TECHNICAL EVALUATION REPORT
VERMONT YANKEE NUCLEAR POWER STATION
STATION BLACKOUT EVALUATION

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TABLE OF CONTENTS

Section		Page
1.0	BACKGROUND	1
2.0	REVIEW PROCESS	3
3.0	EVALUATION	6
	3.1 Proposed Station Blackout Duration	6
	3.2 Alternate AC (AAC) Power Source	12
	3.3 Station Blackout Coping Capability	16
	3.4 Proposed Procedures and Training	21
	3.5 Proposed Modifications	22
	3.6 Quality Assurance and Technical Specifications	23
4.0	CONCLUSIONS	24
5.0	REFERENCES	28

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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 16 hours depending on the plant's characteristics and vulnerabilities to the risk from 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 ...

generic response documents. These documents were reviewed and endorsed by the NRC staff (12) 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 licensee 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 (14) 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 (9), 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 Regulatory Guide 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 for any proposed modifications to emergency AC sources, battery capacity, condensate capacity, compressed air capacity, appropriate containment integrity and primary coolant make-up capability is reviewed. 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.

The licensee's proposed use of an alternate AC power source is reviewed to determine whether it meets the criteria and guidelines of Section 3.3.5 of RG 1.155 and Appendix B of NUMARC 87-00.

This SBO evaluation is based on a review of the licensee's submittals dated April 12, 1989 (10) and March 30, 1990 (11), the information available in the plant Updated Final Safety Analysis Report (UFSAR) (13), and a telephone conversation between NRC/SAIC and the licensee on May 16, 1990); 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 will be made and the audit may 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, the Vermont Yankee Nuclear Power Corporation, calculated (10 and 11) a minimum acceptable SBO duration of eight hours for the Vermont Yankee Nuclear Power Station. The licensee stated that no modifications are necessary to attain this proposed coping duration.

The plant factors used to estimate the proposed SBO duration are as follows:

1. Offsite Power Design Characteristics

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

   a. Independence of offsite power group of "I1/2,"

   b. Estimated frequency of LOOPs due to severe weather (SW) which places the plant in SW group "2,"

   c. Estimated frequency of LOOPs due to extremely severe weather (ESW) which places the plant in ESW Croup "4," and

   e. Expected frequency of grid-related LOOPs of less than once per 20 years.

2. Emergency AC (EAC) Power Configuration Group

   The EAC power configuration of the plant is "C." The Vermont Yankee Nuclear Power Station is equipped with two emergency diesel generators which are normally available to the plant's safe shutdown equipment. One emergency AC power supply is sufficient

to operate the safe shutdown equipment following a loss of offsite power.

3. Target Emergency Diesel Generator (EDG) Reliability

The licensee has selected a target EDG reliability of 0.95 Based on having a nuclear unit average EDG reliability of greater than 0.95 for the last 100 demands.

Review of Licensee's Submittal

Factors which affect the estimation of the SBO coping duration are: the independence of offsite power system grouping, the estimated frequency of LOOPs caused by grid-related failures, the estimated frequency of LOOPs caused by severe weather (SW) and extremely severe weather (ESW) conditions, the classification of EAC, and the selection of EDG target reliability.

The licensee's estimated ESW-caused LOOP frequency is consistent with the guidance provided in NUMARC 87-00, Table 3-2. The SW-caused LOOP frequency at Vermont Yankee is based on the annual snowfall and tornado frequency, and the number of rights-of-way on which offsite power traverses. The Vermont Yankee Nuclear Power Station is served with 345 kV offsite power lines from Northfield, Scobie and Coolidge and a 115 kV line from Keene. All lines leave the adjacent 345 kV and 115 kV switchyards and travel approximately 1600 feet northward, at which point all but the Coolidge line then turns to the east, crossing the 4000 foot wide Connecticut River on a single right-of-way. The Coolidge line travels in northwesterly direction along the river. Since the rights of way are separated by more than one quarter of a mile at a distance of one mile from the plant, the licensee is justified in taking credit for multiple rights-of-way.

The licensee used site specific snowfall data from the plant UFSAR. The UFSAR snowfall data is 60" per year (based on 25 years of National

Weather Service data ending in 1965) compared to 79" per year in NUMARC 87-00, Table 3-3. The licensee used the NUMARC 87-00 tornado frequency of 8.71E-5 per year per square mile rather than the UFSAR estimate of 2.56E-4 per year per square mile (Calculated from 12 tornados on 3 million acres in 10 years per Section 2.3.6.3 of the UFSAR). Using the most advantageous (least conservative) combination of sources of snowfall and tornado data and multiple rights-of-way, (UFSAR snow data and NUMARC 87-00 tornado data) the licensee estimated the frequency of LOOPs caused by SW to be 9.37E-3/yr., which places the plant in SW group "2." However, since using either NUMARC 87-00 or the UFSAR data throughout the analysis would place Vermont Yankee in SW group "3," the licensee needs to provide analysis justifying their choice of data or accept SW group "3."

