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Evaluation of Turkey Point Nuclear Plant Units 3 and 4 Offsite Dose Calculation Manual, Revision 4

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ABSTRACT

The Offsite Dose Calculation Manual (ODCM) for the Turkey Point Nuclear Plant (TPN) Units 3 and 4 contains current methodology and parameters used to calculate offsite doses, dose rates, and effluent monitoring and alarm setpoints, and to conduct the radiological environment monitoring program. The NRC transmitted the most recent complete TPN ODCM, Revision 4, effective January 1, 1994, to the Idaho National Engineering Laboratory for review. The ODCM was reviewed, and the results are presented in this report.

The TPN ODCM generally uses documented and approved methods that are consistent with the methodology and guidance of NUREG-0133 and Regulatory Guide 1.109. The ODCM contains a description of all the required methodology. Thirteen primary comments on monitoring methodology, calculational methods for gaseous and liquid effluents, and total dose should be addressed promptly. Due to several omissions and errors, it is recommended that the ODCM be revised to address and correct the most significant deficiencies identified in the review.

FOREWORD

This report is submitted as partial fulfillment of the "Review of Radiological Issues" project 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 this work under FIN E2084.

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1. INTRODUCTION

1.1 Purpose of Review

This document reports the review and evaluation of Revision 4 of the Offsite Dose Calculation Manual (ODCM) submitted by the Florida Power and Light Corporation, the Licensee for the Turkey Point Nuclear Power Station (TPN). Revision 4 of the ODCM, effective January 1, 1994, was transmitted to the Idaho National Engineering Laboratory for review. The ODCM is a supplementary document for implementing the TPN Technical Specifications (TS) in conformance with Section IV of Appendix I to 10 CFR Part 50.[1] The review of this document was performed to assess conformance of the ODCM to the TPN TS and NRC guidelines.

The ODCM consists of three major parts. The first part includes an introduction to the ODCM and liquid effluent calculational methods that ensure compliance with TPN TS 3.11.1. In addition, descriptions of the radioactive gaseous and liquid effluents pathways are included. Methodology for determining the liquid radioactivity concentrations of batch, continuous, and cumulative releases is presented. In addition, the methodologies for calculating cumulative and projected doses due to liquid effluents and for establishing alarm and trip setpoints for batch and continuous releases are also presented.

The second part of the ODCM includes the calculational methodology needed to ensure compliance with TPN TS 3.11.2 on gaseous radioactive releases. This part of the ODCM addresses dose rates due to gaseous effluents, noble gases and iodine, tritium, and particulates in gaseous effluents. In addition, dose commitments for noble gases and skin dose commitments are addressed.

The third part of the ODCM addresses the calculational methodology and TPN environmental programs implementing TPN TS 3.11.4, which ensure adherence to the guidelines of 40 CFR Part 190.102.

The TPN ODCM is maintained for use as a guide on accepted methodologies and calculations. Changes in the calculational methods or parameters are incorporated into revisions of the ODCM to ensure that this document represents the current methodology in all applicable areas. Any licensee-initiated ODCM change will be implemented in accordance with TPN TS 6.14.2 and ODCM Administrative Control 1.1. A summary of the contents of TPN ODCM, Revision 4, is listed in Table 1.

Table 1. Contents summary of TPN Plant ODCM, Revision 4.

Technical Specification	Procedural details in ODCM	Brief description of contents
—	None	Purpose and scope of the ODCM
3.3.3.5 Tables 3.3-7, 4.3-5	2.6	Liquid effluent monitoring instrumentation and surveillance.
3.3.3.5 Table 3.3-7	2.6.1, 2.6.2	Liquid setpoint determination.
3/3.11.1.1	2.3	Liquid effluent concentration.
4.11.1.1.1 Table 4.11-1	2.2,2.3	Liquid sampling and analysis.
3.11.1.2	2.4	Liquid effluent dose commitment.
3.11.1.3 4.11.1.3.1	2.5	Liquid radwaste treatment and dose projection.
3.3.3.6 Tables 3.3-8, 4.3-6	3.6	Gaseous effluent monitoring instrumentation and surveillance.
3.3.3.6	3.6	Gaseous setpoint determination.
3/4.11.2		Gaseous effluent air dose rate (noble gases).
4.11.2.1.2	3.5.2	Gaseous organ dose rate (iodines, tritium, and particulates).
Table 4.11-2	3.2.2	Gaseous sampling and analysis.
3.11.2.2	3.4	Gaseous air dose commitment.
3/4.11.4	3.5	Gaseous organ dose commitment.
3.11.2.4 4.11.2.4.1	3.7	Gaseous radwaste treatment and dose projections.
3/4.11.4	4.3.1	Uranium fuel cycle (total) dose.
4.12	Appendix C	Radiological environment monitoring, sampling and analysis.
—[a]	—[b]	X/Q and D/Q methodology and data.
—[a]	—[b]	Land use census.
—[a]	—[b]	Interlaboratory Comparison Program.
—[a]	—[b]	Major changes to liquid and gaseous radwaste treatment systems.
6.9.4.b	4.0	Annual Radiological Environmental Operating Report.
6.9.4.a	—[b]	Semiannual Radioactive Effluent Release Report.
6.14.2	1.1.2, 1.1.3, 1.1.4	Changes to the ODCM.

