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Subject: Arkansas Nuclear One - Unit 2
Docket No. 50-368
License No. NPF-6
Response to Request for Additional Information Regarding ANO-2's
Steam Generator Load Handling License Amendment Request

Gentlemen:

In a letter dated September 17, 1999 (2CAN099903), Entergy Operations, Inc. submitted a license amendment request for Arkansas Nuclear One, Unit 2 (ANO-2) regarding the heavy load handling requirements and transportation provisions that would permit the movement of the original and replacement steam generators during the refueling outage planned for the fall of 2000. During a telephone conference call between members of the Nuclear Regulatory Commission (NRC) and ANO staffs on May 24, 2000, the NRC staff requested additional information in regard to the September 17, 1999 letter. Entergy's responses to the NRC's questions are provided in the attachment to this letter.

Should you have any questions or comments, please contact me.

Very truly yours,

Jimmy D. Vandergrift
Director, Nuclear Safety Assurance

JDV/dwb
Attachment

A001

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ANO Responses to NRC Staff Questions Regarding Heavy Load Handling Requirements for the Replacement Steam Generator Project

Provided below are the twelve NRC questions and the ANO responses regarding the September 17, 1999, steam generator load handling license amendment request.

NRC Question #1

Specify the analyzed drop weight of the steam generator. Discuss how the steam generators are lifted from their current locations onto the runway beam support system. Describe the lifting system inside containment that is to be used, including any special lifting and rigging devices used to handle and lift the steam generators onto the runway beam support system. The discussion should address the design capacity and testing criteria used to support and verify the reliability of the lifting system and devices. It should also cite the source of the criteria.

ANO Response

The replacement steam generator weight (approximately 600 tons) was used to assess the impact on structures, systems and components near or under the steam generator haul route, since it bounds the weight of the original steam generators.

The rigging system for moving the original steam generators and replacement steam generators between the steam generator cubicles and the containment construction opening consist of the temporary lifting device, runway beams, transfer and down/up-ending carts, lifting trunnions, and polar crane. Further details of the rigging system components are provided below. Note that the runway beam support system referred to in the question is outside containment and is not discussed in the response. Refer to the response to Question 2 for details of the runway beam support system.

Temporary Lifting Device

The temporary lifting device is a collapsible, rhombusing type gantry crane that will be installed on top of the polar crane girders. It will be used to lift or lower the steam generators between their position in the steam generator cubicles and the runway beams. The temporary lifting device will lift the steam generators to an elevation sufficient to allow the bottom of the vessel to clear cable trays on top of the biological shield wall around the steam generator cubicles (approx. El. 428'-6"). The use of the temporary lifting device is required because the existing polar crane bridge girders are not at a sufficient elevation to lift the steam generators high enough to clear the shield wall.

The temporary lifting device is classified as a non-safety-related, non-seismic component. The temporary lifting device and the associated rigging components have been sized for the steam generators and will be attached to lifting trunnions which will be installed on the steam generators. The temporary lifting device will be tested outside of the containment building using a static load per the requirements of ASME B30.2, "Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)". After successful completion of the load test per ASME NQA-1, Subpart 2.15, the temporary lifting device will be partially disassembled and reassembled inside containment after the reactor vessel is defueled. The temporary lifting device will be removed from containment during the defueled condition after the replacement steam generators are installed.

Runway Beams

The runway beams act as tracks to carry the steam generators into and out of the containment. They are classified as non-safety-related, non-seismic components that will be installed and removed during the defueled condition. The runway beams are supported at the containment wall, the fuel transfer canal wall, and on a support spanning the canal. The supporting structural components have been evaluated for the rigging loads.

Transfer and Down/Up-ending Carts

The transfer carts and down/up-ending carts will be positioned on the runway beams after the reactor vessel is defueled. These components assist in the rigging of the steam generators between the vertical and horizontal orientations. The steam generators will be down/up-ended using the down/up-ending and transfer carts. The carts will be removed from containment prior to the commencement of refueling.

