modification of the plant TS.^{8,9} Based on a study performed by the staff, it was concluded that thermal-hydraulic stability does not pose an immediate safety concern for continued BWR operation prior to orderly examination and possible TS changes. In response to GE and GE Owners' Group recommendations, most licensees have either submitted revised stability TS or plan to do so. A generic letter will be issued by DL to the affected licensees.¹⁰ Thus, this issue has been RESOLVED and no new requirements were established.

⁸ Memorandum for T. Novak from L. Rubenstein, "Susquehanna 1 and 2—Thermal Hydraulic Stability Technical Specification Change (TACS 55021 and 55022)," July 11, 1984. [8407170149]

⁹ Memorandum for G. Lainas from L. Rubenstein, "SER Input for Peach Bottom-3 Technical Specification Changes for Cycle 6 Operation with Increased Core Flows and Decreased Feedwater Temperatures (TACS #55123)," October 23, 1984. [8411010312]

¹⁰ Memorandum for V. Stello from H. Denton, "Close Out Generic Issue #B-19—Thermal-Hydraulic Stability," May 21, 1985. [8506040556]

