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TECHNICAL EVALUATION REPORT

TECHNICAL EVALUATION REPORT FOR THE EVALUATION OF ODCM REVISION 7 JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2

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Managed by the U.S. Department of Energy

EG&G Idaho

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for the

EVALUATION OF ODCM REVISION 7

JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2

NRC Docket No. 50-348 NRC LICENSE NO. NPF-2
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ABSTRACT

The Offsite Dose Calculation Manual (ODCM) for the Joseph M. Farley Nuclear Plant Units 1 and 2 contains current methodology and parameters used in the calculation of offsite doses due to radioactive liquid and gaseous effluents, in the calculation of gaseous and liquid effluent monitoring alarm/trip setpoints, and in the conduct of the environmental radiological monitoring program. A copy of the most recent complete ODCM was transmitted to the NRC as Revision 7, with a letter dated April 13, 1989. The NRC transmitted Revision 7 to the Idaho National Engineering Laboratory (INEL) for review. The revised ODCM was reviewed by EG&G Idaho at the INEL and the results of the review are presented in this report. It was determined that ODCM Revision 7 uses methods that are, in general, in agreement with the guidelines of NUREG-0133. However, it is recommended that some changes and additions be included in the Licensee's next revision to the ODCM.

FOREWORD

This report is submitted as partial fulfillment of the "Review of Radiological Issues" project being conducted by the Idaho National Engineering Laboratory for the U. S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation. The U. S. Nuclear Regulatory Commission funded the work under FIN D6034 (Project 5) and NRC B&R Number 20 19 05 03.

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FIGURES

1. INTRODUCTION

1.1 Purpose of Review

This document reports the review and evaluation of the most recent version of the Offsite Dose Calculation Manual (ODCM) submitted by the Alabama Power Company (APC), the Licensee for the Jospeh M. Farley Nuclear Plant, Units 1 and 2 (FNP). The ODCM is a supplementary document for implementing the Radiological Effluent Technical Specifications (RETS) in compliance with 10 CFR 50, Appendix I requirements[1].

1.2 Plant-Specific Background

The APC transmitted a complete ODCM, designated Revision 7, effective April 3, 1989 to the Nuclear Regulatory Commission (NRC) with a letter dated April 13, 1989[2].

The NRC transmitted Revision 7 of the ODCM to the Idaho National Engineering Laboratory (INEL) for review. The complete ODCM, updated through Revision 7, was reviewed by EG&G Idaho at the INEL. Results and conclusions of the review of Revision 7 are presented in this report.

2. REVIEW CRITERIA

Review criteria for the ODCM were provided by the NRC in two documents:

NUREG-0472, RETS for PWRs[3]
NUREG-0133, Preparation of RETS for Nuclear Power Plants[4]

The following NRC guidelines were also used in the ODCM review: "General Contents of the Offsite Dose Calculation Manual," Revision 1[5], Regulatory Guide 1.109[6], and Regulatory Guide 1.111[7].

As specified in NUREG-0472, the ODCM is to be developed by the Licensee to document the methodology and approaches used to calculate offsite doses and maintain the operability of the radioactive effluent systems. As a minimum, the ODCM should provide equations and methodology for the following:

- Alarm and trip setpoints on effluent instrumentation
- Liquid effluent concentrations in unrestricted areas
- Gaseous effluent dose rates at or beyond the site boundary
- Liquid and gaseous effluent dose contributions
- Liquid and gaseous effluent dose projections

In addition, the ODCM should contain flow diagrams, consistent with the systems being used at the station, defining the treatment paths and the components of the radioactive liquid, gaseous, and solid waste management systems. A description and the location of samples in support of the environmental monitoring program are also needed in the ODCM.

3. EVALUATION

The Farley ODCM, Revision 7, reviewed below, is applicable to Units 1 and 2 of FNP. Revision 7 was submitted by the Licensee as a complete ODCM. It includes major changes in format and used more current data than previous revisions (e.g., dose factors from Regulatory Guide 1.109, Revision 1 instead of those from the original Regulatory Guide issued in 1976). The methodology used in ODCM Revision 7 is based primarily on NUREG 0133 and Regulatory Guide 1.109, Revision 1. An appendix was added, giving the equations and references for calculations described in the body of the ODCM.

Revision 7 is generally better organized and more complete than previous revisions. However, some changes and additions appear to be needed to increase clarity and completeness and to correct errors.

3.1 Liquid Effluent Pathways

The Joseph M. Farley Nuclear Plant consists of two pressurized water reactors (PWR) operating with closed cycle circulating water systems using cooling towers. Radioactive liquid waste is released in batch mode from Waste Monitor Tanks through Waste Lines No. 1 and No. 2, in continuous mode from the Steam Generator Blowdowns, and by either batch or continuous mode from the Turbine Building Sumps. Figure 1 (copied from the ODCM) and Figure 2 (copied from the Technical Specifications) show the Radioactive Liquid Waste Treatment System, the Steam Generator Blowdowns, the liquid effluent Waste Lines, and the release point. Table 2-1 in the ODCM, Tables 3.3-13 and 4.11-1 in the FNP Technical Specifications, and Tables 2A-1 and 2A-2 in the Licensee's Semiannual Radioactive Effluent Release Reports indicate possible release of radioactive material from the Turbine Building Sumps in addition to the Steam Generator Blowdowns and the Waste Monitor Tanks. The release pathways of radioactive liquids from the various sources are not clearly described in the ODCM. The following

