



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

STATION BLACKOUT RULE (10 CFR 50.63)

GULF STATES UTILITIES COMPANY

RIVER BEND STATION, UNIT 1

DOCKET NO. 50-458

1.0 INTRODUCTION

On July 21, 1988, the Code of Federal Regulations (CFR), 10 CFR Part 50, was amended to include a new Section 50.63, entitled "Loss of All Alternating Current Power," (Station Blackout). The Station Blackout (SBO) Rule requires that each light-water-cooled nuclear power plant be able to withstand and recover from an SBO of a specified duration. The SBO Rule also requires licensees to submit information as defined in 10 CFR 50.63 and to provide a plan and schedule for conformance to the SBO Rule. The SBO Rule further requires that the baseline assumptions, analyses, and related information be available for NRC review. Guidance for conformance to the SBO Rule is provided by (1) Regulatory Guide (RG) 1.155, "Station Blackout," (2) the Nuclear Management and Resources Council, Inc. (NUMARC) 87-00, "Guidelines and Technical Bases for NRC Initiatives Addressing Station Blackout at Light Water Reactors," and (3) NUMARC 87-00, "Supplemental Questions/Answers and Major Assumptions" dated December 27, 1989, (issued to the industry by NUMARC on January 4, 1990).

To facilitate the NRC staff's (hereafter referred to as staff) review of licensee responses to the SBO Rule, the staff endorsed two generic response formats. One response format is for use by plants proposing to use an Alternate AC (AAC) power source and the other format is for use by plants proposing an AC independent response. The generic response formats provide the staff with a summary of the results from the licensee's analysis of the plant's SBO coping capability. The licensees are expected to verify the accuracy of the results and maintain documentation that supports the stated results. Compliance to the SBO Rule is verified by a review of the licensee's submittal, an audit review of the supporting documentation as deemed necessary, and possible followup NRC inspections to ensure that the licensee has implemented the appropriate hardware and/or procedure modifications that will be required to comply with the SBO Rule.

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The licensee's responses using an AC independent response format to the SBO Rule were provided by letters from J. C. Deddens of April 17, 1989, March 30, 1990, and October 18, 1991, to the U.S. Nuclear Regulatory Commission, Document Control Desk. The licensee's responses were reviewed by Science Applications International Corporation (SAIC) under contract to the NRC. The results of the review are documented by an SAIC Technical Evaluation Report (TER) SAIC-91/1263, "River Bend Station, Unit 1, Station Blackout Evaluation," dated November 18, 1991, (Attachment).

## 2.0 EVALUATION

After reviewing the licensee's submittals and the SAIC TER, the staff concurs with the SAIC analyses and conclusions as identified in the SAIC TER (refer to the Attachment for details). The staff findings and recommendations are summarized as follows:

### 2.1 Station Blackout Duration

The licensee has calculated a minimum acceptable SBO duration of 4 hours based on a plant AC power design characteristic Group "P1," an emergency AC (EAC) power configuration Group "C," and a target Emergency Diesel Generator (EDG) reliability of 0.95. The EAC power configuration Group "C" is based on 2 EDGs not credited as AAC power sources, with 1 EDG required to operate safe shutdown equipment following a loss of offsite power. The target EDG reliability was based on River Bend Station having an average EDG reliability greater than 0.94 for the last 50 demands. The plant's EDG reliability was calculated for the last 20, 50 and 100 demands in accordance with NSAC-108 and an average reliability of 0.99 was achieved. The "P1" grouping is based on an independence of offsite power classification of Group "I 1/2," a severe weather (SW) classification of Group "1," and an extremely severe weather (ESW) classification of Group "1." However, the staff does not agree with the licensee in the extremely severe weather (ESW) classification of Group "1." As discussed in the attached TER, Section 3.2.1 of NUMARC 87-00 would place the site in the ESW Group "4." With respect to the site specific calculation presented by the licensee, the staff finds that the licensee's calculations are not consistent with the ESW frequency results obtained when using information contained in the plant Updated Safety Analysis Report (USAR). The estimated frequency of loss of offsite power using site specific data contained in the plant USAR, puts the site in ESW "4." The staff classifies the site in ESW Group "4," and hence the ac power design characteristics is "P2." With this determination, in conjunction with EAC Group "C" and EDG reliability target of 0.95, the minimum required SBO duration is 8 hours.

