November 04, 2005

TVA-TS-447

10 CFR 50.90

U.S. Nuclear Regulatory Commission
Mail Stop: OFWN P1-35
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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 - TECHNICAL SPECIFICATIONS (TS) CHANGE TS-447 SECOND REQUEST FOR ADDITIONAL INFORMATION (RAI) - EXTENSION OF CHANNEL CALIBRATION SURVEILLANCE REQUIREMENT PERFORMANCE FREQUENCY AND ALLOWABLE VALUE REVISION (TAC NOS. MC4070, MC4071, and MC4072)

On August 16, 2004, TVA submitted a license amendment request (TS-447, ADAMS accession number ML04237061) to extend the calibration surveillance frequency for the high pressure coolant injection (HPCI) system, reactor core isolation cooling (RCIC) system, and reactor water clean-up (RWCU) system high area temperature isolation instrument channels on BFN Units 1, 2, and 3. On January 10, 2005, NRC informed TVA via memo (ADAMS accession number ML043640556) that additional information was required in support of the requested amendments. On March 11, 2005, TVA provided a response (ADAMS accession numbers ML050770370 and ML050770379) to this RAI. TVA's response addressed the specific NRC RAI questions, and additionally provided excerpts from relevant instrument scaling and setpoint engineering calculations and a copy of the TVA nuclear program instrument setpoint methodology document.

On August 15, 2005, NRC informed TVA via memo (ADAMS accession number ML052130135) of two additional RAI questions. The enclosures to this letter provide TVA's response to these most recent RAI questions. This letter provides additional information only, and no information in the original submittal nor the previous RAI response is being revised. The proposed finding of no significant hazards considerations and environmental impact consideration as submitted in TVA's August 16, 2004 letter remain valid.

While the TS allowable value determinations for the instruments affected by TS 447 were made using ISA Method 3, none of these instruments perform a function related to the protection of a Technical Specifications safety limit. Therefore, none of these instruments implement a limiting safety system setting (LSSS) function. As such, it is TVA's position that no actions related to resolution of the current Method 3 discussion apply to this submittal.

Good ALARA and industrial safety practices for plant personnel are negatively impacted by the current calibration intervals, and these impacts are significant, as stated in both of TVA's prior submittals. Therefore, TVA requests NRC approval of TS-447 as soon as possible. TVA also requests that the implementation of the revised TS be within 60 days of NRC approval.

There are no regulatory commitments associated with this submittal. If you have any questions about this change, please contact me at (256)729-2636 or Paul Heck at (256)729-3624.

Sincerely,

Original signed by:

William D. Crouch
Manager, Site Licensing
and Industry Affairs

Enclosure:

1. TS-447 RAI response – August 15, 2005 RAI
2. Calculation methodology overview

cc: See page 3

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ENCLOSURE 1

BROWNS FERRY (BFN) TS-447 REQUEST FOR ADDITIONAL INFORMATION (RAI)
Response to the August 15, 2005 RAI

1.0 BACKGROUND INFORMATION AND RAI SUMMARY

TVA's August 16, 2004 letter (Reference 1) requested amendments to Operating Licenses DPR-33, DPR-52, and DPR-68 for BFN Units 1, 2, and 3, respectively. The proposed changes are to revise the operating licenses to extend the performance frequency of required calibration surveillance testing on instrumentation channels associated with high area temperature system isolation of the high pressure coolant injection (HPCI), reactor core isolation cooling (RCIC), and reactor water clean-up (RWCU) systems. Allowable values for the trip setpoints for some of these channels would also be revised. The Technical Specifications (TS) currently require performance of these calibration activities on a more frequent interval than is technically necessary, and the continued performance of these calibrations on the current frequency is contrary to both ALARA principles and good industrial safety practices.

NRC's January 10, 2005 letter to TVA (Reference 2) stated that additional information was necessary to allow proper review of this request. TVA's March 11, 2005 letter (Reference 3) provided this additional information to NRC. NRC then, on August 15, 2005, notified TVA via memo that further additional information was required. The text from this second RAI which specifically details NRC's questions is quoted below for ease of reference:

1. *Generic Letter (GL) 91-04, Changes in Technical Specification Surveillance Intervals to Accommodate a 24-Month Fuel Cycle, provides guidance for extending the calibration surveillance interval from 92 and 122 days to 24 months. It should be noted that GL 91-04 was developed to be used when the plant fuel cycle was increased from 18 to 24 months. Since this request increases the test interval 6 to 8 times the original test interval, there may be failure modes which may not be detected because of an increased test interval. This may pose a greater hazard caused by common mode failure creating an increase in risk. Therefore:*
   - *provide an explicit description of the analyses, analyses results, and acceptance criteria used, including a discussion on the acceptability of using the methodology described in the GL, used in your evaluation; and*
   - *demonstrate that extended surveillance test intervals will not significantly increase the probability that the instruments will be unable to perform their safety function including providing the capability for safe shutdown.*

