Tennessee Valley Authority, Post Office Box 2000, Decatur, Alabama 35609-2000

August 1, 2002

TS-419

10 CFR 50.90

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop: OWFN P1-35
Washington, D.C. 20555-0001

Gentlemen:

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

BROWNS FERRY NUCLEAR PLANT (BFN) - UNITS 1, 2, AND 3 - LICENSE AMENDMENT REQUEST - DELETION OF PRESSURE REGULATOR DOWNSCALE FAILURE (PRDF) AS AN ABNORMAL OPERATIONAL TRANSIENT

In accordance with the provisions of 10 CFR 50.59 and 50.90, TVA proposes to amend Facility Operating Licenses DPR-33, DPR-52, and DPR-68. Specifically, TVA requests approval to change the BFN design and licensing basis as described in Section 14.5.2.8 of the Updated Final Safety Analysis (UFSAR) to eliminate consideration of a PRDF event as an Abnormal Operational Transient (AOT).

TVA recently upgraded the main turbine electro-hydraulic control (EHC) system, which provides the reactor pressure regulation function, to a fault-tolerant digital control system. This modification was completed on Units 2 and 3 during their last refueling outages. The reliability of this upgraded EHC system is such that a system failure that results in the simultaneous closure of all turbine control valves is not an anticipated failure and, hence, the PRDF transient no longer merits consideration as an AOT.

BFN Unit 1 is currently defueled and will be similarly modified prior to returning to power operation. Therefore, TVA is also requesting this amendment be approved for Unit 1 based on the enclosed commitment to modify the Unit 1 EHC system.

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Enclosure 1 to this letter provides the description and evaluation of the proposed change, and includes TVA's determination that the proposed change does not involve a significant hazards consideration and is exempt from environmental review. Enclosure 2 is a marked-up copy of the UFSAR showing the proposed change, which removes PRDF as an evaluated AOT. Enclosure 3 lists the commitment to modify the Unit 1 EHC system.

The BFN Plant Operations Review Committee and the BFN Nuclear Safety Review Board have reviewed this proposed amendment and determined that operation of BFN Units 1, 2, and 3 in accordance with the proposed change will not endanger the health and safety of the public. TVA has determined that there are no significant hazards considerations associated with the proposed change and that the change is exempt from environmental review pursuant to the provisions of 10 CFR 51.22(c)(9). Additionally, in accordance with 10 CFR 50.91(b)(1), TVA is sending a copy of this letter and enclosures to the Alabama State Department of Public Health.

TVA requests approval for this amendment as soon as practicable and that it be made effective immediately. This will allow TVA to close a related corrective action document in a timely manner.

If you have any questions about this change, please telephone me at (256) 729-2636.

Sincerely,

T. E. Abney
Manager of Licensing
and Industry Affairs

cc: See Page 3

Subscribed and sworn to before me
on this 1st day of August, 2002

Barbara A. Blanton
Notary Public

My commission Expires 09/22/2002

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ENCLOSURE 1
TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 1, 2, AND 3

TS-419

PROPOSED LICENSE AMENDMENT FOR DELETION OF PRESSURE REGULATOR DOWNSCALE FAILURE (PRDF) AS AN ABNORMAL OPERATIONAL TRANSIENT

DESCRIPTION AND EVALUATION OF THE PROPOSED CHANGE

I. DESCRIPTION OF CHANGE

In accordance with the provisions of 10 CFR 50.59 and 50.90, TVA proposes to amend Facility Operating Licenses DPR-33, DPR-52, and DPR-68. Specifically, TVA requests approval to change the Browns Ferry Nuclear Plant (BFN) design and licensing basis as described in Section 14.5.2.8 of the Updated Final Safety Analysis (UFSAR) to eliminate consideration of the Pressure Regulator Downscale Failure (PRDF) event as an Abnormal Operational Transient (AOT).

The proposed change to UFSAR section 14.5.2.8 is provided below. Enclosure 2 contains a marked-up copy of the UFSAR change.

UFSAR section 14.5.2.8 is currently worded as follows:

> 14.5.2.8 Pressure Regulator Failure
>
> Malfunctions of the pressure regulation function of the turbine control system that result in the turbine steam flow shutoff and a nuclear system pressure increase are similar to but of milder consequence than the generator trip described previously.

The proposed rewording is (NRC amendment references will be added following NRC approval):

> 14.5.2.8 Pressure Regulator Failure
>
> Approval to remove the pressure regulator downscale failure event as an abnormal operational transient was approved by license Amendment Nos. DPR-xxx [add numbers] by NRC on [include approval date] based on the installation of a fault-tolerant electro-hydraulic turbine control system on Units 2 and 3, and a commitment to similarly modify Unit 1 prior to return to power operation. The reliability of the upgraded electro-hydraulic control system is such that a system failure that results in the simultaneous closure of all turbine control valves is not an anticipated failure and, hence, the PRDF transient no longer merits evaluation as an AOT.

