Attachment 1

SAIC-91/6694

TECHNICAL EVALUATION REPORT

R. E. GINNA NUCLEAR POWER PLANT

STATION BLACKOUT EVALUATION

TAC No. 68548

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An Employee-Owned Company

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1.0 BACKGROUND

On July 21, 1988, the Nuclear Regulatory Commission (NRC) amended its regulations in 10 CFR Part 50 by adding a new section, 50.63, "Loss of All Alternating Current Power" (1). The objective of this requirement is to assure that all nuclear power plants are capable of withstanding a station blackout (SBO) and maintaining adequate reactor core cooling and appropriate containment integrity for a required duration. This requirement is based on information developed under the commission study of Unresolved Safety Issue A-44, "Station Blackout" (2-6).

The staff issued Regulatory Guide (RG) 1.155, "Station Blackout," to provide guidance for meeting the requirements of 10 CFR 50.63 (7). Concurrent with the development of this regulatory guide, the Nuclear Utility Management and Resource Council (NUMARC) developed a document entitled. "Guidelines and Technical Basis for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," NUMARC 87-00 (8). This document provides detailed guidelines and procedures on how to assess each plant's capabilities to comply with the SBO rule. The NRC staff reviewed the guidelines and analysis methodology in NUMARC 87-00 and concluded that the NUMARC document provides an acceptable guidance for addressing the 10 CFR 50.63 requirements. The application of this method results in selecting a minimum acceptable SBO duration capability from two to sixteen hours depending on the plant's characteristics and vulnerabilities to station blackout. The plant's characteristics affecting the required coping capability are: the redundancy of the onsite emergency AC power sources, the reliability of onsite emergency power sources, the frequency of loss of offsite power (LOOP), and the probable time to restore offsite power.

In order to achieve a consistent systematic response from licensees to the SBO rule and to expedite the staff review process, NUMARC developed two generic response documents. These documents were reviewed and endorsed (9) by the NRC staff for the purposes of plant-specific submittals. The documents are titled:

1. "Generic Response to Station Blackout Rule for Plants Using Alternate AC Power," and

2. "Generic Response to Station Blackout Rule for Plants Using AC Independent Station Blackout Response Power."

A plant-specific submittal, using one of the above generic formats, provides only a summary of results of the analysis of the plant's station blackout coping capability. Licensees are expected to ensure that the baseline assumptions used in NUMARC 87-00 are applicable to their plants and to verify the accuracy of the stated results. Compliance with the SBO rule requirements is verified by review and evaluation of the licensee's submittal and audit review of the supporting documents as necessary. Follow up NRC inspections assure that the licensee has implemented the necessary changes as required to meet the SBO rule.

In 1989, a joint NRC/SAIC team headed by an NRC staff member performed audit reviews of the methodology and documentation that support the licensees' submittals for several plants. These audits revealed several deficiencies which were not apparent from the review of the licensees' submittals using the agreed upon generic response format. These deficiencies raised a generic question regarding the degree of the licensees' conformance to the requirements of the SBO rule. To resolve this question, on January 4, 1990, NUMARC issued additional guidance as NUMARC 87-00 Supplemental Questions/Answers (10) addressing the NRC's concerns regarding the deficiencies. NUMARC requested that the licensees send their supplemental responses to the NRC addressing these concerns by March 30, 1990.

2.0 REVIEW PROCESS

The review of the licensee's submittal is focused on the following areas consistent with the positions of RG 1.155:

A. Minimum acceptable SBO duration (Section 3.1),

B. SBO coping capability (Section 3.2),

C. Procedures and training for SBO (Section 3.4),

D. Proposed modifications (Section 3.3), and

E. Quality assurance and technical specifications for SBO equipment (Section 3.5).

For the determination of the proposed minimum acceptable SBO duration, the following factors in the licensee's submittal are reviewed: a) offsite power design characteristics, b) emergency AC power system configuration, c) determination of the emergency diesel generator (EDG) reliability consistent with NSAC-108 criteria (11), and d) determination of the accepted EDG target reliability. Once these factors are known, Table 3-8 of NUMARC 87-00 or Table 2 of RG 1.155 provides a matrix for determining the required coping duration.

For the SBO coping capability, the licensee's submittal is reviewed to assess the availability, adequacy and capability of the plant systems and components needed to achieve and maintain a safe shutdown condition and recover from an SBO of acceptable duration which is determined above. The review process follows the guidelines given in RG 1.155, Section 3.2, to assure:

a. availability of sufficient condensate inventory for decay heat removal,

b. adequacy of the class-1E battery capacity to support safe shutdown,

c. availability of adequate compressed air for air-operated valves necessary for safe shutdown,

d. adequacy of the ventilation systems in the vital and/or dominant areas that include equipment necessary for safe shutdown of the plant,

e. ability to provide appropriate containment integrity, and

f. ability of the plant to maintain adequate reactor coolant system inventory to ensure core cooling for the required coping duration.

The licensee's submittal is reviewed to verify that required procedures (i.e., revised existing and new) for coping with SBO are identified and that appropriate operator training will be provided.

