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DUKE POWER COMPANY-OCONEE ACRS REPORT INPUT, DOCKET NOS. 50-269, 270 and 287

Attached is our ACRS report input for Duke Power Company Oconee Nuclear Power Plant, Docket Nos. 50-269, 270 and 287.

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Environmental and Radiation
Safety Group
Division of Reactor Licensing

Enclosure:
ACRS Report Input
Duke Power Co.

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OCONEE ACRS REPORT INPUT

DOCKET NOS. 50-269, 270 and 287

I. Site Location and Description

Oconee Station is in Oconee County, South Carolina, about eight miles northeast of Seneca, South Carolina. The site is adjacent to Lake Keowee which was formed by impounding the Keowee and Little Rivers with separate dams and then joining the lakes by a canal about half a mile north of the site. The nuclear station is about eight-tenths of a mile west of Keowee River at the dam. Anderson, South Carolina, the nearest population center (1960 population of 41,136), is 21 miles south. The applicant proposes a minimum exclusion radius of one mile. Based on the 10 CFR 100 definition of the exclusion radius, we conclude that the distance selected by the applicant is acceptable.

The applicant has proposed a six mile Low Population Zone (LPZ) which he estimates will contain 3,400 people in 1970 and 8,900 people by 2010. The transient population within the LPZ is estimated by the applicant to be 2,000 in 1970 and, because of the development of recreational and vacation facilities along Lake Keowee, is expected to increase to 19,000 by 2010. Based on the population distribution in the proposed LPZ and the 10 CFR 100 definition of the LPZ, we find that the 6 mile LPZ is acceptable.

II. Geology and Seismology

Plant structures will be founded on Piedmont granite gneiss rock. According to the applicant and to the AEC Division of Compliance, no unusual problems concerning the foundation material occurred during construction. The geology and seismology of the Oconee site were reviewed in detail during the construction permit (CP) stage, and nothing has occurred to alter our previous conclusions that the geological and seismological conditions are acceptable for the safe operation of the Oconee nuclear units.

The Class I structures founded on bedrock were designed to withstand horizontal ground accelerations of 0.10g and 0.05g for the Design Basis Earthquake (DBE) and Operating Basis Earthquake (OBE) respectively. For Class I structures on overburden a DBE acceleration of 0.15g was used as a design parameter.

III. Hydrology

Lake Keowee will be the source of condenser cooling water for the Oconee plant. Cooling water will be withdrawn from the Little River arm of the lake and discharged into Lake Keowee just west of Keowee Dam on the north side of the plant property.

In order to provide a continuous supply of emergency cooling water, a Class I submerged weir, which impounds 9-million cubic feet of water, has been constructed across the lagoon from which condenser cooling water is withdrawn. In the unlikely event that Keowee or Little River Dams should fail (both have been shown by the applicant to be capable of withstanding the DBE accelerations), the water retained by the submerged weir would be circulated through the condensers and back to the intake lagoon providing continuous emergency cooling.

The applicant has calculated that the Probable Maximum Flood (PMF) will result in a lake stage of 808 ft. MSL. Plant grade and critical plant components at 796 ft. MSL are provided flood protection to 815 ft. MSL by the Keowee Dam and intake canal dike. We have made an independent analyses of the anticipated wave effects and have concluded that the seven feet of freeboard between the PMF flood stage and the 815 ft. MSL protection level is adequate to protect the nuclear plant against any credible combination of wave effects and PMF stage.

Based on the considerations discussed above, we and our hydrological consultants, the U. S. Geological Survey, conclude that the hydrological conditions at Oconee Station are acceptable relative to the protection of public health and safety during operation of the Oconee nuclear units. A copy of the U. S. Geological Survey report has been forwarded to the Committee.

IV. Meteorology

During the CP review of the Oconee site, the staff and our meteorological consultants, ESSA, concluded that a "Valley" diffusion model would best characterize the meteorology of the site because of the complicated, rough topography between the Oconee nuclear units and the nearest site boundary one mile to the south. In this postulated model it was assumed that the effluent released as a consequence of a reactor accident would be channeled generally down the Keowee River Valley to the nearest site boundary. Complete mixing of the effluents was assumed to occur within the confines of the topographic ridges along Keowee River between the reactors and the exclusion radius. The resultant meteorological diffusion factor was 7.4×10^{-5} sec/m^3. Through his post CP meteorological program, the applicant was to prove that the Valley model was valid for the site.

