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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO.195 TO FACILITY OPERATING LICENSE NO. DPR-33

AMENDMENT NO. 210 TO FACILITY OPERATING LICENSE NO. DPR-52

AMENDMENT NO. 167 TO FACILITY OPERATING LICENSE NO. DPR-68

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY UNITS 1, 2, AND 3

DOCKET NOS. 50-259, 50-260, AND 50-296

1.0 INTRODUCTION

By letter dated July 23, 1992, the Tennessee Valley Authority (TVA, the licensee) submitted an application to amend Facility Operating Licenses DPR-33, DPR-52, and DPR-68 by changing the Browns Ferry Nuclear Plant (BFN) Technical Specifications (TS) for Units 1, 2, and 3. TVA also submitted additional information by letter dated March 16, 1993, in response to a request by the staff dated February 25, 1993. Furthermore, TVA supplemented its July 23, 1992, application with additional Bases changes by letter dated April 6, 1993.

The proposed TS changes are intended to reflect a design change of the Refuel Zone and Reactor Building Ventilation Radiation Monitoring (RBVRM) system. This design change will upgrade the RBVRM system by replacing the existing analog monitors with digital equipment from the General Electric (GE) Nuclear Measurement Analysis and Control (NUMAC) line. The following discussion provides details and conclusions from the staff's safety evaluation of TVA's proposed TS changes and the NUMAC RBVRM modification at BFN.

2.0 SYSTEM DESCRIPTION

The NUMAC RBVRM supports some safety-related functions and class 1E components and some non-essential functions and components. The safety-related functions of the RBVRM are: (a) detecting and measuring gamma radiation in reactor zone and refuel zone, and (b) comparing input signals with preselected levels, and providing upscale trips at preselected set-points.

The RBVRM also performs the following functions:

a. Measuring input current from the digital sensor and converter (DS&C) and performing the specified radiation level calculations;

b. Providing high voltage DC power for operating the detector;

c. Providing -15 VDC to power the associated DS&C electronics;

d. Providing output trip signals to external equipment;

e. Performing automatic calibration;

f. Performing automatic self-test and alarm;

g. Displaying self-test status on demand; and

h. Providing security by keylock and password against unauthorized changes to setpoints.

2.1 Equipment Description

The RBVRM consists of two chassis, each having one channel for monitoring the Reactor Zone radiation and another channel for monitoring the Refuel Zone radiation. In addition, each chassis has the following modules:

- Essential Microcomputer
- Display Microprocessor
- Front Panel Display
- High Speed Parallel Data Bus
- Serial Data Link
- Instrument Power Supply
- Detector High Voltage Power Supply
- Trip and Analog Outputs

The DS&C detects and measures gamma radiation and transmits (via an RS-485 serial connection and a signal splitter) that information to the essential microcomputer, which is based on the Harris 80C86 microprocessor. The essential microcomputer, consisting of the necessary hardware and software, processes the received data and transmits appropriate control signals to other modules within the chassis using a high speed parallel data bus and to the display microprocessor/front panel display using a serial data link. The Essential Microcomputer also performs self-test system diagnostics when not processing instrument data.

The display microcomputer, which is based on the National Semiconductor NSC-800 microprocessor, processes the data from the Essential Microcomputer for display on the front panel display. The front panel display contains all of the circuitry necessary to interface with the display microcomputer, the front panel's keyboard, and electro-luminescent display.

The trip outputs from the RBVRM provide inputs to the Primary Containment Isolation System (PCIS) logic, which in turn initiates the Stand-By Gas Treatment System and isolates the Refuel and Reactor Zone. The analog outputs are used to drive main control room recorders.

The NUMAC RBVRM has instrument power supplies and detector high voltage power supplies. Instrument power supplies power to the RBVRM chassis. Each RBVRM chassis has two redundant diode auctioneered low voltage power supplies for uninterruptable power in the event of a power supply failure. The Geiger-Muller (GM) detectors are powered by two adjustable redundant high voltage power supplies. The adjustable voltage range is from zero to the hardware over voltage protection limit of 650 VDC ±50 VDC.

