



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATED TO AMENDMENT NO. 236 TO FACILITY OPERATING LICENSE NO. DPR-33,
AMENDMENT NO. 256 TO FACILITY OPERATING LICENSE NO. DPR-52,
AND AMENDMENT NO. 216 TO FACILITY OPERATING LICENSE NO. DPR-68
TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3
DOCKET NOS 50-259, 50-260, AND 50-296

1.0 INTRODUCTION

By application dated June 2, 1997, the Tennessee Valley Authority (TVA or the licensee) proposed changes to the Browns Ferry Nuclear Plant (BFN) Technical Specifications (TSs) relating to the reactor coolant recirculation system. The U.S. Nuclear Regulatory Commission's (NRC's) proposed action on the BFN application for an amendment was noticed in the Federal Register (FR) on August 13, 1997 (62 FR 43377). The licensee provided additional details by letter dated November 19, 1998, which did not expand the scope of the application as noticed in the above-cited FR notice, or affect the staff's proposed no significant hazards consideration determination.

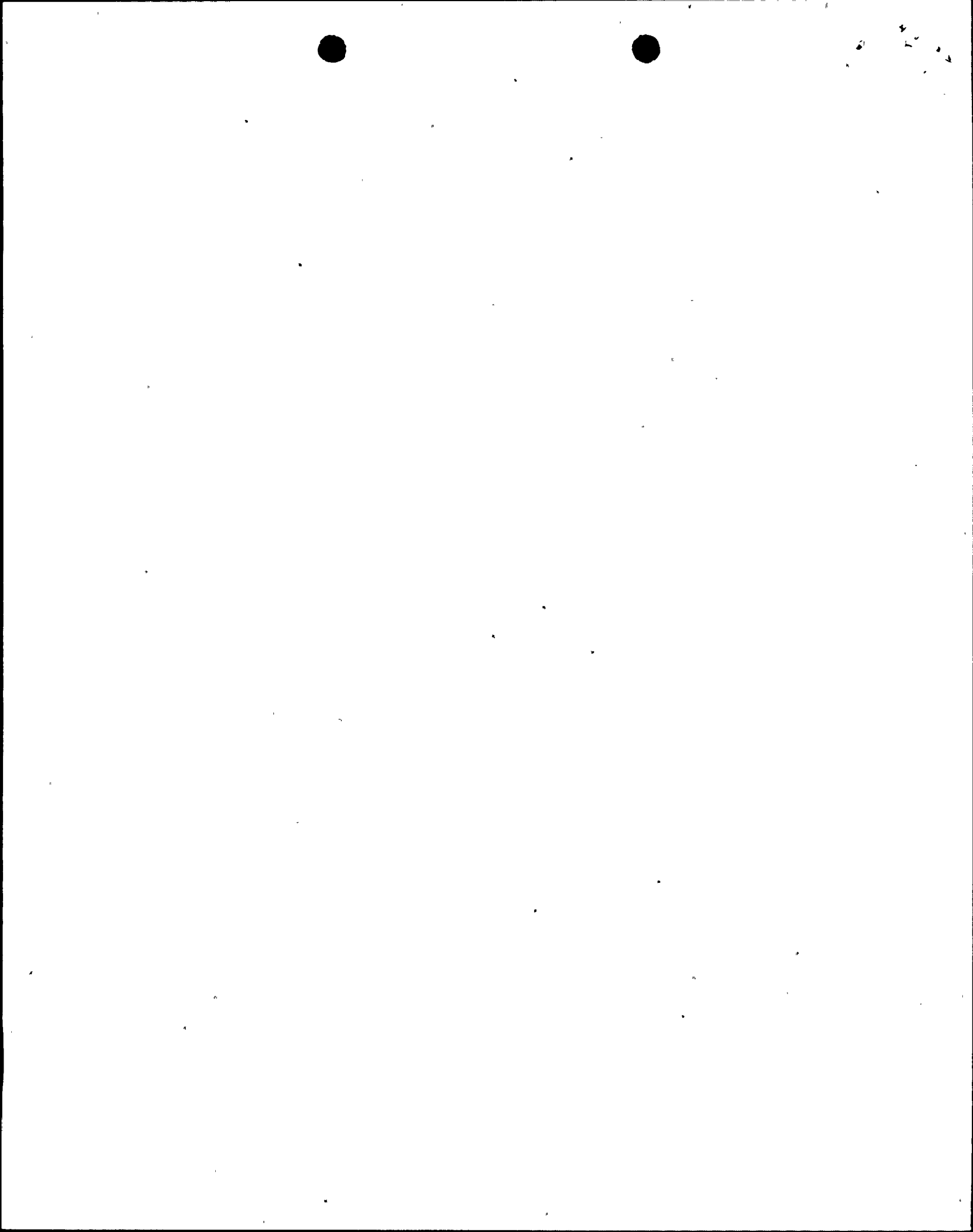
The reactor coolant recirculation system provides coolant flow through the reactor core to remove heat from the fuel. The recirculation system consists of two recirculation pump loops and drive units, each with a recirculation pump, and piping loop. During normal power operation both recirculation pumps operate at matched speeds and the forced recirculation flow removes more heat from the fuel than natural recirculation, and, thus, provides a means to control and change reactor power over a broad range. Presently, the improved TSs require both the recirculation loops to be operable and provide a 12-hour allowable outage time (AOT) for single loop operation (SLO) mode. For more operational flexibility considerations during potential loss of a recirculation loop due to component malfunction, TVA proposed TS changes that would allow indefinite SLO instead of the 12-hour AOT.

2.0 BACKGROUND

Power generation with a single recirculation loop in service is a recognized mode of operation for Boiling Water Reactors (BWRs). Reactor control and operation in single-loop is very similar to that in two-loop recirculation mode. The primary difference is that as the drive flow on the operating pump is increased, part of the total flow from the active jet pump loop will backflow through the inactive jet pumps. This effect reduces the net achievable core flow and limits the power level that can be achieved compared to two-loop operation.

The NRC previously disallowed this mode of operation for most plants. Accordingly, in general, TSs for BWRs required shutdown within several hours if one of the reactor coolant loops

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becomes inoperable. In BWRs, the staff primarily disallowed SLO because of jet pump vibration problems, and thermal-hydraulic stability at certain high thermal power and low core flow operating conditions. Subsequently, the NRC staff studied operation of BWRs and Pressurized Water Reactors with less than full reactor coolant flow (i.e, N-1 loop operation), under Generic Issue No. B-59. On March 31, 1986, the staff issued Generic Letter 86-09 to inform licensees that SLO would be acceptable provided operating limitations are imposed for the detection and suppression of thermal hydraulic instabilities.

3.0 EVALUATION

In support of its proposed SLO, the licensee evaluated its effects on the plant transient and accident analyses. In 1981, General Electric Company performed an analysis of the limiting operational transients for BFN, and documented its results in NEDO-24236, "Browns Ferry Nuclear Plants, Units 1, 2 and 3, Single Loop Operation," dated May 1981. This analysis has been previously approved by the NRC staff. Using this analysis, the licensee has recalculated the Safety Limit Minimum Critical Power Ratio (SLMCPR) during SLO for Units 2 and 3. The SLMCPR is established such that no fuel damage is calculated to occur during reactor transients. Based on the recalculation, the licensee revised TS 2.1.1.2 to specify a new safety limit for the Minimum Critical Power Ratio (MCPR) during SLO. The proposed TS 2.1.1.2 reads: "MCPR shall be ≥ 1.10 for two recirculation loop operation or ≥ 1.12 for single loop operation." The proposed safety limit for MCPR during SLO is based on staff approved methods and operation within the SLMCPR limits would ensure fuel clad integrity. The licensee will perform a cycle-specific analysis with SLO for Unit 1 prior to its restart. Based on industry experience, the NRC staff expects similar results for Unit 1 as those for Units 2 and 3. It should be noted that the Unit 1 license requires TVA to "...review the Technical Specification (TS) changes made by License Amendment No. 234 and any subsequent TS changes, and verify that the required analyses and modifications needed to support the changes are complete prior to entering the mode for which the TS applies."

SLO results in a backflow through the jet pumps in the idle recirculation loop and would affect the relationship between the core flow and recirculation drive flow. The core flow values are used in the Average Power Range Monitor (APRM) and Rod Block Monitor (RBM) setpoint equations. As a result, the licensee proposed changes to TS 3.3.1.1-1, to modify APRM and RBM setpoint equations to correct for the backflow during SLO and thus preserve the original relationship between the setpoints and the effective recirculation drive flow. The revised setpoint equations subtracts the contribution from the idle loop in the algorithm. This does not change the absolute magnitude of the trip or its function.

Average Planar Linear Heat Generation Rate (APLHGR) limits are established to ensure the acceptance criteria for fuel and Emergency Core Cooling Systems specified in 10 CFR 50.46 are met. The licensee performed an SLO Loss of Coolant Accident (LOCA) analysis using approved methodology and showed that, with the application of the proposed APLHGR multiplier, the LOCA peak clad temperature for SLO will always be lower than that for two-loop operation. Based on its analysis, the licensee proposed changes to TS 3.4-1, "Recirculation Loops Operating" to allow operation without matched flow from both recirculation loops. The proposed change prohibits operation in the stability regions I and II and requires that specific operating limits be established in the cycle-specific Core Operating Limits Report and resetting

APRM and RBM trip setpoints during SLO. These limits and trip setpoints would preclude plant operations in the regions of instability.

During Unit 1 preoperational tests including SLO, the licensee recorded vibration data during SLO and determined that all vibration responses would remain within acceptable limits. Further, current TS Surveillance Requirement 3.4.2.1 requires daily monitoring of jet pumps operability. This provides assurance that SLO would not result in any adverse vibration effects.

Based on the above discussion, the staff concludes that the proposed SLO operation with the proposed operating limits are adequate to detect and suppress thermal hydraulic instabilities. Further, the NRC staff reviewed the licensee's submittal and determined the licensee's analyses were based on NRC-approved methodologies. Therefore, the staff finds the licensee's proposed TS changes acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Alabama State official was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

These amendments involve a change in the installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendments involve no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendments involve no significant hazards consideration, and there has been no public comment on such finding (62 FR 43377). Accordingly, these amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

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