The applicant conducted fifteen gas tracer (SF_6) experiments under inversion conditions, and in all cases the centerline concentration was lower than that which would have been predicted by the use of the equivalent Pasquill type diffusion conditions. The best agreement between a measured concentration and the concentration the Pasquill model would predict was at 680 meters where the measured concentration was a factor of 2.2 lower than what Pasquill categorization would have predicted, including building wake credit. In all other cases the measured concentration was even a smaller fraction of the predicted concentration.

An examination of one year's data of the joint frequency tabulation of wind speed, direction, and stability condition (delta T) data from a 150 foot tower indicated that nine percent of the time the diffusion rate was equal to or worse than Pasquill Type F and 1.5 m/sec wind speed. This data indicates that a diffusion rate equivalent to or worse than Pasquill F and 1 m/sec wind speed occurs 5 percent of the time.

Because of the height of the trees in the vicinity of the meteorological tower, the wind measurements were made at 150 feet above grade rather than at a level more appropriate for a ground level release (20 or 30 feet elevation). However, based upon a visual examination of the topography of the site, the 150 feet level appears to be a reasonable lower level at which to collect wind data and not have topographic interference. In a related matter, the applicant stated that a wind speed calibration check was made in October 1969 which indicated the instrument was measuring low by a factor of 1.4. However, there is no rigorous way to determine how long this situation had persisted and to what extend the data in the joint frequency tabulation were affected. Therefore, the effect of not correcting the 150 foot wind measurements down to the appropriate 20 or 30 foot elevation is probably compensated for by the 1.4 calibration factor. For this reason, we believe that the unmodified 150 foot elevation wind data are a reasonable representation of the wind speeds to be expected at the 20 to 30 foot level.

In evaluating the radiological consequences of the design basis accidents, we have employed the usual staff model of Pasquill Type F and a wind speed of 1.0 meter per second (which was shown applicable by onsite data) with building wake credit and with an additional correction factor of 2.2 to account for the improved diffusion at Oconee Station due to topographical effects. This results in a diffusion factor of 1.16×10^{-4} sec/m^3, while without the correction credit the staff's diffusion factor would be 2.18×10^{-4} sec/m^3. ESSA, whose report has been forwarded to the Committee, has concurred in this model.

V. Environmental Radiation Surveillance

A preoperational environmental monitoring program was initiated in January 1969, so that two years of data would be available before startup of Unit 1. (Water samples from private wells and from the Keowee and Little River arms of Lake Keowee have been analyzed since 1966). The preoperational program included the following samples: water, airborne particulates, rain, settled dust, silt (river and lake), vegetation, aquatic vegetation, algae and plankton, fish, milk, and animals. No environmental radiation anomalies have been indicated by the preoperational data thus far reported.

The operational environmental monitoring program will be an extension of the preoperational program with the following additions in order to provide a more comprehensive program to quantitate the environmental effects of operating the nuclear units:

1. two additional onsite air monitoring stations,
2. a continuous water sampling station on the Keowee River just within the exclusion radius, and
3. a thermoluminescent dosimeter network within the one mile exclusion radius.

The frequency of sampling and types of analyses of each media are given in Table 2-1a and in Sections 2.7.2 and 2.7.3 of the FSAR. These references will be incorporated in the Oconee tech specs.

Duke Power Company is cooperating with the South Carolina State Board of Health, South Carolina Pollution Control Authority, South Carolina Wildlife Resources Department, and the U. S. Fish and Wildlife Service in matters concerning the environment.

The Oconee environmental monitoring program encompasses the recommendations of the U. S. Fish and Wildlife Service with the exception of sampling within 500 feet of the liquid effluent outfall.