The licensee's submittal is reviewed for any proposed modifications to emergency AC sources, battery capacity, condensate capacity, compressed air capacity, ventilation system, containment isolation valves and primary coolant make-up capability. Technical specifications and quality assurance set forth by the licensee to ensure high reliability of the equipment, specifically added or assigned to meet the requirements of the SBO rule, are assessed for their adequacy.

This SBO evaluation is based on a review of the licensee's submittals dated April 17, 1989 (12), March 30, 1990 (13), July 10, 1990 (14), and the licensee's response to the questions raised during the review dated April 22, 1991 (15), and the available information in the plant Updated Final Safety Analysis Report (UFSAR) (16); it does not include a concurrent site audit review of the supporting documentation Such an audit may be warranted as an additional confirmatory action. This determination would be made and the audit would be scheduled and performed by the NRC staff at some later date.

3.0 EVALUATION

3.1 Proposed Station Blackout Duration

Licensee's Submittal

The licensee, Rochester Gas and Electric (RGE), calculated (12 - 15) a minimum acceptable station blackout duration of four hours for the R. E. Ginna Nuclear Power Plant. The licensee stated that no modifications are necessary to attain this proposed coping duration.

The plant factors used to calculate the proposed SBO duration are:

1. **Offsite Power Design Characteristics**

   The plant AC power design characteristics group is "P2" based on:

   a. Expected frequency of grid-related LOOPs of less than one per 20 years,

   b. Estimated frequency of LOOPs due to extremely severe weather (ESW) which places the plant in ESW Group "1,"

   c. Estimated frequency of LOOPs due to severe weather (SW) which places the plant in SW Group "3," and

   d. Independence of the plant offsite power system characteristic of "I1/

2. **Emergency AC (EAC) Power Configuration Group**

The EAC power configuration group at Ginna is "C." The site is equipped with two emergency ac power supplies, one of which is necessary to operate safe shutdown equipment following a LOOP.

3. **Target Emergency Diesel Generator Reliability**

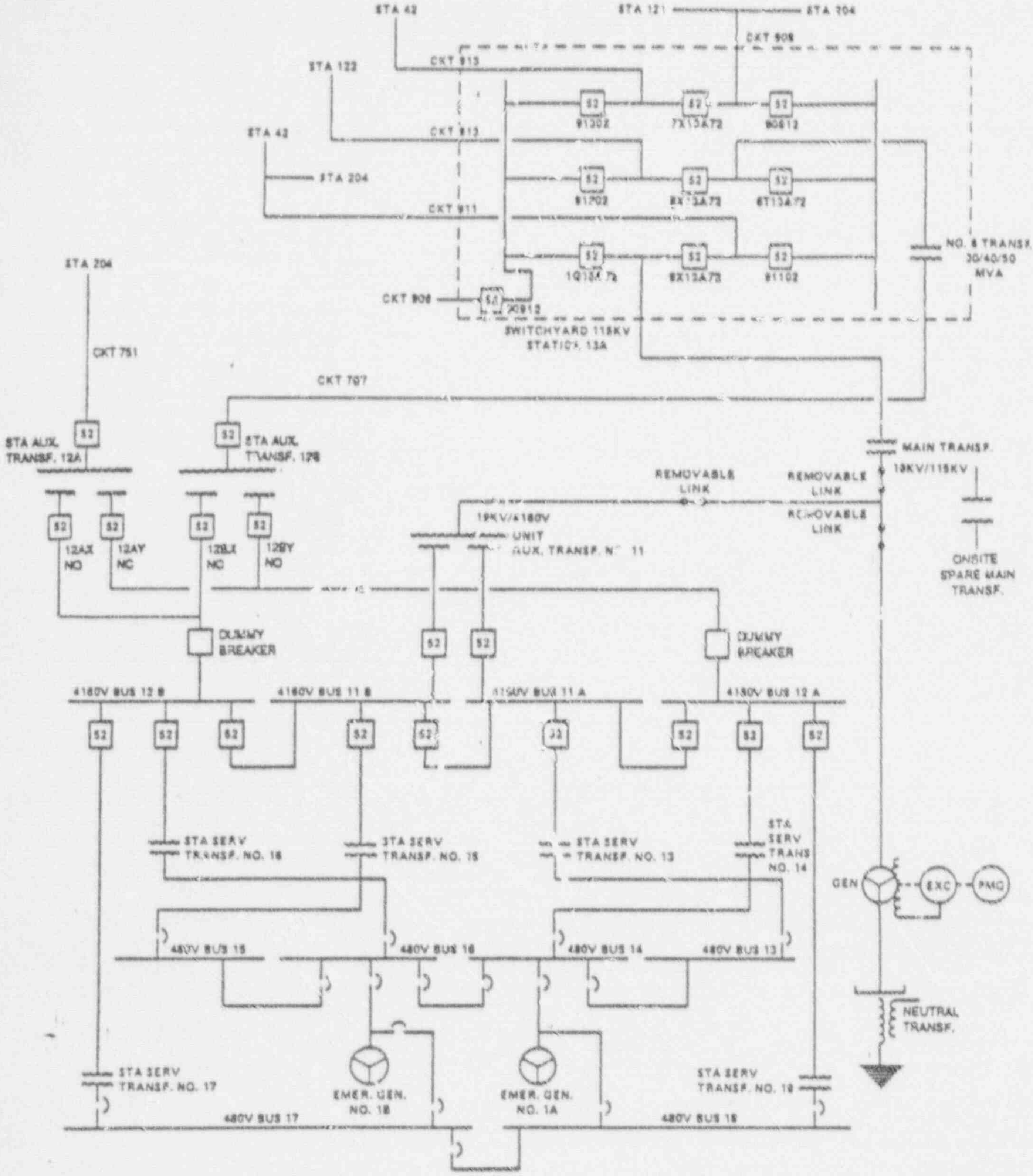
The licensee stated (12) that a target EDG reliability of 0.975 was selected based on the unit average EDG reliability for the last 100 demands of greater than 0.950, consistent with NUMARC 87-00. The licensee is committed to maintain this target reliability (15).