2.2 Improvements

By using the NUMAC RBVRM, TVA expects to reduce the failures experienced by the existing RBVRM significantly. The failures experienced by the existing RBVRM in the last 4 years include 40 equipment failures, 8 inadvertent PCIS initiations, and 12 other events. Most of these failures were caused by (1) human error during maintenance and calibration activities, and (2) equipment and component failures. Use of the NUMAC RBVRM could reduce the failures related to items (1) and (2), because the NUMAC RBVRM has a lower drift rate than the present RBVRM and uses more reliable grade components and equipment than the present RBVRM. In general, GE manufactures the NUMAC product line using military grade components.

3.0 REVIEW CRITERIA

The RBVRM is part of the class 1E PCIS. Therefore, the General Design Criteria (GDC), IEEE standard 279, "Criteria for Protection Systems for Nuclear Power Generation Station" (10 CFR 50.55 a(h)) and the applicable acceptance criteria listed in Section 7.5 of the Standard Review Plan (NUREG-0800) were used as review guidance. In addition, the ANSI/IEEE standard 7-4.3.2, 1982, "Application Criteria for Programmable Digital Computer Systems in Safety Systems of Nuclear Power Generating Stations," and corresponding Regulatory Guide (R.G.) 1.152, " Criteria for Programmable Digital Computer System Software in Safety Related Systems of Nuclear Power Plants," were also used to evaluate the NUMAC RBVRM system software design verification and validation processes.

4.0 EVALUATION

10 CFR Part 50, Appendix A, GDC 2 and 4 require that safety systems be designed to withstand the effects of natural phenomena and accommodate the effects of environmental conditions associated with normal operation and postulated accidents. To ensure that these effects will not adversely impact the ability of the RBVRM system to perform its intended safety function(s), the staff reviewed the environmental qualification of the NUMAC equipment for (1) temperature and humidity, (2) seismic, (3) radiation, and (4) electromagnetic and radio frequency interference.

4.1 Temperature and Humidity

GE has performed temperature and humidity tests on the DS&C and the Instrument Chassis. The test procedures and results are documented in NEDC-31974P, Appendix C. The details of this document are found in Reference 1.

By testing equipment unique to RBVRM and analyzing equipment similar to the NUMAC product line, GE qualified the NUMAC RBVRM to the following limits:

- Components located in the main control room (MCR) (RBVRM chassis, interface panel) are qualified to a min/max temperature of 41/137°F, and min/max relative humidity of 10/90%. The min/max BFN environmental requirements established by TVA are 60/104°F and 10/90% relative humidity.

- Components located on the refuel floor (DS&C, signal splitter) are qualified to a min/max temperature of 22/158°F, and min/max relative humidity of 10/100% (non-condensing). The min/max BFN environmental requirements established by TVA are 22/158°F and 10/100% relative humidity.

The staff finds that the GE temperature and humidity qualification of the GE NUMAC product envelops TVA's temperature and humidity requirements for BFN. Therefore, the staff concludes that the temperature and humidity qualifications are acceptable.

4.2 Seismic Qualification

The RBVRM equipment and panels which replace existing equipment and panels are safety-related seismic category 1 components. Since the replacement might alter some degree of mass and stiffness characteristic of the equipment control panels and structural supports, seismic/dynamic qualification must be demonstrated for the installed equipment.

GE performed a similarity analysis of the NUMAC RBVRM chassis, interface Panels, and DS&C for the licensee. GE performed the similarity analysis to show that the BFN specific devices are mechanically the same or equivalent to previously tested devices, as such GE demonstrated that the NUMAC RBVRM is also capable of withstanding the as tested seismic forces. In addition, GE performed seismic calculations of the panels and ducts where the devices will be mounted and determined that the loads at the mounting locations are enveloped by the tested limits. TVA stated that these analyses were performed in compliance with IEEE 334-1975, and are certified as such by GE on the Product Qualify Certifications provided with the equipment. Based on TVA's statements, the staff concludes that seismic qualification has been established.