2. *Pages E-3 and E-4 of your application state that "necessary modifications will be completed to make the Unit 1 hardware configuration essentially identical to that on Units 2 and 3." For the affected instruments, explain what is meant by essentially identical. Identify any physical differences among the three units' equipment, which could affect the instrument drift analyses and provide justification for continued acceptability assuming a 24-month (+ 25 percent) test interval.*

Each of these areas are addressed below.

2.0 TVA RAI RESPONSE

Quoting from the NRC August 15, 2005 letter to TVA:

1. *Generic Letter (GL) 91-04, Changes in Technical Specification Surveillance Intervals to Accommodate a 24-Month Fuel Cycle, provides guidance for extending the calibration surveillance interval from 92 and 122 days to 24 months. It should be noted that GL 91-04 was developed to be used when the plant fuel cycle was increased from 18 to 24 months. Since this request increases the test interval 6 to 8 times the original test interval, there may be failure modes which may not be detected because of an increased test interval. This may pose a greater hazard caused by common mode failure creating an increase in risk. Therefore:*

   - *provide an explicit description of the analyses, analyses results, and acceptance criteria used, including a discussion on the acceptability of using the methodology described in the GL, used in your evaluation; and*

   - *demonstrate that extended surveillance test intervals will not significantly increase the probability that the instruments will be unable to perform their safety function including providing the capability for safe shutdown.*

TVA response:

The most simple and succinct argument supporting the acceptability of the extended instrument calibration intervals requested in TS-447 is that BFN has similar instrument loops in service, exhibiting good performance, that are already being calibrated on 24-month intervals. The setpoints and allowable values for these in-service instruments were established with the same methodology used in establishing the allowable values, assuming a 24-month calibration interval, requested in TS-447. The good performance of the instruments already in service provides a sound basis for confidence in the calculations supporting the TS-447 request and in the good performance of the affected instruments on a 24-month calibration interval. Additional detail is provided below.

The engineering calculations containing the analyses which establish the requested allowable values and calibration intervals were previously provided to NRC as Enclosure 2 of Reference 3. Enclosure 3 of Reference 3 provided a copy of the TVA nuclear program instrument setpoint methodology document (EEB-TI-28); this document establishes the requirements for the performance of these setpoint calculations. Section 3.0 of Enclosure 1 (Pages E1-2 through -4) of Reference 3 provides histograms of the operating data used in developing the drift values in the calculations.

Regarding the temperature switch based instrument loops, TVA setpoint and scaling calculations analyzed performance characteristics established by the vendor and historical operating data and determined that these instrument loops have no time-dependent uncertainties. These instruments’ setpoint drift

insensitivity to the calibration interval used is most clearly seen in the historical performance of the main steam line tunnel temperature loops. Because the temperature switches in this application have never been accessible with the reactor at power, the calibration interval for these switches has either been at 18-months or 24-months for essentially the entire operating history of BFN. Referring to the main steam line, HPCI, and RCIC as-found setpoint scatter histograms on page E1-3 of Reference 3, it is clear that there is no observable instrument setpoint drift that can be correlated to longer calibration intervals. These histograms show no observable difference in setpoint calibration drift for these type instruments in calibration intervals ranging from under 100 days (~ 3 months) to greater than 720 days (~ 24 months). Enclosure 2 of this current submittal provides an overview of the calculation methodology as applied in the case of the HPCI and RCIC temperature switch based instrument loops.

The quarterly functional testing requirement for these instruments is not changed by TS-447, so loop function will continue to be verified between calibration performances. Since there is no relationship between the length of the calibration interval and the setpoint drift or instrument reliability for the temperature switch based loops, it directly follows that extending these intervals as requested by TS-447 will have negligible impact on the capability of these instruments to perform their safety function or to support safe shutdown.

Regarding the resistance temperature detector (RTD) based temperature loops, TVA setpoint and scaling calculations analyzed performance characteristics established by the vendor and historical operating data and determined that these instrument loops do have a well-established time-dependent uncertainty component. In accordance with TVA's setpoint calculation methodology, this time-dependent uncertainty was taken into consideration in the establishment of the loop trip setpoints and the allowable values. Analog trip unit (ATU)-based rack mounted instrumentation has been in service at BFN on Unit 2 and Unit 3 since restart of these units in 1991 and 1995, respectively, and large amounts of historical operating data on both 18-month and 24-month calibration intervals have been accumulated to date. The ATU instruments have demonstrated a very high reliability and a setpoint drift rate better than stated in the vendor literature.

