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AUTH. NAME AUTHOR AFFILIATION
TUCKER, H. B. Duke Power Co.
RECIP. NAME RECIPIENT AFFILIATION
DENTON, H. R. Office of Nuclear Reactor Regulation, Director (post 851125
STOLZ, J. F. PWR Project Directorate 6

SUBJECT: Forwards addl info supporting util request to operate low level radwaste vol reduction incinerator. Environ impacts of proposed action & alternatives & estimated population exposures resulting from routine operations discussed.

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DUKE POWER COMPANY
P.O. BOX 33189
CHARLOTTE, N.C. 28242

HAL B. TUCKER
VICE PRESIDENT
NUCLEAR PRODUCTION

TELEPHONE
(704) 373-4531

August 18, 1986

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

Attention: Mr. John F. Stolz, Project Director
PWR Project Directorate No. 6

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

Dear Sir:

By letter dated May 30, 1986, NRC requested additional information concerning the Staff's review of Duke's request to operate a low-level radioactive waste incinerator at the Oconee Nuclear Station. Please find attached Duke's response to your request.

Very truly yours,

Hal B. Tucker

Hal B. Tucker

PFG/12/slb

Attachment

xc: Mrs. Helen Pastis
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

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

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1/1

Duke Power Company
Oconee Nuclear Station

Response to NRC Request
For Additional Information
Concerning Volume Reduction Incinerator

Request 1:

Provide additional information needed for the staff's environmental assessment described in 10 CFR 51.30; namely, a brief discussion of:

(a) The need for the proposed action;

(b) Alternative to the proposed action; and

(c) The environmental impacts of the proposed action and alternatives.

The information should include a quantitative comparative assessment of the economic costs and radiation exposure costs (worker and public person-rems) of the proposed action and all reasonable alternatives, including the "no action" alternative. The bases should be provided for each assessment, and should include the decontamination factors (DFs) for the volume reduction [sub]system.

Response 1a: The need for the proposed action

In order to resolve problems with liquid waste processing, solidification and contaminated secondary side wastes, Duke Power Company began developing plans for a multipurpose radwaste facility in the late 1970's. The installation of an incinerator was not one of the initial goals of the facility. The decision to include an incinerator resulted from the engineering evaluation during the solidification equipment selection process.

One of the major functions of the facility was to provide an installed solidification system that assured long term compliance with regulatory requirements for disposal. A variety of systems were evaluated for their ability to meet the above criteria. When the systems that met the technical requirements were identified, the flexibility and economics of the systems determined the final selection. Those systems with incinerators were considered to be the most flexible and provided the best long term economics.

The incinerator/dryer fluidized bed technology was chosen for the following reasons:

(1) The system could process miscellaneous liquid wastes, primary coolant, DAW, resin slurries, organic solutions, and various chemical wastes.

(2) Because the product was homogeneous, free flowing, and dry, it could be transferred to any number of packaging or solidification systems. This made the system less subject to obsolescence.

Subsequent to the selection of the incinerator, numerous factors have added to the need for a reliable method of reducing radwaste volume and processing mixed wastes. Volume allocations and the restrictions on mixed waste disposal were not specifically known at the time of the system selection; however, these changes are the types of external influences against which this system provides a reliable long term buffer.

Response 1b: Alternatives to the proposed action

As described in the previous section, there were numerous factors that influenced the decision to install the incinerator as part of the radwaste facility. The alternatives available at the time of the equipment selection process included various configurations of Volume Reduction (VR) and non-VR subsystems such as thin film evaporators with asphalt, extruders with various solidification agents, various types of incinerators, and straight solidification.

The various VR subsystems all promised similar advantages for certain liquid waste streams; however, the incinerators added the volume reduction of DAW volumes and various organic liquid wastes. The product from the fluid bed incinerator/dryer system provided the most homogeneous and easily mixed product. Because of the product characteristics and the waste stream flexibility, the fluid bed systems seemed the most likely to meet pending and anticipated regulatory requirements.

Duke also evaluated the do-nothing alternative which assumed maintaining existing installed equipment and using vendors to provide solidification services and additional processing for surge volumes.

The do-nothing evaluation was most heavily penalized by reliance on outside companies for a vital function. As described above, the VR potion of the solidification system provided some control over the external impact on economics by controlling waste volumes. The inclusion of VR also represents a commitment to the philosophy of minimizing the environmental impact of nuclear power by reducing station waste volumes.

The fluid-bed system has a relatively wide range of acceptable feed streams. This flexibility is a major advantage in comparing VR to the do-nothing alternative. Restrictions on mixed wastes are making the disposal of oils, decon wastes and certain laboratory wastes very difficult. Although the VR of such wastes is often not cost effective, the incineration of these problem waste streams eliminates the mixed waste issue entirely. This is a significant advantage to operating personnel who must handle and store these wastes using present technology. Future burial restrictions could require longer term storage of these materials which would increase personnel exposure to the non-radiological hazards of these wastes and would represent a potential fire hazard.