The licensee bases the independence of offsite power system grouping of "I1/2" on the following (see Figure 1):

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

2. there are two emergency safety feature divisions, and each division is normally powered from the main generator via a winding of the unit auxiliary transformer T-2,

3. upon failure of the main generator, the safe shutdown buses are automatically transferred to start-up transformers T-3A and T-3B which are powered from a 115 kV bus, (the 115 kV bus is normally powered from the 345 kV switchyard), and,

4. upon loss of 345 kV power to the 115 kV bus, the bus can be manually transferred to the 115 kV power line from Keene. The safe shutdown buses are still receiving power from the start-up transformers T-3A and T-3B.

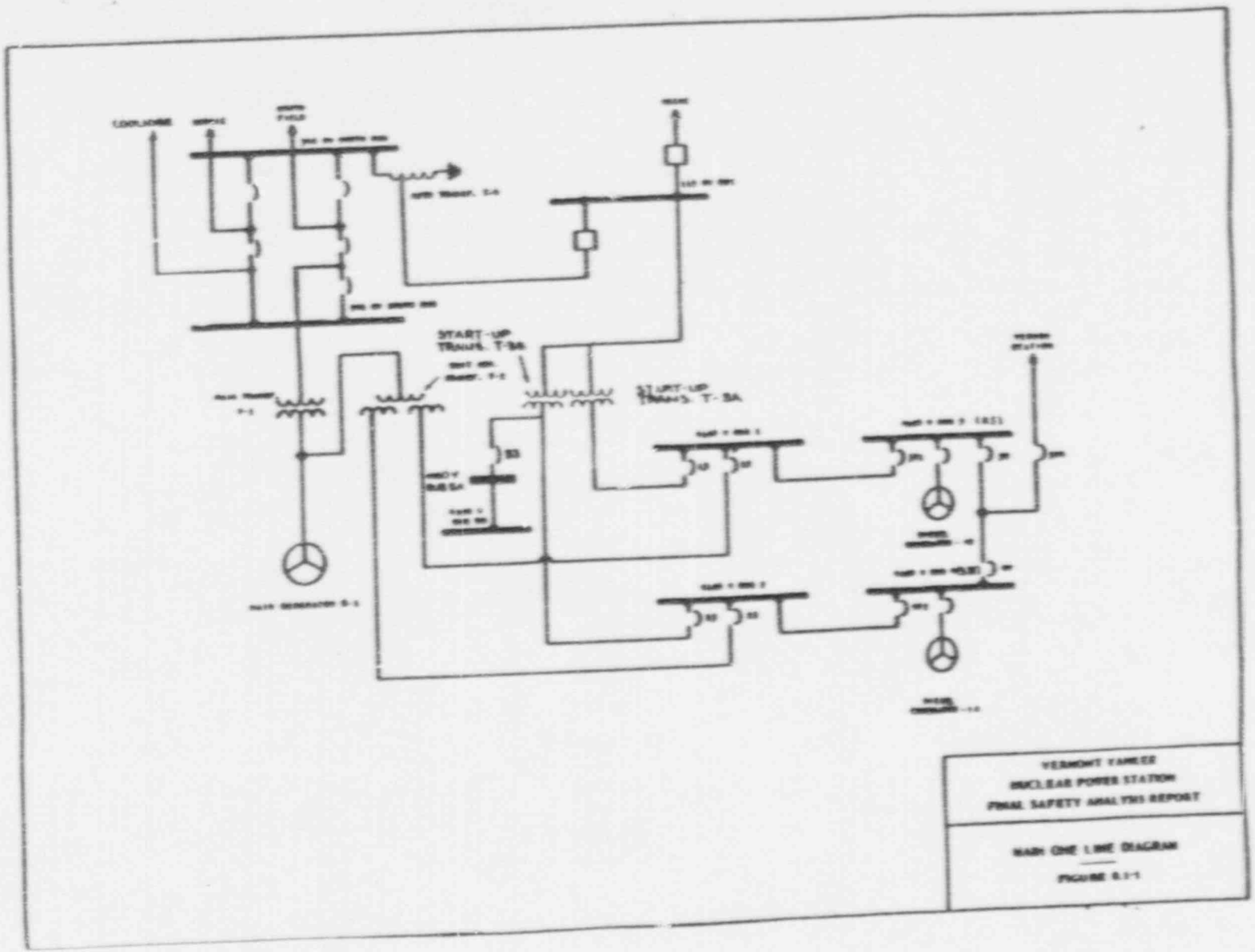

FIGURE 1. VERMONT YANKEE AC POWER SYSTEM

For a plant with electrically connected switchyards, NUMARC 87-00 states that a plant should be considered to be group "I3" if *"The normal source of AC power is from the main generator and there is one automatic transfer and no manual transfers of all safe shutdown buses to one preferred or one alternate off-site power source."* The automatic transfer to the start-up transformers (item 3. above) is acceptable, but the manual transfer (item 4.) involves using the same power source (the start-up transformers) as is used for the automatic transfer. Item 4. is not a valid transfer because a failure of either the 115 kV bus or the start-up transformers would preclude the ability to power the safety buses. Therefore, we conclude that Vermont Yankee is in offsite power group "I3."