As with the temperature switch based loops, the quarterly functional testing requirement for these RTD-based loops is not changed by TS-447, so loop function will continue to be verified between calibration performances. Since the time-drift component of calibration accuracy for these RTD/ATU–based instruments is well understood, well documented, and has been specifically considered in setpoint and allowable value determinations, the extension of the calibration intervals as requested by TS-447 will have negligible impact on the capability of these instruments to perform their safety function or to support safe shutdown.

NRC's Generic Letter (GL) 91-04, "Changes In Technical Specification Surveillance Intervals To Accommodate A 24-Month Fuel Cycle," provides guidance for licensees in implementing the surveillance changes necessary to

accommodate a 24-month fuel cycle. Regarding instrument testing and calibration intervals, GL 91-04 states *"Licensees must address instrument drift when proposing an increase in the surveillance interval for calibrating instruments that perform safety functions including providing the capability for safe shutdown. The effect of the increased calibration interval on instrument errors must be addressed because instrument errors caused by drift were considered when determining safety system setpoints and when performing safety analyses."* While GL 91-04 was written using examples associated with changing from an 18-month to a 24-month fuel cycle, neither the text itself nor the principles expressed prohibit the GL guidance from being used in other applications involving different time frames. As described in the earlier submittals provided by TVA on TS-447, the TVA methodology for instrument scaling and setpoint calculations ensures that instrument drift is appropriately considered. GL 91-04 methodology has been referenced by both TVA and others, and approved by NRC, in prior license amendment requests which extended instrument calibration intervals to 24-months from existing intervals which were significantly shorter than 18-months (see References 5 and 6 for examples).

Quoting from the NRC August 15, 2005 letter to TVA:

2. *Pages E-3 and E-4 of your application state that "necessary modifications will be completed to make the Unit 1 hardware configuration essentially identical to that on Units 2 and 3." For the affected instruments, explain what is meant by essentially identical. Identify any physical differences among the three units' equipment, which could affect the instrument drift analyses and provide justification for continued acceptability assuming a 24-month (+ 25 percent) test interval.*

Note: the page numbers above refer to TVA's August 16, 2004 submittal (Reference 1)

TVA response:

"Essentially identical" means that the hardware installed on Unit 1 when it restarts will be the same as on Unit 2 and Unit 3 with the exception that Unit 1 will be using the current manufacturers' models. In terms of form, fit, function, and theory of operation, the equipment on the three units will be identical.

The original design of each of the Browns Ferry units utilized temperature switches manufactured by Fenwal (bi-metallic strip theory of operation) in the RWCU area leak detection system. During the engineering design effort in support of restarts of Unit 2, then Unit 3, and now Unit 1, engineering issued the necessary design changes to upgrade the instrument loops to utilize RTD-based hardware rather than bi-metallic temperature switches. The temperature switches will be removed and RTD's installed. The RTDs are powered from the ATU cabinets located in each unit's auxiliary instrument room. Master trip units mounted in these cabinets drive current through the RTD's and receive a voltage

input signal to drive indication, computer monitoring points, slave trip units, and isolation logic relays as appropriate. The design issued for the Unit 1 restart hardware upgrade was based on the design installed on Unit 3, which in turn was based on the Unit 2 design. The RTDs and ATUs are the current manufacturers' models for the comparable instruments installed in Unit 3.

As stated in Reference 3 (see page E1-5), the ATU hardware (cabinet power supplies, master trip units, and slave trip units) has been in service at BFN for years on both 18-month and now 24-month calibration intervals. These instruments have proven themselves to be highly reliable and to have stable calibration characteristics. Setpoint and Scaling Calculation EDQ0069890080, which considered historical BFN calibration data, performed the specific analysis for a calibration period of 24 months (+ 25%) for the Unit 1 instrumentation and demonstrated the acceptability of the calibration period. Excerpts from this and similar setpoint and scaling calculations were provided to the NRC as Enclosure 2 of Reference 3.

