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DENTON,H.R. Office of Nuclear Reactor Regulation, Director
STOLZ,J.F. Operating Reactors Branch 4

SUBJECT: Forwards application for disposal of sewage sludge contaminated w/very low levels of radioactivity at public treatment works. Removal of waste necessary for compliance w/State of SC NPDES permit to meet pollutant limits.

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June 7, 1985

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. John F. Stolz, Chief
Operating Reactors Branch No. 4

Re: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287

Dear Mr. Denton:

Pursuant to 10 CFR 20 §20.302, please find attached an application for the disposal of very low-level radioactive waste. Duke Power Company (Duke) hereby requests NRC approval of the proposed disposal method described in the attached application.

This application proposes to dispose of sewage sludge, contaminated at very low levels of radioactivity, from the Oconee sanitary waste treatment system as non-contaminated material to a Publicly Owned Treatment Works (POTW). It should be noted that if the sediment were mixed with the sewage waste water and the total activity were seen as activity of the water-mixture effluent, this could be releasable to the environment as normal effluent releases as allowed by 10 CFR Part 20, Appendix B. But due to sanitary considerations associated with the material involved, release into area water systems is not feasible; nor is it legally allowable per state regulations.

Removal of this waste (sludge) is necessary for compliance with the State of South Carolina issued National Pollutant Discharge Elimination System (NPDES) permit to meet certain pollutant limits. This permit is needed for continuous operation of Oconee's sanitary waste treatment (sewage) system. Duke requests that the NRC review and approve this proposal expeditiously to avoid the possibility of interrupted operation of the Oconee Nuclear Station due to the loss of its waste treatment system.

By a letter dated June 25, 1984, Duke submitted a §20.302 application for disposal of sewage sludge at Oconee Nuclear Station under similar circumstances. Although the concentrations of the contained radionuclides are slightly greater for the present case, the total radioactive material to be disposed of remains extremely small. Please note that the format of the application (i.e., the associated analytical methods, etc.) follows that set forth in the June 25, 1984 application.

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The sludge accumulation problem at Oconee is apparently recurring on a frequency greater than that originally anticipated. Based on the fact that a period of only approximately one year has elapsed since the last sludge disposal took place, it appears that some administrative process may be required, whereby accumulated sludge disposal can be accommodated on a more routine basis. This matter will be addressed more specifically in future correspondence depending upon determination by Duke of the degree of necessity.

Duke has determined that pursuant to 10 CFR 170.12 a license fee is required for this approval; therefore, please find attached a check in the amount of $150.00, as specified by §170.21.

Very truly yours,

H.B. Tucker /RFH

Hal B. Tucker

RFH:slb

Attachment

cc: Dr. J. Nelson Grace, Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

Mr. J. C. Bryant
NRC Resident Inspector
Oconee Nuclear Station

Ms. Helen Nicolaras
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Mr. Heyward G. Shealy, Chief
Bureau of Radiological Health
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, South Carolina 29201

Oconee Nuclear Station
Application for the Approval to Dispose
of Very Low-Level Radioactive Waste

1.1 Purpose

Pursuant to 10 CFR 20, §20.302 Duke Power Company requests NRC approval of proposed method for the disposal of sewage sludge from the sanitary waste treatment system contaminated with very low-levels of radioactivity as non-contaminated material. This application addresses the specific information requested in §20.302.

2.0 Description of Waste Source

The Oconee Sewage Treatment Aeration Basin (lagoon) treats sewage through biological digestion, followed by disinfection in a chlorination chamber. This system is designed under normal biological and hydraulic loading conditions to treat raw sewage such that the effluent from the system will meet the pollutant limits specified in the station's National Pollution Discharge Elimination System (NPDES) permit. Maintenance of the NPDES permit is required for the continuous operation of the station Sanitary Waste Treatment System.

Part of the Sewage Treatment Aeration Basin design requires periodic removal of sludge. Sludge buildup reduces retention, and therefore, sewage treatment time. This makes the basin more susceptible to effluent compliance problems with changes in biological and hydraulic loading.

The Oconee sanitary waste system collects flow (sewage) from three main sources: the turbine and auxiliary buildings; service building and visitors' center; and the SSD area. These flows collect first in the surge basin.