4.3 Radiation

The RBVRM components located in the MCR (the chassis, interface panel) were qualified to a maximum total integrated dose (TID) of 1E+4 rad. The RBVRM components located on the refuel floor (digital sensor and converter, signal splitter) are qualified to a TID of 9E+3 rad. This is well within the Browns Ferry normal and accident doses for the associated areas, and therefore acceptable. The test procedures and the test results are documented in NEDC-31974P, Appendix C.

4.4 EMI & RFI

Electromagnetic interference and radio frequency interference (EMI/RFI) are random noises produced by systems within the operating environment in a nuclear plant. This random noise can affect the safety of the plant since it can potentially lead to common cause failure of redundant safety-related equipment that are particularly vulnerable to the noise.

In safety-related (and non safety-related) instrument and control (I&C) equipment at nuclear plants, digital equipment, which operate at higher speeds and lower voltages than the analog equipment it replaces, are especially vulnerable to EMI/RFI noises. Hence, in reviewing the application of digital I&C equipment at nuclear plants (retrofit at operating plants or in the designs of advanced plants), the NRC staff has placed additional emphasis on addressing the vulnerabilities of this equipment to EMI/RFI noise. For general guidance on the review of EMI/RFI, the staff uses 10 CFR Part 50, Appendix A, Criterion 4, "Environmental and Dynamic Effects Design Bases," and the fourth paragraph of Standard Review Plan Section 7.1, Appendix B, "Guidance For Evaluation of Conformance to IEEE STD 279." For specific guidance on the review of EMI/RFI, the NRC currently uses the following standards for reference:

(1) MIL-STD-461(A,B,C), "Electro-magnetic Emission and Susceptibility Requirements for the Control of Electro-magnetic Interference," (2) MIL-STD-462, "Electro-magnetic Interference Characteristics Measurement," (3) MIL-STD-1399, "Interface Standard for Shipboard Systems, DC Magnetic Field Environment," (4) SAMA PMC 33.1-1978, "Electro-magnetic Susceptibility of Process Control Instrumentation," (5) IN83-83, "Use of Portable Radio Transmitters Inside Nuclear Power Plants," (6) IEC 801-2 "Electromagnetic Compatibility for Industrial-Process Measurement and Control Equipment Part 2: Electrostatic Discharge Requirements," and (7) NUREG CR-3270, "Investigation of Electro-magnetic Interference (EMI) Levels in Commercial Nuclear Power Plants."

EMI/RFI Environmental Evaluation

Using the above standards as guidance, the staff followed four steps to review the effects of the EMI/RFI noise environment around safety-related digital equipment:

1. Evaluating the plant and identifying the potential EMI/RFI sources.

2. Reviewing the vendor EMI/RFI qualification methodology and range of frequency tested.

3. Reviewing the licensee's EMI/RFI qualification process for the installed equipment.

4. Reviewing licensee's measurement of EMI/RFI field at the equipment installed at the plant and verifying that the equipment is operating within its qualified environment.

RBVRM Operating Environment Assessment

The staff visited the site and performed a walkdown to assess the plant environment. The walkdown included the refueling area, the cable spreading room, and the main control room. The staff identified possible EMI/RFI sources in the environment surrounding the RBVRM. The DS&C is located near the refueling bridge crane and floor crane motor and their controls. In addition, the refueling area contained a radio antenna and a 9 Amp 420 voltage power supply on a cart. In response to the staff's concern, the licensee made a commitment during a March 17, 1993, telephone conference, to establish additional administrative controls to prohibit temporary equipment from the immediate area around the DS&C (which already prohibits the use of walkie-talkies).

Vendor Qualification Test and the NRC Review

GE tested the RBVRM for four different EMI/RFI susceptibilities. The four EMI/RFI susceptibility tests were (1) radiated electric fields, (2) radiated magnetic fields, (3) conductive noise, and (4) static discharges. GE selected the test methodologies from various standards. The EMI/RFI test methodologies and results for the NUMAC RBVRM are documented in NEDC-31974P Appendix B. The staff's review of the vendor's test report is discussed below. (Item (4) is discussed separately).