Establishment of the proper Emergency AC (EAC) Configuration Group is based on the number of available EAC sources and the number of EAC sources required to operate safe shutdown equipment following a LOOP. Vermont Yankee has two dedicated EAC sources with one required after a LOOP, placing the plant in EAC Group "C" (RG 1.155, Table 3) as the licensee correctly identified.

The final characteristic needed to establish the required coping duration is the target EDG reliability. The licensee stated (10) that the assignment of the EDG target reliability of 0.95 is based on having an average EDG reliability of greater than 0.95 for the last 100 demands. Although this is an acceptable criterion for choosing an EDG target reliability, the guidance in RG 1.155 requires that the EDG reliability statistics for the last 20 and 50 demands also be calculated. Without this information it is difficult to judge how well the EDGs have performed in the past and if there should be any concern. We are unable to verify the demonstrated start and load-run reliability of the plant EDGs. This information is only available onsite as part of the submittals supporting documents. The available information in the NSAC-108, which give EDG reliability data at U. S. nuclear reactors for calendar years 1983 to 1985, indicates that the EDGs at Vermont Yankee experience an average of 22 valid start demands per diesel per calendar

year and have reliability levels of higher than 0.95. Using this data, it appears that the EDG target reliability (0.95) selected by the licensee (10) is appropriate. Nevertheless, the licensee needs to have an analysis showing the EDG reliability statistics for the last 20, 50, and 100 demands in its SBO submittal supporting documents.

In response to the requirement for an EDG reliability program the licensee, during the telephone conversation on May 16, 1990, stated that a reliability program consistent with the guidance provided in RG 1.155 and NUMARC 87-00 is being developed. This was not documented in the licensee's submittals; however, the licensee is committed to maintain the targeted EDG reliability of 0.95.

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., covers only the events prior to the calendar year 1984. No grid-related LOOPS for Vermont Yankee were reported. During the telephone conversation on May 16, 1990, the licensee stated that Vermont Yankee has not had any grid-related LOOPs in the last 20 years. In the absence of any contradicting information, we agree with the licensee's statement.

Based on an SW group "3" and an ESW group "4," the AC power design characteristics of Vermont Yankee is "P3" irrespective of the plant independence of offsite power system grouping determination. With this determination, in conjunction with EAC group "C" and an EDG reliability target of 0.95, the required coping duration for Vermont Yankee is 16 hours. We reviewed the licensee's submittal for a coping duration of 16 hours. The licensee can reduce the required coping duration to eight hours if it commits to an EDG target reliability of 0.975.

3.2 Alternate AC (AAC) Power Source

Licensee's Submittal

The licensee stated that the AAC source is available within 10 minutes of the onset of an SBO event and has sufficient capacity to operate systems necessary for an eight hour SBO. The AAC power source will provide the approximate equivalent of one emergency EDG and is capable of supplying the entire emergency bus load required under the UFSAR postulated design basis accident.

The licensee stated (10) that an existing 4,160 V tie line to the New England Power Company's (NEPCO's) Vernon Hydroelectric Station will be used as the alternate AC (AAC) power supply, see Figure 2. The Vernon Station has ten 6,000 kVA hydro-electric generators and is connected to the grid via four 69 kV lines. The Vermont Yankee plant is connected to Vernon by a 4,160 V fully insulated cable which runs on a pole line for about 2,300 feet and then runs underground for approximately 1,700 feet to the Vermont Yankee switchgear. The licensee stated that the normal operational mode of Vernon requires that at least 6,000 kW of generation capacity always be connected to the grid either as spinning reserve or as running capacity. The maximum capacity of the transformer that feeds Vermont Yankee is 3,300 kVA, which can be delivered to either of the safety buses as shown in Figure 2. The licensee stated that the control switches for the three breakers (3V, 4V and 3V4) needed to energize the safety buses (Bus 3 and Bus 4) are located in the Vermont Yankee control room and that the availability of the Vernon tie-line is indicated continuously in the control room.