Lifting Trunnions

Lifting trunnions will be installed on both the original steam generators and replacement steam generators. The lifting trunnions are non-safety-related, non-seismic components, which will be attached to the steam generator secondary manways. The temporary lifting device will attach to the trunnions to move the steam generators between the steam generator cubicles and the containment opening.

Polar Crane

The polar crane is an existing permanent plant crane. The polar crane is a non-safety-related, seismic II/I component. The polar crane bridge girders will be used to support the temporary lifting device. During the original plant construction, the crane bridge girders were used to set the steam generators. At that time, the end-trucks were blocked and, therefore, not subjected to the load from a steam generator. Due to the use of the temporary lifting device, the existing trolley (including the hoist system) will remain idle during the steam generator lifts and will be located at the opposite end of the girders from the temporary lifting device. The trolley will be deactivated so that it will remain in its stored location during the lifts.

The steam generator lifts will be performed as planned engineered lifts in accordance with ASME B30.2. The proposed rigging scheme will not result in overloading the polar crane and no permanent modification to the polar crane will be required. The end trucks will be blocked during lifting of the steam generators as was done during original construction. The analysis of the polar crane was performed in accordance with the requirements of the Crane Manufacturer's Association of America No. 70.

The temporary lifting device wheel loads to the bridge girders, ring girders, and end trucks do not exceed the maximum wheel loads imparted by the existing trolley. Based on ASME B30.2 and NQA-1, Subpart 2.15, it is not necessary to perform a load test on the polar crane bridge girders and end trucks since:

- engineering analyses of the polar crane bridge girders, ring girders, brackets, and end trucks were performed;
- crane operational history was reviewed; and
- structural inspections were performed.

Inspections prior to and after each of the engineered lifts will be performed per ASME B30.2 and NQA-1, Subpart 2.15 to ensure the structural adequacy of the components associated with the lifts. In addition, after the final steam generator lift is made, inspections will be performed to ensure the crane is returned to the pre-steam generator replacement outage configuration.

NRC Question #2

Discuss the qualifications of both the runway beam support system and the outside lift system, including any special lifting devices and rigging, their design capacity and testing criteria, to support the capability to (1) lift the steam generator, (2) preclude any adverse effects to adjacent safety-related structures, systems and components during an external event, and (3) avoid collapse under adverse conditions (refer to the top of page 5 of 21).

ANO Response

The outside containment rigging system will consist of a runway beam support system and an outside lift system. The runway beam support system and outside lift system will be erected and used in the vicinity of the containment equipment hatch. The runway beam support system consists of support towers, an outside runway system, and a concrete removal platform. The runway beam support system will be used to:

- provide structural support for the transfer of the steam generators through the containment construction opening,
- support containment construction opening concrete removal and replacement activities, and
- provide temporary access for materials into containment through the containment construction opening.

The outside lift system consists of two support towers and a header assembly composed of two gantry header beams and the lift apparatus. The outside lift system will be erected over the runway beam support system and will be used to rig the steam generators between the runway beam support system and the steam generator transporter. The runway beam support system/ outside lift system will be used to move steam generators during the defueled condition.

The runway beam support system and outside lift system are classified as non-safety-related structures. When the runway beam support system and outside lift system are installed and idle, both in the interim and final configurations, and during their use, external events (i.e., seismic event, tornado, and severe winds) and design basis explosive events (i.e., natural gas line failure) are postulated to occur. During installation/removal of the outside lift system and runway beam support system, the runway beam support system/ outside lift system components will remain attached to the tower and/or mobile cranes until the components have been secured. As described below, the runway beam support system and outside lift system components have been evaluated and will be installed to ensure no structures, systems or components are adversely affected which are relied on to achieve or maintain safe shutdown as a result of an external event.