Recommendation: For reasons stated above, the licensee needs to change the EDG reliability target from 0.95 to 0.975 in order to remain a 4-hour SBO coping duration plant. The EDG target reliability change should be included in the documentation supporting the SBO submittals that is to be maintained by the licensee. Alternatively the licensee needs to change the coping duration to 8 hours and reevaluate the plant for an 8-hour coping duration.

## 2.2 Station Blackout Coping Capability

The characteristics of the following plant systems and components were reviewed to assure that the systems have the availability, adequacy, and capability to achieve and maintain a safe shutdown and to recover from an SBO for a 4-hour coping duration. This assumes that the EDG target reliability has been changed from 0.95 to 0.975.

Recommendation: The licensee needs to conform to the 4-hour coping duration by increasing the EDG reliability target from 0.95 to 0.975. Otherwise, the licensee needs to reevaluate the plant for an 8-hour coping duration and the supporting analyses should be submitted for NRC review.

### 2.2.1 Condensate Inventory for Decay Heat Removal

The licensee stated that the Technical Specification (TS) requires a minimum condensate storage level of 125,000 gallons of water to be maintained which is adequate for an SBO coping duration of 5.7 hours at the River Bend plant. During the course of its review, the staff's consultant, using more conservative assumptions (i.e., 102 percent reactor power, maximum allowable leakage, etc.) conducted an independent analysis which indicated that to cope with a 4-hour SBO event, that River Bend would require 122,000 gallons of water which is less than minimum available condensate for an SBO event.

Based on its review and its consultant's independent analysis, the staff concludes that the licensee will have sufficient condensate inventory to cope with a 4-hour SBO event.

### 2.2.2 Class 1E Battery Capacity

The licensee stated that the existing Class 1E battery calculations meet NUMARC 87-00 guidance. The licensee added that load stripping is not required to maintain the required 4-hour coping duration for battery capacity. The licensee performed a room heat-up calculation which shows the minimum battery room temperatures to be 70°F. The battery sizing calculations have been performed using the lowest electrolyte temperature of 60°F. The licensee's battery capacity calculations were performed to establish a 4-hour load duty cycle for a LOCA load with a 5 percent design margin, 25 percent aging factor and a 11 percent temperature correction factor (60°F electrolyte temperature). The staff considers the Class 1E battery capacity to be adequate to support a 4-hour SBO coping duration, provided the LOCA loads bound the SBO loads. However, the staff notes that the reactor core isolation cooling (RCIC) loads were considered in the licensee's calculations to occur during the first and last minutes of the 4-hour load profile. The licensee needs to ensure that this loading scenario bounds the SBO loading event.

Recommendation: The licensee needs to ensure that RCIC loads are consistent with or bound the expected load profile during an SBO event since any change in RCIC operation will directly impact the loading calculations and alter the battery capacity adequacy.

### 2.2.3 Compressed Air

The licensee stated that the air operated valves needed to cope with an SBO for 4 hours can either be operated manually or have sufficient backup sources independent of the unit's preferred and Class 1E power supplies.

Based on its review, the staff concludes that the River Bend plant will have sufficient compressed air and backup sources to cope with a 4-hour SBO event.

### 2.2.4 Effects of Loss of Ventilation

The licensee has used a computer code to perform plant specific analyses to determine the effects of loss of ventilation in the areas where the SBO response systems, components, and instrumentation and controls are located.

The staff consultant's review of these analyses resulted in questions regarding the following three aspects: methodology, input, and results.

- (a) The computer code used to calculate the room temperatures is not generally used in the nuclear industry. The licensee did not present any information regarding the methodology inherent in the computer code nor any indications as to whether the computer code has been benchmarked for subcompartment heatup calculations similar to the SBO case. There is also no evidence as to whether the computer code is maintained and controlled under an appropriate computer software quality assurance program. There was no evidence of any independent review and approval by the licensee of the calculation files provided for this SBO review.
- (b) A number of input parameter values used in the room heatup calculations have not been technically justified or are non-conservative from the viewpoint of maximizing the room temperature response. These parameters are: initial room temperature, initial room humidity, concrete thermal conductivity, control room free air volume, and constant control room boundary temperature. The licensee needs to either provide adequate technical justification for selecting these parameter values or use more conservative values in a reanalysis of the SBO room heatup.
- (c) Review of the transient temperature plots from the analysis revealed many different temperature trends for different rooms. Some of these trends did not appear to reflect the expected SBO behavior of a room while others did show the expected trend, but with varying slopes. The licensee did not provide a discussion that explained why each room responded the way that it did. (Greater details on the room heatup analysis review comments can be found in Section 3.2.4 of the SAIC TER).