GE conducted the radiated electric fields susceptibility tests in accordance with SAMA standard PMC 33.1, "Electromagnetic Susceptibility of Process Control Instrumentation." RBVRM equipment were subjected to a field strength level of 65 V/m over the frequency range of 20 to 990 Mhz. However, GE did not conduct the test for other frequency ranges. In addition, GE conducted a keying test to simulate the keying of walkie talkies.

GE conducted the radiated magnetic field susceptibility test in accordance with its own internal requirements for testing electromagnetic susceptibility of process control instrumentation. The test required 50-foot wires to be attached to the inputs/outputs of the equipment being tested, and two types of signals were injected from a generator into the test wires to simulate the noise induced on power leads. GE, however, did not conduct the low frequency radiated magnetic field susceptibility test.

GE conducted the conductive noise test in accordance with Swedish standard Svensk Standard SS 436 15 03 and GE's conductive noise test requirements.

The staff finds that GE's testing methodologies are adequate for the tested frequency ranges. In particular, the radiated electric field test injected 65 V/m over the frequency range of 20 to 990 Mhz. This level of field strength appeared to be more than adequate. However, the staff found that the testing methodologies were inadequate for the low and high frequency range. Furthermore, the staff determined that the licensee needs to demonstrate that the BFN EMI/RFI environmental conditions are within the tested envelope either by site survey or analysis. The staff discussed these findings and concerns with the licensee and GE.

In response to the staff's findings and concerns, the licensee has made a commitment to perform additional EMI/RFI testing for the frequency ranges that have not been covered by earlier tests. The licensee plans to perform these additional tests through GE. The current GE schedule calls for issuing an NEDE report sometime in September 1993 that documents the testing performed and the results. The details of GE's planned testing are described in Reference 2. Additionally, in a March 19, 1993 telephone conference, the licensee committed to conduct 2 days worth of site surveys - one day during transient conditions and one day during stable conditions for both the refuel floor and the control room. Transient conditions for the refuel floor around the location of the monitor would be during refueling operations, whereas for the control room it would be during startup.

Conclusion

Although, the licensee did not test the NUMAC RBVRM for all EMI/RFI noise frequencies, nor complete a plant specific survey, the staff considers the following reasons provide sufficient assurance the NUMAC RBVRM will perform its intended safety functions during the brief period until the licensee can conduct the necessary EMI/RFI tests and plant survey:

- Known sources of RF energy at Browns Ferry have been identified. Tests and analysis on the NUMAC RBVRM have been performed which include these sources of noise;
- The NUMAC RBVRM has a data transfer check system which detects error introduced during data transfer. This includes data error introduced by EMI/RFI;
- Defenses for common mode/cause failures exist (see Section 6.0);
- The NUMAC RBVRM signals are stronger than the analog RBVRM;
- The NUMAC RBVRM was designed to fail safe; and
- Plant operators will be altered to failures and can manually initiate all RBVRM safety functions.

Based on the foregoing discussion, the staff accepts that the RBVRM is EMI/RFI qualified for the BFN environment. However, this acceptance is contingent upon the following:

1. Performing an on-site survey and submitting a report with acceptable test results.

2. Performing additional tests as stated in Reference 2 and submitting a report with acceptable test results.

3. TVA maintaining administrative control on the use of walkie talkies, portable telephones, and temporary equipment in the area that already prohibits the use of walkie-talkies.

4.5 Electro Static Discharge

Electro static discharge (ESD) is the transfer of static charges from one object to an another object with different electrostatic potential. Integrated circuit (IC) components are very sensitive to ESD. ESD can stress IC components beyond the components' designed tolerances and might cause the components to fail immediately or reduce the components' service life. For the RBVRM system, which has numerous IC components, ESD could greatly reduce RBVRM reliability.

The NUMAC RBVRM has been qualified per IEC standard 801-2, "Electromagnetic Compatibility for Industrial-Process Measurement and Control Equipment Part 2: Electrostatic Discharge Requirements," by GE. In addition, the operation and maintenance manual provides information on how to avoid electrostatic voltage damage to vulnerable modules while servicing the instrument cards. The precautions provided in the manual include:

- grounding work surfaces
- grounding all tools and test equipment
- having the technicians connect themselves to ground using a conductive bracelet
- not wearing clothing made of nylon or the static generating materials
- never removing or inserting a card in a card file with power applied to the card.