The licensee stated (10) that the 125 V DC control power for breaker 3V and 3V4 is supplied from Station Battery A1 and the control power for breaker 4V is supplied from Station Battery B1. The licensee stated that a design change will be implemented by 1992 to provide a source of control power to Breaker 3V4 that is independent of Batteries A1 and B1.

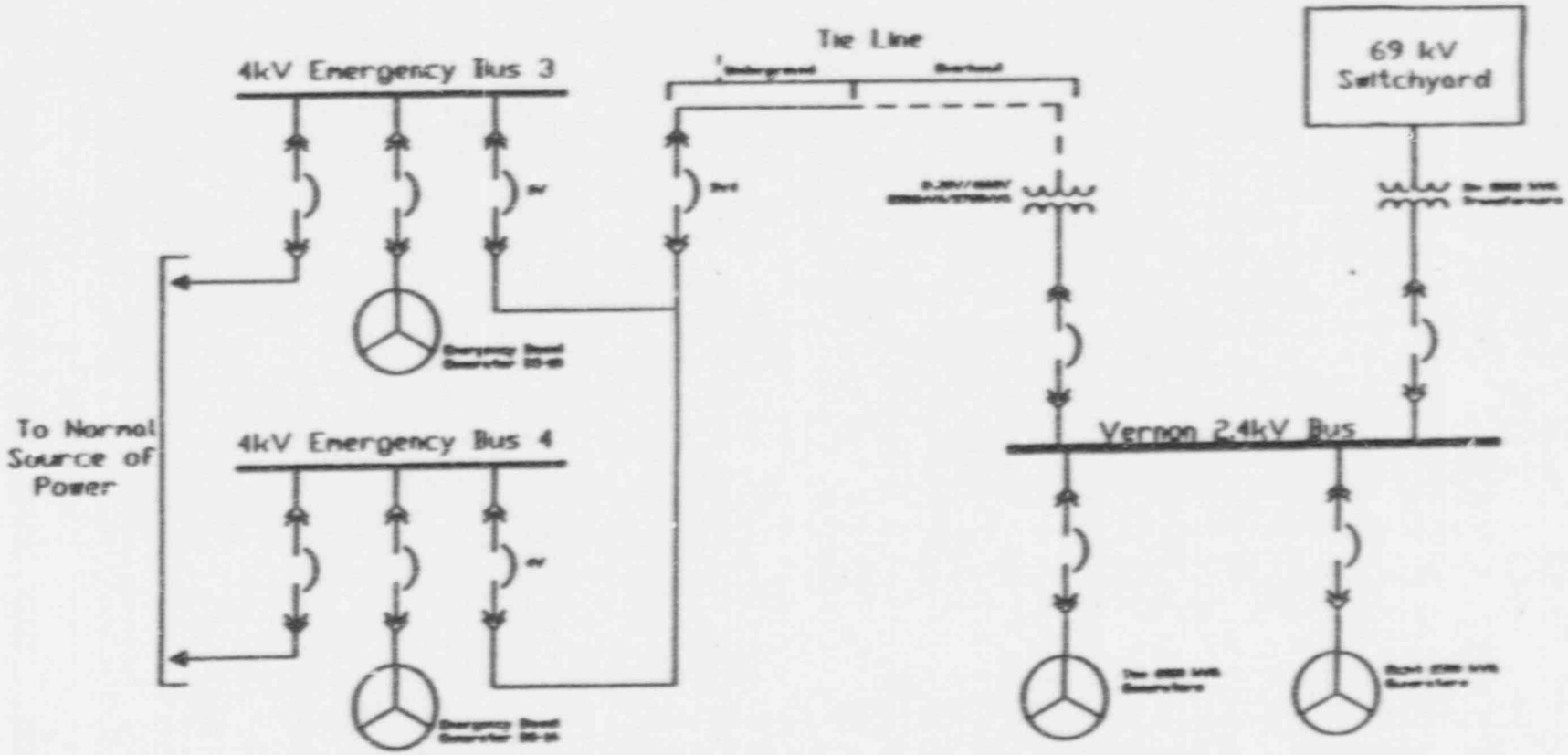

FIGURE 2. VERMONT YANKEE ALTERNATE AC POWER SOURCE

The licensee stated (10) that the existing overhead portion of the tie line does not fully meet the requirements of an AAC system because the line is not protected from the weather. The licensee stated that NEPCO is in the final stages of approving a major upgrade to raise the operating voltage of the hydro-electric station from 2.4 to 13.8 kV and that the upgrades will be completed within the next 3 years. Vermont Yankee is monitoring NEPCO's effort and will coordinate with NEPCO's efforts and perform the tie line modifications necessary to bring the AAC system into full compliance with 10 CFR 50.63.