The basin is a control for the sewage level, preventing surges to the aerated lagoon which could overload the lagoon and cause short-circuiting across the cells. The surge basin has three submergible centrifugal pumps which pump sewage to the aerated lagoon.

The aerated lagoon is a rectangular shaped basin with a normal operating depth of 6 feet (50,000 gal/day) and a maximum operating depth of 8 feet (75,000 gal/day). The lagoon is lined with a Goodyear Flexaseal Liner with a drain line underneath to facilitate the identification of a liner rupture. The lagoon is divided into 4 cells by bioseparation curtains. These curtains have 12 inch by 12 inch openings in alternating ends of the curtains to allow flow from one cell to the next cell. The aerated lagoon has 9 floating aerators, four in Cell 1, two in Cell 2, two in Cell 3, and one in Cell 4.

Cell 1 has a volume of 86,000 gallons and retention time of two days at the normal operating level. A dark brown color and septic smell indicate this initial cell is operating properly. Cell 2 has a volume of 50,000 gallons and a design retention time of 1 day, as do Cell 3 and Cell 4.

The effluent then travels through a chlorine contact chamber to the Chemical Treatment Pond before final discharge through a National Pollutant Discharge

Elimination System (NPDES) permitted outfall to Keowee River/Lake Hartwell. Sludge, which builds up in all cells, must be removed periodically to maintain proper settling and retention of wastewater. The volume of waste being generated per year is projected to be 4,000 cubic feet. Presently, there is approximately 4,000 cubic feet of sewage sludge that needs disposal from the Oconee Sanitary Waste System.

3.0 Sampling Method and Results

The composite sample taken from each cell with a Kemmerer sampler (below surface sampler) was placed directly into a marinelli, taped and then was sent to Duke's Physical Sciences Buildings for radiological analysis.

The counting equipment is a Nuclear Data 6600 Multichannel Analyzer with GeLi detectors. The sample was counted for 100 minutes. The radioactivity concentrations of the sludge have been determined to be very low. The radionuclides and average concentrations obtained from samples of this sludge were identified as follows:

Radionuclide	Average Concentration (pCi/cc)
Co-58	0.06
Co-60	0.29
Cs-134	0.11
Cs-137	0.57

The sample analysis reports are provided in Appendix 1.

4.0 Proposed Disposal Method

The sewage sludge to be removed is located in Cells 2, 3, and 4. Cell 2 has the largest sludge volume. Sludge is usually pumped by vendor to a tanker truck which transports the sludge to a local Publicly Owned Treatment Works (POTW). A GM survey instrument will be used during the pumping process to ensure that there is no hot spot in the sludge to be disposed of. The background radiation level in the general areas has been measured to be less than 0.02 mr/hr.

Fees and permits are generally handled by the vendor as part of the contract. Generally sludge from POTWs is eventually landspread, although other disposal methods, such as incineration, are available.

4.1 Health and Safety Concern

The Oconee Sewage Treatment Aeration Basin (lagoon) system was installed in 1982 and no sludge removal had been required until mid-1984. In March 1984, it was estimated that the sludge would need to be removed by the end of 1984. This estimate proved to be optimistic, when a series of weather conditions led to hydraulic and biological overloads of the system. The system, although generally able to meet the National Pollutant Discharge Elimination System (NPDES) permit compliance of effluent discharge, during periods of higher load, could achieve only marginal compliance. Plans were made for sludge removal, but were delayed when detectable levels of radioactivity were found in sludge samples.

Currently, the effluent from the Aerated Basin is in compliance with the permit limitations, but pollutant levels cannot be considered stable. Adverse weather conditions, unusual biological growth, or heavy system demands could cause hydraulic or biological overloads of the sewage treatment system resulting in exceeding NPDES permit limitations. If this permit governing the system for the Oconee Nuclear Station is not maintained, operation of the station sanitary waste treatment system could be suspended. Without the availability of this system, per OSHA Regulation 29 CFR 1910.141(c)(1)(i) Table J1, occupancy of the Oconee Nuclear Station could be prohibited.