The applicant has added a commitment to sample aquatic biota, crustaceans or molluscs, benthic organisms, and bottom sediments as near the outfall as they can be found. The applicant has stated that the scouring effect of the Keowee Hydro Plant discharge will prevent the development of these organisms or bottom sediment close to the outfall. The comments of the Fish and Wildlife Service have been forwarded to the Committee.

Based on the description of the environmental monitoring program in the PSAR and FSAR, we conclude that the environmental surveillance for Oconee Station is acceptable.

VI. Radioactive Waste Management

As stated in the FSAR, liquid radioactive wastes are segregated in receiving tanks according to their source, sampled, analyzed and then treated. Based upon the analyses, the liquid waste will be treated by one of the following methods:

1. discharge to the Keowee Hydro Plant tailrace;
2. holdup for decay, resampled and analyzed, and discharge to the Keowee tailrace;
3. concentration by evaporation with ultimate disposal as a solid waste.

Also, according to the applicant, liquid waste will be diluted, as necessary, by the hydro plant discharge (30 cubic feet per second to

19,800 cfs) to meet the concentration limits of 10 CFR 20. However, in order to retain operational flexibility, the applicant only assumes the minimum dilution (30 cfs) in estimating the annual release limits. According to the applicant, the Keowee Hydro Plant, which is controlled from the Oconee nuclear plant control rooms, is expected to be operated at least weekly, if not on a daily basis (tech spec section 15.4.4). Thus, flow substantially greater than the minimum leakage flow will usually be available.

In the applicant's design evaluation of the Oconee liquid radwaste treatment system, a minimum holdup time of 30 days was assumed. This is indicative of the amount of waste storage tankage that is available in the plant: 8,100 ft^3 for the miscellaneous liquid waste and 66,000 ft^3 for the primary coolant (coolant storage system). In the proposed tech spec (section 15.3.9), the applicant has committed to treat all liquid radioactive waste " ... to reduce the quantities released to as low a level as practicable if the concentration upon dilution with normal Hydro Plant Leakage at the point of release would be greater than 1/10 MPC without processing." The staff position is that all radioactive liquid waste should be treated with the equipment provided--in this case the evaporator. In addition, with the available holdup capacity in the Oconee plant and with the expected operating routine of the Keowee Hydro Plant, we conclude that reasonable effort on the part of the applicant dictates that the liquid radwaste be discharged only if the hydro plant is being operated. Thus, the waste would receive a much greater instantaneous dilution than if the hydro plant was not operating.

The entire radwaste system is located below grade in Class I structures so that in the event of an accidental spill, the liquid waste will be retained within the structures. In order for accidental discharges to the environment to occur, waste would have to be pumped from the below grade storage tanks to the Keowee tailrace through a discharge valve which is closed by a high radiation signal from a radiation monitor.

The reactor coolant treatment system, which is provided to recover boron and to purify the coolant, provides additional "waste treatment" of the primary coolant before it reaches the liquid waste disposal system. The coolant treatment system, which operates on a batch basis, receives liquid from the primary coolant bleed holdup tanks through bleed evaporator demineralizers (deborating demineralizers). The coolant is fed to the coolant bleed evaporator, and then the condensate is sent to the condensate test tanks. At the operator option the test tanks' contents can be (1) routed to the waste feed tank, (2) returned to the coolant bleed evaporator feed tank, (3) returned to the coolant bleed holdup tanks, or (4) released to the liquid waste effluent header. In conjunction with options 3 and 4, the test tank effluent can be passed through the condensate demineralizers.

The solid waste disposal system includes equipment to collect and store two years' generation of spent demineralizer resins and a hydraulic press for use in handling compressible solid waste. All solid waste are ultimately drummed and shipped offsite for final disposal.

The gaseous waste disposal systems are connected to vent headers which collect potentially radioactive off-gases from all components which may contain radiogases. Before release to the environment, these off-gases are processed either through a waste gas exhauster and a filter bank composed of a prefilter, an absolute filter and a charcoal filter, or through the waste gas decay tanks and then through the filter train. The gas decay tank contents are sampled and analyzed prior to release to the plant vent. Units 1 and 2 share a gaseous waste disposal system and Unit 3 has an independent system. However, these systems can be interconnected through double isolation valves between the respective vent headers; thus, operational flexibility is provided in the event one waste gas system is temporarily out of service.