II. BACKGROUND AND REASON FOR THE PROPOSED CHANGE

TVA is requesting a change to the licensing basis to resolve a discrepancy that currently exists between the UFSAR and the bounding UFSAR Chapter 14 transient analyses that are performed for BFN. This discrepancy was identified during

review of General Electric (GE) Services Instruction Letter (SIL) 614, Revision 0, "Backup Pressure Regulator" (Reference 1) and Revision 1 to the SIL (Reference 2). In SIL 614, GE confirmed that PRDF transients initiated from full power are bounded by other transients (such as the turbine/generator trip AOTs). This is consistent with Section 4.5.2.8 of BFN's UFSAR, which states that PRDF events are milder than generator trip events. The SIL goes on to indicate, however, that PRDF events from reduced powers may not be bounded by the other transients. Accordingly, a BFN corrective action document (PER 00-12276) was initiated to resolve this discrepancy.

TVA subsequently implemented a major main turbine control system design change on Units 2 and 3, which replaced the originally installed analog-based electro-hydraulic control (EHC) system with a upgraded digital EHC system. This modification was made to improve overall plant reliability and address equipment obsolescence issues related to the analog EHC system. A primary attribute of the upgraded EHC system was its highly fault-tolerant design, which also provides a sound technical basis for justifying the elimination of the PRDF event as an AOT. Therefore, to resolve the UFSAR discrepancy cited in the corrective actions document, we are herein requesting a License Amendment to modify the UFSAR to formally remove the PRDF event from consideration as an AOT. This action plan provides the most economical and technically appropriate resolution to the nonconforming condition.

III. BASIS FOR CHANGE

The safety objective of the transient analyses in UFSAR Chapter 14.4 is to demonstrate that for expected AOTs, unacceptable safety results will not occur. AOTs are the result of single equipment failures or single operator errors that can be reasonably expected during any mode of plant operation. One of the postulated equipment failures is the malfunction or maloperation of any single control device. The current BFN UFSAR includes PRDF as an expected failure which can result in a nuclear system pressure increase transient.

The PRDF event as characterized in the UFSAR is a malfunction of the pressure regulation function of the turbine control system that results in steam flow shutoff and a pressure increase similar to, but milder in consequence than a generator trip. The most severe PRDF event could cause total reactor steam flow demand to decrease to zero resulting in the closure of the main

turbine control valves (TCVs) by the servo valves while at the same time generating no signal to open bypass valves. Reactor pressure would increase resulting in void collapse and increase in neutron flux. A reactor scram would occur due to high reactor pressure or high neutron flux. A principal difference between the PRDF event and a generator trip is that the scram signal is initiated at a later time in the PRDF event from increasing reactor pressure or neutron flux, whereas for the generator trip type events, a direct scram signal is initiated from closure of turbine stop or control valves early in the transient.

A. DESCRIPTION OF ORIGINAL EHC DESIGN

The previous turbine control (EHC) system consisted of two independent pressure sensing loops connected to the turbine steam supply header and the associated separate pressure setpoint controllers. These independent controllers each generated a steam flow demand with a small pressure bias difference. The two demand signals were applied to a series of high/low value gates, which selected the higher of the two demand signals to control the TCVs and main turbine bypass valves. This system design ensured that for the majority of possible EHC control system failures, such as pressure sensing loops failures, that the control system responded by opening the turbine valves. This system design response avoided closing turbine valves, which reduced the likelihood of steam system transients that result in significant nuclear system pressure increases. Only limited portions of the original EHC system could fail in such a manner as to demand closure of the TCVs.
However, with one of the individual pressure controllers out-of-service, commonly referred to as operation with one pressure regulator out-of-service or operation without a backup regulator, failure modes that could result in a PRDF event are increased. Avoidance of this mode of operation was the subject of GE SIL 614.

B. DESCRIPTION OF UPGRADED EHC SYSTEM

An upgraded EHC system was installed on Units 2 and 3 during their most recent refueling outages. The upgraded EHC system is a micro-processor based control system, which handles both the turbine trip and control functions, as well as primary system pressure regulation. A separate similar control system serves the turbine bypass valves. The modified turbine control system is a highly fault-tolerant design such that

failure of an individual component cannot cause more than one TCV to close unless it is associated with a turbine trip. A summary system description of the upgraded EHC design is provided in Section 7.11.4 of the UFSAR.