4.2 Possible Disposal Methods by POTW

Sludge, which will be pumped by a contracted vendor, will be transported by that vendor to a POTW (Publicly Owned Treatment Works) where it is to be added to the POTW treatment system as raw sewage (non-contaminated). Once the sludge is pumped into the vendor's transporting vehicle, Duke loses control of the material. Although the contract will require the vendor to dispose of the material in compliance with applicable environmental regulations, we have no means to assure that the vendor will dispose of the sludge properly. That is, it could potentially be illegally dumped, or accidentally spilled. Of course, the environmental and public health effects due to the biological activity and infectious constituents of such waste would far outweigh the concern due to radioactivity, which is detailed in Section C.

Properly disposed of material at the POTW would be introduced as raw sewage or as sludge, either to an anaerobic digester or directly to another aerated lagoon. In either case, it will be significantly diluted (typical dilution factors range from 100 to over 1000) and will receive extended biological treatment. The sludge that the POTW obtained from Oconee will remain in the treatment basin or digester for as short as a few days to as long as several years.

Once this diluted, dispersed sludge is removed from the POTW it would be dried, and then placed and covered in a sanitary landfill. Use of the land upon which the material was landfilled would probably not be restricted. There is the possibility that the land could become recreational, farming, housing, commercial, or industrial land. If requested, the diluted sludge is available from the POTW to area farmers to use as fertilizer for crops.

4.3 Analysis Study

It has been determined that none of the area POTWs incinerate their sludge. Therefore, since only area POTWs are being utilized, acquired dosage by means of incineration, inhalation, is not a potential source of activity.

Ways of receiving possible activity from the sludge include:

1. exposure to container storing diluted (100 to 1000 times) sludge material;

2. ingestion dosage due to consumption of vegetation grown in diluted sludge fertilized soil and the activity (external dosage) received while periodically tending to this vegetation growth;

3. external dosage received while remaining in the center of an area where the diluted sludge material was spread, either covered with soil or left uncovered.

It has been determined that the worst cases possible from any situation resulting from the uncontrolled release of this material hypothetically would be the constant occupation of the center of an area in which the diluted sludge was spread and was either covered with soil or was left uncovered. These cases were analyzed, but in a more conservative sense, in that the dilution was not taken into consideration. This is considered a conservatism in that if properly disposed of by the vendor (delivered to a POTW), the material would be diluted.

Analysis was done assuming that the entire amount of undiluted sludge was spread on the ground to six inches thickness without any soil covering. The annual dose for the total body for a person occupying the area 1000 hours per year was calculated to be less than 0.9 mrem.

Adjustments for realistic factors, such as dilution and actual occupation time in the critical location of the landspread/landfill, would greatly decrease the analyzed dosage. It should be noted that even without adjustments for these factors, the calculated dose rate for the worst cases is less than 1/100 of the reported dose rate due to the background radiation of the general area which is measured to be 2.0E-2 mrem/hour.

4.4 Area Soil Analysis Results

Radionuclide	Measured Concentration (pCi/kg)				
		Location 1		Location 2	
	1977	1980	1983	1980	1983
Co-58	-	-	-	-	-
Co-60	-	34	-	-	9.82
Cs-134	-	-	20.9	-	76.3
Cs-137	269	814	976	664	429

4.5 Monitoring of Sludge "Hot Spots"

A thin window GM survey instrument is the preferred monitoring method to be used during the pumping process to ensure that there are no hot spots in the sludge to be disposed of in the proposed manner. A sodium iodide detector could be used if it is felt that a more sensitive analysis monitoring is needed. If activity is detected that is above the area background radiation level, the "hot" sludge will be transferred into 55 gallon drums to be disposed of as contaminated material.

5.0 Evaluation of Environmental Impact

There will be no impact on topography, geology, meteorology, hydrology, and nearby facilities by the proposed method of disposal.

6.0 Evaluation of Radiological Impact

6.1 Annual Dose Rate Estimation

Assuming that the sludge is spread on the ground to 6" (15.24 cm) thickness and no soil covering, the annual dose rate to the total body for a person occupying the area 1000 hours per year is estimated to be less than 0.9 mrem/yr. Actual doses to any member of the public are anticipated to be much lower due to infrequent occupancy. Detailed calculations of the annual dose rate estimations are included in Appendix 2.