3.0 REFERENCES

1. August 16, 2004, Letter from TVA to NRC transmitting Browns Ferry Nuclear Plant (BFN) - Units 1, 2, and 3 – Technical Specifications (TS) Change TS-447 - Extension of Channel Calibration Surveillance Requirement Performance Frequency And Allowable Value Revision (ADAMS accession number ML04237061)
2. January 10, 2005, Letter from NRC to TVA transmitting Results Of Acceptance Review Regarding Request To Extend Technical Specification Channel Calibration Frequencies (MC4070, MC4071, and MC4072) (TS-447) (ADAMS accession number ML043640556)
3. March 11, 2005, Letter from TVA to NRC transmitting Browns Ferry Nuclear Plant (BFN) - Units 1, 2, And 3 – Technical Specifications (TS) Change TS-447 Request For Additional Information (RAI) - Extension Of Channel Calibration Surveillance Requirement Performance Frequency And Allowable Value Revision (ADAMS accession numbers ML050770370 and ML050770379)
4. August 15, 2005, Letter from NRC to TVA transmitting Browns Ferry Units 1, 2, and 3 - Request for Additional Information Regarding Channel Calibration Test Interval (TAC NOS. MC4070, MC4071, AND MC4072) (TS-447) (ADAMS accession number ML052130135)
5. November 26, 2002 Letter from NRC to TVA transmitting Browns Ferry Nuclear Plant, Units 2 And 3 — Issuance Of Amendments Regarding Extension Of Surveillance Calibration Interval For Area Temperature Monitoring Instrumentation Of The Main Steam Valve Vault (ADAMS accession number ML023310327)
6. April 17, 2003 Letter from NRC to Entergy Nuclear Operations transmitting Pilgrim Nuclear Power Station - Issuance Of Amendment Re: Instrumentation Trip Level Settings And Calibration Intervals Changes (ADAMS accession number ML030690008)

ENCLOSURE 2

BROWNS FERRY (BFN) TS-447 REQUEST FOR ADDITIONAL INFORMATION (RAI)
Response to the August 15, 2005, RAI

Calculation Methodology Overview

The following is a short summary of the techniques used in the drift analysis of the Fenwal temperature switch which determined that the main steam line (MSL) and high pressure coolant injection (HPCI) and reactor core isolation cooling (RCIC) area temperature switch calibration histories could be combined for the purposes of statistical analysis.

1. The vendor description of the operation of the Fenwal thermoswitch is as follows.

PRINCIPAL OF OPERATION

The THERMOSWITCH® controller is a strut-and-tube type thermostat comprised of two basic parts: the outer shell, made of high-expanding metal and the strut assembly, made of low-expanding metal.

A pair of electrical contacts is mounted on the strut assembly and installed in the shell under tension or compression. Since each end of the strut assembly is mechanically connected to the ends of the shell, a net change of force is produced on the strut assembly as the shell expands or contracts with changing temperature. The temperature at which the contacts "make" or "break" can be regulated by a temperature adjusting sleeve.

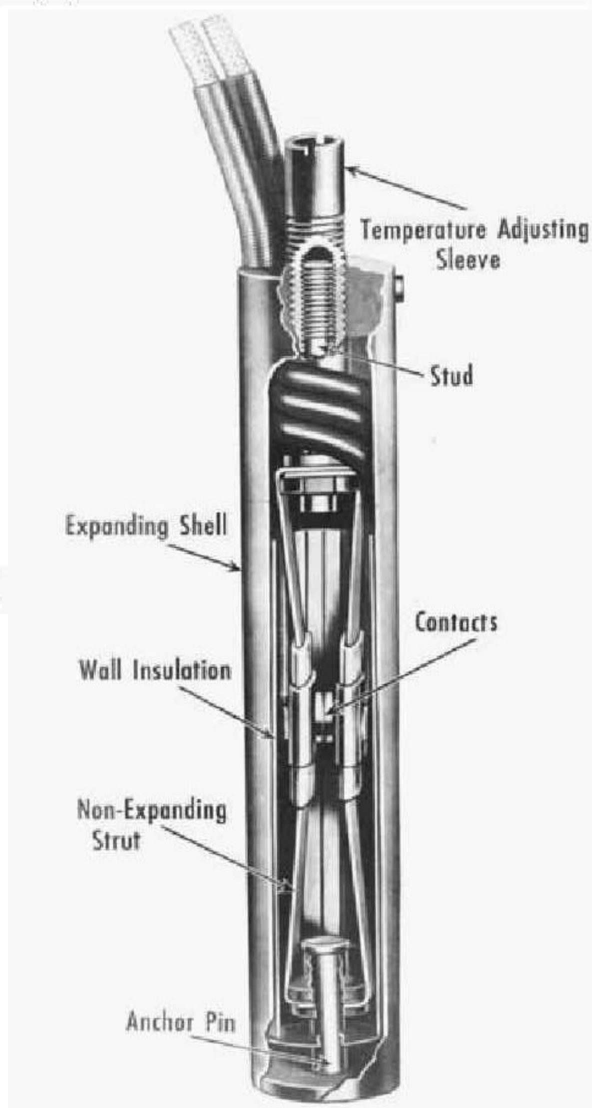
This adaptation of the differential-expansion principle gives several important control advantages:

- **Fast Response**

Since the outer shell of the THERMOSWITCH® is the active sensing member, and not merely a housing, response to temperature change is almost instantaneous.