Review of Licensee's Submittal

Factors which affect the estimation of the SBO coping duration are: the independence of the offsite power system grouping, the estimated frequency of LOOPs due to ESW and SW conditions, the expected frequency of grid-related LOOPs, the classification of EAC, and the selection of EDG target reliability.

The licensee's estimations of the expected frequency of ESW- and SW-caused LOOPs at the Ginna site are in agreement with those given in Table 3-2 and 3-3 of NUMARC 87-00. The licensee correctly identified this configuration as "C." Ginna has two emergency AC power sources powering two class-1E safety buses, of which one is needed to supply safe shutdown loads following a LOOP.

The licensee classified the independence of the plant offsite power system as "I1/2." Our review of the plant UFSAR indicates (16) that (see Figure 1):



ROCHESTER GAS AND ELECTRIC CORPORATION
R. E. GINNA NUCLEAR POWER PLANT
UPDATED FINAL SAFETY ANALYSIS REPORT

Figure 1

Electrical Distribution System

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1. All offsite power sources are connected to the plant through electrically connected switchyards,

2. The safeguard buses are normally powered from two offsite power sources through Station Auxiliary Transformers (SATs) 12A and 12B, (each division of safeguard buses is powered from one SAT),

3. Each SAT is sized to accept all plant auxiliary loads for full power operation, and

4. Upon loss of power from one SAT, the connected safeguard buses can be powered from the other SAT through manual transfer.

Based on the above and the criteria given in RG 1.155, Table 5, the Ginna offsite power characteristics is classified as "I2."

With regard to the expected frequency of grid-related LOOPs at the site, we can not confirm the stated results. The available information in NUREG/CR-3992 (3), which gives a compendium of information on the loss of offsite power at nuclear power plants in the U.S., indicates that Ginna did not have grid-related LOOP through 1984. In the absence of any contradicting information, we agree with the licensee's statement that the frequency of grid-related LOOPs is expected to be less than once per 20 years.

The licensee stated that a target EDG reliability of 0.975 has been selected based on the demonstrated unit average EDG reliability for the last 100 demands Although this is consistent with the criteria given in both the RG 1.155 and NUMARC 87-00, the licensee needs to evaluate the EDG reliability for the last 20 and 50 demands. Since these statistics are only available on site for review, we are unable to verify the assignment of the EDG target reliability at this time. However, the information in the NSAC-108, which gives the EDG reliability data at U.S. nuclear reactors for calendar years 1983 to 1985, indicates that the EDGs at Ginna experience an average of 19 start demands per EDG per year with 100% reliability. Using this data, it appears that the EDG target reliability (0.975) selected by the licensee (12) is appropriate.

With regard the EDG reliability program, the license stated (15) that the established maintenance and testing practices at Ginna have resulted in a calculated EDG reliability that has consistently exceeded the selected target reliability. The licensee added that it plans to implement NUMARC station blackout initiative 5A as soon as Generic Safety Issue B-56 is resolved. The licensee is also committed to maintain the targeted EDG reliability.

Utilizing the above factors in Table 3-5a of NUMARC 87-00 results in an offsite power design characteristics of "P2," which leads to a required coping duration of four hours from Table 3-8, confirming the licensee's statement. The determination of the independence of the plant offsite power system does not affect the classification of offsite power characteristic and the minimum coping duration.

3.2 Station Blackout Coping Capability

The plant coping capability with a station blackout for the required duration of four hours is assessed with the following results:

1. **Condensate Inventory for Decay-Heat Removal**

Licensee's Submittal

The licensee stated (12) that 50,000 gallons of water are required for decay-heat removal and cooldown during a four-hour SBO event. In its response to the questions raised during the review, the licensee revised (15) its estimate of the condensate needed for decay-heat removal and cooldown to 76,823 gallons. The licensee added that the minimum permissible condensate storage tank level, per Technical Specifications, provides 22,500 gallons of water. The licensee identified, per procedure ER-AFW.1, three additional water sources: the 110,000 outside storage tank, city water, and the plant fire water system as supplemental water inventory. The licensee concluded that although no plant modifications are needed to utilize these water sources, some procedures will be revised to preclude confusion and delays in the use of the alternate/supplemental water sources.