Based on the RBVRM ESD qualification test and incorporated ESD precautions, the staff finds that concerns with ESD has been adequately addressed.

5.0 <u>SOFTWARE</u>

The RBVRM application software consists of two principal modules: (1) the functional software for the essential microcomputer, including the self test system, and (2) the front panel keyboard and display software for the display computer. The RBVRM digital equipment software is written in high level languages, to the maximum extent possible, to simplify software maintenance over the lifetime of the equipment. The total lines of code required to perform the RBVRM's intended functions are under 20,000 lines. The functions performed by the software include (1) sampling and filtering sensor data, (2) comparing data to operator defined trip setpoints, (3) updating operator display, (4) generating analog and trip output signals, and (5) performing self-tests.

5.1 Evaluation

A software system with large inputs and outputs has an impractical number of input and output combinations to check for all possibilities. The reliable operation of such software is assessed qualitatively based on the idea that software development processes and configuration management have a significant impact on the producing reliable software.

The staff's software review, as assisted by contractors from Lawrence Livermore National Laboratory and Sohar, included an audit of the NUMAC RBVRM and examination of the NUMAC generic software development process during January 11-15, 1993, with particular attention to: (1) software management plan (SMP) (2) software configuration management plan (SCMP), and (3) software verification and validation plan (SVVP). The staff examined these plans and their implementation for compliance with R.G. 1.152, "Criteria for Programmable Digital Computer System Software in Safety-related Systems of Nuclear Power Plants," and ANSI/IEEE-7-4.3.2-1982, "Application Criteria for Programmable Digital Computer Systems in Safety Systems of Nuclear Power Generating Stations."

Verification and Validation

GE used nuclear quality programs with supplemental Verification and Validation (V & V) procedures based on R.G. 1.152 to develop both Class 1E and non-Class 1E NUMAC RBVRM software. The GE NUMAC line of instruments is highly modulerized and uses NUMAC product code where appropriate. The application requires under 20,000 lines to perform its intended function. The lines of code are stored in the three sets of firmware which are the functional, display, and sensor firmware.

The GE V & V method is based on logical steps with baseline reviews performed at the completion of each phase of the development process. A list of open items was documented and maintained for each review. The reviewers were independent from the designers and communicated their results in written reports. The V & V reviewer team, however, was not totally independent from the design team organization. The validation step includes a matrix relating each validation test to a functional requirement.

The staff's review of GE 23A5163, "Software Verification and Validation Plan," Rev. 1, dated March 12, 1991, determined that this document did not provide sufficient detailed instructions in its description of the V & V process; however, the staff found that in actual practice, GE's software development methodology was implemented consistently and provided an internally reviewed paper trail throughout the software development process. In response to the staff's finding, GE stated that it is currently updating GE 23A5153 to reflect its actual practices.

Software testing was done using emulators; each and every change required testing. An organizationally independent configuration control engineer is required to sign-off on all baseline reviews (verification steps) and controls the NUMAC library of documents and firmware. The NUMAC review team has nine members and must approve all changes for resolutions of open items.

The Design Record file (DRF) has a standard format of six sections that include the associated baseline review documents:

- Definition and Planning
- Product Performance Definition (requirements)
- High Level Software Design
- Design/Code Module Test
- Integration Test
- V&V Test (validation)

The DRF provided a very effective record of the project process steps and results, and it contributed substantially to the auditing process.

Configuration Control

As a part of the configuration control review, the staff reviewed GE 23A5261 "Software Configuration Management Plan," Rev. 1, dated March 12, 1991, and SMP GE 23A5262, "Software Management Plan," Rev. 1, dated March 12, 1991. This review determined that strict configuration control standards were in place and all updates to the NUMAC instruments were performed at GE. Each version of the firmware included all software modules, whether modified or not. Each version was controlled with a separate revision and part number. The User's Manual has a very extensive description of the system as well as instructions for its use.

