GULF STATES UTILITIES COMPANY

RIVER BEND STATION POST OFFICE BOX 220 ST. FRANCISVILLE, LOUISIANA 70775

AREA CODE 504 635 6094 346 8651

June 23, 1993

RBG- 38660
File Nos. G9.5

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D. C. 20555

Gentlemen:

River Bend Station - Unit 1
Docket No. 50-458

On April 1, 1988, the BWR Owners' Group (BWROG) submitted the Licensing Topical Report; "Position on NRC Regulatory Guide 1.97, Revision 3 Requirements for Post-Accident Neutron Monitoring System (NEDO-31558)". This Topical Report provided an event analysis of the neutron monitoring system functions for post accident use. The results of this analysis provided alternate neutron monitoring functional design criteria to that of Regulatory Guide 1.97.

By letter to the BWROG dated January 13, 1993, the NRC found the alternate criteria of NEDO-31558 for neutron flux monitoring instrumentation acceptable in lieu of Regulatory Guide 1.97 criteria for currently licensed BWRs. The safety evaluation report states, in part, that licensees should review their neutron flux monitoring instrumentation against the criteria of NEDO-31558 and confirm that it meets these criteria. Any deviations to the accepted criteria are to be explicitly stated, and a commitment made to meet the criteria or supporting justification provided for alternatives.

The attached provides the RBS evaluation of the neutron monitoring system design as it relates to NEDO-31558. To facilitate NRC review, the section numbering in the attached evaluation corresponds to the design criteria sections of the BRWOG Topical Report.

The NRC safety evaluation report for NEDO-31558 also recommended that each licensee perform a plant specific evaluation of the electrical power distribution to the neutron flux monitoring instrumentation, including recorders. This review should verify that, in addition to the events identified in NEDO-31558, a single

A003 1/1

power supply failure would not cause the loss of redundant channels of neutron flux monitoring instrumentation. RBS has reviewed the power distribution for neutron flux monitoring instrumentation and concluded that each division is powered from separate and reliable class 1E uninterruptible power supplies (UPS). Loss of a single UPS will not cause a loss of redundant neutron flux monitoring instrumentation. However, review of the supply power for neutron flux recorders has identified that these recorders are powered by the same non-class 1E uniterruptible power supply. RBS will provide redundant non-class 1E UPS power for these recorders during the next refueling outage (RF-5). This will ensure that a loss of a single UPS will not cause a loss of redundant neutron flux monitoring recorders.

Sincerely,

JW Leavines for

J. E. Booker
Manager - Safety Assessment
and Quality Verification
River Bend Nuclear Group

JRH/DNL/LLD/WJS/JWM

Attachment

G:\LIC\WJS\RG197.DOC

River Bend Station Neutron Monitoring

Plant Specific Design Evaluation

(NEDO-31558)

INTRODUCTION

An evaluation was provided to the NRC by letter dated June 28, 1989. This submittal supersedes that evaluation.

This attachment provides plant specific information relative to the capabilities of the existing Neutron Monitoring System (NMS) at River Bend Station (RBS) as it applies to the alternative design requirements stated in NEDO-31558 (Reference 1), "Position on NRC Regulatory Guide 1.97, Revision 3 Requirements for Post Accident Neutron Monitoring System".

The topics of discussion in the following sections of this attachment correspond to subsections 5.2.1 through 5.3 of NEDO-31558. To facilitate understanding of the information presented by this attachment, the individual NEDO-31558 subsection headings and requirements are restated followed by the existing capabilities of the RBS NMS with respect to the alternate criteria. The basis for the alternative requirements is not restated as this information is provided in NEDO-31558.

The information provided under each subsection applies to the Average Power Range Monitor (APRM) subsystem.

Since the position of NEDO-31558 is based on the operator's actions stated in the emergency operating procedures (utilization of the NMS for these actions) an initial discussion of the applicable RBS Emergency Operating Procedures (EOPs) and their similarities/ differences to the generic BWR Emergency Procedure Guidelines (EPGs) is included in the following section.

RBS EOP OVERVIEW

The River Bend EOPs were developed from Revision 4 of the EPGs with minor deviations resulting from plant unique design differences. Because core power (neutron flux) is the parameter of interest, discussion will be limited to the EOP which is concerned with the maintenance and control of this parameter. The EOP which deals directly with core power is EOP-0001, "Emergency Procedure-RPV Control" and the associated flowcharts, EOP-1 "RPV Control" and EOP-1A "Anticipated Transients Without Scram" (ATWS).