Response 1c: The environmental impacts of the proposed action and alternatives

Personnel Exposure

The incinerator is housed in a multipurpose facility that is designed to operate under the design base conditions described in earlier correspondence. In support of the VR subsystem a remotely controlled solidification and materials handling system has been provided by Stock Equipment Company. The volume reduction of low-level wastes (i.e., DAW, resins, etc.) results in higher concentrations of radioactivity and higher radiation levels in the packaged waste. To compensate for this, the building and equipment design minimizes the personnel interaction with equipment and vessels that will contain the VR product. Because of this attention to ALARA design, radiation exposures for personnel performing the processing, packaging and disposal functions are not expected to increase over present levels.

The do-nothing alternative is the base case and is based upon historical exposure records for radwaste operating personnel. Historical data has been reviewed and is summarized below for comparison purposes. Since the accounting method for exposures covers a wide range of related activities, the data has been consolidated into two general topical subdivisions: Liquid Waste Processing and Solidification; Solid Waste Processing, Packaging and Shipment.

LIQUID WASTE PROCESSING AND SOLIDIFICATION - The average annual exposure for the base case is 14.5 Person Rem.

SOLID WASTE PROCESSING, PACKAGING AND SHIPMENT - The average annual exposure for the base case is 24.9 Person Rem.

In the original license document which was submitted by Duke letter dated June 10, 1985, Table 4.3.1 was provided to estimate the annual exposure for maintenance, inspection and operation of the VR subsystem. This table estimated 3.8 Person Rem from operation of the VR subsystem. Of the above estimates for base case operation, the VR subsystem should impact on tasks that result in over half of the annual exposures. This decrease in exposure will be somewhat offset by the exposure resulting from operating the VR subsystem. The worst operating scenario should reveal a decrease in overall exposure with a shift in high dose work from solid waste processing (29% of total) to other unaffected tasks such as filter handling (11%). It is difficult to isolate the incinerator's impact on personnel exposure since it must be compared to numerous process and handling tasks in the base case.

By including the solidification and materials handling system in the comparison, the general categories of the base case are comparable. This methodology shows that the new systems will have a positive influence on exposure reduction for tasks that make-up the largest percentage of dose for the categories above.

Population Dose Impact

The total population dose due to effluents from VR system operation has been calculated for both liquid and airborne pathways. The results are a whole body population dose of 3.10E-2 Person Rem and organ dose of 5.45E-1 Person-Thyroid Rem. The assessment methodology, assumptions and results are presented as Attachment 1. The conclusion is that the incremental increase in dose is insignificant.

In addition to station effluents, the VR subsystem will tend to influence population dose resulting from waste shipment and disposal. Although we have no model for a quantitative analysis, a qualitative discussion trends the VR subsystem impact. The source term for shipments will increase, but the number of shipments will decrease. Since all shipments must meet th DOT limits for radiation levels the exposure rate is fairly constant, therefore the number of shipments determines the exposure population size and dominates the population dose model. Because of the conservatism used in establishing regulatory dose limits, the population dose is small even for the base case. The decrease in shipments with VR subsystem makes this dose even more trivial.

The VR subsystem impact on the disposal site population dose model is also difficult to determine quantitatively. The obvious difference from the base case is a smaller volume with a higher concentration of radioactivity. The total disposal source term is essentially the same for VR and the vase case except for the insignificant activity in the plant effluents described in enclosure 1. The VR product will be packaged based on its radioactivity loading per 10 CFR 61 waste form classifications, therefore the environmental dose impact of higher concentrations should be small. The VR waste form will be more homogeneous and consistent than non-volume reduced waste and will be stabilized as required by 10 CFR 61 to reduce dose for long term intruder scenarios. Like the transportation population dose, the base case for disposal is a small dose relative to background and the impact of VR should not change this significantly.

Request 2:

Provide a quantitative assessment of the impact of airborne effluents from the volume reduction [sub]system on the habitability of the reactor control rooms. The assessment should consider radioactive and non-radioactive materials, and toxic and non-toxic materials in the airborne effluents under accident and normal operating conditions. The bases should be provided for each assessment including DFs for the volume reduction system.

Response 2:

RADIOACTIVE IMPACTS

Oconee Control Room radiological exposure impacts resulting form Radwaste Facility postulated accidents and design basis routine operation have been analyzed. Calculational parameters, assumptions, and results are summarized as follows:

Accidents:

Release Source Term: License Submittal Table 3.1.1

Dispersion Factor (X/Q): 2.08E-2 sec/m^3

Filtration Efficiency: Iodines - 90%
Particulates - 99%

Operator Breathing Rate: 3.47E-4 m^3/sec

Occupancy Factor: 100%

Results: Worst Total Body Dose - 0.08 Rem
Worst Max. Organ Dose - 9.7 Rem (Thyroid)

DB Routine Operation:

Release Source Tern: License Submittal Table 2.3.1

Dispersion Factor (X/Q): 7.07E-3 sec/m^3

Filtration: None

Operator Breathing Rate: 2.54E-4 m^3/sec

Occupancy Factor: 100%

Results: Total Body Dose - 3.3 mrem/yr
Maximum Organ Dose - 28 mrem/yr (Thyroid)

In addition to the design basis routine operation dose assessment summarized above, an evaluation of average control room airborne radionuclide concentrations potentially resulting from Volume Reduction (VR) subsystem operation has also been performed and is presented in Table 6.

