South Carolina Electric & Gas Company

Application for Approval to Incinerate Oil Contaminated with Very Low Levels of Licensed Radioactive Material

V. C. SUMMER NUCLEAR STATION
SOUTH CAROLINA ELECTRIC AND GAS COMPANY

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Table of Contents

List of Figures

V. C. Summer Nuclear Station
Application for Approval to Incinerate
Oil Contaminated with Very
Low Levels of Licensed Radioactive Material

1.0 Introduction

Pursuant to 10CFR20, Sections 20.305 and 20.302(a), South Carolina Electric & Gas Company (SCE&G) requests approval to incinerate oil contaminated with very low levels of licensed radioactive materials. Incineration of oil is a proven disposal technology which has been Commission approved for use by several nuclear power plant licensees with inconsequential radiological impact on the health and safety of the public. Other disposal options for waste oil are currently limited to solidification and burial at a licensed near-surface land disposal site or incineration at a licensed commercial incinerator facility. While both of the latter disposal options involve significant costs, shallow land burial would also represent inefficient use of the limited burial ground space.

Onsite incineration represents the most cost effective disposal alternative and would reduce the risk from toxic and fire hazards associated with storage as well as risk associated with transportation to licensed disposal facilities. Additionally, the Environmental Assessment presented in Appendix A of the Proposed Amendment to 10CFR20.305 "Disposal of Waste Oil by Incineration" (53 FR 32917) states that incineration of oil in industrial boilers has been the EPA's preferred method of disposal of used oil based on nonradiological considerations and concludes that onsite incineration would not result in significant radiological effects on the quality of the human environment. Therefore, onsite incineration of slightly contaminated waste oil represents the most economical and safe (both radiologically and non-radiologically) disposal method currently available.

This application addresses the specific information required by 10CFR20, Section 20.302(a) as related to the alternate disposal of licensed byproduct material.

2.0 Waste Stream Description

Since initial start-up, V. C. Summer Nuclear Station (VCSNS) has generated approximately 4000 gallons of spent lubricating oil which is slightly contaminated with radioactive material. The current generation rate of contaminated oil is about 100 gallons per month. Two primary sources of contaminated oil have been identified at VCSNS: the reactor coolant pump (RCP) motor oil and oil skimmed from the plant waste surge basin. Oil from the RCP motors becomes contaminated because the oil reservoirs are exposed to the containment atmosphere through a breather line. Generally, oil from one RCP motor is changed during each refueling outage and results in about 250 gallons per year. Oil from the plant waste surge basin becomes slightly contaminated due to small amounts of primary-to-secondary leakage which have occurred at VCSNS. Oil is introduced into the surge basin via the turbine building sump due to incidental leakage from various motors and pumps located in the turbine and intermediate buildings.

Radionuclides identified in waste oil generated to date include Co-58, Co-60, Cs-134, Cs-137, and Mn-54. Typical concentrations of these radionuclides are presented in Table 1 below.

Table 1
Typical Isotopic Concentrations in Oil

Nuclide	Concentration (uCi/ml)
Co-58	1.00E-7
Co-60	1.90E-7
Cs-134	2.59E-8
Cs-137	4.51E-8
Mn-54	1.73E-8

2.1 Physical Properties of the Waste Oil

The waste stream is composed of spent lubricating oils with viscosities ranging from SAE 10 to SAE 50 weight and densities ranging from 53 to 55 pounds per cubic foot. Solids will be typically less than 10% by volume.

2.2 Sampling and Analysis of Oil

Upon approval of this application and prior to operation of the oil incinerator, Table 1.2-3 of the V. C. Summer Offsite Dose Calculation Manual (ODCM) will be revised to include sampling frequency, types of analysis, and sensitivity requirements. The proposed ODCM revisions are presented in Appendix A of this application.

The proposed LLD (lower limit of detection) was derived by using the Table 1.2-3 gaseous LLD's for the applicable analyses and applying a dilution factor for combustion air flow through the incinerator. This dilution factor is based on a burn rate of 10 gal/hr (maximum) of waste oil and a stack gas flow rate of 20 cubic feet per second. The dilution factor was determined to equal approximately 5×10^4 cubic centimeters of air per ml of waste oil. The product of the dilution factor and the appropriate LLD for gaseous releases provided in Table 1.2-3 results in the equivalent liquid sample LLD. Since this derived liquid LLD was less conservative than the LLD's presented in Table 1.1-4 (Radioactive Liquid Waste Sampling and Analysis Program), the Table 1.1-4 value was used for consistency.

Prior to incineration representative samples of candidate oil will be obtained by methods described in ASTM D 4057-81, Volume 05.03, "Standard Practice for Manual Sampling of Petroleum and Petroleum Products", August 1981.

3.0 Description of the Proposed Disposal Method

The proposed disposal method involves incineration in a dual chamber incinerator. Waste oil is collected in tanks and locations in accordance with applicable Health Physics, Industrial Safety, and Fire Protection Procedures and South Carolina Department of Health and Environmental Control (SCDHEC) requirements. Appropriate Air Quality permits will be obtained

from the SCDHEC Bureau of Air Quality Control prior to operation which will assure compliance with applicable South Carolina Air Quality Regulations.

A feed tank will be utilized for injecting waste oil into the incinerator. Oil may be collected in a feed tank or transferred to a feed tank from other collection tanks. Prior to incineration, the feed tank will be isolated from any further collection of oil or licensed materials and representative samples will be obtained as described in section 2.2. The feed tank will then be transported to the incineration facility provided the oil is acceptable for incineration. In addition to air quality permit sample requirements, the analysis program outlined in Table 1.2-3 (Appendix A) of the ODCM will be implemented to assure acceptability of the oil for incineration.

The incinerator will typically be operated eight hours or more per day at a rate of ten gallons per hour (maximum) of waste oil until the contents of the feed tank are consumed. All transportation and incineration will be accomplished within the licensee owned and controlled area and will be in accordance with all applicable station Health Physics, Industrial Safety, and Fire Protection procedures and SCDHEC requirements. Ash from the incinerator will be handled as dry active waste (DAW) and will be disposed in accordance with 10CFR20.301 requirements at a NRC licensed facility.

3.1 Description of Incinerator

The incinerator is comprised of two chambers; the lower chamber is approximately 30 cubic feet in volume and the upper chamber is 20 cubic feet (see Figure 3). The lower chamber is designed to operate at 1400°F and the upper chamber at 1800°F. Residence time of exhaust gases in the upper chamber will be a minimum of one second which will assure acceptable opacity of stack emissions. Both chambers are fired with propane with automatic temperature controls and safety shut down interlocks if the system runs out of propane. The lower burner is rated at 250,000 BTU/hr and the upper burner is rated at 500,000 BTU/hr. Waste oil will be atomized, prior to burning, with 100 PSI to 250 PSI air. The control design for the upper and lower chambers also include safety interlocks with less than 100 PSI of atomizing air pressure or loss of waste oil feed.

3.2 Incineration Facility Location

The proposed incineration facility is situated approximately 2500 feet southwest of the VCSNS Reactor Building and is contained within the Site Area Boundary, Exclusion Area and Plant Property Line. Figures 1 illustrates the location of the facility with respect to the generating station. The natural topography surrounding the area has an elevation range between 250 and 450 feet above mean sea level (MSL). The elevation of the proposed facility is about 436 feet above MSL. The incinerator will be located within a cinder block building with outside dimensions of 16 feet by 13 feet. The roof of the building is approximately 20 feet above grade (Figure 2). The floor of the building is concrete which will be sealed for ease of maintenance. Auxiliary fuel (propane) and waste feed tanks will be located outside the building for additional safety. The waste oil feed tank will

V. C. SUMMER NUCLEAR STATION

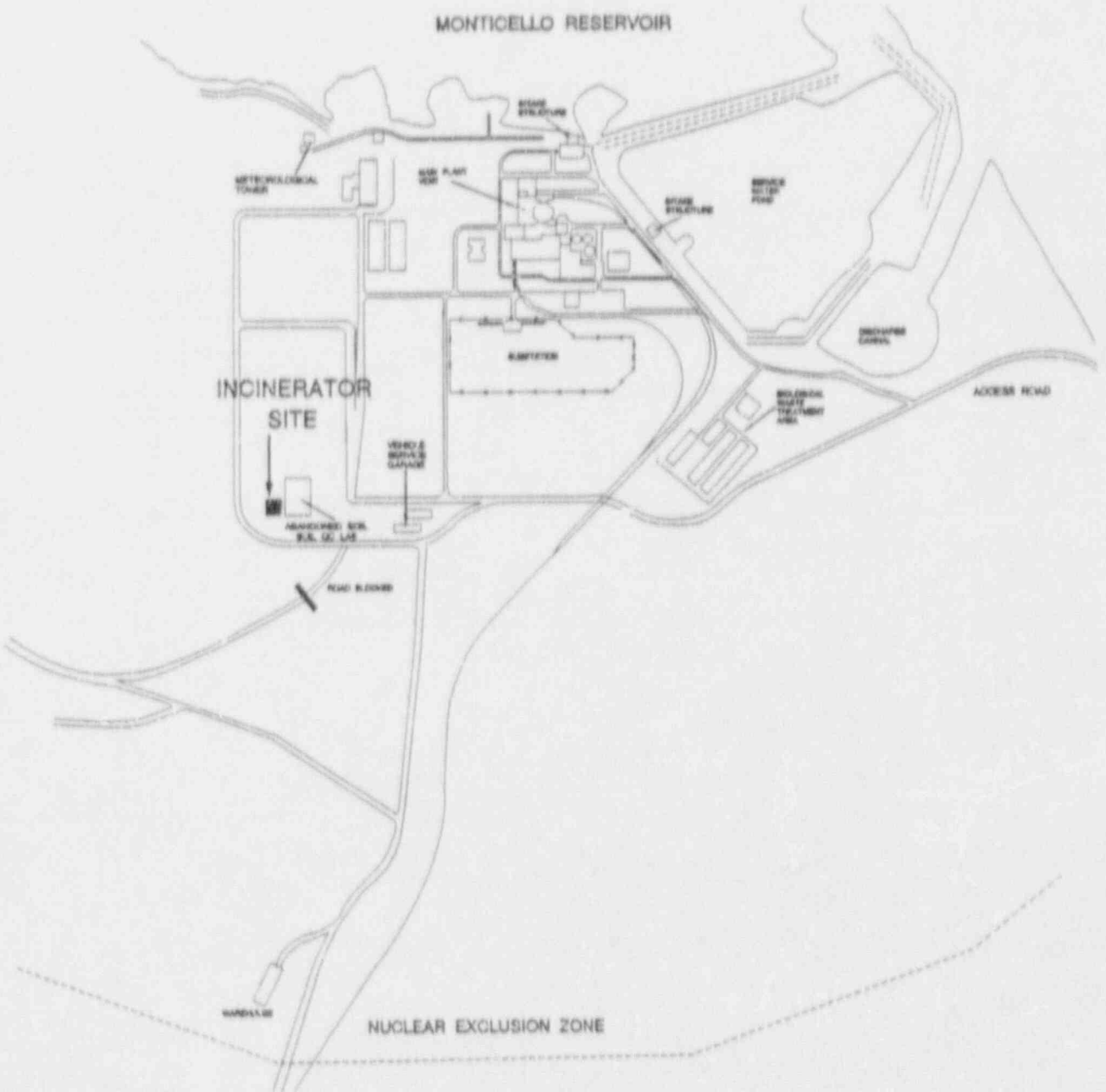


FIGURE 1

INCINERATOR BUILDING LAYOUT

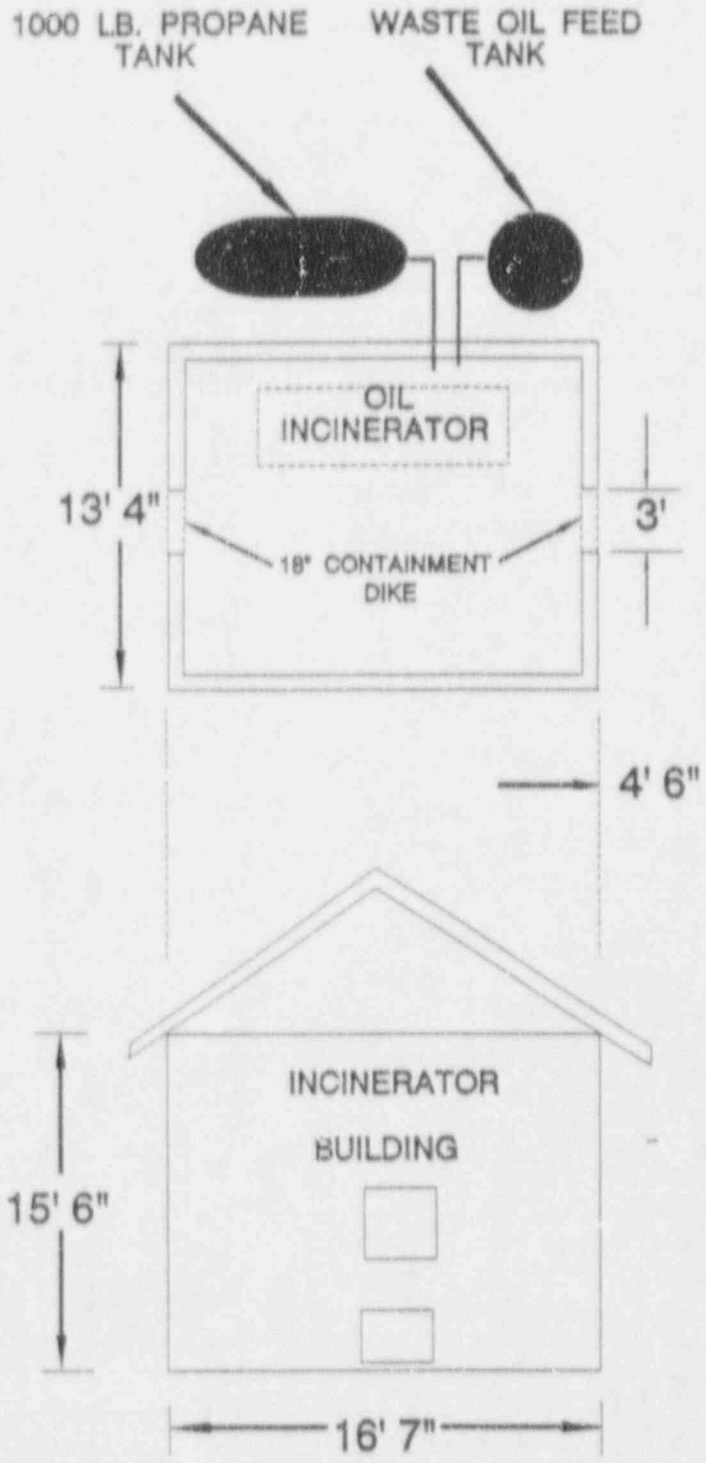
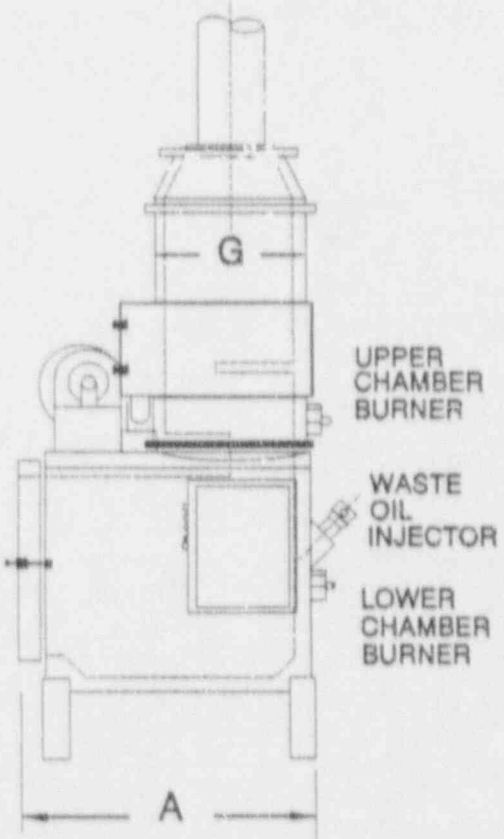


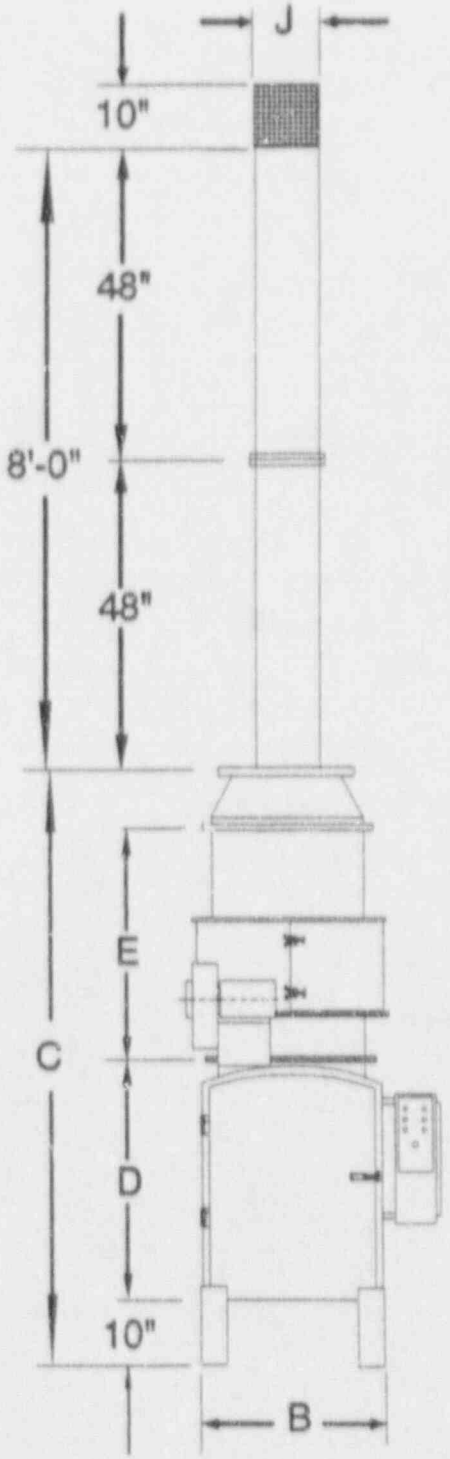
FIGURE 2

WASTE OIL INCINERATOR

A	60"
B	42"
C	108"
D	48"
E	48"
G	42"O.D.
J	18"



SIDE VIEW



FRONT VIEW

FIGURE 3

include secondary containment features for additional spill protection The building will have dikes at each entrance for additional spill protection. The waste oil feed pump will be located inside the building at an elevation which will preclude siphoning in the event of a feed line rupture.

3.3 Administrative Controls

Upon approval of this application and prior to operation of the oil incinerator, appropriate portions of the VCSNS ODCM will be revised (see Appendix A). This revision will include limits on total quantity and release rate of radioactive materials in gaseous effluents as a result of oil incineration which will not exceed 0.1% of ODCM specifications 1.2.2.1(a) and (b) and 1.2.4.1(a) and (b).

These ODCM revisions have been evaluated under the VCSNS 10 CFR 50.59 program. This evaluation has concluded that the proposed activity of oil incineration implemented under these administrative limits does not constitute an unreviewed safety question.

Prior to incineration, each feed tank will be sampled and analyzed to ensure conformance with the limits presented in Attachment I of this request. These results and other pertinent data will be documented and retained by the licensee and made available for review and audit upon request. As stated in Section 2.0, the generation rate is not expected to exceed 100 gallons per month, however, this does not imply an annual volume limit for disposal. The volume of oil incinerated will be limited by the allowable quantities of radioactivity in oil as derived in Attachment I of this request (0.1% of VCSNS ODCM Specification 1.2.4.1). Similarly, as stated in Section 3.0, the typical and maximum burn rate is 10 gallons per hour, however, the actual burn rate will be limited by 0.1% of VCSNS ODCM Specification 1.2.2.1(b) as derived in Attachment I of this request. The incinerator is expected to be utilized for oil disposal for the full operational life of VCSNS.

The basis for the limits presented in Attachment I include the assumption that the total quantity of radionuclides identified in oil will be released to the atmosphere during incineration. This is a conservative approach since a significant portion of the radioactivity will be retained in the ash residue. This assumption combined with the extremely low quantities of radioactivity allowed in oil for incineration eliminates the need for sampling, filtering and/or monitoring of stack emissions.

The limits presented in Attachment I will ensure the resulting annual dose to the maximum exposed individual in the public from oil incineration does not exceed 0.015 mrem to any organ. In addition, these controls shall ensure the dose rate at the site boundary due to oil incineration is maintained less than 0.1% of the limits specified in VCSNS ODCM Specification 1.2.2.1(b). The low levels of licensed materials involved in the oil incineration process should negate the need for personnel monitoring of occupational radiation exposure and the posting and labeling requirements of 10CFR20.203(e) and (f). Radiation levels in the incineration facility and from storage tanks are

not expected to exceed the limits for permissible levels of radiation in unrestricted areas as defined by 10CFR20.105. The level of radioactivity in oil should be well below the exemption criteria for labeling as defined by 10CFR20.203 (f) (3). However, the incinerator access doors for ash removal will be labeled for containing radioactive material since concentration of the radioactivity due to incineration may produce quantities of radioactivity greater than the values listed in 10CFR20, Appendix C. Removal and disposal of ash residue will be conducted in accordance with Health Physics procedures currently used at the V. C. Summer Nuclear Station. Routine surveys will be performed in accordance with 10CFR20.201 to verify that additional controls are not required. Additional controls will be established as necessary to ensure compliance with 10CFR20 based on routine survey results.

Access control to the incinerator facility and oil storage tanks will be established to prevent unauthorized removal of licensed materials as required by 10CFR20.207. In addition, the soil and grounds in the immediate vicinity of the incinerator facility will be surveyed to detect any concentration of radioactivity in the soil due to deposition from the incinerator exhaust. Corrective actions will be taken as necessary upon identification of any adverse trends. The frequency and extent of these surveys will be established based on the presence of radiation and may be adjusted as experience is gained from the incineration process.

Offsite doses and dose rates resulting from oil incineration will be calculated per Sections 3.2.3.2 and 3.2.2.2 respectively of the VCSNS ODCM. The proposed revision of Section 1.6.2 of the ODCM (see Appendix A) will require that quantities of radioactive gaseous effluent and solid waste (ash) released as a result of oil incineration be included in the semiannual effluent release reports (Regulatory Guide 1.21). These reports will also include an assessment of radiation doses to the general public resulting from oil incineration.

4.0 Evaluation of the Radiological Impacts of Waste Disposal

To evaluate the radiological impacts of a waste disposal method, a target dose is established below which the radiological impacts may be considered negligible. For purposes of this application, a value of 0.015 mRem/yr to the maximum exposed organ has been chosen because this value represents a small fraction (0.1%) of annual releases defined under 10CFR50 Appendix I as being As Low As Reasonably Achievable (ALARA).

4.1 Identification of Potential Pathways

Evaluation of the potential exposure pathways generates a long list of exposure scenarios. Using the guidance of NUREG-0133, "Preparation of Radiological Effluent Technical Specification for Nuclear Power Plants", October, 1978, many of the pathways may be eliminated. The decision making process for pathway analysis resulting from atmospheric releases of radioactive materials in particulate form is discussed in the VCSNS Offsite Dose Calculation Manual Revision 16, September 1991 (ODCM) and controlling pathways for atmospheric releases are presented in Section 3.2 and

Table 3.2-2 of the ODCM. Organ doses will be calculated for the maximum exposed individual outside the site boundary using methodology described by the VCSNS ODCM, Section 3.2.3.2.

Section 3.2.3.2 of the ODCM provides the methodology for calculating maximum organ dose to an individual from atmospheric release of radioactive materials in particulate form. Atmospheric dispersion and deposition parameters (X/Q' and D/Q' respectively) are provided for the controlling receptors, locations, and pathways as explained in Tables 3.2-7 and 3.2-8 of the ODCM. It should be noted that the location of the incinerator stack is approximately 2500 feet (750 meters) to the Southwest of the main plant vent. Therefore, an evaluation was performed to determine appropriate X/Q' and D/Q' values to use for the actual incinerator location. The distance for critical receptors in each of the 16 meteorological sectors with respect to the proposed incinerator location was determined and X/Q' and D/Q' values for each location calculated by interpolation of Tables 6.10-10 and 6.1-13 contained in the Operating License Environmental Report (OLER). A comparison was then made between the X/Q' and D/Q' values for the incinerator location and the main plant vent. For the controlling receptor and pathways, the X/Q' and D/Q' values given in the ODCM for the main plant vent were higher than those calculated for the incinerator location since the controlling receptor did not change but the distance from the release point increased from 1.1 to 1.3 miles. Therefore, the more conservative ODCM values for the main plant vent are used for dose calculations in this application. The annual land use census is performed to verify the receptor location. When the land use census indicates significant changes to receptor location, dispersion and deposition parameters will be adjusted as necessary.

As indicated in Table 3.2-8 of the VCSNS ODCM, the controlling receptor is a child eating vegetables from a garden located 1.1 miles (1,800 meters) from the main plant vent in the East sector. The limiting pathways for this receptor include inhalation of airborne particulates, direct radiation from ground plane deposition, and ingestion of particulates deposited on leafy vegetables. All three of these pathways are additive and maximum annual organ and total body doses are calculated by methodology described in Attachment I of this request.

4.2 Dose Evaluation

For purposes of this request, the total quantity of activity potentially released to the atmosphere from incineration of contaminated oil each year was calculated such that the target doses discussed in Section 4.0 would not be exceeded. Since most of the waste oil contains multiple isotopes, compliance with the dose criteria will be demonstrated by maintaining a calendar year inventory for each isotope. Prior to each burn, calculations will be performed to assure offsite doses will not exceed the criteria specified. Actual quantities of each isotope released, Q_{ia}, will be compared with the allowable quantity, Q_{io} (Attachment I), and the fraction of actual release compared to the allowable release for each isotope, i, will be

summed. The sum of the fractions must equal less than one before incineration is permitted.

Specifically, incineration will be permitted provided the following condition is met:

$$\sum_i \frac{Q_{ia}}{Q'_{io}} < 1$$

In addition to the annual dose criteria, the instantaneous dose rate criteria at the plant boundary (i.e. 0.1 percent of VCSNS ODCM Specification 1.2.2.1(b) and 10CFR20 Appendix B, Table II, Col 1 concentrations) will be satisfied by limiting the specific activity of the candidate oil and the burn rate as necessary (see Attachment I). The maximum instantaneous release rate will be limited to 9.0×10^{-3} uCi/sec.

4.3 Summary of Limiting Conditions

As a result of the exposure pathway analysis and subsequent dose calculations, the following limiting conditions are imposed:

A. An annual running inventory will be maintained and the total quantities of all isotopes, i, released will be such that in a calendar year the following condition will be satisfied,

$$\sum_i \frac{Q_{ia}}{Q'_{io}} < 1$$

B. Burn rate (maximum 10 gal/hr) and specific activity of the oil will be controlled to assure the instantaneous release rate does not exceed 9.0×10^{-3} uCi/sec.

C. Annual land use census will be performed, per Technical Specifications, to verify appropriately conservative X/Q, X/Q', and D/Q' parameters are used.

D. If isotopes not identified in this application are detected in candidate oil, an evaluation will be performed and documented to assure that doses from these isotopes are accounted for and the dose and dose rate criteria given in Section 3.3 are not exceeded.

E. Disposal activities will be conducted according to applicable station Health Physics procedures as discussed in Section 3.3.

F. Residual ash will be disposed of as dry active waste in accordance with 10CFR20.301 and applicable disposal site criteria.

G. Quantities of radioactive material released in gaseous effluents and solid waste and resulting doses will be reported in the semiannual effluent (Regulatory Guide 1.21) report.

5.0 Environmental Impact Assessment

Introduction

The proposed activity including construction and operation of the oil incinerator has been evaluated pursuant to Section 3.1 of Appendix B, "Environmental Protection Plan" of the VCSNS, Unit 1 Facility Operating License. This evaluation has concluded that the proposed activity does not constitute an unreviewed environmental question.

5.1 Geology and Water Usage

Operation of the proposed oil incinerator should have no significant regional or local environmental impacts. Since the disposal method involves atmospheric releases, the geology and water usage of the region will not be impacted. The small quantities of dry waste generated will be insignificant when compared to the total quantities of dry active waste routinely generated at VCSNS. For additional information on geology and water usage, refer to Sections 2.4 and 2.5 of the VCSNS FSAR.

5.2 Meteorology

The meteorology of the region (average wind speeds and directions and atmospheric stability) is constantly monitored. Any significant changes will be documented and an evaluation will be performed to assure the controlling receptors and pathways are appropriately selected. Therefore, the local meteorology will have no significant adverse impact on the proposed method of disposal. For additional information regarding meteorology, refer to Section 2.3 of the VCSNS FSAR.

5.3 Nearby Facilities and Communities

The proposed disposal site is located on licensee owned and controlled property, within the Exclusion Area for the VCSNS and about one half mile southwest of the VCSNS Reactor Building. It is located about one half mile south of the Monticello Impoundment, 1 mile south east of Fairfield Pumped Storage Facility and 1 mile east of the Broad River and Parr Hydro and Steam Plant. There are no other large industrial facilities located within 5 miles of the proposed disposal site (see Figure 2).

The only significant transportation facilities located nearby are South Carolina Highways 213 and 215 and the Southern Railways Parr-Blair corridor.

Communities near the proposed incinerator facility site are Jenkinsville (2 miles east southeast), Monticello (5 miles north northwest), Peak (3 miles south) and Pomaria (5 miles west).

The proposed incinerator will have no significant impact on these facilities or communities, nor will they impact the proposed method of disposal.

For more information regarding nearby facilities and communities, refer to Section 2.1 and 2.2 of the VCSNS FSAR.

5.4 Air Quality

Prior to construction, authorization for the operation of the oil incinerator shall be obtained from the South Carolina Department of Health and Environmental Control Office of Environmental Quality Control, Bureau of Air Quality Control. This authorization will be pursuant to the provisions of the South Carolina Air Pollution Control Regulations and Standards and shall contain the standard condition that no applicable law, regulation or standard shall be contravened due to operation of the incinerator. The Board of South Carolina Department of Health and Environmental Control has determined that compliance with the applicable laws, regulations and standards will maintain reasonable standards of purity of the air resources of the State consistent with the public health, safety and welfare of its citizens, the propagation and protection of terrestrial and marine flora and fauna, and the protection of physical property and other resources.

5.5 Regulatory Guide 1.143

A review of Regulatory Guide 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures and Components Installed in Light-Water-Cooled Nuclear Power Plants", was performed to determine its applicability to the design of the waste oil incinerator. The purpose of this regulatory guide is to provide information and criteria that will provide reasonable assurance that components and structures used in the radioactive waste management system are designed, constructed, installed and tested on a level commensurate with the need to protect the health and safety of the public and plant operating personnel.

Specifically referenced within this Regulatory Guide as principle design criteria for waste management systems are Criterion 1, 2, and 60 of Appendix A, "General Design Criterion for Nuclear Power Plants", to 10 CFR Part 50. As stated within Appendix A, Criterion 1 and 2 are applicable only to structures, systems and components important to safety. The safety analysis performed to support the proposed activity of oil incineration takes no credit for system integrity (assumes release of all radioactive material to the environment) and therefore the incinerator and associated systems would not be considered important to safety and criterion 1 and 2 would not be applicable.

Criterion 60, "Control of Releases of Radioactive Materials to the Environment" requires that the nuclear power unit design to include means to control suitably the release of radioactive materials in gaseous and liquid effluents. Administrative controls placed on the concentrations and total quantities of radioactive material in the waste oil were developed to assure negligible impact to the health and safety of the public and plant personnel as a result of the release of this material to the environment. Additionally, the environmental evaluation performed to support the proposed activity concluded that the system design is adequate to protect the public health and

safety from inadvertent oil spillage and non-radiological stack emissions. Therefore, the intent of Criterion 60 has been implemented.

5.6 Conclusion

Onsite incineration represents the most cost effective disposal alternative and would reduce the risk from toxic and fire hazards associated with storage as well as risk associated with transportation to licensed disposal facilities. Additionally, the Environmental Assessment presented in Appendix A of the Proposed Amendment to 10CFR20.305 "Disposal of Waste Oil by Incineration" (53 FR 32917) states that incineration of oil in industrial boilers has been the EPA's preferred method of disposal of used oil based on nonradiological considerations and concludes that onsite incineration would not result in significant radiological effects on the quality of the human environment. The radiological impact assessment contained within this document, demonstrates the negligible radiological impacts of the proposed waste oil incinerator. Therefore, onsite incineration of slightly contaminated waste oil represents the most economical and safe (both radiologically and non-radiologically) disposal method currently available. Thus a finding of "no significant environmental impact" is appropriate.

ATTACHMENT I

DOSE CALCULATIONS FOR OIL INCINERATION

1.0 Discussion

Administrative controls will be established to ensure the resulting annual organ dose to the maximum exposed individual (MEI) in the public from oil incineration does not exceed 0.1% of the condition specified in Section 1.2.4.1 of the VCSNS Offsite Dose Calculation Manual (ODCM). Similarly, controls will be implemented to limit the dose rate in unrestricted areas to 0.1% of the condition specified in Section 1.2.2.1(b) of the ODCM.

Therefore, annual doses to the MEI will be limited to:

During any calendar quarter: Less than or equal to 0.0075 mrem to any organ and,

During any calendar year: Less than or equal to .015 mrem to any organ.

Dose rate in unrestricted area will be limited to:

Less than or equal to 1.5 mrem/yr to any organ.

2.0 Administrative Limits

2.1 Annual Dose

The total quantity of radioactivity in incinerated oil will be limited to ensure compliance with the above dose limits. Table 2.0-1 lists the quantity of each radionuclide that, if released during incineration, results in an organ dose of 0.015 mrem. Since more than one radionuclide is normally present, the total quantity of radioactivity in incinerated oil will be limited by summing the ratios of the quantity of each radionuclide present in incinerated oil to the applicable value for each radionuclide presented in Table 2.0-1. This summation shall not be allowed to exceed 1.0 during any calendar year. The radionuclides listed in Table 2.0-1 are those normally present above LLD values in contaminated oil. In the event that other radionuclides are identified during future operations, station procedures will be revised to incorporate the value for each radionuclide using the same methodology as described in this attachment.

TABLE 2.0-1

ALLOWABLE RELEASE QUANTITIES
OF RADIONUCLIDES IN OIL

Nuclide	Q_{io}, uCi [1]
Co-58	3.84×10^4
Co-60	1.37×10^3
Cs-134	1.14×10^3
Cs-137	1.09×10^3
Mn-54	1.53×10^4

Quantities of radionuclides released during a calendar year shall be limited by:

$$\sum_i \frac{Q_{ia}}{Q'_{i\omega}} < 1.0$$

where Q_{ia} = total quantity of radionuclide i released during the calendar year

2.2 Instantaneous Dose Rate

The release rate of gross radioactivity during oil incineration shall be limited to 9.0 X 10-3 uCi/sec. This limit shall be procedurally controlled by adjusting the burn rate based on the concentration of radioactive material present in the oil.

3.0 Derivation of Administrative Limits

3.1 References

3.1.1 Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR50, Appendix I, Rev. 1 October 1977.

3.1.2 Offsite Dose Calculation Manual (ODCM) for South Carolina Electric & Gas Company, V. C. Summer Nuclear Station Rev. 16, September 1991.

3.1.3 NUREG-0133. Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants, October, 1978.

3.2 Assumptions

3.2.1 Oil is burned at a rate of 10 gallons per hour.

3.2.2 All activity in the oil is released to atmosphere during incineration.

3.2.3 Dose to the maximum exposed individual will be calculated using methodology described in ODCM Section 3.2.3.2.

3.2.4 Organ doses will be calculated using the limiting pathways and dose conversion factors shown in Table 3.2-2 of the ODCM.

3.2.5 Ground plane dose factors given in Table 3.2-2 (ODCM) are for total body.

3.2.6 $(BR)_a$ = The breathing rate of the receptor of age group (a), in m^3/yr (Table E-5, Ref. 3.1.1).

3.2.8 $(DFA_i)_a$ = The total body inhalation dose factor for the receptor of age group (a) for the i^{th} radionuclide, in mrem/pCi (Table E-10, Ref. 3.1.1).

3.3 Organ Dose

Maximum organ doses are calculated pursuant to Section 3.2.3.2 of Ref. 3.1.2.

Dp = Maximum organ dose to an individual from radionuclides in particulate form, with half lives greater than eight days (mrem).

$$= 3.17 X 10^{-8} \sum_{ij} R_{ij} W'_{ij} Q'_i \qquad \text{(eq. 1)}$$

where:

W_{ij}' = Relative concentration or relative deposition for the maximum exposed individual, as appropriate for exposure pathway j and radionuclide i.

W_{ij}' = $\begin{cases} \overline{\chi}' / \overline{Q} & \text{for inhalation pathway} = 2.2 \times 10^{-6} \text{ sec/m}^3 = \text{relative concentration for the location occupied by the maximum exposed individual.} \\ \overline{D}' / \overline{Q} & \text{for other pathways} = 1.2 \times 10^{-8} \text{ m}^{-2} = \text{annual average relative deposition at the location occupied by the maximum exposed individual.} \end{cases}$

R_{ij} = Dose factor for radionuclide i and pathway j, (mrem/yr per uCi/m^3) or (m^2 - mrem/yr per uCi/sec)

$\tilde{Q}_i'$ = Cumulative release of radionuclide i over period of interest (uCi).

3.17×10^{-8} = the fraction of one year per one second.

3.3.1 Calculation of Allowable Release Quantity

Quantities of each radionuclide are calculated which, if released, would result in a maximum organ dose of 0.015 mrem.

The dose equation presented above will be utilized for each radionuclide by setting D_p = 0.015 mrem and solving for Q_i.

EXAMPLE:

For Co-58, Organ Dose

$$0.015\ mrem = 3.17 X 10^{-8} \frac{yr}{sec} \left| 1.106E6 \frac{mrem - m^3}{uCi - yr} (2.2E-6 \frac{sec}{m^3}) + 4.464E8 \frac{m^2 - mrem - sec}{uCi - yr} \right.$$

INHALATION — GROUND PLANE

$$\left. (1.2E-8\ m^{-2}) + 3.771E8 \frac{m^2 - mrem - sec}{uCi - yr} (1.2E-8\ m^{-2}) \right| Q'_o\ uCi$$

VEGETATION

Solving for $\tilde{Q}'_o$

$$\tilde{Q}'_o = 3.84 X 10^4\ uCi$$

Therefore, $\tilde{Q}'_o$ for 0.015 mrem to maximum exposed organ is

Nuclide	$\tilde{Q}'_o$ uCi
Co-58	3.84 X 10^4
Co-60	1.37 X 10^3
Cs-134	1.14 X 10^3
Cs-137	1.09 X 10^3
Mn-54	1.53 X 10^4

3.4 Total Body Dose Rate Calculation

The following calculation will determine the release rate for radionuclides from the oil incinerator which would result in a maximum dose rate to an individual at the site boundary equal to 0.1 percent of ODCM 1.2.2.1.b. Therefore, concentrations of radionuclides at the site boundary would be limited to 0.1 percent of the concentrations of 10CFR20, Appendix B, Table II, Column 1 (see Section 3/4.11.2.1 of VCSNS Technical Specifications).

Isotope	10CFR 20 App. B MPC Table II, Col. 1	0.1 Percent of MPC
Co-58	2E-9 uCi/ml	2E-12 uCi/ml
Co-60	3E-10 uCi/ml	3E-13 uCi/ml
Cs-134	4E-10 uCi/ml	4E-13 uCi/ml
Cs-137	5E-10 uCi/ml	5E-13 uCi/ml
Mn-54	1E-9 uCi/ml	1E-12 uCi/ml

The total gross activity concentration in waste oil to be incinerated will be limited to a value which will assure that airborne concentrations will be less than or equal to 0.1 percent of the values listed in 10CFR20, Appendix B, Table II, Col 1. The following simplifying and conservative assumptions are made:

- Since Co-60 has the most limiting MPC value, all activity in the oil is assumed to be Co-60.

- Incineration rate is 10 gal/hr.

- All activity in oil is assumed released to atmosphere.

- From section 3.1.2 of the VCSNS Offsite Dose Calculation Manual (ODCM), the highest annual average relative concentration at the site boundary, X/Q, is equal to 5.3E-6 sec/m^3. However, for this application, 3.3 X 10^{-5} sec/m^3 will be used based on the fact that the site boundary is closer to the incinerator stack than is the reactor building. The value of 3.3 X 10^{-5} sec/m^3 was calculated by using actual distance to the site boundary (0.53 miles) and interpolation using the Operating License Environmental Report (OLER) Table 6.1-14 and removing the building wake effect.

Calculate the gross activity in waste oil which if incinerated at a rate of 10 gal/hr would result in a concentration at the site boundary of 3E-13 uCi/ml.

$$C_{PB} = Q \cdot X/Q$$

where,

C_{PB} = Concentration at plant boundary = 3E-13 uCi/ml

Q = Average release rate in uCi/sec
= Concentration in oil, C_{OIL}, times burn rate, R,

Substituting,

$$C_{PB} = C_{OIL} \cdot R \cdot X/Q$$

or

$$C_{OIL} = \frac{C_{PB}}{R \cdot X/Q}$$

$$= \frac{(3E\text{-}13\ uCi/ml)(3600\ sec/hr)(10^6\ ml/m^3)}{(10\ gal/hr)(3785\ ml/gal)(3.3E\text{-}5\ sec/m^3)}$$

$$C_{OIL} = 8.65 \times 10^{-4}\ uCi/ml$$

The corresponding maximum allowable release rate would then be:

$$\dot{Q} = (8.65 \times 10^{-4}\ uCi/ml)(3785\ ml/gal)(10\ gal/hr) / (3600\ sec/hr)$$

$$= 9.09 \times 10^{-3}\ uCi/sec$$

Appendix A

Proposed Changes to ODCM

Affected Pages

1.2.2 Gaseous Effluents: Dose Rate

LIMITING CONDITION FOR OPERATION

1.2.2.1 The dose rate in unrestricted areas due to radioactive materials released in gaseous effluents from the site (see Technical Specification Figure 5.1-3) shall be limited to the following:

a. For noble gases: Less than or equal to 500 mrem/yr to the total body and less than or equal to 3000 mrem/yr to the skin, and

b. For all radioiodines and for all radioactive materials in particulate form and tritium with half lives greater than 8 days: Less than or equal to 1500 mrem/yr to any organ.

c. Less than 0.1% of the limits 1.2.2.1(a) and (b) as a result of oil incineration.

APPLICABLE: At all Times.

ACTION:

With the dose rate(s) exceeding the above limits, immediately decrease the release rate to within the above limit(s).

SURVEILLANCE REQUIREMENTS

1.2.2.2 The dose rate due to noble gases in gaseous effluents shall be determined to be within the above limits in accordance with the methods and procedures of the ODCM.

1.2.2.3 The dose rate due to radioiodines, tritium and radioactive materials in particulate form with half lives greater than 8 days in gaseous effluents shall be determined to be within the above limits in accordance with the methods and procedures of ODCM Section 3.2.2 by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Table 1.2-3.

TABLE 1.2-3

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

	Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml)[a]
A.	Waste Gas Storage Tank	P Each Tank Grab Sample	P Each Tank	Principal Gamma Emitters[g]	1X10-4
B1	Reactor Building -36" Purge Line	P Each Purge[b,c]	P Each Purge[b]	Principal Gamma Emitters[g]	1X10-4
	-6" Purge Line			H-3	1X10-6
B2	Reactor Building -6" Purge Line (if continuous)	M[b] Grab Sample	M[b]	Principal Gamma Emitters[g]	1X10-4
				H-3	1X10-6
C.	Main Plant Vent	M[b,e] Grab Sample	M[b]	Principal Gamma Emitters[g]	1X10-4
				H-3	1X10-6
D1.	Reactor Building Purge	Continuous Sampler[f]	W[d] Charcoal Sample	I-131 I-133	1X10-12 1X10-10
2.	Main Plant Vent	Continuous Sampler[f]	W[d] Particulate Sample	Principal Gamma Emitters[g] I-131, others	1X10-11
		Continuous Sampler[f]	M Composite Particulate Sample	Gross Alpha	1X10-11
		Continuous Sampler[f]	Q Composite Particulate Sample	Sr-89,Sr-90	1X10-11
		Continuous Monitor	Noble Gas Monitor	Noble Gases Gross Beta	2X10-6
E.	Oil Incinerator	P Each Batch[h] Grab Sample	P Each Bath	Principal Gamma Emitters[g]	5X10-7[i]

See Table 1.1-3 for explanation of frequency notation.

TABLE 1.2-3 (Continued)

TABLE NOTATION

a. See Table 1.1-4 notation (a) for definition of LLD.

b. Analyses shall be also be performed within 24 hours following shutdown, startup, or a THERMAL POWER change exceeding 15 percent of the RATED THERMAL POWER within a one hour period.

c. Tritium grab samples shall be taken at least once per 24 hours when the refueling canal is flooded.

d. Samples shall be changed at least once per 7 days and analyses shall be completed within 48 hours after changing (or after removal from sampler). Sampling shall also be performed at least once per 24 hours for a least 7 days following each shutdown, startup or THERMAL POWER change exceeding 15 percent of RATED THERMAL POWER in one hour and analyses shall be completed within 48 hours of changing. When samples collected for 24 hours are analyzed, the corresponding LLD's may be increased by a factor of 10.

e. Tritium grab samples shall be taken at least once per 7 days from the ventilation exhaust from the spent fuel pool area, whenever spent fuel is in the spent fuel pool.

f. The ratio of the sample flow rate to the sampled stream flow rate shall be known for the time period covered by each dose or dose rate calculation made in accordance with ODCM Specifications 1.2.2.1, 1.2.3.1 and 1.2.4.1.

g. The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 for gaseous emissions and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141 and Ce-144 for particulate emissions. This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported.

h. Prior to sampling for anlaysis, each batch of oil shall be isolated and representative samples obtained by methods described in ASTM D 4057-81, Volume 05.03, "Standard Practice for Manual Sampling of Petroleum and Petroleum Products".

i. This LLD refer to the liquid sample.

1.2.4 Gaseous Effluents: Dose - Radioiodines, Tritium, and Radioactive Materials in Particulate Form.

LIMITING CONDITION FOR OPERATION

1.2.4.1 The dose to an individual from radioiodines, tritium, and radioactive materials in particulate form, and radionuclides (other than noble gases) with half-lives greater than 8 days in gaseous effluents (see Technical Specification Figure 5.1-3) shall be limited to the following:

a. During any calendar quarter: Less than or equal to 7.5 mrem to any organ and,

b. During any calendar year: Less than or equal to 15 mrem to any organ.

c. Less than 0.1% of the limits 1.2.4.1(a) and (b) as a result of oil incineration.

APPLICABLE: At all Times.

ACTION:

a. With the calculated dose from the release of tritium, radioiodines, and radioactive materials in particulate form with half lives greater than 8 days in gaseous effluents exceeding any of the above limits, in lieu of any other report required by ODCM Section 1.6, prepare and submit to the Commission within 30 days, pursuant to Technical Specification 6.9.2, a Special Report which identifies the cause(s) for exceeding the limit and defines the corrective actions to be taken to releases and the proposed actions to be taken to assure that subsequent release will be in compliance with ODCM Specification 1.2.4.1.

b. The provisions of Technical Specifications 3.0.3 and 3.0.4 are not applicable.

SURVEILLANCE REQUIREMENTS

1.2.4.2 Dose Calculations Cumulative dose contributions for the current calendar quarter and current calendar year shall be determined in accordance with ODCM Section 3.2.3 at least once per 31 days.

1977, is titled "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I". Regulatory Guide 1.113, April 1977, is titled "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Imple-menting Appendix I".

B/1.1.4 Liquid Waste Treatment

The OPERABILITY of the liquid radwaste treatment system ensures that this system will be available for use whenever liquid effluents require treatment prior to release to the environment. The requirement that the appropriate portions of this system be used when specified provides assurance that the releases of radioactive materials in liquid effluents will be kept "as low as is reasonably achievable." This specification implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objective given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the liquid radwaste treatment system were specified as a suitable fraction of the dose design objectives set forth in Section II.A of Appendix I, 10 CFR Part 50, for liquid effluents.

B/1.2 GASEOUS EFFLUENTS

B/1.2.1 Radioactive Gaseous Effluent Monitoring Instrumentation

The radioactive gaseous effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in gaseous effluents during actual or potential releases of gaseous effluents. The alarm/trip setpoints for these instruments shall be calculated in accordance with the procedures in the ODCM to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63 and 64 of Appendix A to 10 CFR Part 50.