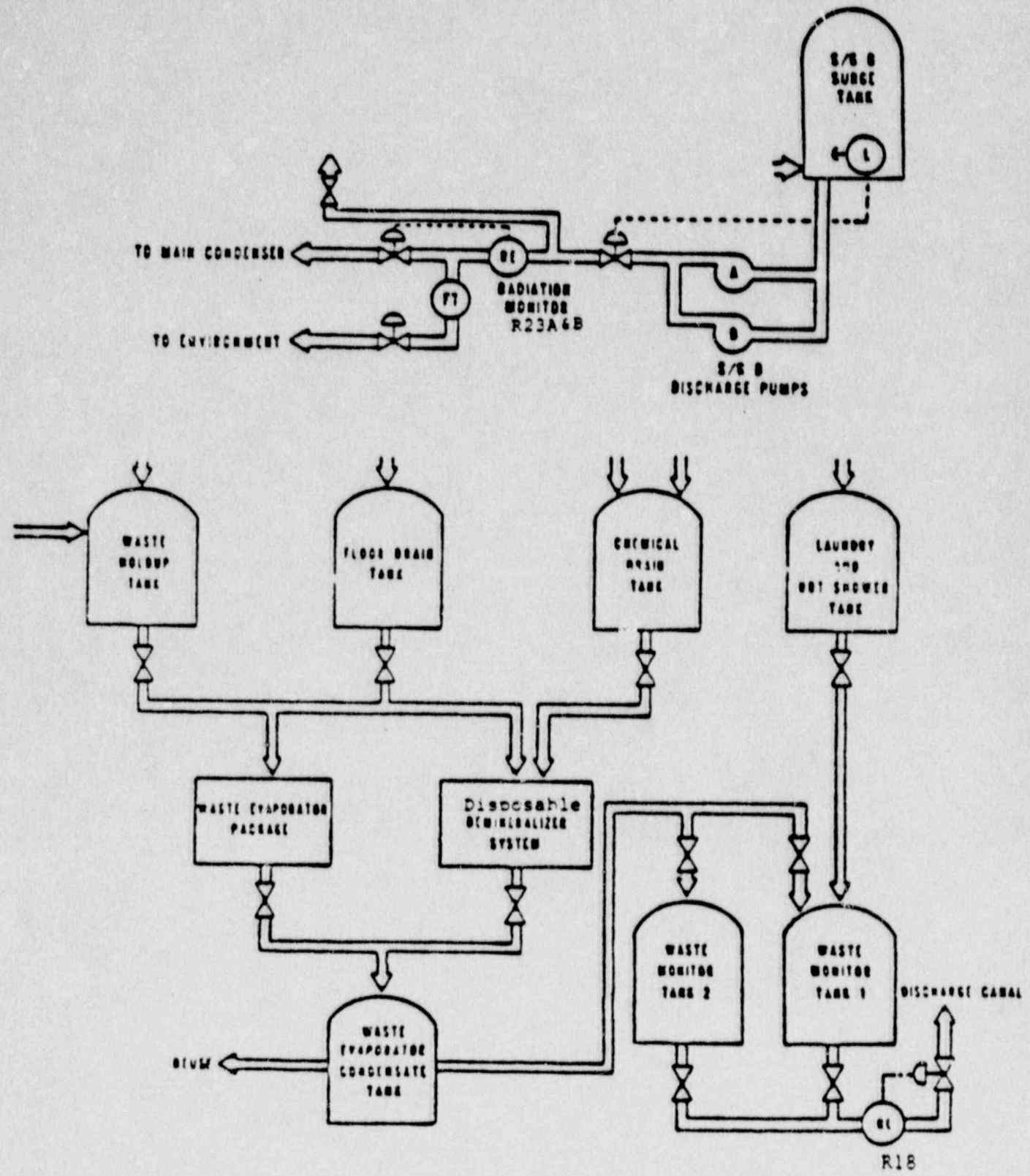

Figure 1. Radioactive liquid waste treatment system and effluent monitors. (Reproduced from Figure 2-1 of the ODCM, Revision 7 for the Joseph M. Farley Nuclear Plant.)