Conclusion

The staff confirmed that GE has established a formal design, code, and test review process with associated documentation. The staff also found that GE has a formal configuration management plan and it was being consistently applied. The decision to maintain a library where each revision is a complete entity removes the problems associated with controlling different versions of the code.

The V & V process in actual use appeared adequate. However, personnel who conducted the V&V activities report to the same first line supervisor as those responsible for the software design. This is considered a deviation from the requirements for organizational independence in R.G. 1.152. The existence of improper oversight or bias due to the lack of organizational independence could not be determined within the scope of the staff audit.

The staff concludes that the NUMAC RBVRM firmware is acceptable for use at BFN. However, the staff's acceptance of the insufficiently detailed V&V program description and the RG 1.152 deviation, discussed above, was based on specific considerations that apply only to this TVA application. Any other applications of NUMAC software by TVA or other licensees, subject to regulatory review, would be expected to resolve these issues or justify why not.

6.0 DEFENSE AGAINST THE COMMON MODE FAILURE

The single failure criterion requires that any single failure within the protection system shall not prevent proper protective action at the system level when required. Common mode/common cause failures can prevent the safety

system from performing its intended function. Common mode/common cause failures could also result in the loss of more than one echelon of defense-in-depth provided by the different safety functions (e.g., monitoring, control, reactor protection, and engineered) performed by digital I&C systems. In particular, a microprocessor based digital system, such as the NUMAC RBVRM, which shares data bases and process equipment, has a potential for common mode/common cause failures in the area of software, hardware, and software and hardware interaction. Defense against common mode/common cause failure is provided by quality and diversity.

The potential sources of common cause failures for the RBVRM include the software, hardware, and their qualifications. The quality aspects of the NUMAC RBVRM's defenses against such failures are discussed in Section 4 and 5.

In the event of command-mode failure of the NUMAC RBVRM, the operator can perform the RBVRM's actuation functions manually in the MCR using the information available from the radiation indicators and alarms in the MCR. This is diverse from the RBVRM.

Based on the staff's review of the RBVRM's defense against common mode failures or common cause failures, the staff considers the RBVRM acceptable.

7.0 TRAINING

Training is an important part of implementing the NUMAC RBVRM in the BFN station environment. The operators and technicians need to obtain a sufficient understanding on how to use and maintain the new system.

The licensee is not planning to provide specific formal training for operations and maintenance personnel. However, BFN personnel attended two 4-hour on-site seminars provided by GE to familiarize themselves with the NUMAC RBVRMs. The licensee's reasons for not providing specific formalized training to operational personnel were:

- The existing generic experience possessed by plant operators with the NUMAC line via the main steam line radiation monitors (MSLRMs).
- The user friendly nature of the NUMAC RBVRM.

In addition, TVA's reasons for not providing the specific formalized training to maintenance personnel were:

- The existing generic experience possessed by maintenance personnel with the NUMAC line via the MSLRMs.
- The detailed manuals supplied by GE for RBVRM maintenance.
- The similarity of the NUMAC RBVRM hardware to the NUMAC MSLRMs hardware.

The staff acknowledges the similarities in operation and equipment between the NUMAC RBVRM and other NUMAC product lines, and its user friendly nature. As such the staff understands TVA's decision not to conduct additional training. However, Operator and I&C personnel performance regarding use and maintenance/surveillance of NUMAC RBVRM may be subject to NRC inspection.

8.0 TECHNICAL SPECIFICATION CHANGES

The licensee proposed amendments to the Technical Specifications (TS) of Facility Operating License DPR-33, DPR-52, and DPR-68. The proposed amendments would revise TS Section 3.2/4.2 to reflect the enhancement of the RBVRM systems by installing the more reliable and accurate NUMAC RBVRM. The proposed BFN RBVRM TS changes involve (1) decreased channel functional testing and calibration frequency, (2) editorial changes, (3) an HVPS functional test, and (4) associated BASES changes. The details of the TS changes are described in enclosure 2 of TVA's submittal dated July 23, 1992.

More specifically, TVA proposed the following TS changes:

- Expanded Definition 12.a to include "digital" channels.