According to the FSAR, the waste gas exhauster will be used when large volumes of gas containing little or no radioactivity are to be released.

The exhauster (fan) and the isolation valves on the waste gas exhauster and decay tank discharge lines are interlocked with a radiation monitor so that in the event of high level activity, discharge through these paths will be terminated.

According to the applicant, containment purging will be through particulate (HEPA) and charcoal filters to the plant vent. However, under conditions of low level activity in the containment air, the applicant proposes to bypass the filter system.

In the proposed tech specs (section 15.3.9) the applicant states that "... gaseous wastes will be processed prior to release to reduce the quantity released to as low a level as practicable if the concentration at the point of release would be greater than 1/10 MPC without processing."

In the technical specifications we shall require that gaseous radioactive waste passing through the off-gas system be held for decay (the holdup time will be established in the tech specs) and that all radioactive gaseous waste be filtered through the systems previously described.

Relative to the tech spec gaseous release limits, the applicant has designated a restricted area which is basically the confines of the nuclear plant structures. He also desires to assume an atmospheric dilution factor which would be applicable to the one mile site exclusion radius in establishing the Oconee gaseous release limits. The applicant believes that 10 CFR 20.106 provides the basis for this approach. He claims that he can prevent Oconee originated radiation exposure of the public within the exclusion radius by venting from the decay tanks only during periods of favorable atmospheric diffusion conditions. The applicant has taken this position because: (1) there is a visitor's center approximately 300 meters from Unit 1, (2) construction will be continuing on Units 2 and 3 after Unit 1 begins operation, (3) there are temporary construction workers' camps within the exclusion radius, and (4) a portion of Lake Keowee within the exclusion radius will be used for recreational purposes.

The staff position is that the annual release limits should be calculated at the nearest boundary of the designated restricted area with an atmospheric diffusion factor appropriate for this distance.

Based on the descriptions of the radwaste systems and the data provided in the PSAR and the FSAR, we conclude that the Oconee radwaste systems are capable of providing waste effluents which can be considered "as low as practicable."

Accident Analyses

The staff has analyzed the radiological consequences of the following design basis accidents in evaluating site acceptability: the loss of coolant accident, refueling accident, gas decay tank rupture, steam line break, steam generator tube rupture and rod ejection accident. The dose consequences are given in Table 1, and the various accident assumptions are provided in Table 2. The dose consequences for the steamline break, steam generator tube rupture and the rod ejection accidents represent only the primary system contribution. The additional contribution due to release of secondary side activity will be reported later after the ad hoc committee on accidents involving the secondary system has completed its work in developing standard staff models. This is expected before the middle of July.

TABLE I

RADIOLOGICAL CONSEQUENCES OF DESIGN BASIS ACCIDENTS

	TWO HOUR SITE BOUNDARY DOSES AT 1 MILE:REM		COURSE OF ACCIDENT LPZ DOSES AT 6 MILES:REM	
ACCIDENT	THYROID	WHOLE BODY	THYROID	WHOLE BODY
LOSS OF COOLANT	190	2	200	1
REFUELING (with filters)[1]	30	<1	6	<1
GAS DECAY TANK RUPTURE	--	2	--	<1
STEAM GENERATOR TUBE RUPTURE[2]	65	1	15	<1
STEAM LINE BREAK[2]	1	1	<1	<1
ROD EJECTION[2]	30	1	6	<1

1 We have informed the applicant that charcoal filtration of the spent fuel pool area atmosphere is required during fuel handling. He has not agreed to this.

2 Primary system contribution only. Secondary system component will be evaluated following ad hoc committee's development of a staff model.