In its submittal dated July 10, 1991 (14), the license stated that it plans to provide an alternate source of cooling water for the turbine-driven auxiliary feedwater (TDAFW) pump. The TDAFW pump needs service water to cool the bearing and lubricating oil during operation. During an SBO event, the licensee intends to use a diesel-driven fire water pump to provide cooling water by backfeeding through service water piping. In its recent submittal (15), the licensee stated that, based on a test, the TDAFW pump can run for at least two hours without any service water cooling.

Review of Licensee's Submittal

Using NUMARC methodology and a maximum reactor power of 1520 MWt, the plant would require 33,622 gallons of condensate to remove decay heat during a four-hour SBO event. This is more than the available minimum technical specification level in the CST. In addition, the licensee calculated that 43,200 gallons are needed for plant cooldown/depressurization. The licensee claimed (15) that the outside storage tank with 110,000 gallons will provide the needed additional water with sufficient NPSH without a need for a transfer pump (i.e. gravity flow). The UFSAR indicates that the outside (all-volatile-treatment) storage tank contains 100,000 gallons, which differs from the 110,000 gallons claimed by the licensee. Although this difference is not significant from an SBO point of view, the licensee needs to verify the correctness of the stated numbers. The licensee claimed that other alternate sources also provide sufficient NPSH for pump operation. Based on the licensee's statement of existence of additional water sources, the site will have sufficient water inventory for decay-heat removal and cool down during an SBO event. However, the licensee needs to add the alternate water sources to its SBO equipment list, and to ensure that sufficient water will be available at all times.

The licensee stated that fire system waters will be used to cool the TDAFW pump lube oil cooler. The licensee claims a previous test has shown that the TDAFW pump can run for at least two hours without any cooling of the pump bearings and oil cooler, thus allowing sufficient time to align the fire system water. Based on this test, we conclude that two hours is an adequate amount of time to align fire water to the TDAFW pump provided that the process is proceduralized and that adequate lighting is available in the required areas.

2. Class-1E Battery Capacity

Licensee's Submittal

The licensee stated (12) that battery capacity calculations have been performed which verify that the class-1E batteries have sufficient capacity to meet SBO loads for four hours. The licensee added that, for operational convenience, additional instrumentation may be added to the battery-backed buses. In response to the questions raised during the review, the licensee provided (15) its calculations of class-1E battery sizing for two and four hours. The licensee added several of the larger DC loads on the station batteries are being removed during the 1991 refueling outage. The loads that were taken off are (16):

- o Turbine DC lube oil pump from Battery A, and

- o Air side generator seal oil back-up pump and two motor-operated valves on the circulating water pump discharge lines from Battery B.

Review of Licensee's Submittal

We reviewed the battery sizing calculations provided by the licensee. The calculations included battery-capacity evaluation for two and four hours with and without the loads which were taken off during the April 1991 refueling. Our review reveals that, only with the recent load changes, the batteries will have sufficient capacity to last for four hours and conform to the recommended guidance of IEEE Std-485.

Without the recent load changes, the battery capacity was insufficient to cope for four hours and at the same time comply with the recommended guidance of IEEE Std-485. The calculations were non-conservative and included the use of an incorrect one-minute capacity rating for the batteries. The non-conservatism included selection of a low or zero aging factor, a zero design margin, and a high electrolyte temperature. In addition, the assumed SBO loads appeared to be too low. The licensee stated that during normal power operation, the battery chargers are run at 100 to 108 Amperes (A), and the inverters are also run at full capacity (7.5 kW). Therefore, without any load shedding, at 120/105 VDC battery terminal voltage, the continuous current on each battery should be 171/179 A, which is the sum of the battery charger and inverter loads. The licensee had only 114 A for Battery A and 145.4 A for Battery B. Finally, the licensee used a one-minute rating of 1360 A which should have been 1306 A for a GNB type NAX-1200 battery.

3. **Compressed Air**

Licensee's Submittal

The licensee stated (12) that air-operated valves relied upon to cope with an SBO can either be operated manually or have sufficient back-up sources independent of the preferred and class-1E power supply. Valves requiring manual operation or that need back-up sources for operation are identified in plant procedures.

Review of Licensee's Submittal

The decay-heat removal systems, including the auxiliary feedwater system and atmospheric steam dump valves were reviewed to determine their dependency on compressed air.

The TDAFW flow control valves are air-operated and fail open upon loss of air. These valves needs to be manually operated to control the AFW flow to each steam generator. The licensee needs to ensure that the area which houses the TDAFW control valves is habitable during an SBO event.

The atmospheric steam dump valves are also air-operated, but each has six bottles of nitrogen as a back-up supply of compressed air (UFSAR Figure 10.3-1). The nitrogen supply will support the automatic operation of each valve for eight hours, according to the licensee (15). This operation keeps the steam-generator pressure at about 1050 psig. However, the ECA 0.0 procedure calls for manual operation of these valves to cool the primary coolant system. These valves are equipped with handwheels to allow manual operation. The licensee performed a heat-up calculation for the area enclosing these valves. The licensee calculated temperatures of 179.8°F and 186°F for conditions when the doors are open and closed, respectively. The licensee did not state whether it is possible to manually operate these valves at the expected temperatures. The licensee needs to ensure the area is habitable by providing the equipment needed for the operation of these valves (i.e., lighting, communication, special outfit, etc.) and to train the operators for the SBO scenario accordingly.