Consistent with the intent of the EPGs, the RPV control flowchart provides the operator with the direction to control reactor power under conditions where it can be determined that the reactor will remain subcritical under all conditions without boron injection. The ATWS flowchart provides instructions under conditions where boron injection may be required.

The entry conditions for EOP-0001 are; any condition requiring an automatic or manual reactor scram, or RPV water level below 9.7 inches, or RPV pressure above 1064.7 psig, or drywell pressure is above 1.68 psid. The scram conditions encompass the condition where the operator may not be able to determine reactor power or reactor power is above 5 %. The bases document for the EPGs discusses the fact that loss of electrical power to the APRMs does not, in itself, require that reactor power is indeterminate. The ensuing discussion provided by the bases document further supports the variables/ methods used to determine reactor power that were described in NEDO-31558 section 6.3. The general guidance provided by EOP-0001 regarding control of reactor power is as follows:

- If all control rods are not fully inserted, initiate alternate rod insertion (ARI). If reactor power is above 5% or indeterminate, recirculation pumps are tripped, all other methods to insert control rods implemented, and if required, boron injection is initiated prior to the suppression pool reaching 100 degrees Fahrenheit (boron injection initiation temperature).

- If at any time during the performance of EOP-0001, all control rods are fully inserted, or if the reactor will stay shutdown under all conditions, terminate boron injection (if previously initiated). Then perform the scram recovery procedure and exit EOP-0001.

The injection of boron into the RPV for the above listed action has a limiting suppression pool temperature of 110 degrees Fahrenheit (suppression pool temperature is a Category I variable as defined in R. G. 1.97). Action is conservatively taken at this temperature to ensure suppression pool heat capacity is adequate to provide pressure suppression during reactor shutdown. Once boron has been injected, operator actions are those which will ensure that the hot shutdown boron weight is injected and that preferential injection systems are utilized to promote the boron effectiveness as a shutdown agent.

5.2.1 Range

Alternate Requirement: 1 to 100% (RBS downscale alarm is 5%)

RG 1.97 Requirement: 10^{-6}% to 100%

The operating range associated with the APRM subsystem at River Bend is 2.8×10^{13} nv to 2.8×10^{14} nv or 1 to 100% core thermal power. This range satisfies the alternate requirement stated above.

5.2.2 Accuracy

Alternate Requirement: ±2% of Rated Power

RG 1.97 Requirement: None stated

The loop accuracy of the RBS APRM subsystem is ±2% (for normal operations), which does not include recorders, based on G.E. setpoint methodology calculations. To maintain this degree of accuracy, the LPRM subsystem is calibrated to compensate for sensitivity degradation due to depletion of the uranium coating of the detectors with increased exposure. In addition, relative sensitivities are determined corresponding to the increased exposures on approximately a six month frequency. Whenever power is greater than 25%, each APRM channel is checked weekly against power as determined by a heat balance and the APRM channel is adjusted as required to produce a deviation of no more than 2%. The loop accuracy for the recorder output is tested and verified to be ±3% which is deemed sufficient for operator guidance. Due to the exhaustive measures taken to assure loop accuracy, the APRM subsystem meets the alternate requirements as stated in NEDO-31558.

5.2.3 Response Characteristics

Alternate Requirement: 5 Sec/10% Change

RG 1.97 Requirement: None Specified

RBS's G.E. supplied power range monitors have a response characteristic of 25 Msec/ 100% Change in flux which far exceeds the above listed alternate requirement.

5.2.4 Equipment Qualification

Alternate Requirement: Operate in ATWS Environment

RG 1.97 Requirement: RG 1.89 and RG 1.100

As discussed in NEDO-31558, the bounding events for determination of design basis requirements for NMS as it applies to RG 1.97 are the lesser ATWS events in which partial control rod insertion occurs or the plant is not isolated from the main condenser. The event selected to be bounding for this category of events is "Inadvertent SRV opening with partial scram failure". Therefore, this event establishes the environmental conditions and function time requirements for the NMS as it applies to post accident event monitoring.

The above identified event has been analyzed in NEDO-24222 assuming complete scram failure (including ARI failure) which would result in harsher (more conservative) environmental conditions than the partial scram scenario presented in NEDO-31558. As the case of complete scram failure is bounding for the special case of partial scram failure, a site specific evaluation based on NEDO-24222 was performed to determine the enveloping environmental conditions. The conservative environmental conditions determined by the evaluation is a peak suppression pool temperature of 177 degrees Fahrenheit and peak containment pressure of 8.5 psig reached at 67 minutes into the event, indicative that the event produces a gradual increase in both parameters during the event. If it is conservatively assumed that these same conditions then translate to the conditions in the drywell, this identifies the worst case conditions existing in the drywell during this event. No degradation of environmental conditions is expected to occur within areas of the Auxiliary and Fuel Buildings during this event. The NEDO-24222 analysis of this event also assumes the unlikely failure of the ARI system currently installed at RBS. In cases where ARI is accomplished, maximum suppression pool temperature would be considerably less than that determined assuming ARI failure.

