UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

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IN REPLY REFER TO:

Docket No. 50-269/270

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Duke Power Company
422 South Church Street
P. O. Box 2178
Charlotte, N. C. 28201

Attention: Mr. W. L. Lee
Vice President

Gentlemen:

This is a request for supplemental information to your application for a construction permit and operating license for the Oconee Units 1 and 2 to be located in Oconee County, South Carolina. During a meeting on Fegruary 14 and 15, 1967, between representatives of your company and the regulatory staff a number of technical areas were discussed and it was concluded that additional written information would be required to continue our review. In this regard you are requested to provide the information listed in the enclosure.

We understand that changes will be made in the core cooling systems of the proposed reactors in response to increased emphasis in this area as reflected in recent licensing actions. Appropriate submittals reflecting these changes should be made so that we can continue our review of these systems.

In order to facilitate our technical review, we urge that you provide full and complete answers to the attached questions so that further questions covering the same material will not be required. We will be available to amplify the meaning of any of the questions.

Sincerely yours,

Original Signed by
Peter A. Morris

Peter A. Morris, Director
Division of Reactor Licensing

Enclosure:
As stated above

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1.0 GENERAL

1.1 Supply specific ASME Code vessel classifications for all components, including heat exchangers, in the systems which handle reactor coolant.

1.2 Your calculations indicate that xenon oscillations might occur in this core. Please describe the method by which xenon oscillations would be controlled should they occur.

1.3 Discuss the use of aluminum components in the primary system from the standpoint of experience with these components in service and state the criteria to which these components will be designed and fabricated including corrosion and fit-up considerations.

1.4 Discuss the inspectability of the primary system and the reactor vessel during their service life. Will representative longitudinal and radial welds, all nozzles and dissimilar metal welds be inspectable? Supply a tentative schedule for inspection of the primary system and reactor vessel during their service life.

1.5 Discuss the containment tests which will be performed initially and over the service life of the containment which will assure that at least the specified 50% of containment leakage will exit through filters via the penetration room.

1.6 Discuss the frequency and type of maintenance likely to be performed on the hydro plants. What is the time required to restore the hydro plants to operation for these various types of maintenance? This should include maintenance that might be performed on the penstocks.

1.7 Please provide a discussion of how the larger water gap and thinner thermal shield in this proposal affect, as compared to currently licensed plants, (1) the neutron irradiation and (2) the thermal stresses in the pressure vessel wall.

1.8 Discuss the limitations on frictional contact between control rods and guide tubes with repsect to the life of the rods and give the inspection criterion.

2.0 SITE

2.1 Provide a drawing indicating the location of all areas within the site boundary which will not be owned by Duke Power and those that will be leased or otherwise used for purposes other than power generation. State the control that will be exercised by Duke Power over these areas.

2.2 Estimate the expected transient population around the future Lake Keowee as a result of summer cottages, boat access and any commercial activities.

2.3 Locate the water intake for the town of Seneca with reference to the reactor and also indicate the distance to the proposed intake point on Lake Hartwell for the city of Anderson and the towns of Clemson and Pendleton. Provide stream flows, travel times, and estimated dilution to these intakes. Estimate the length of time that these muncipalities could suspend use of these intakes.

2.4 Discuss the reasons for discharging liquid radioactive waste into the tailrace of the hydro plants rather than into Lake Keowee. In this regard provide the following information: (a) What is the effective transit time and dilution factor from the plant discharge canal through the lake to the intake canal and how would these be affected by various flow conditions in the rivers? (b) What are the corresponding factors between the discharge canal and the tailrace of the hydro plants? (c) How will the flow through the hydro station be affected by low flow in the rivers feeding the lake?

2.5 Please provide the following information with respect to site meteorology:

2.5.1 What is the average wind speed for Type F stability conditions, including the calms? Considering that this site is an area having a dilution climate which is below average, how can the use of a higher than usual wind speed for site evaluation be justified? Also, why is the persistence of inversion conditions less than 24 hours? Similar sites have shown much longer persistence of inversions. Re-examine the assumed 20% wind direction persistence in 24 hours in light of Weather Bureau data indicating the persistence at most sites is approximately 15 hours.

2.5.2 Please re-examine the assumed 30-day meteorology as compared to that presented for the yearly average.

2.6 Describe the scope of the preoperation and postoperation environmental monitoring program including the type and frequency of sample collection.

2.7 It is our consultants' tentative opinion that the maximum hypothetical earthquake should be about 0.10g for those Class I structures which are founded on bedrock and 0.15g for any Class I structures located on overburden. Please provide your structural design criteria for the maximum hypothetical earthquake.