The runway beam support system/ outside lift system components were evaluated and shown to be capable of operation during 50 mph winds superimposed with the steam generator operating loads (runway beam support system/ outside lift system dead load plus steam generator load plus impact loads) using the American Institute of Steel Construction (AISC) Allowable Stress Design (ASD) method. In addition, the runway beam support system/outside lift system, when unloaded, were evaluated for 90 mph storm winds in accordance with American Society of Civil Engineers (ASCE) 7-95 and will not exceed normal working allowable stresses when exposed to these storm winds. The AISC ASD design method provides a 1.67 factor of safety against material yielding and component buckling. This is conservative in that it not only prevents collapse but also provides for elastic behavior of the system.

The unloaded runway beam support system and outside lift system were evaluated and found to be capable of withstanding tornado winds of up to 290 mph without collapsing both in the interim and final configurations. Analyses demonstrate that these loads impose a more severe loading on the unloaded runway beam support system/ outside lift system than the safe shutdown earthquake loads. Based on the analyzed loads, the unloaded outside lift system/runway beam support system will not collapse in the event of a tornado or safe shutdown earthquake and there will be no adverse effect to plant structures, systems or components. In addition, the outside lift system will not collapse during a safe shutdown earthquake event, even when loaded with the steam generator.

The outside lift system may be load tested during any plant mode or the defueled condition. The load test will be a static test per the requirements of ASME B30.2. A static pull load will be applied by jacking units to lugs embedded in the outside lift system tower foundation. The load test will not be performed during high winds or a tornado watch.

The natural gas pipeline that passes within 600 feet of the Unit 1 containment building is considered to be a sufficient distance away and sufficiently shielded by intervening structures to preclude a failure of the outside lift system /runway beam support system due to blast pressures resulting from a gas explosion.

NRC Question #3

The application states (in Section 2 on page 7 of 21) that an evaluation of other portions of the haul route outside the vicinity of the runway beam support system and the outside lift system determined that other safety-related structures, systems or components could either withstand the impact of a dropped steam generator or will be protected to preclude them from damage. What is the distance between the new and old steam generator storage area and the reactor containment building and what is the method used to load test the haul route? What are the other safety-related components that are located along the remainder of the haul route that could be impacted by a dropped steam generator? What safety functions/systems would be impacted? What measures are to be taken to preclude such components from being damaged if a steam generator drop occurred?

ANO Response

The distance along the haul route between the new steam generator storage area/original steam generator storage facility and the runway beam support system/outside lift system is approximately 1000 feet.

The haul route travels over, intersects, or is routed in close proximity to non-safety-related and safety-related structures, systems and components. Underground utilities below the haul route have been evaluated for the surcharge loads imposed during normal transport of the steam generators. Additionally, all safety-related buried utilities along or in the vicinity of the haul route have been evaluated for impact loads from a postulated steam generator drop from the transporter.

Safety-related or safety-significant structures, systems or components, other than those identified in the September 17, 1999, license amendment request (0CAN099903), which have adequate ground cover and, therefore, do not require any protective measures in the event of a steam generator drop include:

- Unit 2 service water line 2HBC-88-42"
- Unit 2 service water line 2HBC-83-30"
- Unit 2 service water line 2HBD-23-24"
- Unit 1 service water line HBD-12-36"
- Unit 1 service water line HBD-13-18" (outside the protected area only)
- Unit 2 132" circulating water lines 2JF-1 and 2JF-3
- 10" ARKLA gas line

Safety-related or safety-significant structures, systems or components, other than those identified in the September 17, 1999, license amendment request, which do not have adequate protection, but are not required to perform their safety function while the steam generators are being transported include:

- condensate storage tanks 2T41A and 2T41B

Safety-related or safety-significant structures systems or components, other than those identified in the September 17, 1999, license amendment request, which require protective/restrictive measures during steam generator transport include:

- diesel fuel storage vault

The diesel fuel storage vault will be protected by placing a cushion of sandbags along the south wall of the vault to protect the edge of the vault roof from a steam generator impact. Required temporary protection modifications and the associated installation and removal activities are non-safety-related, non-seismic.