Other Environmental Conditions

The analysis of Large Break LOCA, Small Break LOCA and Control Rod Drop Accident presented in Section 4.3.2 of NEDO-31558 parallel RBS operator actions, environmental impact and impact of NMS failure. As stated in NEDO-31558, the LOCA events will produce a harsher environment in containment and drywell than the ATWS.

RBS Environmental Design Considerations

The following information provided for environmental qualification is based upon review of the RBS environmental qualification files.

LPRM/ APRM

The components of the LPRM/APRM are currently qualified to 10CFR50.49 for normal, abnormal, and accident conditions. Specific qualifications contained within the RBS equipment qualification files which demonstrates operability for 12 hours into a small high energy line break in the drywell or containment. The bases for environmental qualification of the equipment considers testing of the detector assemblies to 608 degrees Fahrenheit for normal plant operations, and the fact that design basis events result in negligible changes in the environment of the detectors, which are mounted in dry tubes in the core. All other components (e.g. cable, penetrations, etc.) located in a harsh environment have been qualified as Class 1E components capable of operating during and following a design basis event. The lesser environmental conditions postulated for an ATWS event are enveloped by the existing qualification bases.

5.2.5 Function Time

Alternate Requirement: 1 hour

RG 1.97 Requirement: None Specified

The APRM/LPRM subsystem has been environmentally qualified for 12 hours in small break LOCA conditions which envelop the ATWS conditions determined for RBS. Thus, as the equipment is qualified for 12 hours in a harsher environment than for which the function time requirement is based, the RBS NMS satisfies the alternate requirement specified.

5.2.6 Seismic Qualification

Alternate Requirement: Seismic Qualification Not Required

RG 1.97 Requirement: Seismically Qualify Category 1 Equipment As Important to Safety Per RG-1.100 and IEEE-344

Since the event which has been determined to set the design basis requirements for the NMS is an ATWS event, seismic requirements for the NMS should be consistent with the ATWS rule (10CFR50.62). This rule specifies ATWS environmental conditions which do not require seismic qualification.

5.2.7 Redundancy and Separation

Alternate Requirement: Redundancy to Assure Reliability
RG 1.97 Requirement: Redundant in Division Meeting RG 1.75

The APRM subsystem consists of eight independent channels, each channel consisting of inputs from up to twenty-four LPRM detectors (sixteen to seventeen detectors per division for RBS) and the necessary signal conditioning equipment to provide an output signal directly reflecting average power in the core. The eight channels are divided into four separate divisions with each consisting of two APRM channels. Because of the redundancy in detector inputs, the practices of power and equipment separation, and the total number of channels, the APRM subsystem satisfies the alternate redundancy and separation criteria. The methods used for identification of power cable, signal cable and cable trays as safety related components and the identification scheme used to distinguish between redundant cable, cable trays, and instrument panels is in accordance with Regulatory Guide 1.75.

5.2.8 Power Sources

Alternate Requirement: Uninterruptible and Reliable Power Sources

RG 1.97 Requirement: Standby Power Source (RG 1.32)

The four divisions of the APRM subsystem are normally powered from the RPS bus. Backup power is supplied by Class 1E divisional power via manual control in the event normal RPS power supplies fail. The recorders located on the operators control console are supplied power from a single UPS power source with non-divisional battery backup. A single failure of this UPS or the single breaker that supplies all four recorders will result in loss of redundant neutron monitoring instrumentation. A design change has been scheduled for RF-5 to provide redundant non-class 1E UPS power for these recorders. This will insure that loss of a single UPS supply will not cause loss of redundant neutron flux monitoring recorders per the requirements of the safety evaluation report issued January 13, 1993 for the BWR Owner's Group Topical Report NEDO-31558.

5.2.9 Channel Availability

Alternate Requirement: Available Prior to Accident

RG 1.97 Requirement: Available Prior to Accident

As discussed in NEDO-31558, the power range instrumentation is available and in service while the plant is operating; therefore, the existing design satisfies this requirement.