NON-RADIOACTIVE IMPACTS

Limits maintained for controlling the quantities of feed materials that could potentially result in detrimental non-radiological impacts as well as VR subsystem design features which inhibit toxic compound formation and release subsystem are addressed by Duke in a letter dated October 9, 1985. The factors addressed in the October 9, 1985 letter in conjunction with the relatively small size of the incinerator, ensure that the off-gas pollutant concentrations are well below regulatory limits and represent negligible risk to the reactor operators. Additionally, there are no toxic gas (i.e., clorine, etc.) storage or transport requirements resulting form the VR subsystem operation which could increase onsite toxic gas accidental release hazards.

ENCLOSURE 1

Oconee VR System
Estimated Population Exposures
Resulting From Routine Operations

Population-integrated doses are calculated for the total body (person-rem) and thyroid (person-thyroid-rem) of people living within 50 miles of the Oconee Nuclear Station for airborne pathways, and of people living downstream within 50 miles for water-borne pathways. Table 1 provides a summary of estimated population doses.

The models employed for the population dose calculations outlined below are described in detail in Regulatory Guide 1.109. Population projections for the year 2020 are used in order to maximize the population dose estimates. Population projections are based on 1980 census data. Average usage parameters are used along with agricultural production and population distribution data as further described below. The population dose for a given pathway and organ is obtained by first calculating the dose to an average individual representing each age group in a given subregion. Each is then multiplied by the respective population of that age group. The sum over all age groups gives the population dose for that subregion. The subregion doses are then totalled to obtain the final result.

The dose to an individual in a given subregion depends upon the pathways operating, radioactivity concentrations in the environmental media being exposed to and the exposure time or usage (i.e. eating and drinking rates).

In general, radionuclide concentrations in food products grown within 50 miles of the station are obtained by weighting the concentration obtained for each subregion by the amount produced in that region. The population served by a food pathway within 50 miles is determined, in general, by dividing annual mass of food medium produced within 50 miles (e.g. milk, meat, vegetables) by the average individual consumption rate weighted by age group distribution. The population served by the drinking water pathway is just that associated with municipal water supplies downstream and within 50 miles of the station.

Water Pathway Doses

Although there is no liquid effluent released as a direct result of VR System operation, potential population dose impacts of VR System condensate recycle to the plant liquid radwaste system have been assessed. Annual total body and thyroid population-integrated doses from exposure to liquid effluents are evaluated for: potable water; aquatic food products; and external irradiation from shoreline deposits, boating and swimming pathways. They are determined for the population within a 50 mile radius downstream of Oconee and are based on the following considerations:

1. VR System operating at 80% capacity with an average recycle flow of 6.6 GPH.

2. VR System recycle is evaporated by plant radwaste system resulting in additional radionuclide releases as presented in Table 2.

3. Average dilution flow of Oconee liquid releases for Hartwell Lake pathways is 1100 CFS (Average Keowee River flow); 3400 CFS for pathways downstream of Hartwell Lake.

4. Dose models described in Regulatory Guide 1.109.

5. Population projections for year 2020 as presented in Table 3 (based on 1980 census).

6. Age distributions for year 2020 population projections in Table 3 which give: 0-12 years, 17%; 12-18 years, 11%; over 18 years, 72%.

7. Individual usage parameters are those specified for an "average" individual in Regulatory Guide 1.109.

8. Population associated with drinking water pathway is 182,000 for Hartwell Lake supplied water (Clemson-Pendleton-Anderson municipal intake); 28,000 for the Hartwell municipal intake downstream of Hartwell Lake. User population estimates are based on Table 3 data for the subregions where municipal water intakes exist.

9. Sport fish harvest yield of 8.4 E+4 kg/yr for Hartwell Lake. This is based on the assumption that 10% of the individuals living within 50 miles of the plant obtain 10% of their diet of fish from the Hartwell Reservoir.

10. Swimming, boating and shoreline usages are each assumed at 1 hour per day in Hartwell Reservoir during the three summer months (about 1% of a year). Is is further assumed that 10% of the individuals within 50 miles of the plant swim, boat and use the Hartwell Reservoir shoreline 1% of a year.

Water pathway population does are presented in Table 1.

Airborne Pathway Doses

Annual total body and thyroid population-integrated doses from exposure to airborne radioactivity of VR System origin are evaluated for: inhalation of airborne effluents; ingestion of contaminated terrestrial foods (milk, meat, and produce); and external irradiation from activity deposited on the ground. They are determined for each of 160 subregions bounded by sectors centered on the 16 compass points and by 10 annular bands to include the population within 50 miles of Oconee, and are based on the following considerations:

1. Airborne radionuclide annual release quantities appear in Table 2.

2. Atmospheric dilution and deposition factors, which are based on Oconee site historical meteorology and ground level release assumptions, are presented in Table 4.