The haul route shall be tested by cautiously driving the transporter prime mover over the haul route at low speeds (less than 5 mph) while it is ballasted with 105 kips. Since the prime mover is not as wide as the steam generator transporter, four passes shall be made along the entire haul route in order to ensure that the haul route test covers the full width of the haul route. No modifications are required for the protection of underground utilities during the load test since it has been shown that a test weight will not be dropped and the prime mover will not tip over even when subjected to seismic loads.

Although analysis has shown that no protection is required, two inch thick steel protection plates will be provided at the haul-route crossing over the ARKLA gas line near the barge slip as part of the haul route upgrade, per the request of the gas company. Based on the transporter wheel load reactions, the haul route will be upgraded as necessary so that the imposed loading is within allowable bearing pressure. Upgrades to the haul route may include adding steel plates over utilities, adding fill to the road surface and modifying manholes by filling them with granular material.

The transporter has been evaluated and has sufficient capacity to adequately handle the weight of the steam generators, saddles, and any residual water and sludge in the original steam generators. To provide additional assurance that a transporter failure will not adversely affect safety-related underground structures, systems or components, the transporter will be lowered to its minimum working height while traversing over these structures, systems or components. Lowering the transporter will result in a minimal "lean" in the transporter and retention of a steam generator on the transporter should the hydraulic system fail.

For those structures and buried utilities that are non-safety-related or are not important to safety, the impact of a postulated steam generator drop would not adversely affect structures, systems or components which are relied on for the continued safe operation of the plant. Therefore, these structures and utilities are not evaluated for a load drop impact. However, the safety-related and important-to-safety structures and buried utilities along and underneath the haul route have been analyzed and found acceptable for the postulated impact from a steam generator falling off of the transporter outside the protected area.

NRC Question #4

What is meant by a potentially failed original steam generator as a result of a drop (refer to page 9 of 21). Discuss the resulting offsite dose consequences associated with the drop of the original steam generator both inside and outside containment when the dropped original steam generator has potentially failed. Identify the previously analyzed events in the SAR that are comparable to the steam generator drop event.

ANO Response

The shell of an original steam generator may or may not fail due to a drop of the original steam generator, depending on a number of factors, including the height from which it is dropped, how it lands, what it impacts, etc. To preclude analyzing numerous possible drop scenarios, it was assumed that if an original steam generator is dropped, the shell fails and some amount of the radioactivity contained within the original steam generator is released.

An original steam generator drop is postulated to occur within containment to address the radiological consequences associated with the drop. Since it is more conservative from a dose standpoint to assume a failure of the original steam generator outside containment, the radiological consequences of a steam generator drop outside containment were determined. It was conservatively assumed that 10% of the steam generator activity is released due to the impact of the drop and 1% of this release amount is in the form of particulates small enough to become airborne. Based on an isotopic distribution of surveyed steam generator tubes, the prime contributors to the offsite dose are Co-58 and Co-60. Using these conservative assumptions, the maximum calculated control room dose is 0.549 Rem whole body. The offsite doses to the exclusion area boundary (EAB) and low population zone (LPZ) from a postulated drop at the limiting location along the haul route are 3.96×10^{-2} Rem whole body (EAB) and 6.77×10^{-3} Rem whole body (LPZ).

The acceptability of the offsite dose consequences associated with a postulated drop of an original steam generator has been evaluated and compared to the consequences of postulated accidents for a gaseous release. For assessing offsite dose consequences, the drop of an original steam generator is considered to most closely resemble a rupture of a tank outside containment containing radioactive material. Failure of the waste gas decay tank (Reference SAR Section 15.1.16) is the limiting event currently evaluated in the SAR for an accidental gaseous release from a tank. For the waste gas decay tank rupture, the maximum whole body dose at the LPZ is 4.17 Rem as presented in SAR Table 15.1.16-2.