3.0 THERMAL ANALYSIS

3.1 Please provide a numerical breakdown of the following factors for the hot channel of this reactor:

3.1.1 Integrated power effects due to rod pitch, bowing, pellet diameter and enrichment variations.

3.1.2 Flow distribution effects due to (a) the inlet plenum, (b) redistribution in adjacent channels of dissimilar coolant conditions, (c) physical mixing of coolant between channels.

Discuss the effect of variation of the above factors on exit quality in the hot channel.

3.2 Please discuss the effect of variation of the mass flow rate (G) on the DNB ratio of the hot side cell and the hot corner cell.

3.3 Discuss the degree of confidence which you have in the flow instability analysis. What margin above slug flow exists in the corner and side flow channels? What are the consequences of locally operating in the slug flow regime (e.g. due to unexpectedly low mass flow rates in the corner channel?)

3.4 Provide a description of the methods used to calculate core void fractions.

3.5 What is the effect on the calculated fuel rod internal pressure due to fission gas release if the voids within the fuel are not utilized in the calculations? (It appears that these voids have been used twice; once for fuel expansion and again for fission gas release).

3.6 Please provide information on current burnout experimental studies with multirod geometries and non-uniform heat generation for the configuration and service conditions of the proposed reactor.

3.7 Provide the basis for the conductivity curve used and describe the calculational procedures and assumptions used to calculate the center line fuel temperature.

4.0 INSTRUMENTATION

4.1 Please discuss the reliability of those power generation sources and associated circuitry which will provide emergency power in the event of an accident and simultaneous loss of the external grid. The discussion should include considerations of redundancy and independence of the sources, and the degree of immunity to "single failures" of the total emergency power system (including load-shedding subsystems, d.c. sources feeding breaker control circuits, undervoltage circuits, etc).

4.2 Please re-submit a revised version of Figure 7-2, incorporating your present intentions relating to the design of the nuclear instrumentation and protection systems.

4.3 Please describe the power/flow scram channels.

4.4 Please submit a schematic diagram (similar to the format of Fig. 7-2) showing your proposed three-wire d.c. system. Please include a failure analysis which shows that no single fault within this system (e.g., short, ground, failed breaker, faulted charger. . ., etc.) can preclude the actuation of protection and safeguards devices under accident conditions.

4.5 Does the design of your protection system conflict in any way with the proposed IEEE Standard for Nuclear Power Plant Protection Systems? If so, please state reasons justifying your position.

4.6 Please discuss your criteria relating to the qualification testing of instrumentation and associated circuits to ensure their ability to survive an accident environment.

4.7 Please discuss in further detail the development program of the nutating rod drives, including experimental data which will confirm that the drives will meet design requirements.

4.8 Please list those portions of the containment isolation system which are not fail-safe upon loss of voltage. Provide justification for your design basis.

4.9 Please perform similar analyses to that in Section 14.1.2.3 assuming a reactivity insertion rate equivalent to simultaneous all-rod withdrawal, commencing from various initial power levels sufficient to show that, in no case, does fuel damage occur.

5.0 CORE COOLING

5.1 Provide a plot of the coolant flow within the reactor as a function of time after hot leg and cold leg major coolant line breaks. How does the injection location of the deluge system affect this flow transient?

5.2 Discuss the mechanism of clad failure during heatup and quenching. Could the rods swell and block coolant channels? Could fuel integrity be lost as a result of rapid quenching? How many adjacent channels could be blocked and local melting still be prevented by the core flooding system?

5.3 What temperature transient does a control rod experience during the core heatup. (Consider heat transfer from bowed fuel rods as well as radiant heat). What eutectics might be formed between the dissimilar core materials and could these be formed before either component was molten? Can the core remain subcritical after flooding without control rods in the core?

5.4 Discuss design of the vessel internals to withstand blowdown forces from a hot leg or cold leg break. In particular, provide information on the method used to calculate core pressure drops during the subcooled blowdown phase and compare the results to experimental data such as the LOFT tests. How are assemblies held in place during the calculated transients?

5.5 Justify the use of the steam-limited zirconium water reaction assumption considering that the core deluge system may be partially effective in providing water to the core.

5.6 We understand that the engineered safety features are being redesigned and that stored energy flooding tanks will be provided. Please include the following points in your description and analysis of these systems:

5.6.1 Justify the capacity of the systems including single failure considerations.

5.6.2 Provide the analysis by which injection above rather than below the core was chosen. What experimental information substantiates the ability to flood the hot core from the upper plenum?

5.6.3 Provide the analysis by which the design pressure of the core flooding tanks was chosen from a performance viewpoint, including the variation of significant parameters.