Review of Licensee's Submittal

The Vernon Hydroelectric Station has adequate capacity even if only one hydroelectric generator is available. However, the AAC capacity is limited by the capacity of the 2.4 to 4.16 kV transformer which is located in the line coming from Vernon hydroelectric station. The maximum capacity of this transformer is 3,300 kVA based on the continuous operation its cooling fans as given in Section 8.5.5 of the plant UFSAR. The licensee erroneously showed a 2,700 kVA capacity in its submittal (10), and confirmed that the UFSAR rating is correct during the telephone conversation on May 16, 1990. Using a power factor of 0.8, this corresponds to an AAC system load capacity of 2,640 kW. Referring to the EDG loads listed in Figures 8.5-1 and 8.5-2 of the UFSAR, the total electrical load for an EDG following a design basis accident is 2,308.4 and following a LOOP is 2,287.9 kW. Therefore, assuming that transformer cooling fans are operating, the AAC system has adequate capacity and can be considered to be approximately equivalent to one EDG since either the EDG (with continuous capacity of 2,740 kW) or the AAC system is capable of powering the design basis accident loads. We cannot verify the power supply for the transformer cooling fans from available drawings and documents, but since we have no evidence to the contrary, we accept the licensee's statement that the fans will be operational during an SBO event.

Except for the following concerns, we agree with the licensee's statement that the AAC power source (the Vernon Hydroelectric Station) meets the criteria in Appendix B of NUMARC 87-00:

1. The proposed AAC source is owned, operated and controlled by another company. Therefore, the NRC needs to determine whether it qualifies as an acceptable AAC source for the licensee.

2. The proposed AAC source is offsite and some 4000 feet away. Therefore, the NRC needs to determine whether the proposed AAC source meets the "nearby" requirement of RG 1.155, Section 3.2.5.

3. The licensee needs to protect the AAC equipment from weather-related events that may initiate the loss of off-site power event. Our concern is that the overhead AAC cabling is not protected from weather in accordance with Criterion B.3. Since the major contributor to the total LOOP frequency of the site is snow (Using the formulae in NUMARC 87-00, snow-caused LOOP frequency is 1.0E-2/yr. compared to a total ESW and SW caused LOOP frequency of 1.5E-2/yr.) and snow effects all cable rights-of-ways equally, it is very important to protect against a major snow storm that could cause loss of preferred off-site power and loss of the AAC system.

4. The licensee needs to verify that the AAC system is tested in accordance with Criterion B.10.

5. The licensee needs to verify that maintenance and surveillance procedures for the Vernon Hydroelectric Station and other AAC equipment are implemented considering manufacturers recommendations in accordance with Criterion B.11.

6. The licensee states that the AAC system has been and will continue to be load tested every 5 years. However, a timed test is needed to ensure that the AAC source can be made available to the safe shutdown buses within 10 minutes of the onset of an SBO.

Therefore, this initial test needs to be performed in accordance with Criterion B.12.

7. The licensee needs to provide assurance that the AAC power source (including power source, transformer, breakers and line) will be available at least 95% of the time including both planned and unplanned outages in accordance with Criterion B.13.

3.3 Station Blackout Coping Capability

The licensee stated that since the AAC power source will be available within 10 minutes, the coping evaluations for class 1E battery capacity, compressed air, and containment isolation capabilities are enveloped by design basis accident conditions and need not be addressed per 10 CFR 50.63 (c)(2). The following analysis is based on the assumption that the licensee's proposed AAC source is found acceptable by the NRC and would be available within ten minutes of the onset of an SBO. The plant coping capability with an SBO event for the required duration of 16 hours is assessed based on the following results:

1. Condensate inventory for decay heat removal

Licensee's submittal

The licensee stated (11) that the Vermont Yankee technical specifications require a minimum condensate storage level of 75,000 gallons and that 71,300 gallons are required for primary system cooldown and depressurization to 100 psig, and decay heat removal for 8 hours. The licensee stated that no modifications or procedural changes are necessary to use these water sources.

Review of Licensee's Submittal

Using NUMARC 87-00, Section 7.2.1 and the maximum power level of 1,664 MWt, we estimated that the plant would need 104,666 gallons

of condensate to remove decay heat for 16 hours. Additionally, the estimated leakage of 61 gpm, assuming an 18 gpm per recirculation pump seal leak and 25 gpm for the maximum technical specification-allowed leakage, gives a total leakage of 58,560 gallons over the 16 hour duration of the SBO. Therefore, the plant would need 163,226 gallons to remain in hot standby and more to perform a cooldown. However, since the licensee stated that they intend to approach an SBO like a Design Basis Accident (11), the suppression pool water will be available to supplement the condensate supply. Thus, the licensee has enough water to cope with an SBO event with a duration of 16 hours.

2. Class 1E Battery Capacity

Licensee's Submittal

Since the AAC power source will be available within 10 minutes, no analysis of battery capacity is required.