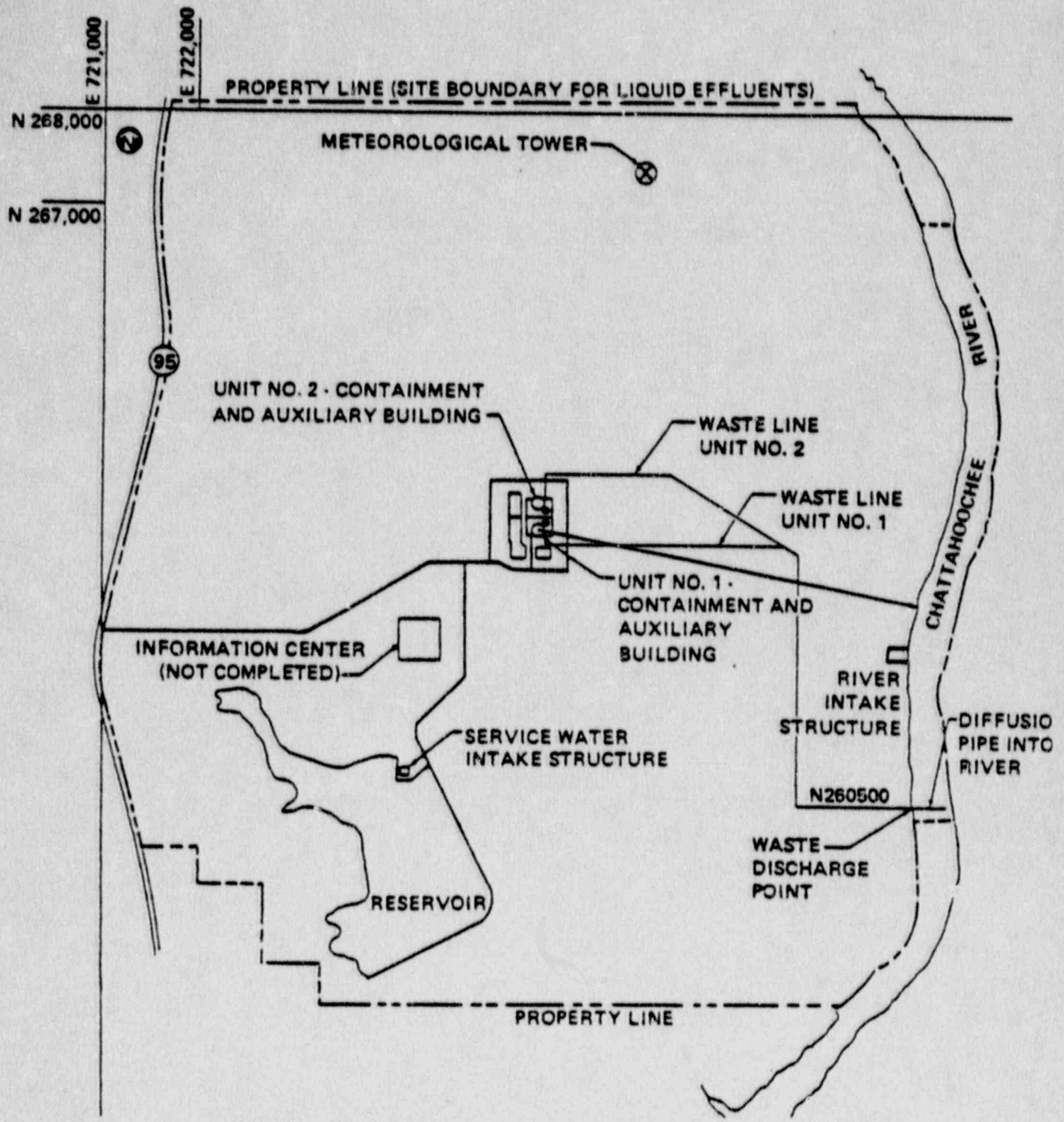

Figure 2. Liquid effluent waste lines and liquid release point. (Reproduced from Figure 5.1-4 of RETS for the Joseph M. Farley Nuclear Plant, Unit No. 2, complete as of July 27, 1984.)

details are not clear from Figures 1 and 2 and the discussions in the ODCM: (a) whether the systems shown are common to both reactor units or exist separately for each unit; (b) whether the Waste Lines shown in Figure 2 are the same as the Liquid Radwaste Effluent Lines identified in Table 3.3-13 of the Technical Specifications; and (c) whether the dilution flow rates discussed are defined for the two units separately or for the site as a whole. The ODCM should clarify these points with a figure and/or a detailed verbal description of the pathways of radioactive liquid waste and dilution water from each source to the discharge point in the Chattahoochee River.

The discussions of setpoints, dose rates, and doses, respectively, in Sections 3.2, 3.5, and 3.7 below are based on assumptions that the systems shown in Figure 1 exist separately for each reactor unit and that the "dilution water flow rate," F_d, refers to the flow rate of dilution water from the site at the Waste Discharge Point shown in Figure 2.

3.2 Liquid Radwaste Monitor Setpoints

Section 2.2 of the ODCM contains methodology to determine setpoints for the radioactive liquid waste discharge line monitors, as required by Technical Specification 3.3.3.10. Technical Specification 3.3.3.10 requires that setpoints for the liquid effluent monitors be established to ensure that the concentration of radioactive material released from the site shall be limited to concentrations specified in 10 CFR 20, Appendix B, Table II, Column 2[8].

For each reactor unit at FNP, Technical Specification Table 3.3-13 requires two radioactive liquid effluent monitors, one on the Liquid Radwaste Effluent Line (RE-18) and another on the Steam Generator Blowdown Effluent Line (RE-23B). This table also identifies flow rate measurement devices for Waste Monitor Tank No. 1, Waste Monitor Tank No. 2, the Steam Generator Blowdown Effluent Line, and the Discharge Canal Dilution Line. Liquid releases from the Turbine Building Sumps are not required to be monitored, but Technical Specification 4.11.1.1.3 requires sampling and analysis of effluents from this source.

Methodology should be included in the ODCM to account for simultaneous releases from each of the six sources of radioactive liquid effluents (2 Turbine Building Sumps, 2 Steam Generator Blowdowns, and Waste Monitor Tanks for each unit). Unless simultaneous releases are considered it would be possible to exceed the concentration limits of 10 CFR 20, since Section 2.2 addresses the setpoint for only one Liquid Radwaste Effluent Line monitor (RE-18), and does not consider releases from the other sources. Equation 2-1 defines this setpoint in terms of the "anticipated dilution factor" (D_a). However, D_a is not specifically defined, although the last sentence in Section 2.2 implies that it is equal to the "actual dilution factor" (R_a) defined by Equation 2.5 in Section 2.3.

Methodology should be added to determine the required setpoints for the Steam Generator Blowdown Effluent Line monitors (RE-23B) and to account for simultaneous releases of radioactive liquid effluents from all sources on the site. With these exceptions, the methodology to determine setpoints for the liquid radioactivity monitors is considered to be within the guidelines of NUREG-0133.

3.3 Gaseous Effluent Pathways

There are six release points for radioactive gaseous effluents at FNP, a Plant Stack Vent for each unit, a Turbine Building Vent for each unit, and an ILRT (integrated leak rate test) Vent for each unit. These vents are shown in Figure 3 (copied from the ODCM) and Figure 4 (copied from the FNP Technical Specifications).

The Containment Ventilation (a continuous release which is also referred to as Containment Purge), the Auxiliary Building Vent, and the Waste Gas Decay Tanks exhaust through the Plant Stack Vents. The Containment Ventilation and Auxiliary Building Vent releases are continuous; the contents of the The Waste Gas Decay Tanks are released in batch mode.

The ILRT, which releases gases from the containment, is described as "a batch release performed infrequently." These batch releases are made at points separate from the Plant Stack Vents.