TABLE II

I. LOSS OF COOLANT ACCIDENT (LOCA)

A. Reactor power level is 2568 Mwt.

B. 100% of the core noble gas inventory is released to the containment and is available for leakage to the environment.

C. 50% of the core iodine inventory is released to the containment.

D. 50% of the iodine plateout in the containment.

E. 10% of remaining iodine is in the organic form.

F. Containment design leak rate is 0.25%/day.

G. After the first day, containment leakage is reduced to 45% of design value due to pressure reduction.

H. 50% of containment leakage is through the penetration room and its HEPA and charcoal filters.

I. 50% of containment leakage is released to the atmosphere unfiltered.

J. Charcoal filter efficiency for iodine is 90%.

K. Breathing rate is 0-8 hrs: $3.47\times10^{-4} m^3/sec$

8-24 hrs: $1.75\times10^{-4} m^3/sec$.

1-30 days: $2.32\times10^{-4} m^3/sec$.

L. Meteorology:
Pasquill condition "F"
Windspeed = 1.0 m/sec
terrain correction factor = 2.2
building wake effect:
C=0.5,
$A=2540m^2$
ground level release.

M. Exclusion radius is 1 mile.

N. Low Population Zone is 6 miles.

II. REFUELING ACCIDENT

A. Reactor power level is 2568 Mwt.

B. 208 pins (1 fuel bundle) are damaged.

C. 20% of noble gases is released from the damaged fuel pins to the environment.

D. 10% of the iodines is released to the fuel pool water.

E. Decontamination factor for iodines in the water is 10.

F. Charcoal filter iodine removal efficiency is 90%.

G. Radial peaking factor is 1.68.

H. Accident occurs after 72 hour fuel decay time.

I. Breathing rate is $3.47 \times 10^{-4} m^3/sec$.

J. Duration of accident is 2 hours.

K. Meteorology - see LOCA.

III. GAS DECAY TANK RUPTURE

A. Entire noble gas content of one primary coolant volume (11,830 $ft.^3$) is in the decay tank prior to rupture.

B. Source term is given by applicant.

C. Entire contents of decay tanks are released to the atmosphere in two hours.

D. Average decay energy of fission products released is 0.7 Mev per disintegration.

E. Meteorology - same as LOCA.

IV. ROD EJECTION ACCIDENT

A. Reactor power level is 2568 Mwt.

B. 4.1% of fuel undergoes cladding damage.

C. Prior reactor coolant fission product inventory is that given by applicant as his design source term.

D. 20% of noble gases released from damaged fuel.

E. 10% of iodines released from damaged fuel.

F. Release path is from primary system to steam generator then to environment through air ejector - assuming a 10 gpm steam generator tube leak.

G. Primary coolant volume is 11,830 ft^3.

H. Duration of accident is 1.7 hrs.

I. Breathing rate is $3.47 \times 10^{-4} m^3/sec$.

J. Meteorology: See LOCA.

K. See Part VII for assumptions leading to secondary system contribution (to be submitted later).

V. <u>Steam Generator Tube Rupture</u>

A. Reactor operating with - fission product inventory given by applicant as his design source term.

B. Exisiting 10 gpm steam generator tube leak.

C. Accident duration - 30 minutes.

D. Volume of primary coolant lost is 1,980 Ft^3.

E. Primary system volume is 11,830 ft^3.

F. All iodines and noble gases released to steam generator are exhausted to the environment without a partition factor.

G. Breathing rate is $3.47 \times 10^{-4} m^3/sec$.

H. Meteorology - see LOCA.

I. See Part VII for assumptions used in deriving secondary side activity release.

VI. <u>Steam Line Break</u>

A. Duration of accident is 3 hours.

B. Steam generator tube leak is 10 gpm.

C. Primary coolant fission product inventory is as given by applicant as his design source term.

D. Tube leak is constant for term of accident.

E. All iodines and noble gases that carry over to secondary side are released to the environment.

F. Breathing rate is $3.47 \times 10^{-4} m^3/sec$.

G. Meteorology: See LOCA

H. See part VII for assumptions used in deriving secondary side contribution.

VII. <u>Secondary Side Contribution to Accidents</u> (IV-VI)

To be submitted later following completion of <u>ad hoc</u> committee's work on standardizing the assumptions for the steam generator tube rupture accident, the steam line break accident and the rod ejection accident.