The SAR presents the radiological consequences of a waste gas decay tank rupture in the context of 10 CFR 100. However, in NRC Standard Review Plan Section 11.3, the waste gas decay tank rupture radiological consequences are limited per the guidance of Branch Technical Position ETSB 11-5. Branch Technical Position ETSB 11-5 establishes an offsite dose limit of 0.5 Rem whole body which at the time of issuance was consistent with 10 CFR 20 limits. The technical specifications acknowledge this regulatory criteria by placing an activity limit on the waste gas decay tanks (Reference technical specification 3/4.11.2 and the associated bases) to ensure the whole body exposure of 0.5 Rem to an individual in an unrestricted area is not exceeded. This limit on dose is greater than the calculated dose for an original steam generator drop. The evaluated consequences of an original steam generator drop are within the applicable regulatory criteria of Branch Technical Position ETSB 11-5 and are less than the limiting licensing design basis accidents currently evaluated in SAR Chapter 15.

NRC Question #5

Identify the licensees and their respective operations in which the runway beam support system/outside lift system was utilized in the past, and in particular, identify prior steam generator replacements and other heavy load handling operations.

ANO Response

The runway beam support system/outside lift system equipment to be used for the ANO-2 Steam Generator Replacement Project has previously been successfully utilized for the South Texas Project Unit 1 (Texas Utilities), Braidwood Unit 1 (Commonwealth Edison), and Byron Unit 1 (Commonwealth Edison) steam generator replacements.

NRC Question #6

Discuss what training and load handling instructions will be provided to operators and steam generator replacement/change-out personnel to help assure reliable operation of the runway beam support system/outside lift system.

ANO Response

The runway beam support system/outside lift system will be provided by Rigging International. Rigging International has extensive experience in safely moving steam generators at several previous steam generator replacements. The outside lift system will be used to move the steam generators between the runway beam support system and the transporter. The runway beam support system is a fixed runway structure that does not perform any lifting function. Loads other than the steam generators that are moved through the containment opening will be handled using the tower and/or mobile cranes.

Personnel involved in operating the outside lift system will receive the following instruction:

- operators will receive ANO site specific training as specified in the Rigging and Hoisting Program,
- personnel will undergo hands on training with the equipment before a load is attached to the equipment,
- prior to every steam generator lift, extensive pre-lift meetings will be conducted, and
- direction to the operators during the steam generator lifts will be given by technical representatives of the equipment owner.

NRC Question #7

Discuss the size of the temporary construction opening in the reactor containment building wall. Describe how the wall material is to be removed to make the opening. Also, address how the wall material will be handled and controlled in order to preclude any potential damage to safety-related structures, systems or components?

ANO Response

The construction opening will be located at azimuth 270°, directly above the existing 15'-6" diameter containment equipment hatch whose centerline is at elevation 363'-0". The bottom of the construction opening will be located at elevation 405'-6" and the opening will be 21'-6" wide and 27'-9" high. The outside grade elevation is approximately 353'-0", resulting in a distance of about 53' between the bottom of the construction opening and grade.

Concrete removal will be performed using construction tools (concrete saw, automated hydraulic jackhammer and manual jackhammer). The rebar and the tendon sheathing within the opening will be cut into manageable lengths to facilitate removal. The containment construction opening enclosure that will be erected around the opening provides a weather enclosure after the containment construction opening is made. The enclosure also serves as a barrier to contain concrete chips during demolition activities. The concrete debris/rubble from chipping the containment opening area will be transferred to dump trucks for offsite shipping, via the chute provided in the debris collection platform. The debris chute will be appropriately positioned and supported to preclude its failure during use.

NRC Question #8

In accordance with recommendations provided in NUREG-0612, "Control of Heavy Loads," Section 5.1, discuss the potential for accidental dropping of the steam generator inside the reactor containment building. Discuss the potential consequences that could result from dropping the steam generator and any compensatory measures that could be implemented to minimize and manage the damage from the drop.

ANO Response

Movement of the steam generators inside containment will only occur during the defueled condition. After ANO-2 is in a defueled condition, there are no technical specification requirements to protect the structures, systems and components inside containment. Therefore, during this condition the heavy load paths specified inside containment do not apply. However, due to personnel safety and potential economic concerns the loads will be transported in a safe manner to meet the intent of station procedures.