6.2 Radioactivity Release Limit

Based on the studies of residual radioactivity limits for decommissioning (NUREG-0613 and NUREG-0707), it can be concluded that surfaces uniformly contaminated at levels of 5000 dpm/100 cm^2 (beta-gamma activity from nuclear power reactors) would result in potential doses that total less than 5 mrem/yr.

Assuming that the sludge is an infinite slab about 1 cm in thickness, the limit of contamination level can be considered as 5000 dpm/100 cm^3 or 50 dpm/cm^3. The radioactivity of the sludge is equal to 1.03 E-6 μCi/cm^3 or less than 4 dpm/cm^3 which is much less than 50 dpm/cm^3, based on 5000 dpm/100 cm^2 criteria.

7.0 Evaluation of Overall Benefits

This sludge (4,000 ft^3), if packaged and disposed of as radioactive waste, will cost approximately $300,000 without solidification, and will cost more than $460,000 if solidification is required depending on radioactive waste packaging and waste form requirements. The actual burial space will be more than 4,800 ft^3 in a licensed radioactive waste burial site. Considering the generation rate of this type of waste (4,000 ft^3 per year), the total cost saving could range from $300,000 to $460,000 per year and save burial site space of 4,800 cubic feet per year. The annual dose rate for both the public and workers is much less than 1 mrem/yr assuming that they continuously occupy the disposal site.

Appendix:

(1) Sewage Sludge Sample Analysis Results

(2) Annual Dose Rate Estimations

APPENDIX 1

Sewage Sludge Sample Analysis Results

1 MAY 1985 11:00:15 AM

ENVIRONMENTAL RADIOLOGICAL LABORATORY

SAMPLE ANALYSES REPORT

OCONEE SPECIAL SAMPLE : SEWAGE LAGOON #2 CELL

TYPE: LIQUID QUANTITY: 3.50

COLLECTION DATE(S): 4/24/85 UNITS: LITERS

RADIONUCLIDE	ACTIVITY(PCI/UT)	SIGMA(PCI/UT)
GAMMA SPEC		
MN-54	4.03E-1	± 1.3E-1
FE-59	* 7.93E-12	± 9.3E-12
CO-58	2.36E-6	± 2.4E-7
CO-60	1.45E 2	± 7.2E 0
ZN-65	*-1.47E-2	± 7.4E-2
ZR-95	*-1.20E-8	± 4.8E-8
NB-95	* 4.10E-15	± 4.6E-15
I-131	* 0.00E 0	± 0.0E 0
CS-134	2.34E 1	± 1.6E 0
CS-137	5.06E 2	± 1.5E 1
BALA-140	* 0.00E 0	± 0.0E 0

* NET ACTIVITY < CRITICAL LEVEL. LESS-THAN LEVEL = ACTIVITY + 1.65×SIGMA

COMMENT: ______________________

BY: J Sigmon

REVIEWED BY: R. S. Jones / [signature] 5/02/85 DATE: 5-2-85

MAY 1985 10:58:06 AM

ENVIRONMENTAL RADIOLOGICAL LABORATORY

SAMPLE ANALYSES REPORT

OCONEE SPECIAL SAMPLE : SEWAGE LAGOON #3 CELL

TYPE: LIQUID QUANTITY: 3.50

COLLECTION DATE(S): 4/24/85 UNITS: LITERS

RADIONUCLIDE	ACTIVITY(PCI/UT)	SIGMA(PCI/UT)
GAMMA SPEC		
MN-54	1.90E 1	± 6.5E 0
FE-59	* 5.29E 0	± 6.4E 0
CO-58	7.40E 1	± 6.9E 0
CO-60	2.49E 2	± 1.1E 1
ZN-65	* 3.77E 0	± 7.5E 0
ZR-95	* 1.59E 0	± 6.5E 0
NB-95	8.30E 0	± 4.1E 0
I-131	* -1.49E 0	± 6.5E 0
CS-134	1.03E 2	± 7.6E 0
CS-137	4.73E 2	± 1.3E 1
BALA-140	* 0.00E 0	± 1.7E 0
K-40	1.64E 2	± 4.9E 1

* NET ACTIVITY < CRITICAL LEVEL. LESS-THAN LEVEL = ACTIVITY + 1.65*SIGMA

COMMENT:

BY: J Sigman

REVIEWED BY: R.S. Jones / [illegible] 5/02/85 DATE: 5-2-85

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1 [illegible]Y 1985 10:59:09 AM

PAGE 1 OF 1

ENVIRONMENTAL RADIOLOGICAL LABORATORY
SAMPLE ANALYSES REPORT

OCONEE SPECIAL SAMPLE : SEWAGE LAGOON #4 CELL
TYPE: LIQUID QUANTITY: 3.50
COLLECTION DATE(S): 4/24/85 UNITS: LITERS

RADIONUCLIDE	ACTIVITY(PCI/UT)	SIGMA(PCI/UT)
GAMMA SPEC		
MN-54	4.63E 1	± 6.1E 0
FE-59	*-4.43E 0	± 8.1E 0
CO-58	3.62E 1	± 5.8E 0
CO-60	4.86E 2	± 1.5E 1
ZN-65	*-4.76E 0	± 1.0E 1
ZR-95	* 0.00E 0	± 8.1E 0
NB-95	*-5.15E 0	± 5.2E 0
I-131	* 8.84E-1	± 7.9E 0
CS-134	1.89E 2	± 1.1E 1
CS-137	7.42E 2	± 1.6E 1
BALA-140	*-1.46E 0	± 3.1E 0
RU-103	1.76E 1	± 4.7E 0
K-40	2.76E 2	± 7.8E 1
TH-SER	2.34E 1	± 5.7E 0

* NET ACTIVITY < CRITICAL LEVEL. LESS-THAN LEVEL = ACTIVITY + 1.65*SIGMA

COMMENT: ______________________

BY: J Sigman

REVIEWED BY: R. S. Jones / [signature] 5/2/85 DATE: 5-2-85

Appendix 2

TABLE 1 ESTIMATED DOSES TO AN INDIVIDUAL FROM STANDING ABOVE THE UNCOVERED DRIED SLUDGE BOTTOMS[a]

Nuclide	Average Concentration pCi/cc	Average Surface Deposition, [b]pCi/m²	External Dose Factor, [c]mrem/hr per pCi/m²	Dose Rate, mrem/hr	Annual Dose,[d] mrem
Co-58	0.06	6.0 E+03	7.0 E-09	4.2 E-5	0.04
Co-60	0.29	2.9 E+04	1.7 E-08	4.9 E-4	0.49
Cs-134	0.11	1.1 E+04	1.2 E-08	1.3 E-4	0.13
Cs-137	0.57	5.7 E+04	4.2 E-09	2.4 E-4	0.24
Total					0.9

a. Exposure of workers from inhalation of radionuclides is estimated to be minimal due to the proposed soil covering.

b. The average surface deposition was estimated by assuming that all of the activities in the top 10 cm of sludge were deposited on the surface, and that the average concentrations of radionuclides in the dried sludge were the same as the measured concentrations (wet weight). These two assumptions tend to counterbalance each other.

c. Dose factors were taken from Regulatory Guide 1.109, Rev. 1, pp. 41-42.

d. In estimating the annual dose the following conservative assumptions have been made: (1) an exposure of 1000 hours/year; (2) no dilution by sludge from other sources; and (3) no soil covering.

Appendix 2

TABLE 2 ESTIMATED DOSES TO AN INDIVIDUAL FROM INGESTION OF FOOD

Nuclide	Average Concentration, pCi/kg		Annual Dose, mrem[b]	
	Sludge	Vegetation[a]	Total Body	Highest Dose to Any Organ
Co-58	60	0.56	0.0005	0.005 (GI-LLI)
Co-60	293	2.75	0.007	0.064 (GI-LLI)
Cs-134	105	1.05	0.074	0.09 (liver)
Cs-137	574	5.74	0.238	0.363 (liver)
TOTAL			0.32	0.52

[a]Based on the transfer factors in Table E-1, p. 37 of Regulatory Guide 1.109, Rev. 1, and assuming no soil covering.

[b]Based on an adult ingesting 580 Kg of fruits, vegetables and grain, and using the dose conversion factors in Regulatory Guide 1.109, Rev. 1, pp. 56, 57. Doses from ingesting milk or meat would be less than the doses from ingesting fruits, vegetables and grain.