Fault-tolerant design is accomplished by the employment of three micro-processors which utilize 2-out-of-3 voting logic to validate inputs (such as reactor pressure) and outputs (such as control valve position demand). An additional pressure control mode was added using four reactor pressure instrument channels as inputs to the pressure regulation function. The pressure control mode of the previous EHC system using two steam line header pressure instrument channels is also included. With the large number of pressure instrument channels provided, the need to operate with only one pressure input (operation without a backup pressure regulator) is virtually eliminated when compared to the original EHC design.

C. JUSTIFICATION FOR ELIMINATION OF PRDF AS AN AOT

The fault-tolerant design of the upgraded EHC system justifies elimination of the PRFD event as an expected failure. During normal plant operation with all EHC components in service, there are no single component failures which would cause more than one TCV to close without an accompanying turbine trip. Additionally, the availability of the larger number of pressure sensing instrument channels in the upgraded EHC system greatly reduces the likelihood of operating with the pressure regulation function of the EHC in a degraded mode such as that described in SIL 614.

In conclusion, the reliability of the upgraded EHC system is such that an EHC system failure that results in the simultaneous closure of all TCVs is not an anticipated failure and, hence, the PRDF transient no longer merits evaluation as an AOT. TVA is also requesting that this amendment be approved for Unit 1 based on the commitment in Enclosure 3 to upgrade the BFN Unit 1 main turbine EHC system to a fault-tolerant digital control system prior to return to power operation.

D. REGULATORY PRECEDENT

Regarding regulatory precedent, in letters to NRC dated October 14, 1998 (Reference 3), August 13, 1999 (Reference 4), September 17, 1999 (Reference 5), and October 22, 1999 (Reference 6), GE requested, for the BWR-6 line of reactors, removal of the PRDF event as an analyzed anticipated operational occurrence based on the remoteness of occurrence frequency. NRC approved the change in classification in the March 29, 2000, Safety Evaluation for Amendment 26 to NEDE-24011-P-A, GESTAR II (Reference 7). The NRC Safety Evaluation agreed that the expected frequency of occurrence of the single initiating event was below the moderate frequency event definition and, therefore, the PRDF could be considered an infrequent event. The BFN upgraded EHC system, also provided by GE, has an increased level of fault-tolerance compared to the original two pressure regulator system design. NEDE-24011-P-A, GESTAR II does not have an analogous PRDF requirement for the BWR-4 designs, therefore, no NEDE changes are needed in this regard.

IV. NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION

TVA is submitting a license amendment to the Browns Ferry Nuclear Plant (BFN) design basis as described in the Updated Final Safety Analysis (UFSAR) to eliminate the consideration of a Pressure Regulator Downscale Failure as an Abnormal Operational Transient. TVA has concluded that operation of BFN Units 1, 2, and 3 in accordance with the proposed design basis change does not involve a significant hazards consideration. TVA's conclusion is based on its evaluation, in accordance with 10 CFR 50.91(a)(1), of the three standards set forth in 10 CFR 50.92(c).

A. The proposed amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.

The proposed amendment involves a change in transient analysis assumptions and does not change the plant or the manner in which it is operated. Therefore, the amendment has no affect on the probability of an accident. The proposed amendment is based upon upgrades and reliability improvements made to the main turbine generator electro-hydraulic control system, which render the analysis of a Pressure Regulator Downscale Failure event and consideration of the associated consequences

unnecessary. Therefore, the proposed amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.

B. The proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

The proposed amendment involves a change in transient analysis assumptions and does not change the plant or the manner in which it is operated. The only event affected, the Pressure Regulator Failure Downscale transient, is of a type already considered. Therefore, the proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

C. The proposed amendment does not involve a significant reduction in a margin of safety.

The proposed amendment eliminates the consideration of the Pressure Regulator Downscale Failure event as an abnormal operational transient based on the low likelihood of occurrence of such an event due to improvements in the system design of the main turbine electro-hydraulic control system. Other abnormal operational pressurization transients as described in the UFSAR will continue to be analyzed and ensure required margins of safety to fuel thermal limits are maintained. Therefore, the proposed amendment does not involve a significant reduction in a margin of safety.

In conclusion, the proposed amendment does not adversely affect the public health and safety, and does not involve any significant safety hazards.

V. ENVIRONMENTAL IMPACT CONSIDERATION

The proposed change does not involve a significant hazards consideration, a significant change in the types of or significant increase in the amounts of any effluents that may be released offsite, or a significant increase in individual or cumulative occupational radiation exposure. Therefore, the proposed change meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), an environmental assessment of the proposed change is not required.

VI. REFERENCES

1. General Electric (GE) Service Instruction (SIL) No. 614, Backup Pressure Regulator, Revision 0, November 5, 1997.

2. GE SIL No. 614, Backup Pressure Regulator, Revision 1, March 15, 1999.

3. GE Letter to NRC dated October 14, 1998, Proposed Revision of GESTAR II to Clarify Classification of Pressure Regulator Downscale Failure Event..