There are no electrical components inside containment that would need to perform a safety-related function in the event of a heavy load drop during the defueled condition. Due to the electrical isolation design of electrical circuits going into containment, a heavy load drop or seismically induced gravity missile inside containment that impacted electrical circuits would not cause any adverse consequences to electrical systems/components outside containment. A review of control circuits has been performed to confirm that there is no potential of a control circuit failure inside containment that could cause the isolation valves outside containment to open.

NRC Question #9

Page 3 of 21 in the application states that there is control room ventilation and cooling equipment that are common to both ANO-1 and ANO-2, and normally powered from ANO-2. Therefore, HVAC systems needed to support continued operation of Unit 1 is powered from Unit 2. The SAR also states that normally both trains of control room cooling are powered from ANO-2 while one train of control room ventilation is powered from ANO-2 and the other train is powered from ANO-1. Please clarify the apparent inconsistency between these two statements. Also describe the administrative controls that would be implemented prior to movement of the steam generators to assure that, if a SG drop occurred and damaged the Unit 2 HVAC power supply and HVAC functions would be maintained to support continued operation of ANO-1.

ANO Response

Regarding the apparent discrepancy between the two statements, it should be noted that the control room cooling (i.e., air conditioning units) and ventilation units (supply fans) are two separate systems. The control room emergency air conditioning units are normally powered by independent safety trains on ANO-2. However, during an ANO-2 outage when the respective electrical power or service water supply may need to be out of service, the unit may be re-aligned to ANO-1 in accordance with Attachment E to the Control Room Emergency Air Conditioning and Ventilation procedure. Attachment E directs the realignment of electrical power and service water to ANO-1. It directs electrical maintenance personnel to perform the actual electrical swap in the field using the Unit 1 Alternate Power Source for 2VE-1A and 2VUCM-27A&B. This process maintains the respective air conditioning unit operable for ANO-1 while ANO-2 is placed in a condition to permit the required maintenance activities.

The control room emergency ventilation supply fan unit 2VSF-9 may also be re-aligned to ANO-1 power if necessary by using Attachment E to the Control Room Emergency Air Conditioning and Ventilation procedure along with the 2VSF-9 Repowering Procedure. This process maintains the emergency ventilation unit operable for ANO-1 in a manner similar to the air conditioning units. VSF-9 is normally powered by ANO-1. The power source to VSF-9 will not be affected by the above changes.

Administrative controls will be implemented in accordance the Steam Generator Drop Contingency Plan to ensure that the control room air conditioning and ventilation systems normally aligned to ANO-2 are aligned to ANO-1, as described above. These controls shall be implemented prior to movement of the steam generators in the vicinity of the equipment hatch.

NRC Question #10

Page 17 of 21 in the application states that in the event of a seismically induced drop of the steam generator and a simultaneous loss of normal offsite power, the licensee will implement contingency plans for providing (1) makeup to the ANO-2 spent fuel pool and (2) fuel oil supply to the ANO-1 EDG and transfer pump. Describe the capability to provide makeup and the source of makeup. Also describe the capability to provide electrical power.

ANO Response

As noted on page 14 of 21 of the submittal, the ANO-2 licensing basis permits the use of spent fuel pool makeup from the service water system (SWS) under emergency conditions to maintain spent fuel pool level. Since makeup from the ANO-2 SWS may not be available due to the postulated loss of all AC power, provisions to permit makeup from the ANO-1 SWS will be provided. Actions to be taken in the event of degraded AC power or station blackout conditions to restore spent fuel pool cooling and maintain spent fuel pool level are detailed in the Spent Fuel Pool Emergencies procedure. The Fuel Pool Systems procedure details actions to provide emergency fuel pool makeup from service water. Use of the ANO-1 SWS to provide makeup to the ANO-2 spent fuel pool will require a change to ANO procedures to permit use of ANO-1 SWS connection SW-72 as the connection point for a hose to the ANO-2 spent fuel pool.