Review of Licensee's Submittal

During the telephone conversation on May 16, 1990, the licensee stated that the plant UFSAR contains analyses, which are based on IEEE Standard - 485, that prove that with some load shedding in division II the batteries will last 8 hours. Additionally, the licensee stated that existing procedures direct the operator to energize division I (4,160 V bus 3) when power is supplied to the unit from the AAC source. This action provides charging to battery A1 from battery charger A-1 and battery B1 from the swing battery charger AB. Vermont Yankee has a third class 1E battery (AS-2) that provides an alternate source of power to EDG A and RCIC. The chargers for AS-2 are powered from division II which will not be energized during an SBO. However, since battery AS-2 is a back-up source of power for equipment and the primary source of power for needed equipment (battery A1 or B1) is available,

this battery is not necessary during an SBO. The licensee's approach meets the guidance in NUMARC 87-00 Supplemental Questions/Answers (14) to provide power to battery-backed plant monitoring equipment. Battery capacity is not relevant to Vermont Yankee because it can provide AAC power to a battery charger within 10 minutes of the onset of an SBO.

3. Compressed Air

Licensee's Submittal

Since the AAC power source will be available within 10 minutes, no analysis of compressed air is required.

Review of Licensee's Submittal

During the telephone conversation on May 16, 1990, the licensee stated that an instrument air compressor would be powered from the AAC source during an SBO event. We agree with the licensee's approach to provide adequate instrument air.

4. Effects of Loss of Ventilation

Licensee's Submittal

The licensee stated (11) that the effects of the loss of ventilation on equipment were evaluated and that the HPCI, RCIC and Main Steam Tunnel were not considered to be dominant areas of concern (DAC) because failure of this equipment does not preclude the capability for decay heat removal. The licensee stated that AAC powered systems such as ADS, RHR, RHRSW and SW, as identified in the Vermont Yankee design basis analyses, are adequate for reaching and maintaining safe shutdown.

Review of Licensee's Submittal

The licensee's analysis of the effects of the loss of ventilation is not consistent with SBO guidance, expected operator actions or other portions of it's SBO submittals (10 and 11). NUMARC 87-00 guidance on procedures (Section 4.2.1) emphasizes the importance of the reliable operation of HPCI and RCIC. Although we did not review Vermont Yankee Emergency Procedures, we expect that the operators will use the turbine-driven HPCI and/or RCIC pumps to control the plant during the initial stages of an SBO. Although not specifically stated, the use of HPCI and/or RCIC is apparently assumed in the licensee's condensate inventory analysis, since only a small amount of condensate inventory was allocated for plant cooldown. Failure of HPCI and RCIC would require depressurization to about 100 psig for RHR operation, which would require significantly more condensate than allocated. The licensee needs to verify that the analytic assumption that HPCI and RCIC will not be required (e.g., they fail due to lack of ventilation) is consistent with the guidance given to the operators or provide ventilation calculations in accordance with the guidance provided in NUMARC 87-00.

In regard to ventilation during an SBO, we understand that the statement in the first submittal (10) that adequate ventilation is provided is superseded by the statement in the second submittal (11) that the HPCI, RCIC and Main Steam Tunnel are not dominant areas of concern because the loss of this equipment does not preclude the capability for decay heat removal. Figure 8.5-2 of the Vermont Yankee UFSAR indicates that the reactor building and drywell will be cooled during a design basis LOOP, but shows only 5 kW of electrical power is required for reactor building ventilation. This is not enough power to cool all areas of the reactor building with SBO equipment for 16 hours of operation. Since the design basis accident analysis for LOOP in the UFSAR is only based on two hours of equipment operation, the analysis

cannot be used as a basis for SBO. Therefore, the licensee needs to verify the equipment operability in areas without ventilation in accordance with guidance provided in Sections 2.7, 4.3.1 (Items 10 and 11), 7.2.4, and Appendix F of NUMARC 87-00 or provide additional ventilation.

The licensee stated (11) that, following a modification to an interlock in the controls, control room ventilation will be available during an SBO. However, the power for control room ventilation was not included on the load list as shown in Figure 8.5-2 of the UFSAR. The licensee needs to verify that the power required for control room cooling will not exceed the capacity of the AAC system.

5. Containment Isolation

Licensee's Submittal

Since the AAC power source will be available within 10 minutes, no analysis of containment isolation is required.

Review of Licensee's Submittal

The arrangement of the AAC system allows the licensee to power either division of the safety buses. Since this AAC power is available within 10 minutes, containment integrity is assured.

6. Reactor Coolant Inventory

Licensee's Submittal

The licensee stated that the AAC source powers the necessary make-up systems to maintain adequate Reactor Coolant System inventory to ensure that the core is cooled for the required coping duration.