a. Reference to these items could not be found in the RETS.
b. Reference to these items could not be found in the ODCM; however, comments and discussions are presented in their respective sections in the review.

1.2 Plant-Specific Background

The Turkey Point Plant consists of two Westinghouse pressurized water reactor (PWR) units, rated at 666 Mwe each, and two fossil fuel units. The circulating water system operates in a once-through mode with water discharged into a cooling canal from all four units. The canal forms a closed loop, which also furnishes intake water for the four units and receives the discharge from the liquid radwaste system and the steam generator blowdown from both nuclear units. The canal does not discharge offsite but provides a hydrological shift toward the ocean. The canal is considered as an offsite discharge point for releases of radioactive materials in liquid effluents.

The two nuclear units share a common liquid radwaste processing system and a common plant vent for gaseous effluents from both nuclear units. Sources of gaseous effluents from both nuclear units include the plant vent, air ejectors, spent fuel pit (Unit 3), steam generator blowdown flash tanks, and hogging pump exhausts. All releases except those from the hogging pump exhaust are considered in the TPN ODCM calculations.

The Turkey Point Plant site is located on the shore of Biscayne Bay, about 25 mi south of Miami, Florida. The area immediately surrounding the site is low and swampy, and is sparsely populated. The nearest farming area lies in the northwest quarter of a 5-mi arc from the site.

The area surrounding the site is flat and slopes gently to the west from sea level at the shoreline of Biscayne Bay to an elevation of about 10 feet above mean sea level at a point some 8 to 10 mi inland. To the east, across Biscayne Bay from a distance of 5 to 8 mi, a series of offshore islands extends in a northeast-southwest direction between the bay and the Atlantic Ocean. Elliot Key is the largest of these islands.

The site is well ventilated with air movement prevailing most of the time. The atmosphere in the area is generally unstable with diurnal inversions of short duration. The Miami area has experienced winds of hurricane forces periodically. During storms, the plant may be subjected to flood tides of varying heights. Consequently, the two nuclear electric generating units on this site have been constructed on compacted limerock fill to an elevation of 18 ft above mean sea level, and protected to an elevation of 22.5 ft to the east and 20 ft above mean sea level on the remaining sides. These elevations are well above any experienced or predicted flood tides. The normal direction of natural drainage of surface and groundwater in the area is to the east and south toward Biscayne Bay so as not to affect off-site wells.

2. REVIEW CRITERIA

Review criteria for the TPN Plant Units 1 and 2 ODCM calculational methods are provided by the NRC in two documents:

1. NUREG-1302, Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors.[2]

2. NUREG-0133, Preparation of RETS for Nuclear Power Plants.[3]

The following NRC guidelines were also used in the ODCM review:

1. Regulatory Guide 1.109, Revision 1, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the purpose of evaluating Compliance with 10 CFR 50, Appendix I."[4]

2. Branch Technical Position, General Contents of the Dose Calculation Manual.[5]

As specified in NUREG-1302, 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 that represent plant systems and that define the treatment paths and the components of the radioactive liquid and gaseous management systems. A description and the location of samples in support of the environmental monitoring program are also needed in the ODCM. NRC regulations require that the ODCM be a stand-alone document.

3. RADIOACTIVE EFFLUENT RELEASE ROUTES

Liquid and gaseous effluent release routes for TPN are discussed in this section together with the current monitoring methodology. The descriptions in Revision 4 of the TPN ODCM, dated January 1, 1994, were reviewed. Comments on the monitoring methodology description, its clarity, and the adequacy of the monitored release routes are included in this section.