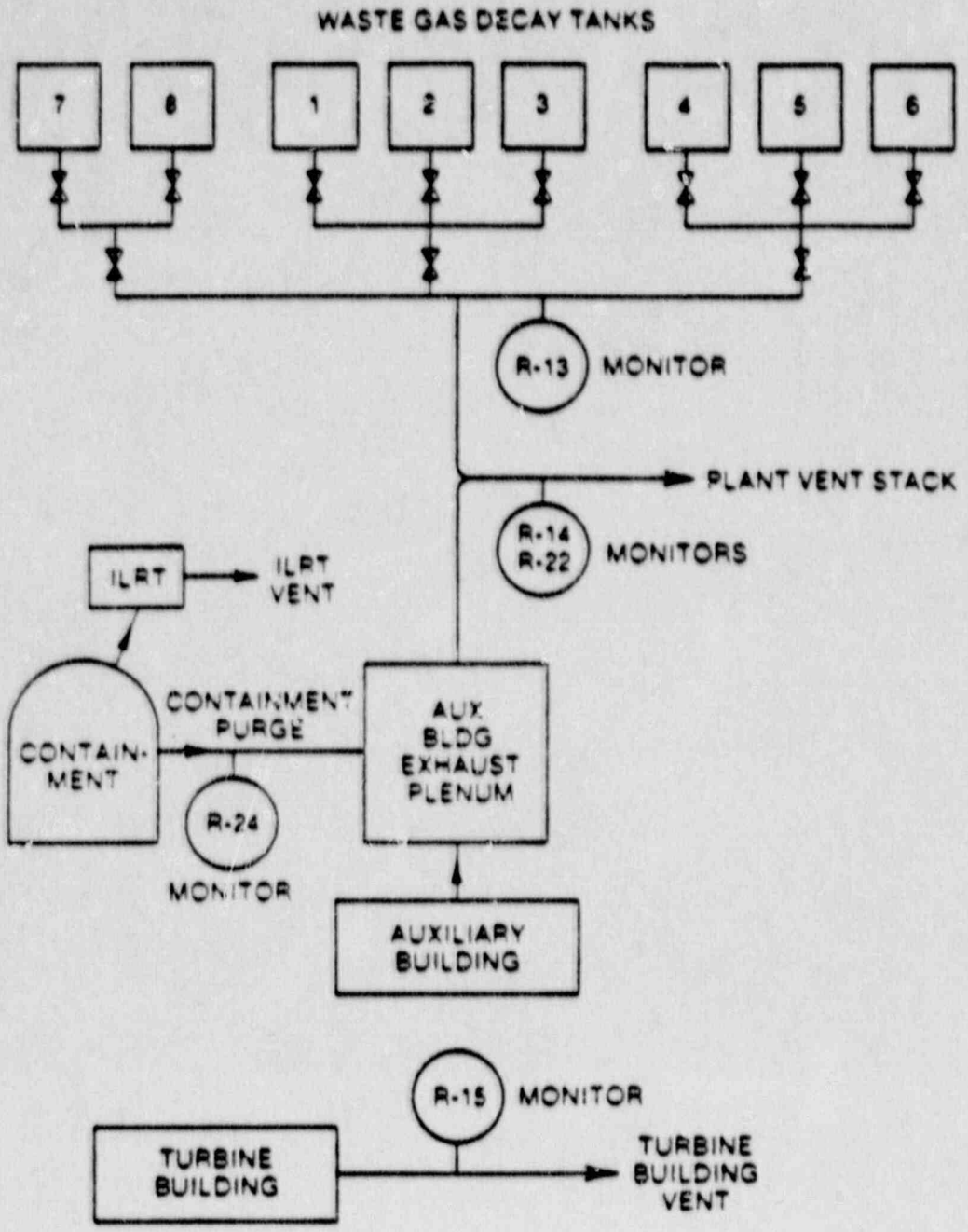

Figure 3. Gaseous radwaste treatment system and effluent pathways. (Reproduced from Figure 3-1 of ODCM, Revision 7 for the Joseph M. Farley Nuclear Plant.)

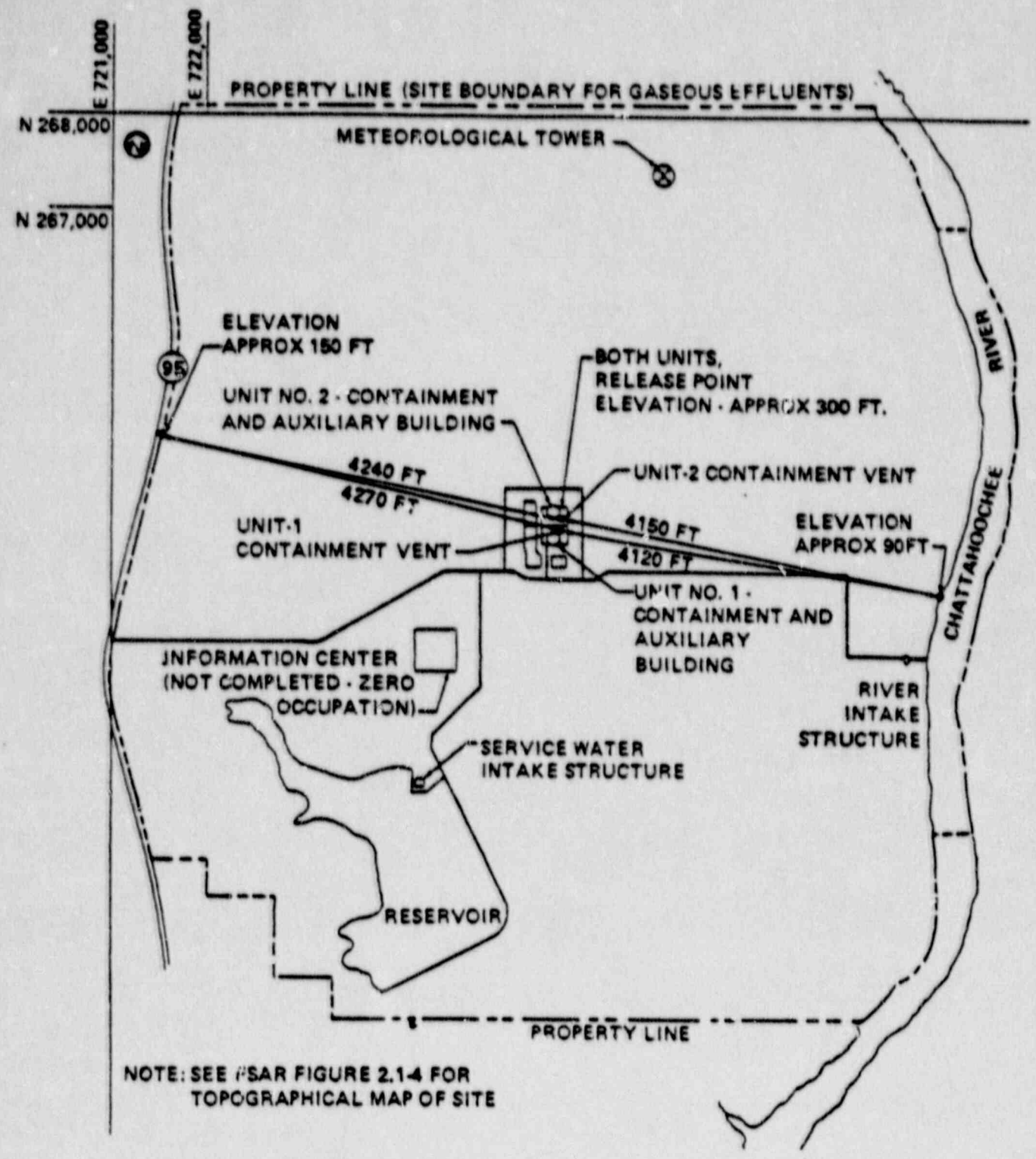

Figure 4. Gaseous effluent release points. (Reproduced from Figure 5.1-3 of RETS for Joseph M. Farley Nuclear Plant, Unit No. 2, complete as of July 27, 1984.)