Review of Licensee's Submittal

Reactor coolant make-up is necessary to replenish the RCS inventory losses due to the RCP seal leakage (18 gpm per pump per NUMARC 87-00), the technical specification maximum allowable leakage (estimated to be 25 gpm), coolant released through the automatic depressurization system and to account for shrinkage during the cooldown to the approximately 100 psig needed for RHR operation. As stated in the condensate inventory analysis (Section 3.3 Item 1), there is adequate water in the suppression pool to provide reactor coolant inventory, but as stated in the effects of loss of ventilation (Section 3.3 Item 4), the licensee needs to ensure that procedural guidance given to the operator is consistent with the analytic assumptions that HPCI and RCIC will not continue to operate because of the lack of ventilation.

3.4 Proposed Procedures and Training

Licensee's Submittal

The licensee stated that plant procedures have been reviewed and that no modifications are necessary to meet the intent of the guidelines in NUMARC 87-00, Section 4, in the areas of AC power restoration and severe weather. The licensee listed (10) the procedures that will be used to cope with a loss of AC power. The licensee claimed that Vermont Yankee will use the LOOP procedures and no specific SBO procedures are needed.

Review of Licensee's Submittal

We neither received nor reviewed the affected procedures or training. These procedures are plant specific actions concerning the required activities to cope with a SBO. 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 in

their contents, and that the associated training needs are carried out accordingly.

3.5 Proposed Modifications

Licensee's Submittal

The licensee stated that control circuit modifications that provide a source of control power to breaker 3V4 which is independent of batteries A1 and B1 will be implemented by 1992. Additionally, the licensee stated that a modification to upgrade the AAC power system to meet the guidance of Appendix B of NUMARC 87-00 is expected to be completed within three years. The licensee stated that the proposed upgrades will raise the operating voltage of the hydroelectric station from 2.4 kV to 13.8 kV. The licensee is monitoring the New England Power Company (NEPCO) effort to upgrade the hydroelectric station, and will coordinate the tie line modifications necessary to meet the guidance of NUMARC 87-00, Appendix B.

The licensee also identified a modification to remove an interlock that could prevent a remote restart of control room ventilation during an SBO event.

Review of Licensee's Submittal

Modifications to meet SBO guidance should be completed within two years of the notification provided by the NRC in accordance with 10 CFR 50.63 (c)(3). It is not clear whether Vermont Yankee, working in conjunction with another company (NEPCO) in the modifications of the AAC system, can meet the timing requirement.

The licensee stated that the modifications will be implemented in accordance with the applicable design and licensing requirements to comply with the guidance of RG 1.155 and NUMARC 87-00. If properly implemented, this modifications to the AAC power system will improve the

availability and availability of the AAC power system and the modification to the co[illegible]l room ventilation controls will improve the reliability of control room ventilation. We have neither received nor reviewed detailed information on these modifications.

3.6 Quality Assurance And Technical Specifications

Quality Assurance

The licensee did not address quality assurance in their submittal. RG 1.155, Section 3.5, states that an AAC source should be maintained and operated in accordance with Appendix A of RG 1.155, "Quality Assurance Guidance for Non-Safety Systems and Equipment". We are concerned that this guidance will not be met, because the AAC source is owned and operated by an organization (NEPCO) that is separate from the organization licensed to operate the Vermont Yankee plant (Vermont Yankee Nuclear Power Corporation). During the telephone conversation on May 16, 1990, the licensee stated the power line from the Vernon Hydroelectric Station and the transformer will be designed, purchased and maintained under the plants QA program. However, the licensee stated that the Vernon Hydroelectric Station will not be operated under a QA program. An AAC source operated without an acceptable QA program is not consistent with the guidance and intent of RG 1.155, Appendix A.

Technical Specifications

The licensee did not provide any information on how the plant complies with the requirements of RG 1.155, Appendices A and B. The licensee stated that all SBO equipment is covered by the normal plant technical specifications. The licensee needs to verify that the AAC power source is covered by appropriate technical specifications consistent with the guidance of RG 1.155, Appendix B.

4.0 CONCLUSIONS

Based on our review of the licensee's submittals, a telephone conversation between NRC/SAIC and the licensee, and the information available in the UFSAR for the Vermont Yankee Nuclear Power Station, we find the submittal conforms with the requirements of the SBO rule and the guidance of RG 1.155 with the following exceptions:

1. **Emergency Diesel Generator Reliability Program**

   The licensee's submittals do not document the conformance of the plant's EDG reliability program with the guidance of the RG 1.155, Section 1.2 and NUMARC 87-00, Appendix D. The licensee stated that plant engineering is in the process of developing a reliability program consistent with the above guidance. The licensee has committed, however, to maintain the targeted EDG reliability of 0.95.