4. GE Letter to NRC dated August 13, 1999, Amendment 26 to GE Topical Licensing Report NEDE-24011-P-A (GESTAR II) for (1) Clarifying Classification of BWR 6 Pressure Regulator Failure Downscale Event, (2) Implementing Improved Steady State Methods, and (3) Incorporation of BWROG Approved Stability Options.

5. GE Letter to NRC dated September 17, 1999, Additional Information Regarding Amendment 26 to NEDE-24011-P-A (GESTAR II).

6. GE Letter to NRC dated October 22, 1999, Review of Amendment 26 to GESTAR II.

7. NRC Letter to GE dated March 29, 2000, Amendment 26 to GE Nuclear Energy Licensing Topical Report NEDE-24011-P-A (GESTAR II) - Clarifying Classification BWR-6 Pressure Regulator Failure Downscale Event (TAC No. MA6481).

ENCLOSURE 2
TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 1, 2, AND 3

TS-419

PROPOSED LICENSE AMENDMENT FOR DELETION OF PRESSURE REGULATOR DOWNSCALE FAILURE (PRDF) AS AN ABNORMAL OPERATIONAL TRANSIENT

MARKED-UP UPDATED FINAL SAFETY ANALYSIS PAGE

ENCLOSURE 3
TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 1, 2, AND 3

TS-419

PROPOSED LICENSE AMENDMENT FOR DELETION OF PRESSURE REGULATOR DOWNSCALE FAILURE (PRDF) AS AN ABNORMAL OPERATIONAL TRANSIENT

COMMITMENT LISTING

Prior to return to power operation, the BFN Unit 1 main turbine electro-hydraulic control system will be upgraded to a digital fault-tolerant design similar to that installed on Units 2 and 3.

The calculated peak bottom vessel pressure is 1234 psia for BFN specific MSIV closure characteristics and is still below the 1375 psig ASME overpressure limit.

14.5.2.7.2 Closure of One Main Steam Isolation Valve

14.5.2.7.2.1 Transient description

Closure of only one isolation valve without scram is permitted for testing purposes. Normal procedures for such a test will normally require an initial power reduction to about 80-90 percent in order to avoid high flux or pressure scram or high steam flow isolation from the active steam lines. During the transient from full power, the steam flow disturbance may raise vessel pressure and reactor power resulting in a high neutron flux scram.

14.5.2.7.2.1 Initial Conditions and Assumptions

This transient has been analyzed with ODYN at 102 percent of rated power, 105 percent of rated core flow (ICF conditions), and EOC exposure. The exposure used has been EOC because the top peaked axial power shape degrades the effectiveness of rod insertion during the reactor scram.

A typical value of 60 psid pressure drop in the steam line is assumed in the analysis. An increase in the steam line pressure drop has a small impact on the results and does not require a re-analysis of this event as long as this event remains a non limiting transient.

14.5.2.7.2.1 Interpretation of Transient Results

Figures 14.5-12a and b illustrate this transient. The steam flow disturbance raises vessel pressure and reactor power causing a high neutron flux scram at about 4 seconds; the peak neutron flux reaches 131 percent of rated. The peak surface heat flux reaches about 110 percent of rated. Peak steam line pressure (1113 psia) remains below the setting of the lowest MSRVs. Peak vessel pressure (1155 psia) remains below the 1375 psig ASME overpressure limit. The peak fuel parameters are well below those from the limiting pressurization transient (LRNBP).

14.5.2.8 Pressure Regulator Failure

Malfunctions of the pressure regulation function of the turbine control system that result in the turbine steam flow shutoff and a nuclear system pressure increase are similar to but of milder consequence than the generator trip described previously.

INSERT

insert

Approval to remove the pressure regulator downscale failure event as an abnormal operational transient was approved by license Amendment Nos. DPR-xxx [add numbers] by NRC on [include approval date] based on the installation of a fault-tolerant electro-hydraulic turbine control system on Units 2 and 3, and a commitment to similarly modify Unit 1 prior to return to power operation. The reliability of the upgraded electro-hydraulic control system is such that a system failure that results in the simultaneous closure of all turbine control valves is not an anticipated failure and, hence, the PRDF transient no longer merits evaluation as an AOT.

ENCLOSURE 3
TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 1, 2, AND 3

TS-419

PROPOSED LICENSE AMENDMENT FOR DELETION OF PRESSURE REGULATOR DOWNSCALE FAILURE (PRDF) AS AN ABNORMAL OPERATIONAL TRANSIENT

COMMITMENT LISTING

Prior to return to power operation, the BFN Unit 1 main turbine electro-hydraulic control system will be upgraded to a digital fault-tolerant design similar to that installed on Units 2 and 3.