Based on its review and the concerns discussed above, the staff has not been able to conclude that the effects of loss of ventilation during an SBO event at the River Bend plant have been properly evaluated.

Recommendations: The licensee should: (1) provide additional information and/or technical justification for the initial conditions and assumptions used in the heat-up analysis for each area of concern, (2) provide detailed information to address the staff's concerns as discussed in the above evaluation with regard to the computer code, and (3) re-perform the heat-up analysis for each area of concern taking into account the non-conservatism as identified in the SAIC TER.

#### 2.2.5 Containment Isolation

The licensee stated that the plant list of containment isolation valves (CIVs) was reviewed and it was determined that all of the valves which must be capable of being closed or operated (cycled) under SBO conditions can be positioned with indication independent of the unit's preferred and Class-1E power supplies. The licensee also stated that modifications and procedure change are required to ensure that appropriate containment integrity can be provided under SBO conditions. This change of procedure consists of revising AOP-0003, "Automatic Isolations" to include additional guidance on closing isolation valves which do not meet the NUMARC 87-00 exclusion criteria during a station blackout.

Based on its review, the staff concludes that the containment isolation valve design and operation at the River Bend plant have met the intent of the guidance described in RG 1.155 and are acceptable.

#### 2.2.6 Reactor Coolant Inventory

The licensee stated that the ability to maintain adequate reactor coolant system (RCS) inventory to ensure that the core is cooled during a 4-hour SBO has been assessed using a plant-specific analysis. The licensee added that the expected rates of reactor coolant inventory loss under the SBO conditions do not result in core uncover for an SBO of 4 hours. The licensee updated its analysis to include additional leakage and concluded that makeup systems, in addition to those currently available under SBO conditions are not required.

The RCS makeup is necessary to remove decay heat, to cooldown the primary system, and to replenish the RCS inventory losses due to the 61 gpm leak rate (18 gpm per recirculation pump per NUMARC 87-00 guideline and 25 gpm for the technical specifications maximum allowable leakage). The RCIC pump has the capability to inject condensate storage tank (CST) water into the reactor at the rate of 600 gpm. In addition, the high pressure core spray (HPCS) pump will also be available as a backup. The combination of these two pumps is sufficient to compensate for the assumed leak rate, to remove decay heat and to keep the core covered and cooled for the duration of the SBO event. Therefore, the staff concurs with the licensee's statement that no additional make-up systems are necessary to keep the core covered and cooled during a 4-hour SBO event.

The reactor coolant inventory evaluation was based on the guidance of NUMARC 87-00 of 18 gpm recirculation pump seal leak rate for boiling water reactors. The 18 gpm seal leak rate was agreed to between NUMARC and the NRC

staff pending resolution of Generic Issue (GI) 23. If the final resolution of GI-23 defines higher recirculation pump seal leak rate than assumed for the RCS inventory evaluation, the licensee should be aware of the potential impact of this resolution on its analyses and actions addressing conformance to the SBO Rule.

### 2.3 Procedures and Training

The licensee stated that plant procedures have been reviewed and will be modified to meet the guidelines in NUMARC 87-00, Section 4, in the following areas:

1. Station Blackout Response Guidelines
2. AC power restoration
3. Severe weather

The staff did not review the affected procedures or training. The staff expects the licensee to implement and maintain these procedures including any others that may be required to ensure an appropriate response to an SBO event. Although personnel training requirements for an SBO response were not specifically addressed in the licensee's submittals, the staff expects the licensee to implement the appropriate training to ensure an effective response to an SBO event.

### 2.4 Proposed Modification

The licensee stated that no modification to the facility will be required to cope with a 4-hour SBO event. The licensee considers the installation of back-up air cylinders a modification to meet Generic Letter 88-14, "Instrument Air Supply System Problems Affecting Safety-Related Equipment." The staff believes that the addition of back-up air cylinders is beneficial to the plant as it provides additional reserve air for air-operated valves.

