DUKE POWER COMPANY

OCONEE NUCLEAR STATION

PROPOSED TECHNICAL SPECIFICATIONS
FOR COMPLIANCE WITH
10 CFR 50 APPENDIX I

JUNE 4, 1976

DUKE POWER COMPANY
OCONEE NUCLEAR STATION

PROPOSED TECHNICAL SPECIFICATIONS
FOR COMPLIANCE WITH
10 CFR 50 APPENDIX I

JUNE 4, 1976

2.4 RADIOACTIVE EFFLUENTS

Introduction

Objective: To define the limits and conditions for the controlled release of radioactive materials in liquid and gaseous effluents to the environs to ensure that these releases are as low as is reasonably achievable in conformance with 10 CFR Parts 50.34a and 50.36a, and to ensure that these releases result in concentrations of radioactive materials in liquid and gaseous effluents released to unrestricted areas are within the limits specified in 10 CFR Part 20.

To ensure that the releases of radioactive material above background to unrestricted areas are as low as is reasonably achievable, the following design objectives as defined in Appendix I to 10 CFR Part 50.36a apply:

A. The annual total quantity of all radioactive material above background that may be released from ~~each light-water-cooled nuclear power reactor~~ The site to unrestricted areas should not result in an annual dose or dose commitment from liquid effluents for any individual in an unrestricted area from all pathways of exposure in excess of ~~3~~ 9 millirems to the total body or ~~10~~ 30 millirems to any organ.

B. The annual total quantity of all radioactive material above background that may be released from ~~each light water cooled nuclear power reactor~~ The Site to the atmosphere should not result in an annual air dose from gaseous effluents at any location near ground level which could be occupied by individuals in unrestricted areas in excess of ~~10~~ 30 millirads for gamma radiation or ~~20~~ 60 millirads for beta radiation, or that this quantity should not result in an annual external dose from gaseous effluents to any individual in unrestricted areas in excess of ~~5~~ 15 millirems to the total body or ~~15~~ 45 millirems to the skin.

C. The annual total quantity of all radioactive iodine and radioactive material in particulate form above background that may be released from ~~each light water cooled nuclear power reactor in effluents~~ The Site to the atmosphere should not result in an annual dose or dose commitment from such radioactive iodine and radioactive material in particulate form for any individual in an unrestricted area from all pathways of exposure in excess of ~~15~~ 45 millirems to any organ.

~~Definitions: To assure uniformity of interpretation, the following definitions are used in Section 3.4 of these Technical Specifications.~~

~~Subscripts~~

~~i = refers to individual radionuclide.~~

~~j = refers to time period for gaseous releases.~~

Δ - refers to time period for liquid releases.

v - refers to all releases per site. These are non-elevated releases as defined in Regulatory Guide 1.111.

s - refers to all stack releases per site. These are elevated releases as defined in Regulatory Guide 1.111.

β - refers to beta emission of a radionuclide.

γ - refers to gamma emission of a radionuclide.

τ - refers to the total body or an organ.

θ - refers to direction sector. The direction sectors for the sites are defined as the sixteen 22-½ degree sectors of a circle with the apex at the center of the building complex. The northsector shall be that sector with true north as a centerline.

Notations

K_i = the total body dose factor due to gamma emissions for each identified radionuclide, in mrem/yr per pCi/m^3 (from Table B-1 of Regulatory Guide 1.109).

L_i = the skin dose factor due to beta emissions for each identified radionuclide, in mrem/yr per pCi/m^3 (from Table B-1 of Regulatory Guide 1.109).

M_i = the air dose factor due to gamma emissions for each identified radionuclide, in mrad/yr per pCi/m^3 (from Table B-1 of Regulatory Guide 1.109).

N_i = the air dose factor due to beta emissions for each identified radionuclide, in mrad/yr per pCi/m^3 (from Table B-1 of Regulatory Guide 1.109).

P_i = the product of the largest inhalation dose factor for any organ of an infant for each identified radionuclide in Table C-4 of Regulatory Guide 1.109 and the infant inhalation rate of 1900 m^3/yr, in mrem/yr per pCi/m^3. The infant age group and pathways are the most restrictive.

$R_{\theta i}$ = the dose factor for each identified radionuclide into sector θ, in mrem/yr per pCi/m^3 from Table 2.4-6. For sectors with real pathways within 5 miles from the center of the building complex, the values of $R_{\theta i}$ have been determined based on these real pathways. For sectors with no real pathways within 5 miles from the center of the building complex, the $R_{\theta i}$ has been determined assuming that all pathways exist at the 5-mile distance.

$D_{\theta\beta}$ = the total beta air dose in sector θ from gaseous effluents for the total time period $\sum_{j=1}^{n} \Delta t_j$, in mrad.

$D_{\theta\gamma}$ = the total gamma air dose in sector θ for gaseous effluents for the total time period $\sum_{j=1}^{n} \Delta t_j$, in mrad.

$D_{\theta\tau}$ = the maximum dose from gaseous effluents to the total body or an organ of an individual in sector θ for the total time period $\sum_{j=1}^{n} \Delta t_j$, in mrem.

D_τ = the cumulative dose to the total body or an organ τ from the liquid effluents for the total time period $\sum_{\ell=1}^{m} \Delta t_\ell$, in mrem.

Δt_ℓ = the length of the ℓ^{th} time period over which $C_{i\ell}$ and F_ℓ are averaged for all liquid releases, in hours.

Δt_j = the length of the j^{th} time period over which $(\chi/Q)_{j\theta}$ and $\dot{Q}_{ij}$ are averaged for all gaseous releases, in hours. For batch releases, no time period Δt_j shall be more than 1 hour; for continuous releases no time period Δt_j shall be more than 24 hours.

m = the total number of time period during which liquid effluent releases occur.

n = the total number of time period during which gaseous effluent release occurs into sector θ.

$\dot{Q}_{ij}$ = the average release rate of radionuclide i in gaseous effluent during time period Δt_j from all stack or all vent release points at the site, in uCi/sec.

$\dot{Q}_i$ = the average release rate of nuclide i in gaseous effluent from all stack or all vent release points at the site during time periods of 1 hour for noble gases and 1 week for all other radionuclides, in uCi/sec.

$C_{i\ell}$ = the concentration of radionuclide i in liquid effluent passing the effluent radiation monitor during time period Δt_ℓ from any liquid release, in uCi/ml.

$A_{i\tau}$ = the adult ingestion dose factor to the total body or any organ τ for each identified radionuclide, in mrem/pCi (from Table A-3 in Regulatory Guide 1.109, listing 169 radionuclides).

F_ℓ = the near field average dilution factor of $C_{i\ell}$ during any liquid effluent release. Defined as the ratio of the maximum liquid waste flow passing the effluent radiation monitor during release to the product of the average measured liquid waste flow from the site discharge sturcture to unrestricted receiving waters and any applicable factor for the mixing effect of the discharge structure.

B_i = the bioaccumulation factor in fish for each identified radionuclide, in pCi/kgm per pCi/liter (from Table A-8 in Regulatory Guide 1.109).

$(X/Q)_{j\theta s}$ = the average atmospheric dispersion factor for the time period Δt_j in sector θ, from all stack release points at the site, in sec/m^3. When Δt_j is greater than 1 hour, the average shall be based on observations of wind speed and atmospheric stability taken at least every hour during Δt_j.

$= k_g L_{\theta s}/\bar{u}$ where

$L_{\theta s} = 2.0 \quad \exp(-h_s^2/2\sigma_z^2)/\sigma_z r_\theta$

The values of $L_{\theta s}$ are provided in Table 2.4-5 for the site boundary and food pathways.

σ_z = the vertical standard deviation of the plume for the applicable atmospheric stability class (Pasquill Category) determined at least hourly, for the distance r_θ during the timer period Δt_j.

r_θ = the distance from the center of the building complex to the receptor for each sector θ, in meters, provided in Table 2.4-5.

h_s = the height of the stack above grade, in meters.

$\bar{u}$ = the average wind speed determined at least hourly, during time period Δt_j in sector θ, at a height of 10 meters for vent releases and at the upper measurement level for stack releases, in m/sec.

k_θ = the recirculation factor accounting for spatial and temporal variations in air flow. For non-continuous releases, its value is unity. For continuous release its value is determined using the methodology described in Regulatory Guide 1.111.

$(\chi/Q)_{j\theta v}$ = the average atmospheric dispersion factor for the time period Δt_j in sector θ, from all vent release points at the site, in sec/m^3. When Δt_j is greater than 1 hour, the average shall be based on observations of wind speed and atmospheric stability taken at least every hour during Δt_j.

$= k_\theta L_{\theta v}/\bar{u}$ where,

$$L_{\theta v} = 2.0/r_\theta \sqrt{\sigma_z^2 + h_v^2}$$

The values of $L_{\theta v}$ are provided in Table 2.4-5 for the site boundary and food pathways. σ_z, r_θ, $\bar{u}$ are defined above.

h_v = the average height of all on site buildings, with the limitation that $h_v \leq \sqrt{2}\ \sigma_z$, in meters.

The noble gases to be considered are:

Ar-41	Kr-88	Xe-133
Kr-83m	Kr-89	Xe-135m
Kr-85m	Kr-90	Xe-135
Kr-85	Xe-131m	Xe-137
Kr-87	Xe-133m	Xe-138

The radioiodines, radioactive materials in particulate form and radionuclides other than noble gases to be considered are:

H-3	Zn-65	Cs-134
C-14	Sr-89	Cs-136
Cr-51	Sr-90	Cs-137
Mn-54	Zr-95	Ba-140
Fe-59	Sb-124	Ce-141
Co-58	I-131	Other nuclides with half-life greater than 8 days.
Co-60	I-133	

A complete list of 169 radionuclides that could be identified in liquid releases is given in Table A-3 of Regulatory Guide 1.109

2.4.1 LIMITING CONDITIONS FOR OPERATION

Specifications for Liquid Waste Effluents

a. The annual average concentration of radioactive materials (excluding noble gases) in any unrestricted area, as a result of liquid releases from the site, shall not exceed the values in Column 2 of Table II of Appendix B to 10CFR20. For noble gases, the annual average concentration shall not exceed 4×10^{-5} μCi/mℓ.

b. The maximum concentration of radioactive materials (excluding noble gases) in any unrestricted area, as a result of liquid releases from the site, shall not exceed 35 times the values in Column 2 of Table II of Appendix B to 10CFR20. For noble gases, the maximum concentration shall not exceed 1.4×10^{-3} μCi/ml.

c ~~b.~~ During release of radioactive material in liquid effluents, the effluent radiation control monitor shall be set to alarm and to initiate the automatic closure/isolation of each radioactive waste discharge to this monitored effluent line prior to exceeding the limits specified in 2.4.1.~~a~~ b above.

d ~~c.~~ The operability of each automatic isolation system in specification 2.4.1.~~b~~ c, above, shall be functionally tested quarterly.

e ~~d.~~ The design objective annual dose from radioactive materials in liquid effluents to unrestricted areas from ~~each radioactive waste producing reactor at~~ the site is ~~3~~ 9 mrem to the total body and ~~10~~ 30 mrem to any organ. The licensee shall maintain a quarterly cumulative record of calculated dose contributions due to the release of radioactive materials in liquid effluents. ~~The dose contributions for the total time period $\sum_{\ell=1}^{m} \Delta t_{\ell}$ shall be calculated for all radionuclides identified in Specification 2.4.2, and a~~ A running sum of these total body and any organ doses shall be recorded after each batch release and at least monthly for all con-

tinuous releases using the equations in Regulatory Guide 1.109 (March, 1976)

~~$D_\tau = 2.4 \times 10^6 \sum_i^{169} A_{io} B_i \sum_{\ell=1}^{m} \Delta t_\ell C_{i\ell} U_\ell$~~

~~where the terms are defined in 2.4.~~

f.e. The maximum quantity of radioactivity contained in any liquid radwaste tank that can be discharged directly to the environs without the continuous automatic control provisions of Specification 2.4.1.~~b~~ c, shall not exceed a quantity which, if evaluated as a batch release, results in calculated doses exceeding Specifications 2.4.1.~~d~~ b or 2.4.1 e at any time.

g.f. The equipment installed in the liquid radioactive waste system shall be maintained and shall be operated to process radioactive liquid wastes prior to their discharge when the projected cumulative release could result in a calculated dose exceeding one-fourth Specification 2.4.1.~~d~~ e in any calendar quarter.

h.g. If the actual release of radioactive materials in liquid effluents results in a calculated dose exceeding one-half Specification 2.4.1.~~d~~ e in any calendar quarter, the licensee shall:

(1) make an investigation to identify the causes for such releases,

(2) define and initiate a program of action to reduce such releases to Specification 2.4.1.~~d~~ e, and

(3) report these actions to the NRC in accordance with Specification ~~(5.6.2)~~.

~~b~~ e. An unplanned or uncontrolled offsite release of radioactive materials in liquid effluents resulting in a calculated dose exceeding one-sixth Specification 2.4.1.~~d~~ e in a single event, requires notification. The notification shall be in accordance with Specification ~~(3.6.2)~~.

2.4.2 LIMITING CONDITIONS FOR OPERATION

Specifications for Liquid Waste Sampling and Monitoring

a. Sampling and analysis of liquid radioactive waste shall be performed in accordance with Table 2.4-1.

b. Prior to taking samples from a tank from which batch liquid waste releases are to be made, at least two tank volumes shall be recirculated to assure that any transferable solids are sampled. ~~If eductors are used, the two tank volumes applies to the entrained fluid.~~

c. Prior to a batch liquid waste release, the sample taken in Specification 2.4.2.b shall be analyzed for nuclide identification and concentration in accordance with Table 2.4-1 and recorded to demonstrate compliance with Specification 2.4.1.

d. Plant records shall be maintained of the radioactive concentration and volume before dilution of all liquid radioactive waste intended for discharge and the average dilution flow and length of time over which each discharge occurred. Sample analysis results and other reports shall be submitted

in accordance with Specification ~~5.6.1~~. Estimates of the sampling and analytical errors associated with each reported value shall be included.

e. The radioactivity in liquid wastes shall be continuously monitored during release. Table 2.4-3 indicates the location and minimum requirements for continuous monitoring instrumentation for liquid waste effluent systems.

(1) If the effluent radiation control monitor on a batch release line is inoperable for a period not to exceed 72 hours, two independent samples shall be taken and analyzed in accordance with Specification 2.4.2.c and two plant personnel shall independently check valving prior to the release. If the monitoring or controlling instrumentation on a batch release line is inoperable for a period exceeding 72 hours, the effluent from this release line shall be terminated.

(2) If the effluent radiation monitor on a continuous release line requiring automatic isolation control in Table 2.4-3 is inoperable, the effluent from this release line shall be terminated.

(3) If the effluent radiation monitor on a release line not requiring automatic isolation control in Table 2.4-3 is inoperable, grab samples shall be taken, analyzed for gross beta activity excluding Tritium at a sensitivity of 10^{-7} uCi/ml and

recorded each eight hours. If this monitoring instrumentation is inoperable for more than seven days, the effluent from this release line shall be terminated.

(4) If the flow rate indicators are inoperable, estimates of the flow based on operating conditions shall be made and recorded whenever there is flow and each four hours thereafter. If the flow rate indicators are inoperable for more than seven days, the effluent from the release line shall be terminated.

f. All liquid effluent radiation monitors shall be calibrated at least annually by means of a known liquid radioactive source and checked at least monthly by means of a known solid radioactive source. The gamma spectrum for the known liquid source shall contain the principal gamma emitter peaks representative of those to be monitored at the set point alarm level by the effluent radiation monitor. The known solid source ~~shall have an average gamma energy within ±25% of the average gamma energy of the radionuclides known to be present in the liquid stream, and~~ shall have a check position for reproducible calibration of the monitor. The known solid source and the sources used to calibrate the known liquid source shall be certified to standards of the National Bureau of Standards. The relationships between the known liquid source, the known solid source, and the effluent radiation monitor readings shall be established. Each effluent radiation monitor shall have a monthly functional check, and

shall have an instrument check either prior to making a release or daily for continuous release effluent radiation monitors.

Bases: The release of radioactive materials in liquid effluents to unrestricted areas shall not exceed the concentration limits specified in 10 CFR Part 20 ~~at any time~~ and should be as low as is reasonably achievable in accordance with the requirements of 10 CFR Part 50.34a and 50.36a. These specifications provide reasonable assurance that the resulting average annual dose or dose commitment from liquid effluents from The Site ~~each radioactive waste producing reactor~~ for any individual in an unrestricted area from all pathways of exposure will not exceed ~~5~~ 9 mrem to the total body or ~~10~~ 30 mrem to any organ. At the same time, these specifications permit the flexibility of operation, compatible with considerations of health and safety, to assure that the public is provided a dependable source of power even under unusual operating conditions which may temporarily result in releases higher than such numerical guides for design objectives but still within levels that assure that the average population exposure is equivalent to small fractions of doses from natural background radiation.

Specification 2.4.1.a requires the licensee to limit the Annual Average concentration of radioactive materials in liquid waste effluents released from the site to levels specified in 10 CFR Part 20.106. This specification provides assurance that no member of the general public will

be exposed ~~at any time~~ to liquid containing radioactive materials in excess of limits considered permissible under the Commission's Regulations.

Specification 2.4.1b limits the quantity of radioactive material released in liquid effluents from the site such that the dose to an individual in any unrestricted area would not exceed 2 mrem whole body or its equivalent in any one hour, consistent with 10CFR Part 20.105.

Consistent with the requirements of 10 CFR Part 50, Appendix A, General Design Criteria 60 and 64, Specifications 2.4.1.~~b~~ c and 2.4.1.~~c~~ d require operation of suitable equipment to control and monitor the releases of radioactive materials in liquid wastes during any period that these releases are taking place.

Specification 2.4.1.~~d~~ e establishes the annual quantity of radioactive materials in liquid waste effluents from ~~each radioactive waste producing reactor~~ the site to unrestricted areas, in accordance with Appendix I to 10 CFR Part 50 dose design objectives and calculational procedures based on models and data such that the actual exposure of an individual through liquid pathways is unlikely to be substantially underestimated.

Specification 2.4.1.~~e~~ f establishes an upper limit to the quantity of radioactive material that is allowed to be released without the automatic control provisions of Specification 2.4.1.~~b~~ c. The intent of this specification is to permit operational flexibility when releases will not result in doses exceeding the design objectives of Appendix I to 10 CFR Part 50 or the dose limits of 10 CFR 20.105

Specification 2.4.1.~~f~~ g requires the licensee to maintain and operate the equipment installed in the liquid radwaste treatment systems to

reduce the release of radioactive materials in liquid effluents to as low as is reasonably achievable, consistent with the requirements of 10 CFR Part 50.36a. Normal use and maintenance of installed equipment in the liquid radwaste treatment system provides reasonable assurance that the quantity released will not exceed the design objective. In order to keep releases of radioactive materials as low as is reasonably achievable, the specification requires operation of equipment whenever the projected cumulative discharge rate could result in doses exceeding one-quarter of the design objectives in Section II.A of Appendix I to 10 CFR Part 50 during any calendar quarter.

The reporting requirements of Specification 2.4.1.~~g~~ h are in accordance with Section IV.A of Appendix I to 10 CFR Part 50 and Specification (~~5.6.2~~)of these Technical Specifications.

Specification 2.4.1.~~h~~ i provides for reporting spillage or release events which, while below the limits of 10 CFR Part 20, could result in exposures higher than the design objectives.

The sampling and monitoring requirements given under Specification 2.4.2 provide assurance that radioactive materials in liquid wastes are properly controlled and monitored in conformance with the requirements of General Design Criteria 60 and 64. These requirements provide the data for the licensee and the Commission to evaluate the plant's performance relative to radioactive liquid

wastes released to the environment. Reports on the quantities of radioactive materials released in liquid waste effluents are furnished to the Commission according to Section (~~5.6.1~~) of these Technical Specifications. On the basis of such reports and any additional information the Commission may obtain from the licensee or others, the Commission may from time to time require the licensee to take such action as the Commission deems appropriate.

2.4.3 LIMITING CONDITIONS FOR OPERATION

Specification for Gaseous Waste Effluents

a. The annual average concentration of radioactive materials in any unrestricted area, as a result of gaseous effluent releases from the site, shall not exceed the values in Column 1 of Table II of Appendix B to 10CFR20.

b. The maximum concentration of radioactive materials in any unrestricted area, as a result of gaseous releases from the site, shall not exceed 35 times the values in Column 1 of Table II of Appendix B to 10CFR20.

c. ~~b.~~ During the release of gaseous wastes from the primary system waste gas holdup system, the effluent monitor shall be operating and set to alarm and to initiate the automatic closure of the waste gas discharge valve prior to exceeding the limits specified in 2.4.3.~~a.(1)~~ b above. During purging of the containment building, the effluent monitor shall be operating and set to alarm and to initiate the automatic closure of the containment purge release valve prior to exceeding the limits specified in 2.4.3.~~a.(1)~~ b above.

d. ~~c.~~ The operability of each automatic isolation valve in Specification 2.4.3.~~b~~ c above, shall be functionally tested quarterly.

e. ~~d.~~ The design objective annual air dose from radioactive noble gases in gaseous effluents to unrestricted areas in each direction sector from ~~each radioactive waste producing reactor at~~ the site is 30 mrad for gamma radiation and 60 mrad for beta radiation. The licensee shall maintain a quarterly cumulative record of calculated dose contributions to each of the 16 sectors due to the release of radioactive materials in all gaseous effluents. ~~The sector dependent dose contributions for the total time period $\sum_{j=1}^{n} \Delta t_j$ shall be calculated for all noble gases identified in Specifications 2.1.1.a, b and c, and~~ A a running sum of these doses per sector shall be recorded after each batch release and at least weekly for all continuous releases using the equations, in Regulatory Guide 1.109 (MARCH, 1976)

~~$$D_{\theta\gamma} = 110 \sum_{i}^{15} M_i \sum_{j=1}^{n} \Delta t_j \left[(\chi/Q)_{j\theta v} \dot{Q}_{ijv} + (\chi/Q)_{j\theta s} \dot{Q}_{ijs} \right]$$~~

~~and~~

~~$$D_{\theta\beta} = 110 \sum_{i}^{15} N_i \sum_{j=1}^{n} \Delta t_j \left[(\chi/Q)_{j\theta v} \dot{Q}_{ijv} + (\chi/Q)_{j\theta s} \dot{Q}_{ijs} \right]$$~~

~~where the terms are defined in 2.4.~~

f ~~e.~~ The design objective annual dose or dose commitment from radioiodines, radioactive material in particulate form and radionuclides other than noble gases in gaseous effluents to unrestricted areas in each direction sector from ~~each radioactive waste producing reactor at~~ the site is ~~15~~ 45 mrem to the total body or any organ. The licensee shall maintain a quarterly cumulative record of calculated dose contributions to each of the 16 sectors due to the release of radioactive materials in all gaseous effluents. ~~The sector dependent dose contributions for the total time period $\sum_{j=1}^{n} \Delta t_j$ shall be calculated for all radioiodines, radioactive material in particulate form and radionuclides other than noble gases identified in Specifications 2.4.4.a, b and c, and a~~ A running sum of these doses per sector shall be recorded after each batch release and at least weekly for all continuous releases using the equation, in Regulatory Guide 1.109 (MARCH, 1976)

~~$$D_{\theta\tau} = 110 \sum_{i=1}^{19} R_{i\theta} \sum_{j=1}^{n} \Delta t_j \left[(\chi/Q)_{j\theta v} \dot{Q}_{ijv} + (\chi/Q)_{j\theta s} \dot{Q}_{ijs} \right]$$~~

where the terms are defined in 2.4.E.

g. ~~f.~~ The maximum activity to be contained in one waste gas storage tank shall not exceed 3.8×10^{6} curies (considered as Xe-133).

h ~~g~~ All equipment installed in the gaseous radioactive waste system shall be maintained. The licensee shall operate equipment installed to reduce the radioactive materials in gaseous wastes prior to their discharge when the projected cumulative doses could exceed one-fourth Specification 2.4.3.~~d~~ e in any calendar quarter, or could exceed one-fourth Specification 2.4.3.~~e~~ f in any calendar quarter.

i ~~h~~. If the actual release of radioactive materials in gaseous effluents results in a calculated dose exceeding one-half Specifications 2.4.3.~~d~~ e or ~~e~~ f above, in any calendar quarter, the licensee shall:

(1) make an investigation to identify the causes for such release rates,

(2) define and initiate a program of action to reduce such releases to Specification 2.4.3.~~d~~ e and 2.4.3.~~e~~ f, and

(3) report these actions to the NRC in accordance with Specification ~~(5.6.2)~~.

j ~~i~~ An unplanned or uncontrolled release of radioactive materials in gaseous effluents resulting in a calculated dose excessing of one-sixth Specifications 2.4.3.~~d~~ e or ~~e~~ f above, in a single event requires notification. This notification shall be in accordance with Specification ~~(5.6.2)~~

K ~~j~~ Potentially-explosive gas mixtures of hydrogen and oxygen contained in waste processing system components shall be continuously monitored for gas concentration during power

operation. All gas monitors shall have daily sensor checks, monthly functional checks, and quarterly calibration.

(1) For systems designed to withstand a hydrogen explosion, the gas monitor shall alarm, both locally and in the control room, at a set point of 4% by volume of hydrogen or oxygen. If the gas monitor or alarm is inoperable, gas samples shall be taken and analyzed each 4 hours during power operation, and either the instrument should be made operable within two weeks or the licensee shall notify the NRC in accordance with Specification ~~5.6.2.a(2)~~ 30-Day Report.

(2) For systems not designed to withstand a hydrogen explosion, the automatic control features to prevent potentially-explosive gas mixtures in the system components shall be initiated by either of two independent gas monitors and both shall alarm, locally and in the control room, at the set points of 2% and 4% by volume of hydrogen and/or oxygen. At least one continuously controlling gas monitor with alarms shall be in operation whenever the gaseous waste processing system is operating.

2.4.4 LIMITING CONDITIONS FOR OPERATION

Specifications for Gaseous Waste Sampling and Monitoring

a. Sampling and analysis of radioactive material in gaseous effluent, including radioactive materials in particulate forms and radioiodines shall be performed in accordance with Table 2.4-2.

b. Noble gas releases to the environment, except from the turbine building ventilation exhaust, shall be continuously monitored for gross radioactivity and flow according to Table 2.4-4. Whenever these radiation monitors are inoperable, grab samples shall be taken and analyzed daily for gross radioactivity. Meteorological monitoring instrumentation should be operated as specified in ~~3.2.~~ If these monitors, devices or instruments are inoperable for more than seven days, these releases shall be terminated.

c. During any planned batch release of radioactive materials in effluent, the gross activity monitor, the iodine collection device, the particulate collection device, and the metecrological monitoring instrumentation specified in ~~3.2~~ shall be operating.

d. Plant records shall be maintained and reports of the sampling and analyses results shall be submitted in accordance with Specification ~~5.6.1~~ Estimates of the sampling and analytical errors associated with each reported value should be included.

e. All gaseous effluent radiation monitors shall be calibrated at least annually by means of a known noble gas radioactive source and checked at least weekly by means of a known solid radioactive source. The gamma or beta spectrum for the known noble gas source shall contain at least one of the principal gamma or beta emitter peaks known to be present in the gas stream to be monitored by the effluent radiation monitor. The known solid source ~~shall have an average gamma or beta energy within ± 25% of the average gamma or beta energy of the nuclides known to be present in the gas stream, and~~ shall have a check position for reproducible calibration of the monitor. The known solid source and the sources used to calibrate the known noble gas source and monitors used for analysis in Specification 2.4.4.a shall be certified to standards of the National Bureau of Standards. The relationships between the known noble gas source, the known solid source, and the effluent radiation monitor readings shall be established. Each effluent radiation monitor shall have a monthly functional check, and shall have an instrument check or a solid source check either prior to making a release or daily for continuous release effluent radiation monitors.

Bases: The release of radioactive materials in gaseous waste effluents to unrestricted areas shall not result in concentrations that exceed limits specified in 10 CFR Part 20 ~~at any time~~ and should be as low as is reasonably achievable in accordance with the requirements of 10 CFR Part 50.34a and 50.36a. These specifications provide reasonable assurance that the resulting annual air dose due to gamma radiation will not exceed $\frac{30}{10}$ mrad and that the resulting annual air dose due to beta radiation will not exceed $\frac{60}{20}$ mrad from the gaseous waste effluents from ~~each radioactive waste producing reactor or~~ the site. These specifications also provide reasonable assurance that no individual in an unrestricted area will receive an annual dose to the total body greater than $\frac{15}{5}$ mrem or an annual dose to the skin greater than $\frac{45}{15}$ mrem from these gaseous effluents, and that the annual dose to any organ of an individual from radioiodines and radioactive material in particulate form will not exceed $\frac{45}{15}$ mrem from ~~each radioactive waste producing reactor at~~ the site.

At the same time, these specifications permit the flexibility of operation, compatible with considerations of health and safety, to assure that the public is provided with a dependable source of power even under unusual operating conditions which may temporarily result in releases higher than such numerical guides for design objectives but still within levels that assure that the average population exposure is equivalent to small fractions of doses from natural background radiation.

Specification 2.4.3.a limits the release of radioactive material in gaseous waste effluents to the environs so that the

Specification 2.4.3.b limits the quantity of radioactive material released in gaseous effluents from the site such that the dose to an individual in any unrestricted area would not exceed 2 mrem whole body or its equivalent in any one hour, consistent with 10CFR Part 20.105.

The equations utilized in these Technical Specifications are provided in Regulatory Guides 1.109 and 1.111. Since many reactors do not have provisions for instantaneous radionuclide identification at all batch and continuous release points for radioactive materials in gaseous effluents, and since the collection process required to obtain adequate sensitivity for the identification of particulates and radioiodine is a function of time, these Technical Specifications permit the accumulation of atmospheric dispersion factors over time periods consistent with those utilized in the collection of effluent data. For batch releases, the average χ/Q corresponding to release rate $\dot{Q}$ during each time period Δt_j not greater than 1 hour shall be determined after each batch for each sector from the average wind speed and atmospheric stability

class (Pasquill Category) measured during each time period ~~Δt_j~~. For continuous releases, the average χ/Q shall be determined for each time period ~~Δt_j~~ not greater than 24 hours. This average χ/Q is derived from the χ/Q values calculated hourly or more frequently, and is based on hourly or more frequent observations of wind speed and atmospheric stability class (Pasquill Category), and is equal to the sum of the individual χ/Q determinations divided by the total number of determinations during ~~each~~ each time period ~~Δt_j~~. These sector-dependent doses are cumulated and recorded to show compliance with the requirements of 10 CFR Part 20 and design objectives of Appendix I to 10 CFR Part 50. The licensee may employ a computerized system to measure, determine, cumulate, and record the sector doses to show compliance with the Commissions Regulations.

The release rate Specifications for radioiodine, radioactive material in particulate form and radionuclides other than noble gases are dependent on existing radionuclide pathways to man. The pathways which were examined for these Specifications are 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 milch 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. Methods for estimating doses ~~to the thyroid~~ via these pathways are described in Regulatory Guide 1.109.

~~Specification 2.4.3.a(2) limits the release rate of radioiodines, radioactive material in particulate form and radionuclides other than noble gases so that the corresponding thyroid dose rate above background to an infant via the inhalation pathway is less than 1500 mrem/yr at the site boundary, in compliance with the limits of 10 CFR Part 20.~~

Consistent with the requirements of 10 CFR Part 50, Appendix A, Design Criteria 60 and 64 Specifications 2.4.3.~~b~~ c and 2.4.3.~~c~~ d require that suitable equipment to monitor and control the radioactive gaseous releases are operating during any period these releases are taking place.

Specification 2.4.3.~~d~~ e establishes the design objectives for radioactive noble gases in waste effluents from each radioactive waste producing reactor to unrestricted areas. Specification 2.4.3.~~e~~ f establishes the design objective for radioiodines, radioactive materials in particulate form and nuclides other than noble gases in releases from ~~each unit~~ the site to unrestricted areas. These Specifications are in accordance with Appendix I to 10 CFR Part 50 dose design objectives and calculational procedures based on models and data such that the annual exposure of an individual through gaseous and airborne pathways is unlikely to be substantially underestimated.

Specification 2.4.3.~~f~~ g limits the maximum quantity of radioactive gas that can be contained in a waste gas storage tank. The calculation of this quantity ~~should~~ assumes instantaneous ground release, a χ/Q based on 5 percent meteorology, an average gross gamma energy of ~~0.19~~ 0.645 Mev per disintegration (considering Xe-133 to be the principal emitter) and exposure occurring at the minimum site boundary radius using a semi-infinite cloud model. The calculated quantity will limit the offsite dose above background to 0.5 rem or less, consistent with Commission guidelines.

Specification 2.4.3.~~g~~ h requires that the licensee maintain and operate the equipment installed in the vent, purge, exhaust, off-gas and ventilation systems to reduce the release of radioactive materials in gaseous waste effluents to as low as is reasonably achievable, consistent with the requirements of 10 CFR Part 50.34a and 50.36a. Normal use and maintenance of installed equipment in the gaseous waste system provides reasonable assurance that the quantity released will not exceed the design objectives. In order to keep releases of radioactive materials as low as is reasonably achievable, the specification requires operation of equipment whenever the projected cumulative discharge rate will exceed one-fourth the dose design objectives of Appendix I to 10 CFR Part 50 during any calendar quarter.

The reporting requirements of Specification 2.4.3.~~h~~ i are in accordance with Section IV.A of Appendix I to 10 CFR Part 50 and Specification (~~5.6.2~~) of these Technical Specifications.

Specification 2.4.3.~~i~~ j provides for reporting release events which, while below the limits of 10 CFR Part 20, could result in exposures higher than the design objectives.

Specification 2.4.3.~~j~~ k provides for maintaining instrumentation on systems handling potentially-explosive gas mixtures of hydrogen and oxygen.

The sampling and monitoring requirements given under Specification 2.4.4 provide assurance that radioactive materials released in gaseous effluents are properly controlled and monitored in conformance with the requirements of General Design Criteria 60 and 64. These requirements provide the data for the licensee and the Commission to evaluate the plant's performance relative to radioactive materials released in gaseous effluents. Reports on the quantities of radioactive materials released in gaseous effluents are furnished to the Commission according to Section ~~5.6.1~~ of these Technical Specifications. On the basis of such reports and any additional information the Commission may obtain from the licensee or others, the Commission may from time to time require the licensee to take such action as the Commission deems appropriate.

Specification 2.4.4.b excludes monitoring the turbine building ventilation exhaust for PWR reactors since this release is expected to be a negligible release point.

2.4.5 LIMITING CONDITIONS FOR OPERATION

Specifications for Solid Waste Handling and Disposal

a. The total curie quantity and principal radionuclide composition shall be determined by measurement or estimates for all radioactive solid waste shipped offsite.

b. Reports of the radioactive solid waste shipments, volumes, principal radionuclides, and total curie quantity, shall be submitted in accordance with Section ~~5.6.1~~

Bases: The requirements for solid radioactive waste handling and disposal given under Specification 2.4.5 provide assurance that solid radioactive materials stored at the plant and shipped offsite are packaged in conformance with 10 CFR Part 20, 10 CFR Part 71, and 49 CFR Parts 170-178.

TABLE 2.4-1

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS

Liquid Source	Sampling and Analysis Frequency	Type of Activity Analysis	Detectable Concentrations (μCi/ml)[a]
A. Monitor Tank Batch Releases	Each Batch	Principal Gamma Emitters	5×10^{-7}[b]
	One Batch/Month	Dissolved Gases[e]	10^{-5}
	~~Weekly Composite[f]~~	~~Sr-89, Sr-90~~	~~10^{-8}~~
	Monthly Composite[c]	H-3	10^{-5}
		Gross α	10^{-7}
	~~Quarterly Composite[f]~~	~~Sr-89, Sr-90~~	~~5×10^{-8}~~
~~B. Primary Coolant~~	Tech. Spec. = Appendix A[d]	Radioiodines	10^{-6}
~~C. Steam Generator Blowdown~~	~~Weekly[f]~~	Principal Gamma Emitters	~~5×10^{-7}~~[b]
		~~Sr-89, Sr-90~~	~~10^{-8}~~
	~~One Sample/Month~~	~~Dissolved Gases[e]~~	~~10^{-5}~~
	~~Monthly Composite[f]~~	~~H-3~~	~~10^{-5}~~
		~~Gross α~~	~~10^{-7}~~
	~~Quarterly Composite[f]~~	~~Sr-89, Sr-90~~	~~5×10^{-8}~~

[a] The detectability limits for activity analysis are based on the technical feasibility and on the potential significance in the environment of the quantities released. For some nuclides, lower detection limits may be readily achievable, and when nuclides are measured below the stated limits, they should also be reported.

[b] For certain mixtures of gamma emitters, it may not be possible to measure radionuclides in concentrations near their sensitivity limits when other nuclides are present in the sample in much greater concentrations. Under these circumstances, it will be more appropriate to calculate the concentrations of such radionuclides using measured ratios with those radionuclides which are routinely identified and measured.

[c] A composite sample is one ~~in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged and in~~ which the method of sampling employed results in a specimen which is representative of the liquids released.

[d] ~~The power level and cleanup or purification flow rate at the sample time shall also be reported. Specification 5.6.1.~~

[e] ~~For dissolved noble gases in water, assume a MPC of 4×10^{-5} μCi/ml of water.~~

[f] ~~To be representative of the average quantities and concentrations of radioactive materials in liquid effluents, samples should be collected in proportion to the rate of flow of the effluent stream. Prior to analyses, all samples taken for the composite should be thoroughly mixed in order for the composite sample to be representative of the average effluent release.~~

TABLE 2.4-2

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS

Gaseous Source	Sampling and Analysis Frequency	Type of Activity Analysis	Detectable Concentrations (μCi/ml)[a]
A. Waste Gas Decay Tank Batch Releases	Each Tank	Principal Gamma Emitters	10^{-4}[b]
		H-3	10^{-6}
B. Containment Purge Batch Releases	Each Purge[c]	Principal Gamma Emitters	10^{-4}
		H-3	10^{-6}
C. Condenser Air Ejector Continuous Releases	Monthly (Gas Sample)[c]	Principal Gamma Emitters	10^{-4}[b]
		H-3	10^{-6}
D. Other Environmental Continuous Releases	Monthly (Gas Samples)[c]	Principal Gamma Emitters	10^{-4}[b]
		H-3	10^{-6}
	~~Weekly (Charcoal Sample)[d,e]~~	I-131	10^{-12}
	~~Monthly (Charcoal Sample)[d,e]~~	I-133, I-135	10^{-10}
	~~Weekly (Particulates)[d,e]~~	Principal Gamma Emitters (Ba-La-140, I-131, Others)	10^{-11}
	~~Monthly Composite[d]~~ (Particulates)	Gross α	10^{-11}
	~~Quarterly Composite[d]~~ (Particulates)	Sr-89, Sr-90	10^{-11}

[a] The above detectability limits for activity analysis are based on technical feasibility and on the potential significance in the environment of the quantities released. For some nuclides, lower detection limits may be readily achievable, and when nuclides are measured below the stated limits, they should also be reported.

[b] For certain mixtures of gamma emitters, it may not be possible to measure radionuclides at levels near their sensitivity limits when other nuclides are present in the sample at much higher levels. Under these circumstances, it will be more appropriate to calculate the levels of such radionuclides using observed ratios with those radionuclides which are measurable.

[c] Analyses shall also be performed following each refueling, startup, or similar operational occurrence which could alter the mixture of radionuclides.

[d] ~~To be representative of the average quantities and concentrations of radioactive materials in particulate form released in gaseous effluents, samples should be collected in proportion to the rate of flow of the effluent stream.~~

[e] ~~Analyses shall also be performed daily for a week following each refueling, startup or similar operational occurrence which could lead to significant increase or decrease in radioiodine releases.~~

BLE 2.4-3

PRESSURIZED WATER REACTOR LIQUID WASTE SYSTEM

LOCATION OF PROCESS AND EFFLUENT MONITORS AND DEVICES REQUIRED BY TECHNICAL SPECIFICATIONS

Process Stream or Release Point	Continuous Monitoring Instrumentation					Grab Sample Station	High Liquid Level or Overflow Alarm	Radiation Monitor Plant Instrument No.
	Gross Activity	Gross Activity Recorder	Radiation Alarm	Auto Control to Isolation Valve	Flow Rate Indicator			
Process Waste Control Tanks[a]						X	X	
Batch Waste Release Tanks[b]						X	X	
Outdoor Storage Tanks (Potentially Radioactive)						X[e]	X	
Primary Coolant System						X		
Liquid Radwaste Effluent Line	X	X	X	X	X	X		
~~Steam Generator Blowdown Effluent Line[f]~~	~~X~~	~~X~~	~~X~~	~~X[d]~~	~~X~~	~~X~~		
Service Water Effluent Line[c]	X		X			X		
Component Cooling System	X		X			X		
~~Turbine Building Sumps (Floor Drains) Effluent Line~~	~~X~~		~~X~~			~~X~~	~~X~~	

X-Required

a - Any tank that provides liquid waste management control of a process stream by valve isolation prior to sampling to determine the need for treatment, decay or removal of radioactive materials prior to liquid waste transfer (Not Release).

b - Any tank that provides liquid waste management control of a liquid stream by valve isolation prior to mixing, representitive sampling and analyses of the radioactive materials in the liquid waste prior to each tank batch release. If compartments are used, each compartment shall have these requirements.

c - Required downstream of the heat exchangers and before the release point on service water lines cooling any unmonitored, potentially radioactive process stream.

d - Required to automatically terminate radioactive SGB effluent. The automatic control function may also transfer the SGB stream into tanks for monitored batch releases, to the SGB treatment system or to the radwaste treatment system based on continuous radiation monitoring of the SGB stream or the secondary system, as a plant design feature.

e - Grab sample to be taken and analyzed for gross beta excluding tritium activity at alarm and each 4 hours thereafter during alarm conditions.

f - In some PWRs processed liquid from the steam generator blowdown system is returned directly to the secondary system, and the need for continuous monitoring at this release point is eliminated.

TABL 4.4

PRESSURIZED WATER REACTOR GASEOUS WASTE SYSTEM

LOCATION OF PROCESS AND EFFLUENT MONITORS AND SAMPLERS REQUIRED BY TECHNICAL SPECIFICATIONS

Process Stream or Release Point	Continuous Monitoring Instrumentation					Release Point Continuous Sampler		Grab Sample Station	Radiation Monitor Plant Instrument No.
	Noble Gas Activity	Activity Recorder	Radiation Alarm	Auto Control to Isolation Valve	Flow Rate Indicator	I	Particulate		
Waste Gas Storage Tank Releases	X	X	X	X	X	X	X	X	
~~Condenser Air Removal System~~[a]	X	X	X		X	X	X	X	
Unit Vent ~~Header System~~[c]	X	X	X		X	X	X	X	
~~Building Ventilation Systems~~									
Reactor Containment Building (Whenever There is Flow)	X	X	X	X	X	X	X	X	
~~Auxiliary Building~~[c]	X	X	X		X	X	X	X	
~~Fuel Handling & Storage Building or Area~~[c]	X	X	X		X	X	X	X	
Radwaste Building ~~or Area~~[c]	X	X	X		X	X	X	X	
~~Steam Generator Blowdown Tank Vent or Condenser Vent~~[b]	X		X		X	X	X	X	
~~Turbine Gland Seal Condenser~~	X		X		X	X	X	X	
~~Waste Evaporator Condenser Vent~~[d]	X		X		X	X	X	X	

X—Required

~~[c] If any or all of the process streams or building ventilation systems are routed to a single release point, the need for a continuous monitor at the individual discharge point to the main exhaust duct is eliminated. One continuous monitor at the final release point is sufficient.~~

~~[b] In some PWRs the steam generator blowdown tank vent is routed to the main turbine condenser, and the need for a continuous monitor at this release point is eliminated.~~

~~[d] For PWRs in which the waste evaporator condenser is vented directly to the atmosphere.~~

TABLE 2.4-5

VALUES OF $L_{\theta v}$ AND $L_{\theta s}$, IN METERS^{-2} FOR PRESSURIZED WATER REACTORS

Vent		Site Boundary $L_{\theta v}$, m^{-2}								Food Pathway $L_{\theta v}$, m^{-2}						
Sector θ	Distance	Pasquill Category							Distance	Pasquill Category						
	r_θ	A	B	C	D	E	F	G	r_θ	A	B	C	D	E	F	G
1. N																
2. NNE																
3. NE																
4. ENE																
5. E																
6. ESE																
7. SE																
8. SSE																
9. S																
10. SSW																
11. SW																
12. WSW																
13. W																
14. WNW																
15. NW																
16. NNW																

Stack		Site Boundary $L_{\theta s}$, m^{-2}								Food Pathway $L_{\theta s}$, m^{-2}						
Sector θ	Distance	Pasquill Category							Distance	Pasquill Category						
	r_θ	A	B	C	D	E	F	G	r_θ	A	B	C	D	E	F	G
1. N																
2. NNE																
3. NE																
4. ENE																
5. E																
6. ESE																
7. SE																
8. SSE																
9. S																
10. SSW																
11. SW																
12. WSW																
13. W																
14. WNW																
15. NW																
16. NNW																

h_v = _____ h_s = _____

TABLE 2.4-6
DOSE FACTOR $R_{\theta i}$, IN mrem/yr PER pCi/m^3 FOR
PRESSURIZED WATER REACTORS

Sector, θ	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Distance, $r\theta$																
Radionuclide																
H-3																
C-14																
Cr-51																
Mn-54																
Fe-59																
Co-58																
Co 60																
Zn-65																
Sr-89																
Sr-90																
Zr-95																
Sb-124																
I-131																
I-133																
Cs-134																
Cs-136																
Cs-137																
Ba-140																
Ce-141																

5.6.2 NONROUTINE REPORTS

c. Nonroutine Radioactive Effluent Reports

(1) Liquid Radioactive Wastes Report. If the cumulative dose due to releases of radioactive materials in liquid effluents exceeds one-half Specification 2.4.1.~~d~~ e during any calendar quarter, the licensee shall make an investigation to identify the causes of such releases and define and initiate a program of action to reduce the releases to correspond with the dose design objective levels of Appendix I to 10 CFR Part 50. A written report of these actions shall be submitted to the NRC within 30 days from the end of the quarter during which the release occurred.

(2) Gaseous Radioactive Wastes Report. Should the conditions (a) or (b) listed below exist, the licensee shall make an investigation to identify the causes of the releases and define and initiate a program of action to reduce the releases to correspond with the dose design objective levels of Appendix I to 10 CFR Part 50. A written report of these actions shall be submitted to the NRC within 30 days from the end of the quarter during which the releases occurred.

(a) If the cumulative dose due to releases of noble gases during any calendar quarter exceeds one-half Specification 2.4.3.~~d~~ e.

(b) If the cumulative dose due to releases of all radioiodines, radioactive materials in particulate form and nuclides other than noble gases discharged during any calendar quarter exceeds one-half Specification 2.4.3.~~e~~f.

(3) Unplanned or Uncontrolled Release Report. Any unplanned or uncontrolled offsite release of radioactive materials that results in exceeding one-sixth of the annual dose design objectives for radioactive materials in liquid or gaseous effluents requires notification. This notification must be made by a written report within 30 days to the NRC. The report shall describe the event, identify the causes of the unplanned or uncontrolled release and report actions taken to prevent recurrence.