- **Close Control**

The controller's shell and strut arrangement has "anticipation" characteristics which substantially reduce the amount of overshoot and undershoot during conditions of rapid temperature change. Anticipation is produced by an inherent time lag between the shell and struts, which causes the shell 'to "lead" the struts by an interval that varies with the rate of temperature change. With rapid temperature rise, the shell exerts a larger net force on the struts and tends to pull them apart sooner than if the temperature were rising slowly. The result is several degrees or more of anticipation which helps produce closer control.



The physical construction of the device shown at right basically consists of a shell and two contact carrying struts. The shell and struts have different thermal growth rates. None of the materials or the basic construction of the devices would indicate a propensity to drift.

The picture at right depicts normally closed (NC) contacts that pull appart when the shell grows with temperature. The normally open (NO) contacts are arranged such that they pull together when the shell grows in length with temperature. The slight difference in the strut arrangement for the NO and NC contacts would expectedly result in a difference in the repeatability (variability) of the two types of Thermoswitch (NO vs NC). The HPCI/RCIC switches are NO, and the MSL switches are NC.

Calculation Methodology Overview

2. Calibration records were used to determine the deviations of as-found to as-left setpoints for the duration of the calibration interval for the HPCI, RCIC, and MSL temperature switches.
3. The as-found to as-left setpoint deviation versus calibration duration data were used to generate graphs of the setpoint deviation versus time and a histogram of the deviations for determining normality of the data.
4. Statistical analysis of each data set was performed to determine the mean and standard-deviation from the mean.
5. The HPCI and RCIC data sets contained calibration intervals of approximately 50 to 110 days while the MSL data set contained calibration intervals of 186 to approximately 733 days. Although these intervals do not overlap, they are close. The construction of the switches is similar, and the calibration interval of the MSL data encompasses the 24 month time frame of interest.
6. Statistical analysis of the three data sets was performed to determine if the three sets were from the same general population (e.g. the differences due to chance). This statistical analysis (1) consisted of performing a null-hypothesis test (2) of the variances of the individual data sets against the combined data set using an F-test (95% significance level for the appropriate degrees of freedom) (3). If the null-hypothesis test indicated that the data sets could be combined, then a further t-test (95% significance level for the appropriate degrees of freedom) (4) of the means was performed to determine if the differences could be explained by chance (sampling from general population).
7. The conclusion of the F-test and t-test statistical analyses was that the HPCI and RCIC data sets could be combined, but the MSL data set variance was larger and therefore could not be combined with the HPCI and RCIC data.
8. Visually examining the deviation versus duration plots of the HPCI, RCIC, and MSL data sets indicates that there is no apparent link between deviation and calibration interval. Based upon the device construction and theory of operation, no time related drift would be expected. The device operates on the thermal growth (or contraction) of the shell in response to changes in the ambient area temperature. Other than for functional testing, the switches are not cycled through their setpoints during normal operation, therefore the ribbons carrying the contacts are not stressed due to binding.

Notes:

(1) See Sections 8.3 *Hypothesis concerning two variances*, and 7.8 *Hypothesis concerning two means* from Probability and Statistics for Engineers, Prentice-Hall 1977 by Irwin Miller and John E. Freund

(2) In statistics, a **null hypotheses** is a hypothesis that is presumed true until statistical evidence in the form of a hypothesis test indicates otherwise, or re-defining the null hypothesis, for example as a hypothesis that an effect falls within a range considered negligible.

(3) The **f-test** is the most commonly used method to evaluate the differences in data variance between two groups, and is a prerequisite test to performing a t-test comparison of the means of two data groups.

(4) The **t-test** is the most commonly used method to evaluate the differences in means between two groups.

Calculation Methodology Overview

9. As a follow-on to the issued calculation, the variance of the data from the MSL dataset was examined for the three distinct calibration durations (approximately 186, 551, and 711 days). Using the same F-test (95% significance level) as before, it was determined that the slight differences of the variance of the three distinct time periods can be explained by chance and that the variability of the data does not change.

10. The standard deviation multiplier used to predict a 95% confidence that 95% of the Fenwal switches will operate within the limits is based upon the 96 HPCI and RCIC switches and the single sided confidence tables of Probability and Statistics for Engineers (see Note 1 on page E2-2).