4. **Effects of Loss of Ventilation**

Licensee's Submittal

The licensee initially provided (12) the result of a heat-up calculation for TDAFW pump room and assumed that the control-room temperature would not exceed 120°F during an SBO event. In its later submittal (14), the licensee stated that control room and atmospheric steam dump valve area heat-up calculations are being undertaken. In response to the questions raised during the review, the licensee provided the heat-up calculations for TDAFW pump room, atmospheric dump valve area, and the control building rooms. The following table summarizes the calculated post-SBO temperatures, heat-up analysis method, and justification for Reasonable Assurance of Operability (RAO) for the areas of concern at Ginna station (15).

AREA	TEMPERATURE ° F		ANALYSIS	RAO JUSTIFICATION
	FINAL	INITIAL		
Turbine-driven AFW pump room Closed/Open Doors	158/145	104	NUMARC	equipment evaluation
Control room Closed/Open Doors	124/116 (4 hr.)	77	Non-NUMARC	Less Than 120° F
ADV Area Closed/Open Doors	186/178.9	115.5	NUMARC	equipment evaluation
Relay Room Closed/Open Doors	103/99 (4 hr.)	77	Non-NUMARC	Less Than 120° F
Battery Room A Closed/Open Doors	107/106.4 (4 hr.)	85	Non-NUMARC	Less Than 120° F
Battery Room B Closed/open Doors	106.2/105.8 (4 hr.)	85	Non-NUMARC	Less Than 120° F

The licensee stated that the RAO of SBO response equipment in the above areas of concerns has been assessed using Appendix F to NUMARC 87-00 and/or the Topical report. Reasonable assurance of equipment operability is established without further analysis if temperatures in the DAC are calculated to be equal to or less than 120°F (NUMARC 87-00 Supplemental Questions/Answer #2.2) (10). The licensee concluded that no modifications or associated procedures are required to provide reasonable assurance of equipment operability.

Review of Licensee's Submittal

We reviewed the licensee's provided (15) heat-up calculations for the control room, TDAFW pump room, ADV area, relay room, and battery rooms. The ADV area and the TDAFW pump room heat-up calculations were performed using NUMARC method. These calculations clearly identified the assumptions used and provided excerpts from references where thermo-physical properties were taken. On the other hand, the control building (control room, relay room, and battery rooms) heat-up analysis only provided a summary of the method and assumptions used and did not explicitly identify individual parameters used in the calculations. Our review of theses analyses are summarized below:

o **Turbine-Driven AFW Pump Room**

The turbine-driven AFW pump (TDAFWP) room is in the Intermediate Building (IB) at elevation 253'-3", surrounded by the containment, turbine, service, and auxiliary buildings. The room above this room is the ADV area. The heat load in the TDAFWP room is generated from steam lines. We consider the licensee to have correctly identified the heat sources in this and other areas. The licensee used the surrounding walls as heat sinks, and neglected the floor, which is the basement, and the ceiling surface area. The licensee claimed that these assumptions make the calculation conservative. Our review of the licensee's calculations indicates that the ceiling, which is constructed of corrugated metal attached to the 5-inch poured concrete slab, could be at a temperature higher than the 104°F assumed for all the walls except that of the containment. We performed the same type of analysis as the licensee has performed for the ceiling area temperature in the ADV room and found an average ceiling surface area temperature of 123°F in the TDAFWP room. It should be mentioned that the NUMARC method assumes a constant wall temperature during an SBO event. In this calculation, the licensee determined the weighted average wall temperature by summing the individual wall surface area temperature corrected for its contribution to the overall heat sink surface area. Therefore, the effect of considering the ceiling will result in a 7°F higher average wall surface area temperature than that calculated by the licensee. This increase in the average wall temperature results in a final room temperature of 152°F with the doors open. The licensee needs to evaluate the effects of such a temperature on the equipment in this room, and provide a procedural action to open the TDAFWP room within 30 minutes of the onset the event. This room contains more equipment than just the AFW pump. Operability of other components may need to be considered.

o **Atmospheric Dump Valve area**

The ADV room is located above the TDAFWP room in IB. The licensee used the heat sources in this room and a room above this room to estimate the ADV room final temperature during an SBO. The reason for considering the room above the ADV room is that the floor separating these two rooms is constructed of the same material as that used for the floor between the TDAFWP and the ADV room. The licensee did not consider the ADV room floor surface area, which is the ceiling of the TDAFWP room, as a heat sink. As we discussed above, this assumption is non-conservative since the average floor temperature could be as high as 123°F. Considering the floor as an additional heat sink results in a higher average wall temperature of 1°C. This change directly adds to the final temperature. We also noticed that the licensee has used an empirical equation for natural convection heat transfer which is only applicable in the laminar region. The calculation shows that the heat transfer is occurring in the transitional laminar-turbulent region.

Since there is no suitable empirical equation for this region, we consider the equation used by the licensee to be reasonable for the intended purpose.

o **Control Building**

The control building houses the control room, the relay room, and the battery rooms. The licensee stated that a test has been performed to determine the heat loads in each room of this building. The licensee monitored the temperature of different areas in each room and calculated a heat load for each room based on its ventilation air flow and change in temperature. Using these loads licensee calculated a time-dependent temperature in each room of this building. The licensee claimed that the heat loads are conservative for an SBO event.