5.2.10 Quality Assurance

Alternate Requirement: Limited QA Requirements on Generic Letter 85-06 (Reference 3)

RG 1.97 Requirement: Application of Specific Regulatory Guides

The entire APRM subsystem is safety related with the exception of the APRM recorders located on the operators control console. The guidance provided under NRC Generic Letter 85-06 for non-safety related ATWS equipment has been fully satisfied by the procurement, design, installation and ongoing operational quality assurance program, for the APRM system. Based on the above , the APRM subsystem satisfies the alternate requirement stated above.

5.2.11 Display and Recording

Alternate Requirement: Continuous Recording

RG 1.97 Requirement: Continuous Recording

Every APRM channel has continuous recording capability provided by strip chart recorders located on the operators control console. The requirement of NEDO-31558 is fully satisfied.

5.2.12 Equipment Identification

Alternate Requirement: Identify in Accordance with CRDR

RG 1.97 Requirement: Identify as Post-Accident Monitors

The NMS recorders are all clearly marked and labeled by division, and signal input. These recorders are located on the central portion of the operators control console along with the other plant parameters which are of primary significance to the operator. Located between the four APRM recorders are the APRM status indicators, clearly identifying alarm levels (upscale/downscale/inop, etc.). This instrumentation was reviewed from a Human Factors standpoint for both useability and identification during performance of the DCRDR effort. Based on the above, the identification of the equipment satisfies the requirement of NEDO-31558.

5.2.13 Interfaces

Alternate Requirement: No Interference with RPS Trip Functions

RG 1.97 Requirement: Isolators to be used for Alternate Functions

At RBS, the non-1E portions of the NMS are isolated and separated as required from the 1E portions of the system. The NMS; therefore, satisfies the alternate requirement as stated.

5.2.14 Service, Test, and Calibration

Alternate Requirement: Establish In Plant Procedures

RG 1.97 Requirement: Establish In Plant Procedures

The NMS is tested and calibrated on the frequencies as specified in the RBS technical specifications. Channel checks are generally performed every 12 hours and channel functionals are performed weekly when the particular instrumentation is required to be in service, as defined in technical specifications. The IRMs (trips, alarms, recorders, power supplies, regulators, etc.) are calibrated every 18 months while these same functions on the APRMs are calibrated semi-annually. On a weekly basis (with core power > 25%) each APRM is checked against core thermal power as indicated by heat balance. Adjustments are made when the APRM output deviates by more than 2% from the heat balance indicated power. Every 1000 MWD/T the LPRM detectors are calibrated using the TIP system. Additionally, LPRM signal currents are trended to determine expected detector lifetimes.

Plant section procedures cover the above described items. The control of the frequency of performance of these procedures is performed in the same manner as all other technical specifications surveillance procedures. Based on this discussion, this requirement, as specified in NEDO-31558, is satisfied.

5.2.15 Human Factors

Alternate Requirement: Incorporate HFE Principles

RG 1.97 Requirements: Incorporate HFE Principles

The DCRDR effort has been performed for the instrumentation and controls located on the operators control console. Human factors engineering principles were incorporated into this review process; therefore, the NMS satisfies this criteria.

5.2.16 Direct Measurement

Alternate Requirement: Direct Measurement of Neutron Flux

RG 1.97 Requirement: Direct Measurement of Neutron Flux

The NMS utilizes fission detectors and, as such, directly monitors neutron flux in the core. Therefore, this criteria is satisfied.

5.3 Conclusion

In all cases the APRM subsystem of the NMS meets or exceeds the alternate requirements established by NEDO-31558 and in many cases complies with the guidance in RG 1.97. After RF-5, RBS will also comply with the SER requirement to have reliable and redundant power supplies for neutron flux recorders to preclude loss of redundant channels upon a single failure of a UPS.

References

1. NEDO-31558; Position on NRC Regulatory Guide 1.97, Revision 3 Requirements for Post Accident Neutron Monitoring System. March 14, 1988, General Electric Company.

2. NEDO-24222; Assessment of BWR Mitigation of ATWS, Volume 2 (NUREG 0460) Alternate No. 3), February 1981, General Electric Company.

3. Generic Letter 85-06; Quality Assurance Guidance for ATWS Equipment That Is Not Safety Related, April 16, 1985, Nuclear Regulatory Commission.

4. NRC Evaluation of BWR Owner's Group Topical Report NEDO-31558, "Position on NRC Regulatory Guide 1.97, Revision 3, Requirements for Post-Accident Neutron Flux Monitoring System" (TAC M77660), by letter to BWROG dated January 13, 1993.