3. Dose models described in Regulatory Guide 1.109.

4. Population projections for the year 2020 as presented in Table 3.

5. Age distributions for year 2020 projections: 0-12 years, 17%, 12-18 years, 11%; over 18 years, 72%.

6. Individual usage parameters are those specified for an "average" individual in Regulatory Guide 1.109.

7. Truck farming (vegetables and produce), milk and meat production is that presented in Table 5. Table 5 data was compiled for Appendix I compliance filing purposes in 1980.

Airborne pathway population doses are presented in Table 1.

Conclusion

The total estimated population does resulting from VR System operation are 3.10 E-02 person-rem total body, and 5.45 E-01 person-thyroid-rem. These doses represent insignificant radiation exposure costs

Table 1

Oconee VR System
Integrated Population Dose Summary

Pathway	Total Body Dose (Person-REM)	Total Body Dose % of Total	Thyroid Dose (Person-REM)	Thyroid Dose % of Total
Gaseouse Effluents 0-50 miles				
Ground	4.55 E-03	18.75	4.55 E-03	0.93
Inhalation	4.62 E-03	19.06	1.86 E-01	38.26
Vegetable	6.65 E-03	27.42	1.40 E-01	28.70
Milk	3.80 E-03	15.66	1.39 E-01	28.55
Meat	4.63 E-03	19.10	1.73 E-02	3.55
Gaseous Pathways TOTAL	2.42 E-02	100%	4.87 E-01	100%
Liquid Effluents 0-50 miles				
Drinking Water	5.28 E-03	77.2	5.69 E-02	98.3
Fish	1.10 E-03	16.1	5.47 E-04	0.9
Shoreline	4.50 E-04	6.6	4.50 E-04	0.8
Swimming	7.59 E-06	0.1	7.59 E-06	0.0
Boating	3.79 E-06	0.0	3.79 E-06	0.0
Liquid Pathways TOTAL	6.84 E-03	100%	5.79 E-02	100%
Total Population Dose for Gaseous and Liquid Pathways 0-10 miles	3.10 E-02		5.45 E-01	

TABLE 2

LIQUID AND AIRBORNE RADIONUCLIDE RELEASES
RESULTING FROM VR SYSTEM OPERATION
USED FOR ESTIMATING POPULATION EXPOSURES

NUCLIDE	LIQUID RELEASES (CI/YR)	AIRBORNE RELEASES[a] (CI/YR)
H3	6.1E-01	2.4E+00
C14	1.9E-08	8.8E-02
MN54	9.1E-07	3.0E-06
FE55	3.3E-06	2.2E-05
NI59	4.0E-09	2.6E-08
CO58	4.9E-05	1.5E-04
CO60	7.4E-06	4.6E-05
NI63	1.2E-06	8.0E-06
NB94	8.3E-10	1.3E-10
SR90	3.7E-08	1.7E-07
TC99M	1.9E-07	5.5E-07
TC99	1.6E-10	7.4E-10
MO99	2.1E-07	5.9E-07
I129	4.7E-09	2.2E-07
I131	3.5E-04	1.0E-02
I133	9.1E-06	2.6E-04
I134	9.1E-06	2.6E-04
CS134	2.8E-05	8.8E-05
CS135	1.6E-10	7.4E-10
CS137	4.9E-05	1.5E-04
TOTALS	6.1E-01	2.5E+00

[a] Based on VR System DF's of 1.0E+04 for iodines and 1.0E+06 for particulates. DF's for H3 and C14 are assumed to be 1.0.

TABLE 3 - Projected 2020 Population Within 50 Miles Distance From Oconee[1]