Releases from the SJAE (Steam Jet Air Ejector) are made in continuous mode through the Turbine Building Vents.

The Plant Vent Stacks release gaseous effluents to the atmosphere at 145 ft 9 in (44.4 m) above grade. Other releases are at lower elevations.

3.4 Gaseous Radwaste Monitor Setpoints

Section 3.3 of the ODCM contains methodology to determine the alarm/trip setpoints for the radioactive gaseous effluent monitors, as required by Technical Specification 3.3.3.11. Technical Specification 3.3.3.11 requires that the setpoints be established to ensure that the dose rates due to radioactive noble gases released offsite shall not exceed either 500 mrem/yr to the total body or 3000 mrem/yr to the skin.

Technical Specification 3.3.3.11 requires noble gas activity monitors at the Steam Jet Air Ejector (R-15, shown between the Turbine Building and the Turbine Building Vent in Figure 3), the Vent Header System (R-14 or R-22, shown on the line to the Plant Vent Stack in Figure 3), and the Gaseous Radwaste Treatment System (R-14, also shown on line to the Plant Vent Stack in Figure 3). Monitor R-14 provides automatic termination of release. Figure 3 shows two monitors not required by the technical specifications, one on the line from the Waste Gas Decay Tanks to the Plant Vent Stack (R-13) and one on the line leading from containment to the Auxiliary Building Plenum (R-24). (In ODCM Figure 3-1, monitor R-13 should apparently be shown on the effluent line from all the Waste Gas Decay Tanks instead of from only 3 of 8 as is shown now.)

Equation 3.17, used to implement the methodology for determining setpoints for the Vent Header System monitor (R-14 or R-22) and Gaseous Radwaste Treatment System monitor (R-14) uses the highest annual average atmospheric dispersion factor at the site boundary. The equation includes a factor, F_v, to account for simultaneous releases from the two monitored release points at each reactor unit and a factor, F, to account for the number of units (2) at FNP. The term "average" should be removed

from the definition of Q_{iv} in Equation 3.17, since the dose rate limits are instantaneous. The ODCM methodology to determine setpoints does not address releases from the Unit 1 and Unit 2 ILRT Vents. The technical specifications do not require radioactivity monitors for these vents, but the methodology should account for contributions to dose rates due to releases from them on the basis of the sampling and analysis required by Technical Specification Table 4.11-2.

The Licensee's methodology determines setpoints based on the assumption that all noble gas released is Kr-89. The metholology results in conservative setpoints except of the failure to consider releases from the ILRT Vents, as noted in the above paragraph.

The methodology given in the ODCM for determining the setpoints of gaseous effluent monitors is, in general, within the guidelines of NUREG-0133. However, contributions to the offsite dose rates due to releases of noble gases via the ILRT Vents should be specifically addressed and the use of the modifier "average" with the release rate should be removed or justified.

3.5 Concentrations in Liquid Effluents

Section 2.3 of the ODCM contains methodology to assure that the concentration of radioactive materials in liquid effluents is maintained within the limits of Technical Specification 3.11.1.1 as required by Specifications 3.11.1.1.1, 4.11.1.1.2, and 4.11.1.1.3. Technical Specification 3.11.1.1 requires that the concentration of radioactive material released from the site in liquid effluents shall be limited to the concentrations specified in 10 CFR 20, Appendix B, Table II, Column 2 for radionuclides other than dissolved or entrained noble gases, and to 2×10^{-4} μCi/mL total activity for noble gases. Technical Specifications 4.11.1.1.1, 4.11.1.1.2, and 4.11.1.1.3 require the results of pre-release and post-release analyses to be used to assure that the concentration limits at the point of release are/were not exceeded.

Equation 2.4 of Section 2.3 defines a conservative "required dilution factor," D_r, by including a "safety factor" of 2. However, releases from only one liquid radwaste tank (Waste Monitor Tank) are specifically accounted for in the calculations. Possible simultaneous releases from the Steam Generator Blowdowns, Turbine Building Sumps, and more than one Waste Monitor Tank should be addressed, as discussed in Section 3.2 above. The source of dilution water flow, F_d, for each waste effluent stream should be identified.

With the exceptions noted in the previous paragraph, the methodology to determine that the concentrations of radioactive material in liquid effluents are/were within the limits of 10 CFR 20 is considered to be within the guidelines of NUREG-0133.

3.6 Dose Rates Due to Gaseous Effluents

Section 3.4 of the ODCM contains methodology to determine that the dose rates in unrestricted areas due to the release of radioactive materials in gaseous effluents are within the limits of Technical Specification 3.11.2.1, as required by Technical Specification 4.11.2.1.1 and 4.11.2.1.2. Technical Specification 3.11.2.1 requires that the dose rate due to radioactive materials released in gaseous effluents from the site does not exceed 500 mrem/yr to the total body or 3000 mrem/yr to the skin for noble gases, and that the dose rate to any organ does not exceed 1500 mrem/yr due to all radioiodines and all radioactive materials in particulate form and radionuclides (other than noble gases) with half lives greater than 8 days. The methodology of Section 3.4 limits the doses to one half of these values for each of the two reactor units on the site.

The definition of Q_{iv} in Equations 3.2.3, 3.2.4, and 3.2.5 states, "Noble gases may be averaged over a period of 1 hour, and any other nuclides may be averaged over a period of 1 week." These time periods should be justified, since Section 2.2 of NUREG recommends the "second" as the practical unit for establishing release rates to show compliance with

the requirements of 10 CFR 20. (Since these calculations are intended to verify compliance with instantaneous dose rate limits, the averaging period should be as short as is feasible with the installed instrumentation.)