3.1 Liquid Effluent Release Routes

Radioactive liquid effluent releases from TPN Units 3 and 4 are discharged through three pathways: steam generator blowdown from each unit and a common radwaste monitor tank. These three pathways are monitored with alarm and termination monitors. Radioactive materials in liquid effluents from TPN are diluted by condenser cooling water from fossil Units 1 and 2 and from nuclear Units 3 and 4 in the condenser cooling water mixing basin. Water in the basin flows into an onsite closed cooling canal system and does not actually leave the site in a surface discharge. The total condenser cooling water flow from all the operating condenser cooling water pumps at the four units is assumed for dilution, and the restricted area boundary is assumed to be at the end of the condenser cooling water mixing basin at the entry of the cooling canal system. Figure 1 shows a schematic diagram of the TPN radioactive liquid effluent pathways. However, the condenser cooling water mixing basin and the storm drains are not shown in the radioactive liquid effluent pathways diagram.

3.1.1 Liquid Radwaste System

Waste holdup tanks collect radioactive liquid effluent from the chemistry laboratory, containment sumps, floor drains, showers, and other miscellaneous sources of Units 3 and 4. Liquid waste from the waste holdup tanks is processed through a demineralizer system, and the demineralizer effluent is stored in one of three waste monitor tanks. Laundry liquid wastes are stored in one of two monitor tanks. Sampling of the waste monitoring tanks is performed after tank isolation and recirculation for a minimum of one tank volume. Liquid waste release from these tanks is performed after sampling and analysis of the waste.

Section 2.2.1 of the ODCM indicates that the discharge points for radioactive liquid effluents from TPN are common to both units, and the measured releases from the common discharge monitor (R-18) "are apportioned to each unit as a ratio equal to the ratio of the specific isotopic concentrations in the primary coolant of the two reactors to assure the effluents are within the allowable limits per reactor." The TPN ODCM suggests an alternate method that would allocate effluent releases equally to both units.

The concern with this methodology is the following:

> The ODCM suggests two methods to apportion the radioisotopic concentrations in liquid effluents but does not state which method is actually used in the calculations or the calculational details of either method. The description of the methodology as presented does not allow its review or evaluation. However, the validity of both methods are questionable. As presented, the methods can lead to non-conservative results. For