SITE POPULATION DATA

DIR	0.0-1.	1.-2.	2.-3.	3.-4.	4.-5.	5.-10.	10.-20.	20.-30.	30.-40.	40.-50.	TOTAL
N	0.0	0.0	0.0	3.400E+01	0.0	1.700E+02	9.600E+01	5.466E+03	2.493E+03	3.193E+04	4.019E+04
NNE	0.0	0.0	4.400E+01	9.000E+01	7.200E+01	4.290E+02	1.199E+03	5.656E+03	2.061E+04	5.262E+04	8.072E+04
NE	0.0	4.400E+01	5.600E+01	3.750E+02	4.690E+02	2.767E+03	7.416E+03	7.320E+03	7.134E+03	4.854E+04	7.412E+04
ENE	0.0	1.600E+01	1.060E+02	3.070E+02	5.990E+02	2.689E+03	2.613E+04	7.694E+04	7.654E+04	4.378E+04	2.271E+05
E	0.0	4.000E+01	1.560E+02	3.230E+02	6.640E+02	2.859E+03	5.193E+04	1.653E+05	1.332E+05	3.753E+04	3.920E+05
ESE	0.0	1.000E+02	1.180E+02	1.180E+02	4.030E+02	4.720E+03	8.814E+03	3.911E+04	1.129E+04	1.110E+04	7.577E+04
SE	0.0	1.460E+02	5.600E+01	6.800E+01	4.250E+02	1.324E+04	9.789E+03	6.729E+04	2.450E+04	1.347E+04	1.290E+05
SSE	0.0	4.000E+01	1.600E+01	0.0	1.650E+02	2.301E+04	1.210E+04	5.553E+04	1.187E+04	3.580E+03	1.063E+05
S	0.0	5.100E+01	0.0	0.0	7.130E+02	4.037E+03	5.661E+03	6.277E+03	1.155E+04	1.405E+04	4.234E+04
SSW	0.0	5.000E+00	0.0	0.0	9.000E+00	1.495E+04	6.550E+03	7.852E+03	1.221E+04	1.107E+04	5.265E+04
SW	0.0	5.100E+01	0.0	1.510E+02	1.890E+02	3.281E+03	1.057E+04	5.763E+03	5.780E+03	5.253E+03	3.104E+04
WSW	0.0	0.0	1.200E+01	5.530E+02	1.290E+02	3.756E+03	7.323E+03	2.009E+04	1.567E+04	1.949E+04	6.702E+04
W	0.0	5.000E+00	1.120E+02	1.550E+02	1.290E+02	5.057E+03	3.312E+03	2.162E+03	2.413E+03	3.280E+03	1.663E+04
WNW	0.0	2.200E+01	2.900E+01	5.600E+01	1.090E+02	1.247E+03	1.387E+03	4.558E+03	5.259E+03	4.951E+03	1.762E+04
NW	0.0	0.0	2.810E+02	2.200E+01	4.300E+01	1.621E+03	6.070E+02	3.695E+03	1.747E+04	6.033E+03	2.977E+04
NNW	0.0	5.000E+00	4.800E+01	5.000E+00	2.200E+01	1.677E+03	1.710E+02	2.978E+03	1.159E+04	1.976E+04	3.626E+04
TOTAL	0.0	5.250E+02	1.034E+03	2.257E+03	4.140E+03	8.551E+04	1.531E+05	4.760E+05	3.696E+05	3.264E+05	1.419E+06

DENSITY(/M**2) = 7.09E-05

[1]Based on 1980 census

TABLE 4 - Oconee Meteorological Data Used For Population Dose Calculations

SITE ANNUAL X/Q DATA, SEC/M3

DIR	0.0-1.	1.-2.	2.-3.	3.-4.	4.-5.	5.-10.	10.-20.	20.-30.	30.-40.	40.-50.
N	1.051E-05	2.738E-06	6.118E-07	2.786E-07	1.649E-07	1.119E-07	3.924E-08	1.602E-08	9.560E-09	6.649E-09
NNE	9.369E-06	2.440E-06	5.332E-07	2.422E-07	1.422E-07	9.600E-08	3.315E-08	1.339E-08	7.962E-09	5.524E-09
NE	1.119E-05	2.943E-06	6.514E-07	2.932E-07	1.721E-07	1.161E-07	4.000E-08	1.608E-08	9.525E-09	6.590E-09
ENE	9.756E-06	2.555E-06	5.662E-07	2.570E-07	1.518E-07	1.029E-07	3.596E-08	1.465E-08	8.730E-09	6.075E-09
E	1.128E-05	2.954E-06	6.610E-07	3.011E-07	1.782E-07	1.209E-07	4.230E-08	1.726E-08	1.028E-08	7.142E-09
ESE	1.174E-05	3.052E-06	6.948E-07	3.201E-07	1.909E-07	1.302E-07	4.632E-08	1.909E-08	1.144E-08	7.978E-09
SE	1.419E-05	3.678E-06	8.380E-07	3.874E-07	2.315E-07	1.582E-07	5.654E-08	2.340E-08	1.905E-08	9.812E-09
SSE	2.059E-05	5.309E-06	1.217E-06	5.651E-07	3.385E-07	2.318E-07	8.321E-08	3.454E-08	2.077E-08	1.451E-08
S	3.573E-05	9.171E-06	2.100E-06	9.775E-07	5.867E-07	4.024E-07	1.451E-07	6.057E-08	3.653E-08	2.558E-08
SSW	1.734E-05	4.428E-06	1.000E-06	4.645E-07	2.785E-07	1.909E-07	6.881E-08	2.874E-08	1.736E-08	1.217E-08
SW	1.703E-05	4.481E-06	1.012E-06	4.627E-07	2.743E-07	1.864E-07	6.549E-08	2.670E-08	1.591E-08	1.105E-08
WSW	9.834E-06	2.625E-06	5.880E-07	2.656E-07	1.563E-07	1.056E-07	3.646E-08	1.465E-08	8.661E-09	5.983E-09
W	8.477E-06	2.244E-06	5.010E-07	2.261E-07	1.330E-07	8.493E-08	3.102E-08	1.284E-08	7.384E-09	5.105E-09
WNW	6.107E-06	1.601E-06	3.631E-07	1.656E-07	9.802E-08	6.653E-08	2.330E-08	9.473E-09	5.636E-09	3.911E-09
NW	7.320E-06	1.903E-06	4.217E-07	1.906E-07	1.123E-07	7.593E-08	2.636E-08	1.069E-08	6.360E-09	4.415E-09
NNW	9.252E-06	2.434E-06	5.441E-07	2.466E-07	1.455E-07	9.852E-08	3.428E-08	1.390E-08	8.271E-09	5.738E-09