6.0 ACCIDENT ANALYSIS

6.1 Please provide additional information concerning the effect of the positive moderator temperature coefficient on the reactivity insertion and fuel heat-up during a loss of coolant accident. This should include a thorough discussion of the work done to date and the major areas (if any) which remain to be resolved. Include curves illustrating the coolant condition (e.g. flow and density) as a function of time. Also provide plots of the various reactivity components, power, and integrated energy as a function of time for the various break sizes and break locations studied. Provide information in the following areas in conjunction with your consideration of the above problem:

6.1.1 Discuss your analysis of heat transfer during the blowdown including experimental information which might support the heat transfer coefficients assumed. Discuss the effect which a significantly larger or smaller heat transfer coefficient might have on the above analysis.

6.1.2 Show that the positive moderator temperature coefficient could be eliminated if this is found necessary (e.g., by fixed shims). Is there a practical limit to the size of the positive coefficient that could be negated in this manner? Provide the bases for determining the maximum acceptable positive moderator temperature coefficient from an operational viewpoint.

6.1.3 Discuss the method used to calculate the maximum reactivity insertion including (1) the variation of the spatial density distribution as a function of time, and (2) the nuclear calculations required to estimate the effect of this variation on the reactivity of the system.

6.1.4 Discuss the method used to calculate the energy generated in the reactivity transient.

6.1.5 Discuss the accuracy you believe may be assigned to (c) and (d) above, including experimental corroboration of the accuracy of the calculations.

6.2 Please provide the following information concerning the rod ejection accident:

6.2.1 Justify the assumed rod worth values of 0.2% reactivity from full power and 0.5% reactivity from zero power. On what basis was a rod ejection accident from hot standby not considered?

6.2.2 Discuss the thermal-hydraulic assumptions used in the transient calculations.

6.2.3 Provide plots of the various reactivity components, power and integrated energy as a function of time.

6.2.4 Justify the use of the point kinetics model in this analysis. We understand that some comparisons of the point kinetic results with explicit space time calculations (WIGL) has been made. A presentation and discussion of these results would be useful.

6.2.5 Discuss the margin which exists between the calculated transient and those transients which could (1) cause major damage to vessel internals and (2) cause primary system rupture.

6.3 Provide a plot of the temperature of the primary system water after a steam line break as a function of time and justify the 60°F cooldown figure used in the analysis. Provide a plot of the power and reactivity as a function of time for this condition.

6.4 Consider the case of a steam line break accident in which feedwater continues to be fed to the steam generator. What is the temperature response of the steam generator shell and what stresses are imposed on the tubes?

6.5 Provide an analysis of the effects of steam generator tube ruptures coincident with (precipitated by) a steam line break with respect to (1) reactivity effects on the primary system and (2) release of fission products to the environment, as a function of number of tubes ruptured.

6.6 Discuss the need for isolation valves on the secondary system particularly with reference to leakage from the primary system after a steam line break. Co[illegible] safety valves on the secondary side be run through separate penetrations and an isolation valve be located inside containment?

6.7 Provide the method used to calculate the reactor coolant activity from 1% failed fuel. Include assumptions on the release rate of noble gases and the cleanup rate. Provide a definition of "equivalent curies of iodine-131."

6.8 Justify the use of a 10^4 reduction factor for fission products in the event of a steam generator tube rupture and release through secondary system safety valves.

6.9 Justify the assumption that hydrogen evolved in a metal-water reaction would be above the ignition temperature in all cases. Particularly consider partial effectiveness of the cooling systems. What effect would delayed burning of hyrdogen have on containment design margins?

6.10 What mixing depth and deposition areas in the lake are assumed in calculating iodine intake from rainout after an accident during the first 5 or 10 days? For how long is the intake of water assumed in the dose calculation?

7.0 <u>CONTAINMENT COOLING</u>

7.1 Describe the capability to flood the reactor cavity after an accident. How does the volume required to flood the cavity compare with the primary system volume?

7.2 Discuss the requirements for cooling the water recirculated from the containment sump.

7.3 Discuss the NPSH requirements of the recirculating pumps with respect to the minimum height of water required in the sump. To what water volume inside containment does this correspond? Discuss the sump location considerations, intake design details and the criterion for redundancy in sump outlet capacity.

7.4 Provide an analysis to show the amount of time available to isolate the service water in case of a break in the containment cooler tubular heat exchanger (resulting in the injection of unborated water).

7.5 Provide an analysis showing the minimum containment safeguards required to handle the design basis accident and illustrate the margin, in terms of metal water reaction, provided by the proposed system capacities.

7.6 Discuss the separability and location of the recirculation system pumps to avoid flooding of the pumps in case of a major system leak.

8.0 <u>STRUCTURAL DESIGN</u>

8.1 Provide the loading combination considering the design basis accident-maximum earthquake combination, and the design basis accident-maximum wind combination.