Dose rates to the critical organ of an infant (for each radionuclide) due to gaseous radioactive effluents other than noble gases are calculated at the nearest receptor in each sector and summed over applicable pathways for comparison with the organ dose limit of Technical Specification 3.11.2.1. This methodology is expected to calculate a conservative (high) dose rate.

The statement in Section 3.4(b) concerning radionuclides that are to be considered in determining compliance with the limiting dose rate specified in Technical Specification 3.11.2.1(b) contains two errors. First, "radionuclides" should read "radioiodines;" and second, the statement in the ODCM does not include tritium, which is included in the methodology.

All assumptions used in the calculations of the $R_{\theta i}$'s should be furnished in the ODCM, (e.g., it could be stated that the default values of Regulatory Guide 1.109 are used for consumption, transit times, etc.) The definition of W_{mv} should specify the use of $(\chi/Q)_{j\theta v}$ for carbon-14 for all pathways (See Equation C-8 in Regulatory Guide 1.109. (Note, however, that C-14 calculations could be omitted since it is not included in recent NRC guidance[3].)

The following corrections should be made in Table 3-4, Infant Dose Factors, which is used with Equation 3.25 for calculating the organ dose rate: (a) The ground plane dose factor for C-14 should be 0.0; (b) The Cow-Milk and Goat-Milk dose factors for C-14 should be 3.23E+06 mrem/yr per $\mu Ci/m^3$ instead of 2.34E+09 m^2(mrem/yr) per $\mu Ci/s$, based on the dose methodology for C-14 in Section C.3.c and Sections 3.a and 3.b of Appendix C of Regulatory Guide 1.109 ; and (c) Goat-Milk dose factors for many radionuclides should be non-zero, since Section 1, Appendix E, of Regulatory Guide 1.109 specifies use of F_m for the Cow-Milk pathway from Table E-1 when there is no F_m given for the Goat-Milk pathway in Table E-2. The 3 in Equation 3.6 of Section 3.2 should be $(3)^{1\backslash 2}$.

The methodology given in the ODCM to determine that the dose rates offsite due to releases of radioactive materials in gaseous effluents are not exceeded is, in general, within the guidelines of NUREG-0133; but the corrections identified in the previous paragraph should be made and the use of 1 hour as the averaging period for doses due to noble gas effluents should be justified.

3.7 Dose Due to Liquid Effluents

Section 2.4 of the ODCM contains the methodology to determine that doses due to radioactive materials in liquid effluents are within the limits of Technical Specification 3.11.1.2, as required by Technical Specification 4.11.1.2. Technical Specification 3.11.1.2 requires that the dose or dose commitment to an individual due to liquid effluents from each reactor unit be limited to 1.5 mrem to the total body and to 5 mrem to any organ during any calendar quarter, and to 3 mrem to the total body and to 10 mrem to any organ during any calendar year.

Section 2.4 considers only doses due to adult fish consumption. The subject of doses due to shoreline sediment and to potable water and invertebrate consumption should be addressed (e.g., either by adding methodology to calculate the doses or stating that the pathways do not exist, as appropriate). A subscript should be added to the F in the definition of Δt_s.

Table 2-3, Liquid Dose Conversion Factors, should include Mo-99, since it is one of the principal gamma emitters for which analysis is required by Notation e of Technical Specification Table 4.11-1.

The Licensee may wish to consider the following changes. Change the bioaccumulation factor for P in Table 2-2 from 1.00E+05 to the currently recommended value of 3.00E+03[9,10]. Use the 1000 cfs per reactor dilution flow permitted by Section 4.3 of NUREG-0133 instead of "the average flow from the site discharge structure to unrestricted receiving waters times 5" in the definition of F_s, (since sources other than the ODCM indicate that the product now used is less than 1000 cfs per reactor).

Calculate doses for the reporting periods, calendar quarter or calendar year, using the average dilution flow for the reporting period instead of the actual dilution flows during releases. (This is acceptable to the NRC Staff, and permits independent determination of the calculated dose commitments for the reporting periods.)

The subject of doses due to shoreline sediment and to potable water and invertebrate consumption should be addressed in the ODCM. With this exception, the methodology to calculate dose commitments due to liquid effluents is considered to be within the guidelines of NUREG-0133.

3.8 Dose Due to Gaseous Effluents

Noble Gases. Section 3.6.1 of the ODCM contains methodology to determine offsite doses due to the release of noble gases from the site, as required by Technical Specification 4.11.2.2. Technical Specification 4.11.2.2 requires that cumulative dose contributions be determined at least once per 31 days. Specification 3.11.2.2 requires that the air dose due to noble gases released in gaseous effluents, from each reactor unit, from the site be limited to less than or equal to 5 mrad per quarter and 10 mrad per year for gamma radiation, and 10 mrad per quarter and 20 mrad per year for beta radiation.

The ODCM contains two methods for calculating the gamma and beta air doses. "Method A" uses real time meteorological input and "Method B" uses annual average values of χ/Q. The M_i should be defined in this section. All release points, including the ILRT Vents, should be specifically included in the calculations, possibly by identifying the vents included and summing over the subscript v.

If all release points are specifically included in the calculations, the Licensee's methods to determine site boundary noble gas air doses are, in general, within the guidelines of NUREG-0133.

Radionuclides in Particulate Form and Tritium. Section 3.6.2 of the ODCM contains methodology to determine "the dose to an individual from

radioiodines and radioactive materials in particulate form, with half lives greater than 8 days, in gaseous effluents released from each reactor at the site to unrestricted areas." The methodology in this section conforms closely to the requirements of Technical Specification 4.11.2.3, but the introductory statement in quotes above should be relocated so it applies to both Method A and Method B, and reworded to read exactly like the technical specification requirement. As it now reads it does not require calculation of doses due to tritium (although the methodology does include tritium). Technical Specification 4.11.2.3 requires that cumulative dose contributions be determined at least once per 31 days. Technical Specification 3.11.2.3 requires that "the dose to an individual from radioiodines and radioactive materials in particulate form, and radionuclides (other than noble gases) with half-lives greater than 8 days in gaseous effluents released, from each reactor unit, from the site," be limited to less than or equal to 7.5 mrem to any organ per quarter and to less than or equal to 15 mrem to any organ per year.