The licensee did not state when the test was performed nor what the atmospheric conditions were at the time of the test. This is important due to the fact that three sides of the building are directly affected by solar radiation. The control room is located on the top floor of the control building, and therefore receives additional solar radiation on its ceiling. Except for the initial temperature and the heat load in each room, no other information was provided; therefore, we are unable perform a detailed review. Our review of the information provided resulted in the following concerns:

1. The calculated heat load in the control room is 14.25 kW. The licensee stated that the two inverters of 7.5 kW each are fully loaded during normal plant operation. Therefore, it appears that the calculated heat load is low. One reason could be the assumption of air flow rate into the control room. For calculating this load the licensee used a 1987 control room air flow measurement, and considered that to be still

valid. The UFSAR, Section 6.4 states that the control room HVAC provides an air exchange rate of 20 and 10 times per hour for the control room and for the office and kitchen, respectively. The air flow rate used by the licensee would result in a much lower exchange rate. Therefore, the licensee's assertion that the heat load is conservative does not appear to be valid, and the room heat load may be higher than that calculated.

2. The licensee used a non-conservative initial control room temperature of 77°F. The plant has only one train of HVAC in the control room, and there is a potential for a degraded HVAC system during normal plant operation. The licensee can use this temperature if it provides an assurance that this temperature will not be exceeded. The licensee needs to establish procedural controls to ensure that this temperature will not be exceeded under any circumstances during normal plant operation.

3. The licensee first made an assumption that the area between the drop ceiling tiles and the control room ceiling, or the "truss area," receives the cooled air first and then the air passes through holes to the area below, i.e. operating area. At the end of the calculation the licensee identifies a need for removing the ceiling tiles, but did not indicate when nor which tiles should be removed. Removal of the tiles needs to be performed in the first 30 minutes of the event.

4. The licensee did not identify a need to open the control room cabinet doors. This needs to be proceduralized and actions taken within 30 minutes from the on set of an SBO event.

5. It appears that the licensee has used all surface areas (i.e., side walls, floor, and ceiling) in each room as heat sink. Since the battery room, relay room, and control room are at different elevations, the ceiling for one room is the floor of the next room. It is not clear how the licensee has modeled this dependency. Our understanding of the calculation is that the licensee used a one dimensional heat transfer code which assumes the surrounding room temperatures to remain unchanged during the analysis. This approach will result in underestimating the final temperatures of the individual rooms if the dependency is ignored. Other factors that affect the heat-up calculation are the outside ambient air temperature, heat transfer coefficient, and thermo-physical properties of the materials considered in the analysis. Without this information we unable to concur with the licensee's findings.

5. Containment Isolation

Licensee's Submittal

The licensee stated (12) that the plant list of containment isolation valves had been reviewed to verify that containment isolation valves that must be operated under SBO conditions can be positioned, with indication, independent of the preferred and class-1E AC power supplies. The licensee concluded that no modifications or procedure changes are necessary to ensure that containment integrity can be obtained, if needed, under SBO conditions.

Review of Licensee's Submittal

The licensee provided (15) a list of containment isolation valves and justification for exclusion per NUMARC 87-00 for each penetration. This list was reviewed and found to be consistent with the guidance provided in RG 1.155, and the existing operating/administrative procedures, which meet the intent of RG 1.155. Therefore, we concur with the licensee's conclusions.

6. **Reactor Coolant Inventory**

Licensee's Submittal

The licensee stated that the ability to maintain adequate reactor coolant system (RCS) inventory to ensure that the core is cooled has been assessed for four hours. A plant-specific simulation using the TREAT code was run (15) for the projected station blackout scenario. The licensee provided (15) excerpts from this analysis, and stated that this transient was also evaluated with the MAAP 3.0B Revision 17 with similar results. The MAAP results show that there will be voiding in the upper head and upper plenum. However, natural circulation will keep the core cooled. In addition, the reactor coolant loss decreases from 6.6 lb/sec (63 gpm) initially to about 3.45 lb/sec at four hours as a result of RCS pressure change. The licensee concluded that the expected rates of reactor coolant inventory loss under SBO conditions do not result in core being uncovered during a 4-hour SBO event.

Review of Licensee's Submittal

The licensee provided several figures showing the water level in the steam generator and pressurizer along with the AFW flow, break flow, RCS cold and hot leg temperatures, RCS pressure, upper head and upper plenum level, etc. during the SBO and recovery period. These figures indicate that the RCS pressure was kept at ~1100 psia using ADV set point to control the steam generator pressure. This analysis is not consistent with the assumptions made in calculating the condensate water inventory. This analysis shows that the RCS remains near its saturation temperature corresponding to a pressure of 1100 psia, and very little cooldown, if any, occurs. In the condensate inventory calculation, the licensee assumes a 50°F/hr cooldown.