Upon further evaluation, the proposed compensatory measures discussed in the September 17, 1999, license amendment request regarding the fuel oil supply to the ANO-1 emergency diesel generator (EDG) and transfer pump have been re-evaluated. We believe the implementation of such an evolution would be highly susceptible to human error due to the complexity and time pressure to complete the actions within one hour. Instead, we propose to credit the alternate AC diesel generator (AAC generator) as described below.

The two events discussed that would possibly cause a steam generator drop to potentially damage underground safety related systems, structures and components were: 1) non-mechanistic failure of the runway beam support system/outside lift system (or associated rigging) or 2) a seismic event, which encompasses the effects of any other initiating event such as severe weather or high winds.

The alternate AC diesel generator (AAC generator) was installed in accordance with the requirements of Title 10 of the Code of Federal Regulations, Part 50, paragraph 63 (10CFR50.63), "Loss of all alternating current power." It is a reliable source of electrical power that may be aligned to supply either units' engineered safety features or non-engineered safety features 4160 VAC switchgear (A1, A3, A4, 2A1, 2A3, and/or 2A4).

The AAC generator is rated for continuous operation at 4400 KW. The ANO-2 EDGs have a continuous rating of 2850 KW. The ANO-1 EDGs have a continuous rating of 2750 KW. ANO-1 auto-sequenced accident loads will be less than the 2 out of 24 hour rating of 2860 KW. With an assumed full load of one ANO-1 engineered safety features bus loaded onto the AAC generator at 2860 KW there still exists a 1540 KW margin to the AAC generator's rated load. This margin would allow additional loading on the AAC generator from the required pumps to allow resumption of forced flow spent fuel pool cooling if necessary. The required additional pump on ANO-1 would require 34 KW. The required pumps on ANO-2 for spent fuel pool cooling would include a service water pump, rated at 600 KW and a spent fuel pool cooling pump rated at 50 KW. With all possible loading described above, the proposed loading on the AAC generator would be 3544 KW, allowing an 856 KW margin to the rated capacity.

The AAC generator has a fuel oil day tank with automatic makeup from an external bulk storage tank whose level is administratively controlled to ensure a 4.5 day fuel oil supply at a rated load of 4400 KW. Considering the 3544 KW loading described above, the same required minimum level would supply a 5.5 day fuel oil supply.

From a risk-benefit perspective, crediting the AAC generator for compensatory measures appears to be a better option. The AAC generator is considered to be more reliable than the compensatory measures as proposed in the September 17, 1999, license amendment request. The AAC generator was designed and installed to function during a station blackout; therefore, this option appears to be acceptable, particularly in view of the low likelihood of a seismic event occurring during the brief duration (72-96 hours) of the steam generator handling operations.

The calculated probabilities of seismic events for ANO are as follows:

Uniform Building Code Seismic event (0.05g) $\cong 7.3 \times 10^{-6}$

Operating Basis Earthquake event (0.1g) $\cong 1.6 \times 10^{-6}$

Design Basis Earthquake event (0.2g) $\cong 3.3 \times 10^{-7}$

Although not a seismic category I installation, the station blackout regulatory requirements imposed specific reliability and quality requirements. The requirements of station blackout are embodied in 1) 10CFR50.63, "Loss of all alternating current power," 2) Regulatory Guide 1.155 (August 1988), "Station Blackout," and 3) industry standard NUMARC 87-00, Rev. 1, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors." The following is a list of the codes and standards to which the station blackout diesel generator was designed and installed:

Required Codes and Standards at the Interface with the Engineered Safety Features Buses:

- IEEE 279-1, "Criteria for Protection Systems for Nuclear Power Generating Stations"
- IEEE 308-71, "Standard Criteria for Class 1E Systems for Nuclear Power Generating Stations"
- IEEE 344-71, "Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations"

Other Required Codes and Standards

- American Society of Mechanical Engineers Section VIII - Unfired Pressure Vessels
- American Society for Testing and Material (ASTM)
- American National Standards Institute (ANSI)
- Diesel Engine Manufacturers Association (DEMA), Standard Practices for Low and Medium Speed Stationary Diesel and Gas Engines
- National Fire Protection Association (NFPA) (FIA)
- National Electrical Manufacturer's Association (NEMA)
- Institute of Electrical and Electronics Engineers (IEEE)
- National Electrical Code (NEC)

As discussed in the September 17, 1999 letter, administrative controls will be utilized to confirm the availability of the AAC generator prior to movement of the steam generators in the vicinity of the outside lift system.

NRC Question #11

The application states that the surface protection over several buried structures, systems and components is insufficient to be able to rule out the potential for a dropped steam generator to damage or cause failure of these structures, systems or components. Provide a brief description and summary of the analyses/evaluations performed (as mentioned on page 2 of 21 in the application) to demonstrate that critical structures, systems or components will be adequately protected during the erection/disassembly of the runway beam support system and outside lift system, and during the load testing of the haul route.

ANO Response

It is noted that the weights of the runway beam support system/outside lift system components are small in comparison to the steam generators. To preclude damaging a safety-related structure, system or component during installation/removal of the runway beam support system/outside lift system, safe load paths, load exclusion areas, and load height restrictions have been defined based on an assessment of safety-related structures, systems or components in the vicinity of the runway beam support system/outside lift system. In addition, the runway beam support system/outside lift system concrete foundation pads (including the wide flange load test struts) and sandbags placed over various structures, systems or components provide adequate protection. Further, during the installation of the runway beam support system/outside lift system with the tower and/or mobile crane(s), the runway beam support system/outside lift system components will remain attached to the crane hook until the components have been secured to foundations, baseplates, or previously installed structural components and applicable connections are attached. When the runway beam support system/outside lift system components are removed, these components will be attached to the tower and/or mobile crane hook prior to unsecuring them.

The haul route will be tested by cautiously driving the transporter prime mover over the haul route at low speeds (less than 5 mph) while it is ballasted with 105 kips (in the form of concrete blocks). No modifications are required for the protection of underground utilities during the load test since it has been shown that a test weight will not be dropped and the prime mover will not tip over even when subjected to seismic loads. The evaluation of the loaded prime mover determined that the restoring moment is greater than the overturning moment during a seismic event. This evaluation also determined that the frictional forces between the concrete test blocks and the steel bed of the prime mover exceeds the applied lateral load due to a seismic event. To further ensure that the test blocks will not slide off the prime mover, they will be lashed to the truck bed.

NRC Question #12

Provide a summary of the results of the structural analyses performed to substantiate the statement (on page 5 of 21 in the application) that the seismic loads determined in the evaluations of runway beam support system/outside lift system are bounded by the tornado loads. Describe briefly how you obtained the design basis response spectra used in your seismic evaluations of the affected structures, systems or components and the runway beam support system/ outside lift system or steam generator transporter.

ANO Response

The fundamental frequency of the outside lift system towers was calculated using a simplified model and Rayleigh's Equation. This approximate approach was benchmarked by testing it on a previous outside lift system installation for which the frequency had been determined using a finite element model. This analysis determined that the outside lift system tower fundamental frequency was 0.77 Hz.

Tornado wind forces on the tower were calculated for E-W and N-S wind directions with and without the header beam installed using ASCE 7-95. These were used to calculate the applied forces and base reactions of the tower. The seismic acceleration required to generate an equivalent tornado wind force and base moment was calculated to be 0.4g. The calculated seismic acceleration of 0.4g was compared to the response spectrum value of 0.3g obtained from SAR Table 3.7-2, which conservatively used 0.5% damping at the corresponding system frequency of 0.77 Hz. Since the seismic accelerations required to create loads greater than those from a tornado exceed the seismic accelerations from the SAR response spectrum (at 0.77 Hz), the tornado loads were determined to be limiting.