8.2 Please provide a complete, detailed description of how the design wind and tornado wind are translated into static loadings on the structure. Estimate the ultimate capability of the containment and other structures to withstand tornado differential pressure and wind loadings. Justify use of 225 mph as the tornado design wind load and the differential pressure associated with this tornado.

8.3 Clarify the design approach in the PSAR allowing limited plastic yielding in a working stress design.

8.4 Provide the following information relative to seismic design in light of question II.7.

8.4.1 The damping factors to be used in the various loading combinations that include a seismic contribution.

8.4.2 A statement of the intent of the designer with regard to combination of maximum vertical and horizontal earthquake components in conjunction with the other applicable loadings.

8.4.3 The mathematical model to be used in the seismic design analysis.

8.4.4 The stiffness factors to be used in the design analysis and a detailed basis for the selections.

8.4.5 The design criteria and procedures for design of the piping systems and supports for Class I components for seismic loadings in combination with the other applicable loads.

8.5 With regard to earthquake response spectra provide the following:

8.5.1 A response spectrum for the maximum earthquake.

8.5.2 The basis for the shape of the proposed response spectra.

8.5.3 Identify, explain and justify the scaling of the response spectra with respect to displacement, velocity, acceleration and frequency on the plots presented.

8.6 Provide analytical studies to support the safety of the dam against failure under earthquake loading. If such a failure were to occur, what effect would it have on the capability for safe plant shutdown specifically in the areas of shutdown cooling and emergency power.

8.7 Provide the following information with regard to shear design:

8.7.1 An analysis of recent test experience (such as the University of Washington data) under combined shear and tensile loading and an evaluation of the extent to which this experience influences the radial shear design criterion.

8.7.2 A revised shear criterion incorporating clarified principal stress limits for loadings both including and excluding thermal effects.

8.7.3 An analysis of recent test experience on strength in shear of sections with large sized bars and low longitudinal steel percentages and an evaluation of how such experience influences the shear design criterion.

8.8 Provide the following information with regard to penetration design:

8.8.1 A concise criterion with regard to prevention of failures at leakage barriers due to all conceivable loading conditions during accidents and typical details illustrating how the criterion will be implemented.

8.8.2 The basis for providing reinforcing in the containment concrete wall around penetrations and typical details indicating implementation of this criterion.

8.9 Provide justification for the use of lapped splices in large sized reinforcement bars under biaxial tensile loading.

9.0 MATERIALS AND CONSTRUCTION

9.1 With regard to construction practice indicate:

9.1.1 The extent to which ACI 301 will be adhered to in construction.

9.1.2 The construction procedures to be used to achieve bonding between lifts.

9.1.3 The pattern of construction joints that will be used in the structure and the degree to which joint staggering will be accomplished. Where joint stagger is not accomplished justify in detail its elimination.

9.1.4 The extent to which liner plate radiography will be accomplished.

9.2 Provide details on the prestressing system to be used.

9.3 Provide details on what user testing of liner plate, reinforcing steel, corrosion inhibitors, cement, prestressing wire (or strand) and anchorage hardware will be conducted.

9.4 Define the amount of concrete testing to include more specifics on slump testing, justification of the amount of strength testing, and how this testing will be factored into an overall statistical sampling program.

9.5 Define in more detail the program for construction inspection by identifying the organization, responsibilities, authority and independence of the quality control group and by indicating how supervision and review by the design group will be achieved.

9.6 With regard to design details on load transfer through the leakage barrier provide:

9.6.1 A typical crane support bracket detail.

9.6.2 A typical detail on equipment support load transfer through the base liner.

9.7 With regard to corrosion protection provide the cover provision for reinforcing steel for the dome, base slab and cylinder. Also justify the selected cover requirements on the basis of code practice and field experience.

10.0 CONTAINMENT INSPECTION AND INSERVICE SURVEILLANCE

10.1 Provide an enlarged detail of instrumentation planned to monitor the equipment opening during the proof test, indicate the purpose of the instrumentation provided, and state the interpretation that will be placed on these measurements.

10.2 Provide a detailed comparison of the stresses in the structure and liner under combined accident conditions and under the proof test loading.

10.3 Provide a detailed prediction of strains around the equipment hatch, in the cylinder-dome region, at the base-cylinder junction and in the liner. Also provide detailed predictions of overall shell and dome growth. Provide an estimate (plus and minus) of the prediction accuracy, a description of the instrumentation that will monitor structural performance at the prediction location during the proof test, and an estimate of instrumentation accuracy.

10.4 List the quality control records that will be in the possession of Duke Power Company after construction of the plant has been completed and indicate the length of time these records will be maintained. Include both reactor system and containment records.