SITE ANNUAL DEPOSITION DATA, M-2

DIR	0.0-1.	1.-2.	2.-3.	3.-4.	4.-5.	5.-10.	10.-20.	20.-30.	30.-40.	40.-50.
N	4.895E-08	1.195E-08	2.128E-09	8.206E-10	4.279E-10	2.620E-10	7.050E-11	2.157E-11	1.036E-11	6.049E-12
NNE	5.967E-08	1.457E-08	2.595E-09	1.000E-09	5.217E-10	3.194E-10	8.595E-11	2.629E-11	1.263E-11	7.375E-12
NE	6.771E-08	1.653E-08	2.944E-09	1.135E-09	5.920E-10	3.624E-10	9.752E-11	2.983E-11	1.433E-11	8.368E-12
ENE	4.457E-08	1.086E-08	1.938E-09	7.472E-10	3.896E-10	2.385E-10	6.419E-11	1.964E-11	9.434E-12	5.508E-12
E	4.753E-08	1.160E-08	2.067E-09	7.968E-10	4.155E-10	2.544E-10	6.846E-11	2.094E-11	1.006E-11	5.874E-12
ESE	4.356E-08	1.063E-08	1.894E-09	7.303E-10	3.808E-10	2.331E-10	6.274E-11	1.919E-11	9.221E-12	5.384E-12
SE	3.900E-08	9.520E-09	1.696E-09	6.538E-10	3.410E-10	2.087E-10	5.617E-11	1.718E-11	8.256E-12	4.820E-12
SSE	4.741E-08	1.157E-08	2.062E-09	7.948E-10	4.145E-10	2.537E-10	6.828E-11	2.089E-11	1.004E-11	5.859E-12
S	8.496E-08	2.074E-08	3.694E-09	1.424E-09	7.428E-10	5.547E-10	1.224E-10	3.743E-11	1.798E-11	1.050E-11
SSW	4.717E-08	1.151E-08	2.051E-09	7.907E-10	4.123E-10	2.524E-10	6.793E-11	2.078E-11	9.984E-12	5.829E-12
SW	6.745E-08	1.646E-08	2.933E-09	1.131E-09	5.897E-10	3.610E-10	9.714E-11	2.972E-11	1.428E-11	8.336E-12
WSW	5.130E-08	1.252E-08	2.231E-09	8.600E-10	4.485E-10	2.746E-10	7.388E-11	2.260E-11	1.086E-11	6.340E-12
W	4.025E-08	9.824E-09	1.750E-09	6.747E-10	3.519E-10	2.154E-10	5.796E-11	1.773E-11	8.519E-12	4.974E-12
WNW	2.417E-08	5.901E-09	1.051E-09	4.053E-10	2.113E-10	1.294E-10	3.482E-11	1.065E-11	5.117E-12	2.980E-12
NW	2.994E-08	7.309E-09	1.302E-09	5.020E-10	2.618E-10	1.603E-10	4.312E-11	1.319E-11	6.338E-12	3.700E-12
NNW	3.955E-08	9.654E-09	1.720E-09	6.631E-10	3.458E-10	2.117E-10	5.696E-11	1.743E-11	8.372E-12	4.888E-12

TABLE 5 - Agricultural Production Within 50 Miles Distance From Oconee

SITE MILK PRODUCTION, LITERS

DIR	0.0-1.	1.-2.	2.-3.	3.-4.	4.-5.	5.-10.	10.-20.	20.-30.	30.-40.	40.-50.	TOTAL
N	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.196E+04	2.486E+04	6.203E+06	6.270E+06
NNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.722E+04	6.123E+04	2.390E+07	2.399E+07
NE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.179E+04	3.671E+05	3.789E+05
ENE	0.0	0.0	0.0	0.0	0.0	3.629E+03	3.438E+05	3.538E+05	2.782E+06	5.753E+06	9.236E+06
E	0.0	0.0	0.0	0.0	0.0	0.0	1.787E+05	1.052E+06	7.374E+06	3.027E+06	1.163E+07
ESE	0.0	0.0	0.0	0.0	0.0	0.0	7.026E+05	2.440E+06	5.824E+06	1.298E+06	1.026E+07
SE	0.0	0.0	0.0	0.0	0.0	0.0	1.187E+06	2.624E+06	3.533E+05	1.619E+06	5.783E+06
SSE	0.0	0.0	0.0	0.0	0.0	2.041E+06	7.006E+05	1.752E+06	2.100E+06	1.206E+06	7.800E+06
S	0.0	0.0	0.0	0.0	0.0	0.0	5.259E+05	8.793E+05	4.204E+06	2.121E+06	7.730E+06
SSW	0.0	0.0	0.0	0.0	0.0	0.0	2.626E+06	2.000E+06	5.014E+06	1.959E+06	1.160E+07
SW	0.0	0.0	0.0	0.0	0.0	4.627E+03	2.268E+04	5.177E+05	1.079E+06	2.846E+05	1.909E+06
WSW	0.0	0.0	0.0	0.0	0.0	0.0	9.072E+03	2.104E+04	1.015E+06	2.440E+06	3.485E+06
W	0.0	0.0	0.0	0.0	3.266E+05	4.454E+05	9.072E+03	2.722E+04	1.361E+03	6.123E+04	8.709E+05
WNW	0.0	0.0	0.0	0.0	0.0	2.277E+04	9.072E+03	2.350E+05	2.209E+06	6.337E+05	3.110E+06
NW	0.0	0.0	0.0	0.0	0.0	9.072E+03	0.0	2.214E+05	9.334E+06	5.449E+06	1.501E+07
NNW	0.0	0.0	0.0	0.0	0.0	1.023E+04	0.0	6.747E+05	7.598E+05	8.407E+05	2.285E+06
TOTAL	0.0	0.0	0.0	0.0	3.266E+05	2.537E+06	6.314E+06	1.287E+07	4.215E+07	5.716E+07	1.214E+08