The licensee has mentioned the removal of ceiling tiles to achieve an adequate control room SBO temperature on loss of ventilation but has not stated whether this will be a permanent modification, or an operator action covered by an appropriate SBO procedure.

Recommendation: The licensee needs to clarify whether the removal of control room ceiling tiles will be a permanent modification or an operator action covered by an appropriate SBO procedure.

### 2.5 EDG Reliability Program

The licensee stated that the plant has an EDG reliability program that complies with Position 1.2 of RG 1.155. The staff did not review the licensee's EDG reliability program. The staff accepts the licensee's statement that its EDG reliability program meets the guidance of RG 1.155, Section 1.2.

## 2.6 Quality Assurance and Technical Specifications

The licensee stated that no modification to the facility will be required to cope with a 4-hour SBO and that existing plant components, currently subject to 10 CFR 50 Appendix B QA requirements, will be utilized to mitigate the SBO event. The staff concurs with the licensee's statement, provided that no modifications are made to the plant. However, the licensee needs to have a list of SBO equipment including mitigating systems, and instrumentation and controls, with proper cross reference to a qualified QA program in its supplementary documentation.

The TS for the SBO equipment are currently being considered generically by the NRC in the context of the Technical Specifications Improvement Program and remains an open item at this time. However, the staff would expect that the plant procedures will reflect the appropriate testing and surveillance requirements to ensure the operability of the necessary SBO equipment. If the staff later determines that TS regarding the SBO equipment is warranted, the licensee will be notified of the implementation requirements.

## 2.7 Scope of Staff Review

The SBO Rule (10 CFR 50.63) requires licensees to submit a response containing specifically defined information. It also requires utilities "...to have baseline assumptions, analyses, and related information used in their coping evaluations available for NRC review." The staff and its contractor (SAIC) did not perform a detailed review of the proposed procedural modifications which are scheduled for later implementation. However, based on our review of the licensee's supporting documentation, we have identified the following areas for focus in any follow-up inspection or assessment that may be undertaken by the NRC to verify conformance with the SBO Rule. Additional items may be added as a result of the staff review of the actions taken by the licensee in response to this SE.

- (a) Hardware and procedural modifications,
- (b) SBO procedures in accordance with RG 1.155, Position 3.4, and NUMARC 87-00, Section 4,
- (c) Operator staffing and training to follow the identified actions in the SBO procedure,
- (d) EDG reliability program meets, as a minimum, the guidelines of RG 1.155,
- (e) Equipment and components required to cope with an SBO are incorporated in a QA program that meets the guidance of RG 1.155, Appendix A, and
- (f) Actions taken pertaining to the specific recommendations noted above in the SE.

### 3.0 SUMMARY AND CONCLUSIONS

The staff has reviewed the licensee's responses to the SBO Rule (10 CFR 50.63) and the TER prepared by the staff's consultant, SAIC. Based on our review, the minimum required SBO coping duration is determined to be 8 hours rather than 4 hours as determined by the licensee. The 8-hour coping duration is based on the staff's determination of ESW Group "4." To remain a 4-hour plant, the licensee needs to change the EDG reliability target from 0.95 to 0.975. Alternatively, the licensee could reevaluate the plant for an 8-hour coping duration. Based on the staff's review of the licensee's submittals and the SAIC TER, the staff finds that River Bend Station does not conform with the SBO Rule and the guidance of RG 1.155, and therefore recommends that the licensee reevaluate the areas of concern that have been identified in this SF. Guidance for the licensee to review and implement the staff's recommendations is provided in RG 1.155, NUMARC 87-00, and the supplementary guidance (NUMARC 87-00 Supplementary Questions/Answers; NUMARC 87-00 Major Assumptions) dated December 27, 1989, which was issued to the industry by NUMARC on January 4, 1990. The staff's concerns that are identified in this SE should be addressed by the licensee, and a revised response submitted to the NRC within 60 days. The licensee is expected to ensure that the baseline assumptions of NUMARC 87-00 are applicable to the River Bend Station. Also, the licensee should maintain all analyses and related information in the documentation supporting the SBO submittal for further inspection and assessment as may be undertaken by the NRC to audit conformance with the SBO Rule.

Attachment:  
SAIC-91/1263, Technical Evaluation Report,  
River Bend Station, Unit 1, Station  
Blackout Evaluation

Date: