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Docket Nos. 50-438
and 50-439

OCT 23 1973

Tennessee Valley Authority
ATTN: Mr. James E. Watson
Manager of Power
818 Power Building
Chattanooga, Tennessee 37401

Gentlemen:

In order that we may continue our review of your application for a license to construct the Bellefonte Nuclear Plant, Units 1 and 2, additional information is required. The information requested is described in the enclosure and pertains to Chapters 3, 9 and 10 of the Preliminary Safety Analysis Report.

In order to maintain our licensing review schedule, we will need a completely adequate response to all enclosed questions by November 30, 1973. Please inform us within 7 days after receipt of this letter of your confirmation of the schedule date or the date you will be able to meet. If you cannot meet our specified date or if your reply is not fully responsive to our request, it is highly likely that the overall schedule for completing the licensing review for the project will have to be extended. Since reassignment of the staff's efforts will require completion of the new assignment prior to returning to this project, the extension will most likely be greater than the delay in your response.

Please contact us if you have any questions regarding the information requested.

Sincerely,

A. Schwencer, Chief
Pressurized Water Reactors Branch 4
Directorate of Licensing

Enclosure:
Request for Additional Information

cc: Mr. R. H. Marquis
General Counsel
629 New Sprakle Building
Knoxville, Tennessee 37902

OFFICE ▶	X7548 L:PWR-4	L:C/PWR-4				
SURNAME ▶	Don Davis:cjr	ASchwencer				
DATE ▶	10/16/73	10/ /73				

Form AEC-318 (Rev. 9-53) AECM 0240 GPO c43-16-81465-1 445-678

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REQUEST FOR ADDITIONAL INFORMATION
TENNESSEE VALLEY AUTHORITY
BELLEFONTE NUCLEAR PLANT, UNITS 1 AND 2
DOCKET NOS. 50-438 AND 50-439

3.0 DESIGN OF STRUCTURES, COMPONENTS, EQUIPMENT AND SYSTEMS

3.67 Based on the tornado described in Section 3.3.2, expand the spectrum of tornado missiles considered to include the following:

1. 4" x 12" plank x 12 ft long with density of 50 lbs/ft^3;
2. Utility pole 13.5" dia x 35 ft long with a density of 43 lbs/ft^3;
3. 1" solid steel rod 3 ft long with a density of 490 lbs/ft^3; and
4. 3" schedule 40 pipe, 15 ft long with a density of 490 lbs/ft^3;
5. 6" schedule 40 pipe, 15 ft long with a density of 490 lbs/ft^3;
6. 12" schedule 40 pipe, 15 ft long with a density of 490 lbs/ft^3

For each of the above tornado-borne missiles, provide the following information:

(a) The maximum velocity and height attained. Assume in the analyses that each of the missiles originate at ground level and at higher elevations, in 50 ft intervals, up to the highest structural elevation on the site capable of producing each missile.

(b) The required thickness of a reinforced concrete missile barrier to stop the missiles without their breaching the missile barrier.

(c) The required thickness of a reinforced concrete missile barrier to preclude the generation of secondary missiles within the structure.

(d) Discuss the effect that secondary missiles may have on safety related equipment and systems with respect to safe plant shutdown.

In developing the information requested above provide the applicable mathematical model used, modified to include the assumption that the missiles do not tumble and are oriented such as to have the maximum value of $\frac{C_d A}{W}$ while being accelerated but impact with their minimum cross sectional area.

3.68 The velocity equation listed on page 3.5-12 of the PSAR appears to be incorrect. Explain how the data shown in Table 3.5.2 are determined.

9.0 AUXILIARY SYSTEMS

9.19 Provide the results of an analysis to demonstrate that failure of any non-Category I system or component will not have a detrimental effect (i.e., flood, sprays, leaks) on any safety related systems or prevent the safe shutdown of the plant.

9.20 Provide a tabulation of all valves in the reactor pressure boundary and in other seismic Category I systems, as recommended in Regulatory Guide 1.29 (e.g., safety valves, relief valves, stop valves, stop-check valves, control valves) whose operation is relied upon either to assure safe plant shutdown or to mitigate the consequences of a transient or accident. The tabulation should identify the system in which it is installed, the type and size of valves, the actuation type(s), and the environmental design criteria to which the valves are qualified, as stated in the design specifications.

9.21 For all vessels that contain gas under pressure (such as nitrogen, chlorine, hydrogen, oxygen, air and CO_2 tanks), provide the following additional information:

a. the design and operating pressure,
b. the maximum pressure of the gas supply,
c. the location of the vessel,
d. the total energy released if the largest pipe connected to the vessel should rupture,
e. the protective measures taken to prevent the loss of function of adjacent equipment essential to achieve and maintain a safe reactor shutdown, and
f. for each vessel identified, discuss and supply the basis for any exceptions or deviation that will be taken to the positions set forth by the Occupational Safety and Health Administration, OSHA 29 CFR 1910.

9.22 Section 9.1.1.2 of the PSAR states that sharing of the new fuel storage facilities presents no problem from a criticality standpoint, since the storage rack analysis uses an infinite array of assemblies. Provide the basis for this analysis and a numerical example to verify this statement.

9.23 Section 9.1.1.2 of the PSAR states that a cask drop accident which damages the loading area to the extent that water in this area was lost would not cause a significant loss of water from the storage area. In this regard, describe the effect on the separating wall and the fuel pool in the event that the cask is dropped in the tipped position, including the possibility of the cask falling into the fuel pool.

9.24 Provide a description of the heat transfer and fluid flow model and the results of the analysis to demonstrate the ability of the spent fuel cooling system to maintain the pool water temperature at less than 130°F with 1/3 batch of fuel assemblies in the pool.

9.25 Provide the mathematical model and results of the analysis to demonstrate that with a total 1-1/3 cores in storage, the system is capable of maintaining the spent fuel pool water temperature below 150°F while removing the total decay heat load of 33.3×10^6 BTU/HR from the following combinations of stored fuel assemblies:

(a) 1/3 core irradiated for 1044 days and cooled for 40 days.
(b) 1/3 core irradiated for 634 days and cooled for 10 days.
(c) 1/3 core irradiated for 342 days and cooled for 10 days.
(d) 1/3 core irradiated for 50 days and cooled for 10 days.

9.26 The fuel pool cooling system is interconnected with the ECCS which provides a supplementary cooling source from the decay heat removal system. It appears that these two systems are separated by two normally closed and manually operated valves. Describe the operational limitations to be placed on the system and the reactor when in use.

9.27 Describe in detail the applicable codes and standards used in the design, fabrication, installation and testing of the crane and associated rails, supporting structures, bridge, trolley, hoists, cables, lifting hooks, special handling fixtures and slings. For the equipment listed above, list the design load rating, pre-operation test load, maximum operating loads and any other test loads that will be used throughout the life of the facility.

9.28 Describe the modes of failure that were considered in the design of the cranes such as breaking of cables and lifting slings, shearing of shafts and keys, stripping of gear teeth and brake failures. Also discuss the limitations and control that will exist in handling objects over an open reactor vessel.

9.29 In Section 9.2.1, Essential Raw Cooling Water (ERCW) System, provide the following additional information:

a. Drawings to show that the pump motors are adequately protected to the probable maximum flood level including maximum wave runup.

b. Drawings and the results of an analysis to indicate that the design of the intake water pumping station provides a minimum pool elevation of ample depth and supply to maintain flow requirements to the ERCW system during a downstream dam failure accident.

9.30 The information contained in Section 9.2.5 is not in sufficient detail to permit a meaningful evaluation of the ultimate heat sink and any potential for associated safety related problems, the following information is required:

a. Provide the results of an analysis, in sufficient detail to permit an independent review, supporting your conclusion that the suggested criteria in Regulatory Guide 1.27 are met.

b. Discuss how the positions set forth in Regulatory Guide 1.27 were implemented. Identify each exception taken and provide the bases.

c. Provide a tabulation and plot spanning a thirty-day period of the total heat rejected, the sensible heat rejected, the station auxiliary system heat rejected, and the decay heat from radioactive material. Use the methods set forth in the October 1971 draft Proposed ANS Standard "Decay Energy Release Rates Following Shutdown of Uranium-Fueled Thermal Reactors", to establish the heat release due to the decay of radioactive material. Assume an equilibrium fuel cycle (ANS formulation for finite operating time) and calculated heat release as follows:

1. For the time interval 0 to 10^3 seconds, add 20 percent to the heat released by the fission products to account for the uncertainty in their nuclear properties.

2. For the time interval 10^3 to 10^7 seconds, add 10 percent to the heat released by the fission products to account for the uncertainty in their nuclear properties.

3. For the time interval 0 to 10^7 seconds, calculate the heat released by the heavy elements (using the best estimate of the production rate for each unit) and add 10 percent to account for the uncertainties in their nuclear properties.

In submitting the results of the analysis requested, include the following information in both tabular and graphical form:

d. The heat rate and total integrated heat released due to the fission product decay heat.

e. The heat rate and total integrated heat released due to the heavy elements.

f. The heat rate and total integrated heat rejected by the Station Auxiliary Systems.

g. The heat rate and total integrated heat rejected due to sensible heat.

h. The maximum allowable plant inlet water temperature taking into account the rate at which the heat must be removed, the water flow rate, and the capabilities of the respective heat exchangers.

i. The required NPSH for the water pumps (taking the required water flow rates and temperatures into account).

j. The maximum and minimum available NPSH for the ERCW pumps.

9.31 The essential compressed air system is designed to provide oil free control air, dried to a low dew point and free of foreign materials, to all essential pneumatically operated instruments, controls and final operators. Considering the past failure history of essential pneumatic operators at nuclear power plants, provide a description of the procedure for periodic tests of the essential system components.

9.32 Section 9.3.1.3 of the PSAR states that the compressed air system includes sufficient receiver capacity to supply essential and control air after a loss-of-power accident until restart of compressors by the diesel generators. Provide the result of an analysis to substantiate such capability. The results should include the air consumption for continued operation of all safety related portions of the instrumentation and control systems, and the pressure decay of the receiver.

9.33 The PSAR states that to ensure air supply to all essential instrumentation and control systems, motor operated flow control valves are employed to isolate the essential air header from the control air and service air supply headers. It appears that positive isolation of the non-essential air supply headers would not be assured unless the motor operated valves fail closed. Provide either a description on the adequacy of loop isolation considering these valves fail open or a description of the modifications necessary to achieve the design objectives.

9.34 Section 9.3.3.2.2 of the PSAR states that if a probable maximum flood occurs, the three-way valves will be manipulated to shut off any possible backflow from the turbine building and divert the drainage into the diesel generator building sump. Provide information to show the positive means of this valve manipulation. Provide an analysis to show that the emergency drains from the train A and train B areas are sufficient to handle water resulting from the largest possible essential raw cooling water line failure.

9.35 With a 45 mile per hour overwater wind, the maximum water level would be raised to elevation 628.4. Figure 9.3-6 of the PSAR indicates that the reactor building normal sump tank, non-tritiated waste holdup tank, reactor building sump pumps, DH pump room leak detector drain, RB spray pump room leak detector drain, makeup and HPI pump room emergency drain are well below elevation 628.4 Describe the positive means taken to ensure proper functioning of these systems and other such systems for safe shutdown or accident mitigation and to prevent the subsequent release of radioactive contamination to the environment due to flooding of the drainage system.

9.36 The makeup and purification system is designed to maintain and control the reactor coolant inventory, the reactor coolant boron concentration and to provide injection water to the reactor coolant pump seals. In addition this system also serves as HPI for the ECCS to provide emergency high pressure injection against small breaks in the reactor coolant boundary. According to Chapter 6 of the PSAR, one makeup pump (high pressure injection pump) is sufficient to prevent core damage for the smaller break sizes. In light of the safety related functions of this system, provide the following additional information:

a. Definition of "smaller break sizes" and "intermediate-sized leaks" as related to one HPI pump operation.

b. The letdown cooler reduces the temperature of the letdown flow from the temperature of the reactor coolant system to a temperature suitable for demineralization and injection to the reactor coolant pump seals. The letdown temperature is measured and a signal for high temperature interlock is provided to close the letdown isolation valve. The makeup and purification is to be operated at all times with the purification devices, i.e., the purification demineralizer pre-filter, the mixed-bed purification demineralizer and the purification filter, in operation. In view of this specific functional requirement, discuss the effects of system operation and the safety implication in the event the interlock malfunctions.

c. The system is also utilized for detection of small breaks in the reactor coolant system. After a break has occurred, the makeup tank will be actuated after a certain time interval depending on the size of the break. The PSAR states that operator action is required to maintain the HPI pump NPSH by opening valves to permit suction from the borated water storage tank or from the demineralized water storage tanks. Clarify what manual operation is required to realign the system and provide the time interval available for this operator action assuming minimum equipment is available.

d. Section 9.3.4.2.3 of the PSAR states that the reactor coolant pumps may be operated without seal injection water or component cooling water. Discuss the effects and the upper temperature limit which the reactor coolant pumps seals and bearings can withstand prior to seizure of the pump shaft. Provide a description of the methods and tests used to develop the upper temperature limit.

9.37 Figure 9.3-8 of the PSAR shows two supply lines connecting the borated water storage tank to the decay heat pump suction, each with a normally open motor operated valve and a check valve. However, the relative positions between the pump suction, the valves, and the BWST have not been indicated. Provide drawings of sufficient detail to show the position and elevations of the above items. Demonstrate that sufficient NPSH would be readily available to the decay heat pumps during the ECCS recirculation mode operation. Also provide the design basis, or modification of the system, to demonstrate that the system functions would not be compromised under any normal or accident conditions.

9.38 The BWST is utilized as the water supply source for various systems, each requiring a definite water quantity. Provide a table indicating the amount of water required for each system and an analysis to demonstrate the adequacy of the BWST capacity for all operation modes.

9.39 Indicate the acceptable values of over-temperature operation in the control buildings and discuss the consequences of control room equipment failure due to any over-temperature operation.

9.40 Provide a table listing the operating temperature limits and humidity and temperature sensitivity for all control room equipment. Identify any equipment that is likely to fail under high temperature and high moisture content environment. Discuss the permissible instrumentation failures under which the control room will remain functional.

9.41 Provide the design capacity for the air-conditioning and ventilating system components, the building pressurizing air supply fans, the control room emergency air cleanup supply fan and filter assemblies, and the control room emergency pressurized air supply fan.

9.42 Provide the results of an analysis to support the adequacy of the main control room emergency air pressurized supply system.

9.43 Describe the gaseous contamination which would require manual operation of the control room emergency air cleanup system and the means of detecting the contaminant.

9.44 Section 9.4.1.3.5 of the PSAR states that for the battery rooms and battery board rooms the ventilation system will be required to operate at all times. Provide the design basis and a discussion to justify the ability and need for the system to operate continuously under the accident conditions such as earthquakes and other natural phenomena with consideration of single active failures.

9.45 Since instrumentation for detection of toxic gases are not provided in the control building air intakes, descirbe the alternative means of detecting the presence of toxic gases. Also list the types of toxic gases that the alternative means would be capable of detecting and their sensitivity to each of the gases.

9.46 Provide arrangement drawings of the diesel generator building and ventilation system and the results of an analysis to demonstrate the capability of ensuring the continuous operation of the diesel generators during accident conditions.

9.47 Provide the design basis and criteria for the diesel generator building emergency lighting system which supports the adequacy of the system's functional requirement.

9.48 In the event of an AC power failure, discuss the time interval required for the standby and emergency systems to re-supply lighting power to the critical areas of the facility.

9.49 Tabulate the Lighting systems which would be required for safety related functions during accident condition. Identify the vital areas and the hazardous areas where emergency lighting is needed for safe shutdown of the reactor and the evacuation of personnel.

9.50 Discuss means for detecting or preventing growth of algae in the diesel storage tanks. If algae were detected, describe the methods provided for cleaning the affected storage tank to prevent contaminated fuel from being supplied to the emergency diesels.

9.51 In the event that a yard fuel oil storage tank or the transfer piping between a tank and the diesel generator building has been damaged by earthquake or other accident, additional fuel oil may be needed after seven days. Describe the nearest fuel storage location where additional diesel oil may be procured. Since tank trucks are mentioned as a means for fuel oil transportation, discuss the measures to be taken to ensure that tank trucks can reach the site after an earthquake or flood.

9.52 The PSAR states that a closed circuit circulating water cooling system is furnished for each diesel engine. Each of the cooling water systems includes a pump, heat exchanger, expansion tank, and piping. State the seismic category for the DG cooling water systems.

10.0 STEAM AND POWER CONVERSION SYSTEM

10.5 Describe the turbine control and overspeed protection systems in sufficient detail to permit an evaluation of the degree of independence and redundancy of components and systems for each function.

10.6 The PSAR states that the turbines and safety related components and facilities are oriented in a manner which will reduce the turbine-missile hazard to safety related items to an acceptable small probability. Provide information in sufficient detail to enable an independent evaluation of the adequacy of the proposed orientation.

10.7 Provide the criteria and basis of design which will be used to preclude the consequences of postulated high energy line ruptures outside of the primary containment from having an adverse effect on safety related structures, systems or components necessary for safe shutdown. Include in the discussion, a failure mode and effects analysis to demonstrate that a concurrent single active component failure will not produce an unsafe condition. Also indicate the time interval required for complete isolation of the normal feedwater flow to the steam generator. In order to enable the staff to independently evaluate and verify the adequacy of your design, compare your criteria to those set forth in Mr. A. Giambusso's letter, dated December 12, 1972, and in Mr. John F. O'Leary's letter, dated July 12, 1973.

10.8 Section 10.3.2 of the PSAR states that in the event of a main steam pipe rupture, the air operated main steam isolation valves are capable of closing and isolating a steam generator with 7.5 seconds of the detection of high containment pressure or low steam generator pressure. Also, the check valves are capable of preventing reverse steam flow in the event of accidental pressure reduction in any steam generator or its associated piping. Describe the results of an analyses for the main steam pipe rupture accident, considering first the rupture occurs upstream of the isolation valves and then downstream of the isolation valves. The results should include the following:

a. transient flow area;
b. curves of mass flow rate versus time after steam line breaks for hot standby, 25% load, 50% load, 75% load, 100% and 105% load conditions;
c. pressure differential across the valves for the above conditions;
d. change in total energy for conditions listed in 10.8b above;
e. fluid flow velocity, mass flow rate and pressure differential at choke flow condition; and
f. a description of the mathematical model including the method used to consider the effects of moisture content in steam.

10.9 Expand the Auxiliary Feedwater System description to provide the following additional information:

a. With the aid of Figure 10.4-8, discuss the time required to realign the system, considering a single active failure coincident with the following accidents:

1. Steam generator IA main steam line break accident.
2. Steam generator IA main feedwater line break accident.

b. Provide the design basis and criteria for the auxiliary feedwater pumps, together with an analysis to support the adequacy of the pump capacity.

c. Indicate the accident conditions under which the demand of auxiliary feedwater would be most severe, also provide the required feedwater flow rate for such conditions.

d. With the results of the analysis as requested in 10.9b above, provide a curve indicating the steam generator water level at various times (0-130 minutes) after the accident, and demonstrate the adequacy of heat transfer area available in the steam generator.

e. The condensate tank is not designed to engineered safety feature standards, therefore, postulating a condensate tank failure, the auxiliary feed system must take suction from the ERCWS. Provide a description of system operations that must be performed to ensure a safe plant shutdown for such a failure.