B/1.2.2 Dose Rate

This specification is provided to ensure that the dose at any time at the site boundary from gaseous effluents from all units as well as the oil incinerator on the site will be within the annual dose limits of 10 CFR Part 20 for unrestricted areas. The annual dose limits are the doses associated with the concentration of 10 CFR Part 20, Appendix B, Table II, Column 1. These limits provide reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of an individual in an unrestricted area, either within or outside the site boundary, to annual average concentrations exceeding the limits specified in Appendix B, Table II of 10 CFR Part 20 (10 CFR Part 20. 106 (b)). For individuals who may at times be within the site boundary,the occupancy of the individual will be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the site boundary. The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to an individual at or beyond the site boundary to less than or equal to 500 mrem/year to the total body or to less than or equal 3000 mrem/year to the skin. These release rate limits also restrict, at all times, the corresponding thyroid dose rate above background to a child via the inhalation pathway to less than or equal to 1500 mrem/year.

B/1.2.3 Dose - Noble Gases

This specification is provided to implement the requirements of Sections II.B, IIIA and IV.A of Appendix I, 10 CFR Part 50. The Limiting Condition for Operation implements the guides set forth in Section II.B of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in gaseous effluents will be kept "as low as is reasonably achievable". The Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of an individual through appropriate pathways is unlikely to be substantially underestimated. The dose calculations established in the ODCM for calculating the doses due to the actual release rates of radioactive noble gases in gaseous effluents are consistent with the methodology provided in NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants", section 5.3. NUREG-0133 implements Regulatory Guide 1.109, Revision 1, October 1977 and Regulatory Guide 1.111, Revision 1, July 1977. Regulatory Guide 1.109 is entitled "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, "Revision 1, October 1977 and Regulatory Guide 1.111 is entitled "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water Cooled Reactors, "Revision 1, July 1977. The ODCM equations provided for determining the air doses at the site boundary are based upon the historical average atmospheric conditions.

This specification applies to the release of gaseous effluents from all reactors at the site and from the incineration of oil.

B/1.2.4 Dose-Radioiodines, Tritium and Radioactive Materials in Particulate Form

This specification is provided to implement the requirements of Sections II.C, III.A and IV.A of Appendix I, 10 CFR Part 50. The Limiting Conditions for Operation are the guides set forth in Section II.C of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A Appendix I to assure that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable." The ODCM calculational methods specified in the Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of an individual through appropriate pathways in unlikely to be substantially underestimated. The ODCM calculational methods for calculating the doses due to the actual release rates of the subject materials are consistent with the methodology provided in NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants", section 5.3. NUREG-0133 implements Regulatory Guide 1.109, Revision 1, October 1977 and Regulatory Guide 1.111, Revision 1, July 1977. Regulatory Guide 1.109 is entitled "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, "Revision 1, October 1977 and Regulatory Guide 1.111 is entitled "Methods for Estimating Atmospheric Transport and Dispersion of of Gaseous Effluents in Routine Releases from Light-Water-

Cooled Reactors, "Revision 1, July 1977. These equations also provide for determining the actual doses based upon the historical average atmospheric conditions. The release rate specifications for radioiodines, tritium, and radioactive materials in particulate form are dependent on the existing radionuclide pathways to man, in the unrestricted area. The pathways which were examined in the development of these calculations were: 1) individual inhalation of airborne radionuclides, 2) deposition of radionuclides onto green leafy vegetation with subsequent consumption by man, 3) deposition onto grassy areas where milk animals and meat producing animals graze with consumption of the milk and meat by man, and 4) deposition on the ground with subsequent exposure of man.

This specification applies to the release of gaseous effluents from all reactors at the site and from the incineration of oil.

B/1.2.5 Gaseous Radwaste Treatment

The OPERABILITY of the GASEOUS RADWASTE TREATMENT SYSTEM and the VENTILATION EXHAUST TREATMENT SYSTEM ensures that the systems will be available for use whenever gaseous effluents require treatment prior to release to the environment. The requirement that the appropriate portions of these systems be used, when specified, provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable". This specification implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50, and the design objectives given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the systems were specified as a suitable fraction of the dose design objectives set forth in Sections II.B and II.C of Appendix I, 10 CFR Part 50, for gaseous effluents.

B/1.3 RADIOACTIVE EFFLUENTS: TOTAL DOSE

The specification is provided to meet the dose limitations of 40 CFR 190. The specification requires the preparation and submittal of a Special Report whenever the calculated doses from plant radioactive effluents exceed twice the design objective doses of Appendix I. For sites containing up to 4 reactors, it is highly unlikely that the resultant dose to a member of the public will exceed the dose limits of 40 CFR 190 if the individual reactors remain within the reporting requirement level. The Special Report will describe a course of action which should result in the limitation of dose to a member of the public for 12 consecutive months to within the 40 CFR 190 limits. For the purposes of the Special Report, it may be assumed that the dose commitment to the member of the public from other uranium fuel cycle sources is negligible, with the exception that dose contributions from other nuclear fuel cycle facilities at the same site or within a radius of 5 miles must be considered. If the dose to any member of the public is estimated to exceed the requirements of 40 CFR 190, the Special Report with a request for a variance (provided the release conditions resulting in violation of 40 CFR 190 have not already been corrected), in accordance with the provisions of 40 CFR 190.11, is considered to be a timely request and fulfills the requirements of 40 CFR 190 until NRC staff action is completed. An individual is not considered a member of the public during any period in which he/she is engaged in carrying out any operation which is part of the nuclear fuel cycle.

1.6.2 Semiannual Radioactive Effluent Release Report

1.6.2.1 Routine radioactive effluent release reports covering the operation of the unit during the previous 6 months of operation shall be submitted within 60 days after January 1 and July 1 of each year. The period of the first report shall begin with the date of initial criticality.

1.6.2.2 The radioactive effluent release reports shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit as outlined in Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants", Revision 1, June 1974, with data summarized on a quarterly basis following the format of Appendix B thereof. The summary will also include quantities of radioactive gaseous effluent and solid waste (ash) released as a result of on-site oil incineration.

The radioactive effluent release report to be submitted within 60 days after January 1 of each year shall include an annual summary of hourly meteorological data collected over the previous year. This annual summary may be either in the form of an hour-by-hour listing of wind speed, wind direction, and atmospheric stability, and precipitation (if measured) on magnetic tape, or in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability. This same report shall include an assessment of the radiation doses due to the radioactive liquid and gaseous effluents released from the unit or station and oil incinerator during the previous calendar year. This same report shall also include an assessment of the radiation doses from radioactive liquid and gaseous effluents to members of the public due to their activities inside the site boundary (Figures 5.1-3 and 5.1-4 of the VCSNS Technical Specifications) during the year. All assumptions used in making these assessments (i.e., specific activity, exposure time and location) shall be included in these reports. Historical annual average meteorology or meteorological conditions concurrent with the time of release of radioactive materials in gaseous effluents (as determined by sampling frequency and measurement) shall be used for determining the gaseous pathway doses. The assessment of radiation doses shall be performed in accordance with the OFFSITE DOSE CALCULATION MANUAL (ODCM).