We performed an independent calculations using the information available in the plant UFSAR and the licensee's submittals. Ginna has two reactor coolant pumps, each is assumed to leak 25 gpm through the seals resulting in 50 gpm total seal leakage. Adding the maximum leakage allowed by Technical Specifications of 11 gpm results in a total leakage of 61 gpm. Over the four-hour SBO event, this would result in 14,640 gallons being lost from the primary coolant system. The RCS water volume at the guaranteed full power is 5671 ft^3. The leakage, in conjunction with the RCS level shrink due to the 50°F/hr cooldown, results in an RCS inventory of ~2473 ft^3 at the end of four hours. This is more than that needed to keep the core covered. In addition, our calculation does not consider the accumulator water as a source of the RCS inventory, even though the RCS pressure at the end of four hours is much less than the accumulator injection pressure. Therefore, we concur with the licensee that the core will remain covered and will be cooled by natural circulation through reflux boiling.

<u>NOTE:</u>

> "The <u>25 gpm reactor coolant pump seal leak rate</u> was agreed to between NUMARC and the staff pending resolution of generic Issue (GI) 23. If the final resolution of GI-23 defines higher seal leak rates than assumed for the RCS inventory evaluation, the licensee needs to be aware of the potential impact of this resolution on its analyses and actions addressing conformance to the SBO rule."

3.3 Proposed Procedures and Training

Licensee's Submittal

The licensee stated (12) that the plant procedures have been reviewed as required to meet the guidelines in NUMARC 87-00, Section 4, in the following areas:

1. Station Blackout Response,
2. AC Power Restoration, and
3. Sever Weather Guidelines.

The licensee listed (12) individual procedures for each category. The licensee stated (14) that the severe weather plant procedure, SC-2 "Adverse Weather Emergency Plan," will be revised within two years of the notification by the NRC staff.

Review of Licensee's Submittal

We neither received nor reviewed the affected procedures. These procedures are plant-specific actions concerning the required activities to cope with an SBO event. The licensee identified the procedures that need to be modified to cope with an SBO event. It is the licensee's responsibility to revise and implement these procedures, as needed, to mitigate an SBO event and to assure that these procedures are complete and correct, and that the associated training needs are carried out accordingly.

3.4 Proposed Modifications

Licensee's Submittal

The licensee did not identify any plant modifications to be required in order to order to cope with an SBO of four hours duration, and stated that any needed procedural revisions will be completed within two years from the NRC's notification.

Review of Licensee's Submittal

This review identified several concerns to which the licensee needs to respond and which may require modifications.

3.5 Quality Assurance and Technical Specifications

Quality Assurance

The licensee prepared and provided (15) a list of SBO response equipment identifying the QA classification for each. This list shows most of the SBO response equipment to be safety-related and therefore covered under a qualified QA program. Some equipment is classified as "not nuclear safety," which is not covered by a QA program. This includes the outside condensate storage tank, and a series of manual valves used to route water from this tank to the main CST's. The licensee stated that since this water source is one of three methods of supplying water to the condensate storage tanks, it is unnecessary to reclassify these components as SBO-required equipment since the other two comply with 10 CFR, Appendix R, QA requirements and are available for coping with an SBO event. This review concurs with the licensee.

Technical Specifications

The licensee did not address the compliance of the SBO equipment with the guidance of RG 1.155, Appendix B.

4.0 CONCLUSIONS

Based on our review of the licensee's submittals and the information available in the UFSAR for R. E. Ginna Nuclear Power Plant, we find the plant conforms to the requirements of the SBO rule and the guidance of R.G. 1.155 with the following exceptions:

1. **Condensate Inventory**

   The licensee proposes to use fire water as cooling for the TDAFW pump lube oil cooler. The licensee claims a previous test has shown that the TDAFW pump can run for at least two hours without any cooling to the pump bearings and oil cooler, thus allowing time to align the fire system water. Although we agree with the licensee that two hours is an adequate time to align fire water to the TDAFW pump, the licensee needs to provided that procedures for action and verify adequate lighting is available in the required areas.

2. **Compressed Air**

   The TDAFW flow control valves and ADV's are air-operated which require local manual action for their control. The licensee needs to ensure that the area which houses these valves are habitable during an SBO event. The ADV area is calculated to have an average temperature of ~180°F. The licensee needs to ensure the habitability (lighting, communications, special outfit, etc.) for the operation of these valves and to train the operators for the SBO scenario accordingly.

3. **Effects of Loss of Ventilation**

a. Turbine-Driven AFW Pump Room

The licensee used the surrounding walls as heat sink, and did not consider the floor or the ceiling surface areas. Our review indicates that the ceiling, which is constructed of corrugated metal attached to the 5-inch poured concrete slab, could be at a temperature of 123°F. Considering the ceiling as an additional heat sink will result in a 7°F higher average wall temperature than that calculated by the licensee. This increase in average wall temperature results in a final room temperature of 152°F with the doors open. The licensee needs to evaluate the effects of such temperature on the equipment in the TDAFWP room, and provide procedural guidance to open the room doors within 30 minutes of the onset the event. This room contains equipment other than the AFW pump. The licensee needs to ensure that the operability of other equipment in this room will not be jeopardized at the expected room temperature. This equipment may be needed for recovery from an SBO.

b. Control Building: Control, Battery, and Relay Rooms

Our review of the information provided by the licensee resulted in the following concerns:

1. The calculated heat load in the control room is 14.25 kW. The licensee stated that the two inverters of 7.5 kW each are fully loaded during normal plant operation. Therefore, it appears that the calculated heat load is low. One reason could be the assumption of air flow rate into the control room. For calculating this load the licensee used a 1987 control room air flow measurement, and considered that to be still

valid. The UFSAR, Section 6.4 states that the control room HVAC provides an air exchange rate of 20 and 10 times per hour for the control room and for the office and kitchen, respectively. The air flow rate used by the licensee would result in a much lower exchange rate. Therefore, the licensee's assertion that the heat load is conservative does not appear to be valid, and the room heat load may be higher than that calculated.

