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SEP 23 1988

U.S. Nuclear Regulatory Commission
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Gentlemen:

In the Matter of	)	Docket Nos. 50-259
Tennessee Valley Authority	)	50-260
		50-296

BROWNS FERRY NUCLEAR PLANT (BFN) - MODERATE ENERGY LINE BREAK (MELB) FLOODING EVALUATION

In Volume III of the Nuclear Performance Plan for BFN, Section 14.2 of Revision 1, TVA committed to perform an evaluation of the effects of flooding due to breaks in moderate energy lines outside of primary containment and identifying appropriate corrective actions. In preparation for performing this evaluation TVA reviewed existing documentation that was submitted to the Atomic Energy Commission on this subject. The results of this review are contained in the attached report (Enclosure 1). In summary, this review established that the previous MELB flood evaluations are still valid for the current BFN design and that critical flood mitigating or limiting features are still incorporated in the plant design. Corrective actions were identified during the review concerning rework of cable splices and sealing of conduit penetrations. TVA has concluded that BFN continues to conform with the original licensing basis for MELB flooding and therefore additional evaluations are not warranted.

Summary statements of commitments contained in this submittal are provided in enclosure 2.

Please refer any questions concerning this submittal to Patrick Carier, BFN Site Licensing (205) 729-2689.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

R. Gridley, Manager
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Enclosures
cc: See page 2

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U.S. Nuclear Regulatory Commission

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ENCLOSURE 1
MODERATE ENERGY LINE BREAK (MELB) FLOODING REVIEW

SUMMARY REPORT

Section 14.2 of Volume 3 of the Nuclear Performance Plan states: "The effects of flooding due to breaks in moderate energy lines outside primary containment will be evaluated, and appropriate corrective action will be identified prior to unit 2 restart." This report summarizes the review conducted and the corrective actions being taken to resolve discrepancies found during the course of the review.

CONDUCT OF REVIEW

TVA reviewed the original MELB licensing bases for BFN Units 1, 2, and 3 and compared these bases to present day guidance in the Standard Review Plan. The licensing bases and present guidance are virtually the same. A review of the original docketed studies was then conducted to ensure that these studies were still valid. Finally a review of modifications, implemented since these studies, was performed to determine if critical plant features had been affected. Critical features were found to be unaffected by subsequent modifications.

ORIGINAL LICENSING BASES

The original licensing bases for BFN are contained in two letters from the Atomic Energy Commission (AEC) dated August 11, 1972 and December, 1972 (References 1 and 2) and amendment 40 to the FSAR. The Standard Review Plan 3.6.1 and its attached Branch Technical Position (BTP) ASB 3-1 provide present day guidance for licensees and endorses the December 1972 AEC letter discussed above.

TVA provided their response on pipe break in two reports (references 4 and 5) and amendment 40 to the FSAR. The TVA plans were acknowledged in supplement 3 to the SER dated July 9, 1973 for BFN Units 1, 2, and 3. Supplement 6 to the SER dated June 28, 1974 approved exemptions for unit 2 operation before the first refueling outage.

FLOODING EVALUATION

The August 11, 1972 AEC letter, requested that BFN be evaluated for the effects of low pressure pipe failures outside of containment. Analyses were made by TVA, including the effects of certain nonqualified piping failures on plant shutdown capabilities. The findings of these analyses were documented and transmitted to the AEC by BFN FSAR Amendment 40, Response 10.1. The intent of the original evaluations was to define a bounding case for internal flooding in Class I structures, demonstrate the ability to achieve and maintain shutdown given the bounding case and to concentrate on evaluating safety related electrical equipment (mainly electrical boards) which had piping routed in the vicinity of the equipment. The areas of the plant evaluated for failures in pressure boundaries of fluid systems were the Reactor Building, the Diesel Generator Building, the Intake Pumping Station, the Turbine Building, the Service Building, the Radwaste Building, the Off-Gas Building and the Stack.

The evaluation determined that failures in the pressure boundaries of liquid systems in the Turbine Building, the Service Building, the Radwaste Building, the Off-Gas Building, the Stack and the Diesel Generator Building would not prevent a safe shutdown of the plant. This determination was based on:

1) No engineered safety systems are located inside these areas that are susceptible to flooding and that are required for safe shutdown.

2) Adequate flood protection measures were incorporated into the design of these structures. Credit was taken for sumps, flood seals, drainage systems and consideration in the design of maximum probable river flood levels.

For the Intake Pumping Station the loss of the residual heat removal service water (RHRSW) pumps, which could prohibit a safe shutdown of the plant, was not considered credible for the following reasons:

1. The high walls forming the four compartments around the RHRSW pumps provide protection against natural phenomena such as tornado and wind waves in conjunction with river floods (probable maximum flood plus waves from 45 mph winds).

2. Failures in the pressure boundaries of the water systems inside one compartment will not cause the water to overflow into an adjacent compartment because the wall design is such that the water preferentially overflows the rear wall (rear walls are one foot lower than other walls). A single failure resulting in the loss of three pumps in one compartment would not prevent the safe shutdown of the plant.

3. Cables that serve the RHRSW/EECW equipment and are located in the interior compartments of the Intake Pumping Station and the cable tunnel were considered qualified for submergence provided that the cables did not have junctions in areas subjected to the maximum river flood.

The circuits for the RHRSW/EECW equipment are routed through areas subjected to submergence due to either a flood of the river or a pipe break in the lower common compartment. TVA recognized that these cables could be inundated with water during a flood. Therefore, the designers ensured that there were no junctions in the RHRSW pump cables routed through intake pumping station elevations subject to flood water inundation. However, the original study did not consider auxiliary equipment necessary to ensure RHRSW/EECW operability. Consequently, additional evaluations have been made for the cables for support equipment.

For the Reactor Building the bounding case for internal flooding is the draining of one condensate storage tank and the suppression chamber into one unit's reactor zone.

During such an event the unit's Residual Heat Removal (RHR) systems were considered to completely fail due to water inundation. Credit was taken for the Standby Coolant Supply System and the unit RHR crossties to provide continued core cooling for this scenario. The standby coolant supply connections and RHR crossties are provided to maintain long-term core and primary containment cooling capability irrespective of primary containment integrity or operability of the RHR system associated with a given unit.

In summary, the original flooding study took credit for the Standby Coolant Supply System and the unit RHR crossties in providing the means for safe shutdown for the most limiting flooding event in the Reactor Building. TVA was able to conclude that all other pipe breaks would result in less adverse consequences than the bounding case because: (1) the Reactor Building is designed in such a manner that water from pipe breaks in the upper elevations of the building would ultimately flow to the basement through open passages (i.e., stairwells, hatchways, doorways, etc.) or floor drain pipes; (2) transient buildup of water in individual compartments in the upper elevations would be limited to inconsequential amounts since passive type drainage paths were available to route flood water to the lower elevations where flood level switches and sump pump actuations would alert the operators to take remedial actions to stop the flow out of a pipe break; (3) flooding from the Turbine Building into the Reactor Building was not a consideration since flood seals were provided between the buildings up to elevation 572.5, and (4) flooding would be limited to one reactor zone (i.e., a single unit) because flood seals are provided between reactor zones up to elevation 565. These features allowed TVA to conclude that adequate protective measures were provided to detect and mitigate the effects of all moderate energy pipe breaks within the confines of the Reactor Building.

CURRENT CONFORMANCE

To ensure that plant modifications have not invalidated the conclusions of the original flood evaluation, a review was made of each area. As an example for the Reactor Building, the review verified that a moderate energy line break will not preclude the operators ability to shutdown the plant in the event of a through wall crack in the largest flowrate moderate energy line as specified in BTP ASB 3-1. Using the estimated maximum inleakage rate for each elevation, the flood level estimations for each floor elevation above elevation 519 were limited to 6 inches or less by the major drainage paths that route the water to elevation 519. It was assumed that a flood level of six inches would not damage essential equipment because essential equipment is normally placed on an equipment foundation. Therefore, for the building areas above elevation 519 the drainage paths to elevation 519 adequately limited flood levels to six inches or less and essential equipment in these areas would not be damaged.

Since all reactor building flood waters would ultimately end up on elevation 519, a review was made to ensure that flooding on this elevation would be detected and that adequate time would be available for the operator to stop the inleakage and to shutdown the plant. The review of the physical piping drawings revealed that Emergency Core Cooling System components on elevation 519 would not be damaged by flood waters until the water level reached elevation 521. Using the worst case line break inleakage rate, it was estimated that the reactor building floor drain sumps and flood level switches would alarm in the main control room within eight minutes. Upon flood level alarm actuation, the operator would refer to the appropriate procedures to achieve and maintain the reactor shutdown. The operator would have at least one hour to stop the flooding and initiate shutdown before essential Class I equipment in the affected unit was damaged. If essential safe shutdown equipment in the affected area was damaged, the operator could use the RHR crossties to provide coolant to the reactor from the adjacent unit.

It is concluded that for flooding due to the worst case moderate energy line break in any portion of the unit 2 Reactor Building, safe shutdown of the plant can be achieved because of the equipment protection provided by the drainage paths to elevation 519, the elevation 519 flood detection equipment, the RHR cross tie equipment, and appropriate procedures. Although a detailed review of unit 1 and 3 was not made, it is assumed that an argument similar to unit 2 could be made for each of these units because they are equipped with (1) large drainage paths to route flood waters down to elevation 519, (2) flood detection equipment on elevation 519, and (3) RHR crossties for providing coolant to the reactor from an adjacent unit. The review also indicated that plant modifications have not affected the critical features of the original evaluation.

For the design bases flood the RHRSW intake pumping station and cable tunnel are postulated to remain flooded for a maximum of five and one-half days. An inspection and evaluation was conducted to assure that cable and conduit related to equipment in the RHRSW intake pumping station and cable tunnel would not be subject to submergence or were qualified/sealed for submergence. All reviewed cables were determined to be qualified for submergence or in the process of being replaced, for other reasons, with qualified cable. Three splices subject to submergence were found in the RHRSW control cables.

Documentation could not be found to verify that the splices were correctly installed and they are therefore being replaced. Six conduits between the Intake Pumping Station Compartment were not sealed. These will be sealed prior to restart.

All cables discussed above are qualified for wet or dry conditions. The only failure mechanism under submergence conditions identified for the power cables is electrochemical treeing which occurs after long periods (usually 10 years or greater) of submergence while continuously energized and lightly loaded. Since no evidence of significant submergence was found and submergence during postulated events will not exceed five and one-half days this is not a concern at BFN.

CONCLUSIONS

Our review has established that the previous flooding and MELB evaluations are still valid for the current BFN design and that critical flood mitigating or limiting features are still incorporated in the plant design. An inspection of RHRSW pump and auxiliary equipment power and control cables established that this equipment would remain operational under MELB and flood conditions. The only corrective actions necessary are the reworking of the three splices identified in the RHRSW pump control cables and sealing of intercompartment conduit penetrations. TVA has concluded that BFN continues to conform with the original licensing basis for moderate energy line break flooding and therefore, additional evaluations are not warranted.

Enclosure 2

List of Commitments

1. Three RHRSW pump control cable splices will be reworked to ensure their operation in a submerged condition for the duration of a probable maximum river flood.

2. The conduit penetrations between compartments in the intake pumping station will be sealed.

   This work will be complete before restart of unit 2.

REFERENCES

1. AEC letter from Roger S. Boyd to J. E. Watson (TVA) dated August 11, 1972

2. AEC letter from A. Giambusso to Licenses dated December, 1972, regarding Pipe Breaks outside of Containment

3. AEC letter from J. F. O'Leary to Licensees dated July 12, 1973, regarding postulated piping failures outside containment

4. Concluding Report on the Effects of Postulated Pipe Failure Outside of Containment for Unit 1 of Browns Ferry Nuclear Plant DED-TM-PFI submitted November 2, 1973

5. Concluding Report on the Effects of Postulated Pipe Failure Outside of Containment for Units 2 and 3 DED-TM-PF2 submitted March 29, 1974

6. Amendment 40 to the FSAR