DENSITY(/M**2) = 6.07E-03

SITE ANNUAL MEAT PRODUCTION, KGR

DIR	0.0-1.	1.-2.	2.-3.	3.-4.	4.-5.	5.-10.	10.-20.	20.-30.	30.-40.	40.-50.	TOTAL
N	0.0	0.0	0.0	0.0	3.629E+03	1.826E+04	1.826E+04	1.480E+05	1.565E+05	2.304E+05	5.750E+05
NNE	0.0	3.629E+02	3.742E+03	5.557E+03	1.100E+04	7.492E+04	9.545E+04	8.505E+05	8.686E+05	1.948E+06	3.858E+06
NE	3.629E+02	1.814E+03	3.670E+03	1.021E+04	1.569E+04	1.956E+05	3.737E+05	3.158E+05	2.461E+05	1.164E+06	2.327E+06
ENE	1.814E+03	3.629E+03	7.371E+03	1.145E+04	1.474E+04	1.100E+05	5.583E+05	3.924E+05	1.436E+06	2.208E+06	4.744E+06
E	1.814E+03	3.724E+03	5.557E+03	1.123E+04	1.486E+04	1.100E+05	5.519E+05	1.103E+06	2.477E+06	2.608E+06	6.887E+06
ESE	3.629E+02	1.814E+03	3.856E+03	9.412E+03	1.474E+04	9.185E+04	1.034E+06	1.803E+06	1.796E+06	2.126E+06	6.881E+06
SE	0.0	3.629E+02	3.629E+02	4.763E+02	1.928E+03	7.412E+04	9.787E+05	1.696E+06	3.908E+06	2.120E+06	8.780E+06
SSE	9.979E+01	0.0	1.134E+02	4.763E+02	2.041E+03	1.820E+05	1.136E+06	1.696E+06	4.048E+06	2.262E+06	9.327E+06
S	0.0	0.0	1.996E+02	0.0	3.629E+02	1.760E+03	8.179E+05	8.861E+05	1.697E+06	1.025E+06	4.428E+06
SSW	0.0	9.979E+01	1.996E+02	0.0	0.0	1.996E+02	1.374E+06	5.900E+05	4.328E+06	2.523E+06	8.815E+06
SW	0.0	0.0	0.0	2.994E+02	1.996E+02	1.041E+04	1.373E+06	6.572E+05	4.324E+06	3.155E+06	9.520E+06
WSW	0.0	0.0	5.987E+02	1.324E+04	2.994E+02	3.184E+04	3.950E+05	2.143E+05	1.139E+06	1.187E+06	2.981E+06
W	0.0	9.979E+01	3.992E+02	7.983E+02	3.992E+02	9.186E+04	7.344E+04	1.412E+05	3.388E+05	3.855E+05	1.032E+06
WNW	0.0	0.0	1.996E+02	3.992E+02	0.0	2.713E+04	2.071E+04	2.682E+05	3.773E+05	5.986E+05	1.293E+06
NW	0.0	0.0	0.0	0.0	9.979E+01	6.178E+03	1.374E+05	1.552E+05	1.181E+06	2.784E+05	1.758E+06
NNW	0.0	0.0	0.0	3.992E+02	9.979E+01	8.142E+03	9.866E+03	2.637E+05	7.189E+05	1.372E+06	2.373E+06
TOTAL	4.454E+03	1.191E+04	2.627E+04	6.395E+04	8.009E+04	1.034E+06	8.948E+06	1.118E+07	2.904E+07	2.519E+07	7.558E+07