- In Tables 3.2.A and 4.2.A, "Reactor Building Ventilation High Radiation" instrument channels for both Reactor Zone and Refuel Zone:

  (a) Incorporate the word channel(s) into the remarks section for Table 3.2.A;

  (b) Delete from Table 3.2.A the referal to note (9), and add a referral to note (14) for Unit 2 and note (15) for Units 1 and 3, then add note 14(15) at the end of Table 3.2.A to describe the new RBVRM system configuration and logic operation;

  (c) Add allowed outage times for conducting RBVRM functional testing and calibration to note (11) at the end of Table 3.2.A;

  (d) Delete referral to note (22) from Table 4.2.A, and delete note (22) from the end of Table 4.2.A as the allowed outage times would not be contained in note (11) of Table 3.2.A;

  (e) Add a referral to Table 4.2.A for note (31) of Unit 1, note (32) of Unit 2, and note (30) of Unit 3, then add these notes to the end of Table 4.2.A to define the functional and channel functional testing requirements of the NUMAC RBVRM system; and

  (f) Revise the calibration frequency of Table 4.2.A from "3 months" to "18 months."

- Revise associated BASES to provide an expanded discussion on the basis for the NUMAC RBVRM allowed outage times and frequencies of calibration, functional testing and channel functional testing.

The staff reviewed TVA's proposed editorial changes and associated BASES revisions, and concluded they were acceptable. Those portions of the above changes dealing with decreasing the channel functional testing and calibration frequency, and HVPS functional test, are addressed below.

Using conservative parameters, the NUMAC RBVRM subsystem channel calibration frequency was calculated to be once per fuel cycle. A cycle is defined as 18 month ± 25%. This is a substantial increase over the previous calibration frequency of once every 90 days.

The potential drift sources for the NUMAC RBVRM instrument loop include the GM tube, the DS&C's discriminator, the high voltage power supplies (HVPS), and the digital circuits located in the RBVRM chassis. The DS&C's discriminator and digital circuit located in the RBVRM chassis add a negligible amount to the channel drift due to the precision components used and the characteristics of the digital instrument. However, the GM tube and the HVPS are considered to be the main contributor to the instrument drift. The GM tube drifts by 2% per plant cycle, and HVPS drifts a maximum of 15 volts per month. These values are obtained from the manufacturer. However, for the drift calculation, a 4% drift per cycle for the GM tube, and a maximum HVPS drift limit of 27 volts were used. The results of the drift calculations were documented in the GE-NE-533-20-0492.

Based on the above information and results, the staff accepts the licensee's proposal to change the NUMAC RBVRM subsystem channels calibration frequency from once every 90 days to once every cycle. Furthermore, the staff finds acceptable the licensee's proposal to perform an HVPS functional test every 30 days to limit HVPS drift to 12 Volts.

Defense against the common mode/cause failures of the NUMAC RBVRM was discussed in Section 6 above. Based on this discussion, TVA's letter dated April 6, 1993, and the highly reliable nature of the components used in NUMAC RBVRM equipment (i.e., mean time between failure of components is very long), the staff accepts the licensee's proposal to change the NUMAC RBVRM subsystem channels functional test frequency to once every cycle.

9.0 REFERENCES

1. NEDO-31974P "NUMAC Qualification Report for RBVRM System for TVA BFNP Units 1, 2, and 3," November 1991.

2. Letter from O. J. Zeringue, Tennessee Valley Authority to Nuclear Regulatory Commission, dated March 16, 1993, "Browns Ferry Units 1, 2, and 3 Application for Amendment to Facility Operating Licenses DPR-33, DPR-52, and DPR-68, Section 3.2/4.2, Technical Specifications, Response to NRC Request for Additional Information, NRC Docket Nos. 50-259, 50-260, and 50-296."

10.0 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.

11.0 ENVIRONMENTAL CONSIDERATION

Pursuant to 10 CFR 51.21, 51.32, and 51.35, an environmental assessment and and finding of no significant impact was published in the Federal Register on April 13, 1993 (58 FR 19281).

Accordingly, based upon the environmental assessment, the Commission has determined that issuance of the amendments will not have a significant effect on the quality of the human environment.

12.0 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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Date: April 13, 1993