2. **Proposed Station Blackout Duration**

   a. <u>Severe Weather Group/Offsite Power Design Characteristic</u>

   The licensee estimated the expected frequency of LOOPs due to severe weather (SW) conditions to put the site in group "2." The licensee needs to provide justification for its selection of data sources in their determination of this frequency. In its calculation, the licensee used UFSAR snowfall data and the NUMARC 87-00 tornado frequency data. If a complete set of data (either NUMARC 87-00 or the UFSAR) were to be used the expected LOOP frequency puts the site in SW group "3." SW group "3" changes the AC power design characteristic of the from group "P2" to "P3," and affects the determination of the required coping duration and EDG reliability target.

b. Independence of Offsite Power System Group

The licensee claims that Vermont Yankee can be considered either as "I1" or "I2" grouping. Our review indicates that the Vermont Yankee safety buses are normally supplied from the main generator, and upon loss of power from the main generator there is an automatic transfer to the start-up transformer. However, upon failure of the start-up transformer, there is no additional preferred or alternate source of offsite power. Therefore, the plant is in the independence of offsite power group "I3." This classification, however, does not affect the determination of the offsite power design characteristic or the required coping duration.

c. SBO Coping Duration and EDG Target Reliability

Based on item a, the licensee can either commit to an EDG reliability target of 0.975 and a required coping duration of eight hours, or to an EDG reliability target of 0.95 and a required coping duration of 16 hours. The licensee's analysis is based on an eight hour coping duration, our review was based on a 16 hour coping duration.

3. **Alternate AC power source**

The licensee needs to verify that the AAC system meets the following criterion from Appendix B of NUMARC 87-00:

- B.3: The licensee needs to provide protection for AAC components, especially the transmission lines from the Vernon Hydroelectric Station, against weather-related events.

- B.10 and B.12: The licensee needs to perform a test of the AAC system in accordance with these criterion to ensure that

the AAC system is available within 10 minutes of the onset of an SBO event.

- B.11: The licensee needs to verify that maintenance and surveillance procedures for the Vernon Hydroelectric Station and other AAC equipment are implemented considering manufacturers recommendations.

- B.13: The licensee needs to provide assurance that this AAC system (including power source, transformer, breakers and line) is available at least 95% of the time including both planned and unplanned outages.

Additionally, the licensee needs to provide assurance that the distance between the plant and the AAC power source does not degrade the AAC system performance.

4. Effects of Loss of Ventilation

The licensee stated (11) that the effects of the loss of ventilation on equipment were evaluated and that the HPCI, RCIC and Main Steam Tunnel were not considered to be dominant areas of concern (DAC) because failure of this equipment does not preclude the capability for decay heat removal. The licensee's analysis of the effects of the loss of ventilation is not consistent with SBO guidance, expected operator actions or other portions of their SBO submittals (10 and 11). The licensee needs to verify that the analytic assumption that HPCI and RCIC will fail is consistent with the operation of the plant or provide ventilation calculation in accordance with the guidance provided in NUMARC 87-00.

In addition, the licensee needs to verify the equipment operability in areas without ventilation in accordance with guidance provided in NUMARC 87-00 or provide additional ventilation. Further, the licensee needs to verify that the

required power for control room cooling will not exceed the capacity of the AAC system.

5. Quality Assurance and Technical Specifications

During the telephone conversation of May 16, 1990, the licensee stated the power line from the Vernon Hydroelectric Station and the transformer will be designed, purchased and maintained under the plants QA program. However, the licensee stated that the Vernon Hydroelectric Station will not be operated under a QA program that meets the guidance of RG 1.155 Appendices A.

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.

2. U.S. Nuclear Regulatory Commission, "Evaluation of Station Blackout Accidents at Nuclear Power Plants - Technical Findings Related to Unresolved Safety Issue A-44," NUREG-1032, Baranowsky, P. W., June 1988.

3. U.S. Nuclear Regulatory Commission, "Collection and Evaluation of Complete and Partial Losses of Offsite Power at Nuclear Power Plants," NUREG/CR-3592, 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. Nuclear Safety Analysis Center, "The Reliability of Emergency Diesel Generators at U.S. Nuclear Power Plants," NSAC-108, Wyckoff, H., September 1986.

10. Murphy, W. P., letter to U.S. Nuclear Regulatory Commission Document Control Desk, "Response to Station Blackout Rule 10CFR50.63," BVY 98-36, April 12, 1989.

11. Murphy, W. P., letter to U.S. Nuclear Regulatory Commission Document Control Desk, "Supplement to Response to Station Blackout Rule 10CFR50.63," BVY 90-038, March 30, 1990.

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

13. Vermont Yankee Nuclear Power Station, Updated Final Safety Analysis Report.

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