DENSITY(/M**2) = 3.78E-03

SITE VEGETATION PRODUCTION, KGR

DIR	0.0-1.	1.-2.	2.-3.	3.-4.	4.-5.	5.-10.	10.-20.	20.-30.	30.-40.	40.-50.	TOTAL
N	0.0	0.0	0.0	0.0	0.0	2.268E+03	6.078E+03	1.029E+06	1.746E+04	1.631E+07	1.736E+07
NNE	0.0	0.0	0.0	0.0	1.633E+03	1.225E+04	2.449E+04	2.109E+06	6.821E+06	3.211E+07	4.108E+07
NE	0.0	0.0	1.633E+03	2.449E+03	6.205E+03	4.393E+04	2.180E+05	2.138E+06	2.136E+07	4.873E+07	7.250E+07
ENE	0.0	0.0	1.633E+03	2.449E+03	4.082E+04	3.609E+04	7.718E+04	8.784E+05	5.287E+06	1.026E+08	1.089E+08
E	0.0	0.0	8.165E+02	8.165E+03	8.443E+04	1.119E+05	3.666E+05	1.930E+05	3.640E+06	3.847E+07	4.287E+07
ESE	0.0	0.0	8.165E+02	2.449E+03	2.449E+03	4.360E+04	1.177E+05	1.633E+05	1.105E+06	1.129E+06	2.564E+06
SE	0.0	0.0	0.0	7.511E+03	1.633E+03	2.041E+04	2.277E+04	1.807E+05	1.560E+05	6.745E+05	1.064E+06
SSE	0.0	1.134E+03	0.0	0.0	2.722E+03	3.293E+04	8.596E+04	9.072E+04	1.277E+05	1.012E+05	4.424E+05
S	0.0	1.134E+03	5.987E+03	0.0	0.0	1.715E+04	5.552E+04	3.506E+05	5.694E+06	5.676E+05	6.692E+06
SSW	0.0	5.987E+03	2.858E+03	1.134E+03	1.134E+03	5.126E+04	7.983E+05	3.899E+05	6.273E+06	9.465E+05	8.470E+06
SW	0.0	1.134E+03	0.0	5.987E+03	1.089E+04	5.557E+04	5.987E+05	2.837E+05	2.924E+05	1.886E+06	3.134E+06
WSW	0.0	0.0	1.030E+04	1.374E+04	5.987E+03	7.510E+04	6.037E+05	2.977E+05	1.248E+06	6.075E+06	8.330E+06
W	0.0	1.030E+04	1.030E+04	1.030E+04	1.089E+04	9.979E+04	1.010E+06	8.078E+06	7.688E+04	1.195E+06	1.050E+07
WNW	0.0	0.0	2.291E+03	3.992E+03	0.0	3.589E+05	1.044E+05	1.039E+07	2.644E+06	6.459E+05	1.415E+07
NW	0.0	1.030E+04	0.0	1.134E+03	5.987E+03	2.859E+05	2.867E+04	5.052E+06	6.735E+06	2.260E+06	1.438E+07
NNW	0.0	1.030E+04	1.134E+03	1.134E+03	1.134E+03	3.541E+05	1.202E+04	9.230E+06	3.318E+06	1.494E+06	1.442E+07
TOTAL	0.0	4.029E+04	3.777E+04	6.044E+04	1.760E+05	1.601E+06	4.130E+06	4.085E+07	6.480E+07	2.552E+08	3.669E+08

DENSITY(/M**2) = 1.83E-02

TABLE 6 - RWF ROUTINE RELEASES
SUMMARY OF OCONEE UNIT-3 CONTROL ROOM IMPACTS

NUCLIDE	RELEASES (CI/YR)	CONTROL ROOM CONC. (pCi/M^3) [a]	10CFR20 MPCi (pCi/M^3) [b]	AVERAGE CR MPC FRACTION
H3	2.4E+00	5.4E+02	2.0E+05	2.7E-03
C14	8.8E-02	2.0E+01	1.0E+05	2.0E-04
MN54	3.0E-06	6.7E-04	1.0E+03	6.7E-07
FE55	2.2E-05	4.9E-03	3.0E+04	1.6E-07
NI59	2.6E-08	5.8E-06	2.0E+04	2.9E-10
CO58	1.5E-04	3.4E-02	2.0E+03	1.7E-05
CO60	4.6E-05	1.0E-02	3.0E+02	3.4E-05
NI63	8.0E-06	1.8E-03	2.0E+03	9.0E-07
NB94	8.3E-10	1.9E-07	1.0E+02	1.9E-09
SR90	1.7E-07	3.8E-05	3.0E+01	1.3E-06
TC99M	5.5E-07	1.2E-04	5.0E+05	2.5E-10
TC99	7.4E-10	1.7E-07	2.0E+03	8.3E-11
MO99	5.9E-07	1.3E-04	7.0E+03	1.9E-08
I129	2.2E-07	4.9E-05	2.0E+01	2.5E-06
I131	1.0E-02	2.2E+00	1.0E+02	2.2E-02
I133	2.6E-04	5.8E-02	4.0E+02	1.5E-04
I134	2.6E-04	5.8E-02	6.0E+03	9.7E-06
CS134	8.8E-05	2.0E-02	4.0E+02	4.9E-05
CS135	7.4E-10	1.7E-07	3.0E+03	5.5E-11
CS137	1.5E-04	3.4E-02	5.0E+02	6.7E-05
TOTALS	2.5E+00	----	----	2.6E-02

[a] CALCULATED USING A X/Q=7.07E-03.

[b] 10 CFR 20, APPENDIX B, TABLE II, COLUMN 1 CONCENTRATION LIMITS FOR UNRESTRICTED AREAS.