2. The licensee used a non-conservative initial control room temperature of 77°F. The licensee needs to establish procedural controls to ensure that this temperature will not be exceeded under any circumstances during normal plant operation.

3. The licensee first made an assumption that the area between the drop ceiling tiles and the control room ceiling, or the "truss area," receives the cooled air first and then the air passes through holes to the area below, i.e. operating area. At the end of the calculation the licensee identifies a need for removing the ceiling tiles, but did not indicate when nor which tiles should be removed. Removal of the tiles needs to be performed in the first 30 minutes of the event.

4. The licensee did not identify a need to open the control room cabinet doors. This needs to be proceduralized and actions taken within 30 minutes from the on set of an SBO event.

5. It appears that the licensee has used all surface areas (i.e., side walls, floor, and ceiling) in each room as heat sink. Since the battery room, relay room, and control room are at different elevations, the ceiling for one room is the floor of the other room. It is not clear how the licensee has modeled this dependency. Our understanding of the calculation is

that the licensee used a one dimensional heat transfer code which assumes the surrounding room temperatures to remain unchanged during the analysis. This approach will result in underestimating the final temperatures of the individual rooms if the dependency is ignored. Other factors that affect the heat-up calculation are the outside ambient air temperature, heat transfer coefficient, and thermo-physical properties of the materials considered in the analysis. Without this information we unable to concur with the licensee's findings.

4. **Proposed Modifications**

The licensee did not identify any need for modifications to cope with an SBO event. Our review has identified several concerns which may require modifications for their resolutions.

5. **Technical Specifications**

The licensee's submittals do not document the plant compliance with the guidance of RG 1.155, Appendix B.

5.0 REFERENCES

1. The Office of Federal Register, "Code of Federal Regulations Title 10 Part 50.63," 10 CFR 50.63, January 1, 1989.

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3. U.S. Nuclear Regulatory Commission, "Collection and Evaluation of Complete and Partial Losses of Offsite Power at Nuclear Power Plants," NUREG/CR-3992, February 1985.

4. U.S. Nuclear Regulatory Commission, "Reliability of Emergency AC Power System at Nuclear Power Plants," NUREG/CR-2989, July 1983.

5. U.S. Nuclear Regulatory Commission, "Emergency Diesel Generator Operating Experience, 1981-1983," NUREG/CR-4347, December 1985.

6. U.S. Nuclear Regulatory Commission, "Station Blackout Accident Analyses (Part of NRC Task Action Plan A-44)," NUREG/CR-3226, May 1983.

7. U.S. Nuclear Regulatory Commission Office of Nuclear Regulatory Research, "Regulatory Guide 1.155 Station Blackout," August 1988.

8. Nuclear Management and Resources Council, Inc., "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," NUMARC 87-00, November 1987.

9. Thadani, A.C., letter to W. H. Rasin of NUMARC, "Approval of NUMARC Documents on Station Blackout (TAC-40577)," October 7, 1988.

10. Thadani, A.C., letter with attachment to A. Marion of NUMARC, "Publicly Noticed Meeting, December 27, 1989," dated January 3, 1990 (confirming "NUMARC 87-00 Supplemental Questions/Answers," December 27, 1987).

11. Nuclear Safety Analysis Center, "The Reliability of Emergency Diesel Generators at U.S. Nuclear Power Plants," NSAC-108, Wyckoff, H., September 1986.

12. Letter, Robert C. Mecredy (RGE) to Thomas E. Murley, Director, Nuclear Reactor Regulations, USNRC, "10 CFR 50.63 Station Blackout, R.E. Ginna Nuclear Power Plant," dated April 17, 1989.

13. Letter, Robert C. Mecredy (RGE) to Thomas E. Murley, Director, Nuclear Reactor Regulations, USNRC, "10 CFR 50.63 Station Blackout, R.E. Ginna Nuclear Power Plant," dated March 30, 1990.

14. Letter, Robert C. Mecredy (RGE) to Thomas E. Murley, Director, Nuclear Reactor Regulations, USNRC, "10 CFR 50.63 Station Blackout, R.E. Ginna Nuclear Power Plant," dated July 10, 1990.

15. Letter, Robert C. Mecredy (RGE) to Allen R. Johnson (USNRC), "10 CFR 50.63, Loss of all alternating current power, R.E. Ginna Nuclear Power Plant," dated April 22, 1991.

16. Ginna Updated Final Safety Analysis Report.

17. Telephone Conversation with E. Trottier (NRC) on August 16, 1991.