The ODCM contains two methods for calculating doses due to radioiodines and particulates. "Method A" uses real time meteorological input and "Method B" uses annual average values of χ/Q and D/Q. Both of these methods should contain methodology to specifically include releases of radioactive material from the ILRT Vents as well as releases from the Plant Vent Stacks and the Turbine Building Vents (e.g., by indicating a summation over v and specifying the vents included.) The basic equation for Method B should require summation over the applicable pathways, as does Equation 3.30 for Method A.

The definitions of R_{ipa}, $W_{\theta jv}$, and W should specify the use of $(\chi/Q)_{j\theta v}$ for carbon-14 for all pathways (See Equation C-8 in Regulatory Guide 1.109). Alternatively, the calculation of doses due to C-14 could be eliminated since recent NRC guidance does not require it[3]. The definition of R_{ip7a} in Section 3.6.2 should reference Table 3-5 instead of "an appendix." Dose factors for Mo-99 should be added to Table 3-5, since it is in the list of principal gamma emitters in Notation e of Technical Specification Table 4.11-1. All assumptions used in the calculations of the $R_{\theta i}$'s should be specified in the ODCM,

(e.g., it could be stated that the default values of Regulatory Guide 1.109 are used for consumption, transit times, etc).

The determination of the "maximum exposed individual" by summing the doses to all organs for each age group implies that the maximum organ doses for comparison with the dose limits of Technical Specification 3.11.2.3 are calculated by this method. This is a very conservative method, since the dose limits apply to the dose to a single organ (with dose commitments due to all pathways and all radionuclides considered). The Licensee may wish to revise the methodology of the ODCM to use the highest dose to a single organ for comparison with the technical specification limits.

Both Method A and Method B for calculating doses due to iodines and particulates are, in general, within the guidelines of NUREG-0133. However, the deficiencies noted above should be addressed.

3.9 Dose Projections

Sections 2.6 and 3.8 of the ODCM require projection of doses based on expected operating conditions as required by Technical Specifications 4.11.1.3.1 and 4.11.2.4.1 respectively.

3.10 Diagrams of Effluent Pathways

Figure 2-1 in the ODCM is a diagram of the liquid radwaste treatment system at FNP, and Figure 3-1 is a diagram of the gaseous release sources and release points. Figure 2-1 should be clarified or another figure added to indicate the pathways from sources to the release point, as discussed in Section 3.1 above. No diagram of the solid waste management system is included in the ODCM.

3.11 Total Dose

Section 4 of the ODCM contains a discussion of the Special Report required by Technical Specification 4.11.4 if any of the dose limits of Technical Specifications 3.11.1.2, 3.11.2.2, or 3.11.2.3 are exceeded. Assessment techniques used to determine dose contributions from direct

radiation from the plant and its components will be documented in the Special Report. The Licensee states that there are no other uranium fuel cycle sources within a 50 mile radius. (The Licensee may desire to amend Technical Specification 3.11.4 so it corresponds to Specification 3.11.4 of NUREG-0472, Revision 3, Draft 7," which requires a special report only if the limits of 40 CFR 190 have been exceeded during a calendar year.)

3.12 Environmental Monitoring Program

Section 5 of the ODCM contains a table and figures giving locations for obtaining each and every radiological environmental monitoring sample, as required by Technical Specification 4.12.1, except for the locations of indicator locations for a milk animals. The locations of milk animals as reported in the annual land use censuses changes frequently, so it is not certain if a milk animals existed within 5 miles of the plant at the time the latest revision of the ODCM was prepared. However, if no milk animals exist within 5 miles of the plant this fact should be included in the ODCM. For completeness, a future revision of the ODCM should modify the "sample location" column in the table of monitoring locations to unambiguously define the units of entries that appear to be distance in miles. The descriptions of locations for obtaining radiological environmental monitoring samples are, however, in general, within the guidelines of NUREG-0133.

3.13 Summary

The Licensee's ODCM uses documented and approved methods that are, in general, consistent with the methodology and guidance in NUREG-0133, Regulatory Guide 1.109, and Regulatory Guide 1.111. However, it is recommended that deficiencies noted in this review be addressed in a future revision of the ODCM.

4. CONCLUSIONS

The Licensee's most recent complete ODCM, Revision 7, effective April 3, 1989 and transmitted to the NRC with a letter dated April 13, 1989, was reviewed. It was determined that the ODCM uses methods that are, in general, consistent with the guidelines of NUREG-0133, Regulatory Guide 1.109, and Regulatory Guide 1.111. However, it is recommended that deficiencies noted in the review be addressed in a future revision of the ODCM.

The following summarizes the identified deficiencies:

- In Section 2.1, another figure and/or a detailed description should be added to clearly define the pathways of radioactive liquid waste and dilution water from each source to the the discharge point in the Chattahoochee River.

- Figure 2-1 should be expanded to show the solid waste management system or a figure showing this system should be added to the ODCM.

- Section 2.2 should include methodology to determine setpoints for the monitors on the Steam Generator Blowdowns.

- The methodology to determine setpoints of liquid effluent monitors in Section 2.2 and compliance with the 10 CFR 20 limits in Section 2.3 should specifically address the simultaneous release of radioactive materials from several sources, including the Turbine Building Sumps. Also, the source of dilution water flow for each radioactive effluent stream should be identified.

- Liquid pathways other than fish consumption should be addressed in Section 2.4, either by including the methodology for calculating doses or stating that the pathways do not exist, as appropriate.

- Table 2-3, Liquid Dose Conversion Factors, should include Mo-99, since it is one of the principal gamma emitters for which analysis is required by Notation e of Technical Specification Table 4.11-1.

- In Section 3.3, the term "average" should be removed from the definition of Q_{iv}, since the dose rate limits are instantaneous.

- The methodology in Section 3.3 to determine setpoints of the gaseous monitors should account for releases from the ILRT Vents.

- The averaging of noble gas releases in Section 3.4 over a period of 1 hour and other releases over 1 week should be changed or justified, since NUREG-0133 recommends "1 second" for the averaging period.

- The following corrections should be made in Table 3-4, Infant Dose Factors, which is used with Equation 3.25 for calculating the organ dose rate: (a) The ground plane dose factor for C-14 should be 0.0; (b) The Cow-Milk and Goat-Milk dose factors for C-14 should be 3.23E+06 mrem/yr per $\mu Ci/m^3$ instead of 2.34E+09 m^2(mrem/yr) per $\mu Ci/s$, based on the dose methodology for C-14 in Appendix C of Regulatory Guide 1.109 ; and (c) Goat-Milk dose factors should be non-zero for all nuclides with a transfer factor in either Table E-1 or E-2 in Regulatory Guide 1.109

- In Section 3.4(b), all assumptions used in calculations of the $R_{\theta i}$'s should be furnished in the ODCM, (e.g., it could be stated that the default values of Regulatory Guide 1.109 are used for consumption, transit times, etc.)

- The definitions of W_{mv} in Section 3.4(b) and of R_{ipa}, $W_{\theta jv}$, and W in Section 3.6.2 should specify the use of $(\chi/Q)_{j\theta v}$ for carbon-14 for all pathways (See Equation C-8 in Regulatory Guide 1.109.) Alternatively, the calculation of doses due to C-14 could be eliminated since it is not required by recent NRC guidance(3).

- In Section 3.6.1 and 3.6.2, all release points, including the ILRT Vents, should be specifically included in the calculations (e.g., by identifying the vents included and summing over the subscript v.)

- The basic equation for Method B in Section 3.6.2 should require the summation of doses over the applicable pathways.

- The first sentence of Section 3.6.2 should be relocated so it applies to both Method A and Method B, and reworded so it requires calculation of doses due to tritium releases.

- Indicator locations for milk sampling should be added to Table 5-1, or an explanation given for their omission.

The following mainly editorial and typographical corrections should be made in a future revision of the ODCM:

- A subscript should be added to F in the fefinition of Δt_s in Section 2.4

- The 3 in Equation 3.6 of Section 3.2 should be $(3)^{1\backslash 2}$.

- A definition of M_i should be included in Section 3.6.1.

- In ODCM Figure 3-1, monitor R-13 should apparently be shown on the effluent line from all the Waste Gas Decay Tanks.

- The word "radionuclides" in the first sentence of Section 3.4(b) should read "radioiodines." This sentence should also be reworded so doses due to tritium are required to be calculated.

- The definition of R_{ip7a} in Section 3.6.2 should reference Table 3-5 instead of "an appendix."

- The units of distance should be specified in Table 5-1.

The following are possible changes the Licensee may wish to consider.

- In Section 3.4, revise the technical specifications and/or the ODCM requirements so as to use the calculated dose to the thyroid of a child via the inhalation pathway at or beyond the site boundary as the criteria for satisfying the organ dose limit for gaseous effluents, as recommended by the basis statement for Specification 3/4.11.2.1 in NUREG-0472.

- Change the bioaccumulation factor for P in Table 2-2 from 1.00E+05 to the currently recommended value of 3.00E+03[9,10].

- In Section 2.4, use the 1000 cfs per reactor dilution flow permitted by Section 4.3 of NUREG-0133 instead of "the average flow from the site discharge structure to unrestricted receiving waters times 5" in the definition of F_s, (since sources other than the ODCM indicate that the product now used is less than 1000 cfs per reactor).

- Calculate doses due to liquid effluents, in Section 2.4, for the reporting periods, calendar quarter or calendar year, using the average dilution flow for the reporting period instead of the actual dilution flows during releases. (This is acceptable to the NRC Staff, and permits independent determination of the calculated dose commitments for the reporting periods.)

- Revise the methodology of Section 3.6.2 so the maximum dose to an single organ is calculated for comparison with the organ dose limits of Technical Specification 3.11.2.3.

- Amend Technical Specification 3.11.4 and Section 4 of the ODCM so they correspond to Specification 3.11.4 of NUREG-0472, Revision 3, Draft 7," which requires a special report only if the limits of 40 CFR 190 have been exceeded during a calendar year.

5. REFERENCES

1. Title 10, Code of Federal Regulations, Part 50, Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion, 'As Low As Is Reasonably Achievable,' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor

2. Letter from R. P. McDonald (APC) to U. S. Nuclear Regulatory Commission, [transmitting the Joseph M. Farley Offsite Dose Calculation Manual (FNP-O-M-011, Rev. 4)], April 13, 1988.

3. "Standard Radiological Effluent Technical Specifications for Pressurized Water Reactors," Rev. 3, Draft 7", intended for contractor guidance in reviewing RETS proprosals for operating reactors, NUREG-0472, September 1982.

4. "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants, A Guidance Manual for Users of Standard Technical Specifications," NUREG-0133, October 1978.

5. "General Contents of the Offsite Dose Calculation Manual," Revision 1 Branch Technical Position, Radiological Assessment Branch, NRC, February 8, 1979.

6. "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I," Regulatory Guide 1.109, Rev. 1, October 1977.

7. "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Regulatory Guide 1.111, Revision 1, July 1977.

8. Title 10, Code of Federal Regulations, Part 20, Appendix B, "Concentrations in Air and Water above Natural Background."

9. E. F. Branagan, C. R. Nichols, and C. A. Willis, "Importance of P-32 in Nuclear Reactor Liquid Effluents," Health Physics Society Annual Meeting, June 1982.

10. B. Kahn and K. S. Turgeon, "The Bioaccumulation for Phosphorus-32 in Edible Fish Tissue," NUREG/CR-1336, March 1980.

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ABSTRACT (200 words or less)

The Offsite Dose Calculation Manual (ODCM) for the Joseph M. Farley Nuclear Plant Units 1 and 2 contains current methodology and parameters used in the calculation of offsite doses due to radioactive liquid and gaseous effluents, in the calculation of gaseous and liquid effluent monitoring alarm/trip set-points, and in the conduct of the environmental radiological monitoring program. A copy of the most recent complete ODCM was transmitted to the NRC as Revision 7, with a letter dated April 13, 1989. The NRC transmitted Revision 7 to the Idaho National Engineering Laboratory (INEL) for review. The revised ODCM was reviewed by EG&G Idaho at the INEL and the results of the review are presented in this report. It was determined that ODCM Revision 7 uses methods that are, in general, in agreement with the guidelines of NUREG-0133. However, it is recommended that some changes and additions be included in the Licensee's next revision to the ODCM.

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