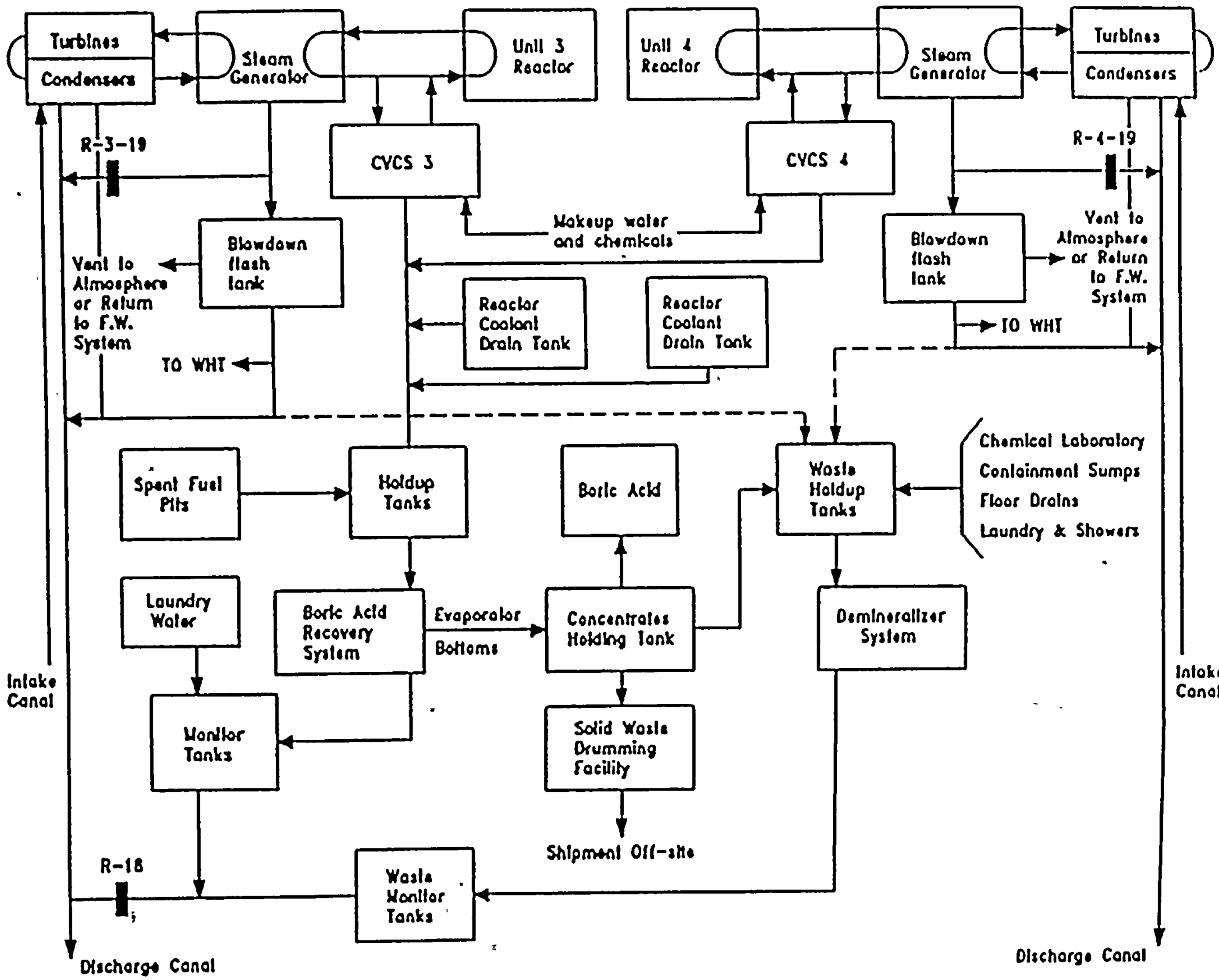

Figure 1. Liquid effluent release routes at TPN.

example, apportioning radioisotopic concentration on the basis of reactor coolant radioisotopic concentrations does not take into account the actual contribution from each unit. If the unit with a higher radioisotopic concentration contributes a larger volume to the liquid effluent pathway, the method will show a lower radioisotopic concentration for the liquid effluent than the actual values.

3.1.2 Steam Generator Blowdown

The steam generator blowdown from Units 3 and 4 can be discharged directly from the blowdown flash tanks to the condenser cooling water mixing basin, or they can be routed to the waste holdup tanks, which are discussed in the previous sections. A composite sample is obtained from each steam generator blowdown discharge prior to the blowdown flash tank for each unit. Releases from the steam generator blowdown are sampled and analyzed in accordance with TS Table 4.11-1. These releases are monitored for units 3 and 4 by radiation monitors R-3-19 and R-4-19, respectively.

3.1.3 Storm Drains

Storm drains from Units 3 and 4 discharge into both the circulating water intake and the condenser cooling water mixing basin. They are sampled and analyzed in accordance with TS Table 4.11-1.

3.2 Gaseous Effluent Release Routes

Radioactive gaseous effluents from TPN Units 3 and 4 are released from four monitored release points: the common plant vent via a stack above the containment building, the Unit 3 spent fuel pit vent, and the condenser air ejector vents for both nuclear units. The gaseous effluent sources are listed in Table 2 together with their respective release points.

Airborne releases from these radioactive gaseous effluent release points are considered as a mixed-mode release from a single location for calculating doses and dose rates. Figure 2 shows a schematic diagram of the TPN Units 3 and 4 radioactive gaseous effluent pathways.

The height of the plant vent stack, the release point of the air ejectors, and the Unit 3 spent fuel vent should be specified in the ODCM to support dispersion modalities used in the calculation of air doses.

Radioactive and potentially radioactive gaseous effluents from the TPN Units 3 and 4 containment buildings, the auxiliary building, the Unit 4 spent fuel pit, the radwaste building, and the laundry area are released via the monitored plant vent after processing through gas filtration systems, which are not described in the ODCM. Radioactive gases from the primary systems such as the Chemical Volume Control System holdup tanks are stored in gas decay tanks prior to release via the plant vent. The Unit 3 spent fuel pit area is vented after filtration through its own monitored vent. The steam jet air ejectors from Units 3 and 4 are vented through monitored release pathways.

Table 2. TPN Units 3 and 4 gaseous release points.

Effluent source	Effluent release point
Gas decay tanks	Plant vent
Radwaste building	Plant vent
Auxiliary building	Plant vent
Containment purge	Plant vent
Unit 4 spent fuel pit	Plant vent
Unit 3 spent fuel pit	Spent fuel pit vent
Air ejectors	Turbine deck

Specific comments regarding the description of the gaseous radwaste system are:

1. The filtration system associated with the containment buildings, the auxiliary building, the Unit 4 spent fuel pit, the radwaste building, and the laundry area should be described in the ODCM.

2. Section 3.2.1 of the ODCM indicates that "Other steam losses concurrent with primary to secondary leakage are unmonitored and their effluents must be accounted for." The ODCM should provide the methodology used to account for these releases, or the reasons for omitting it should be included in the ODCM.

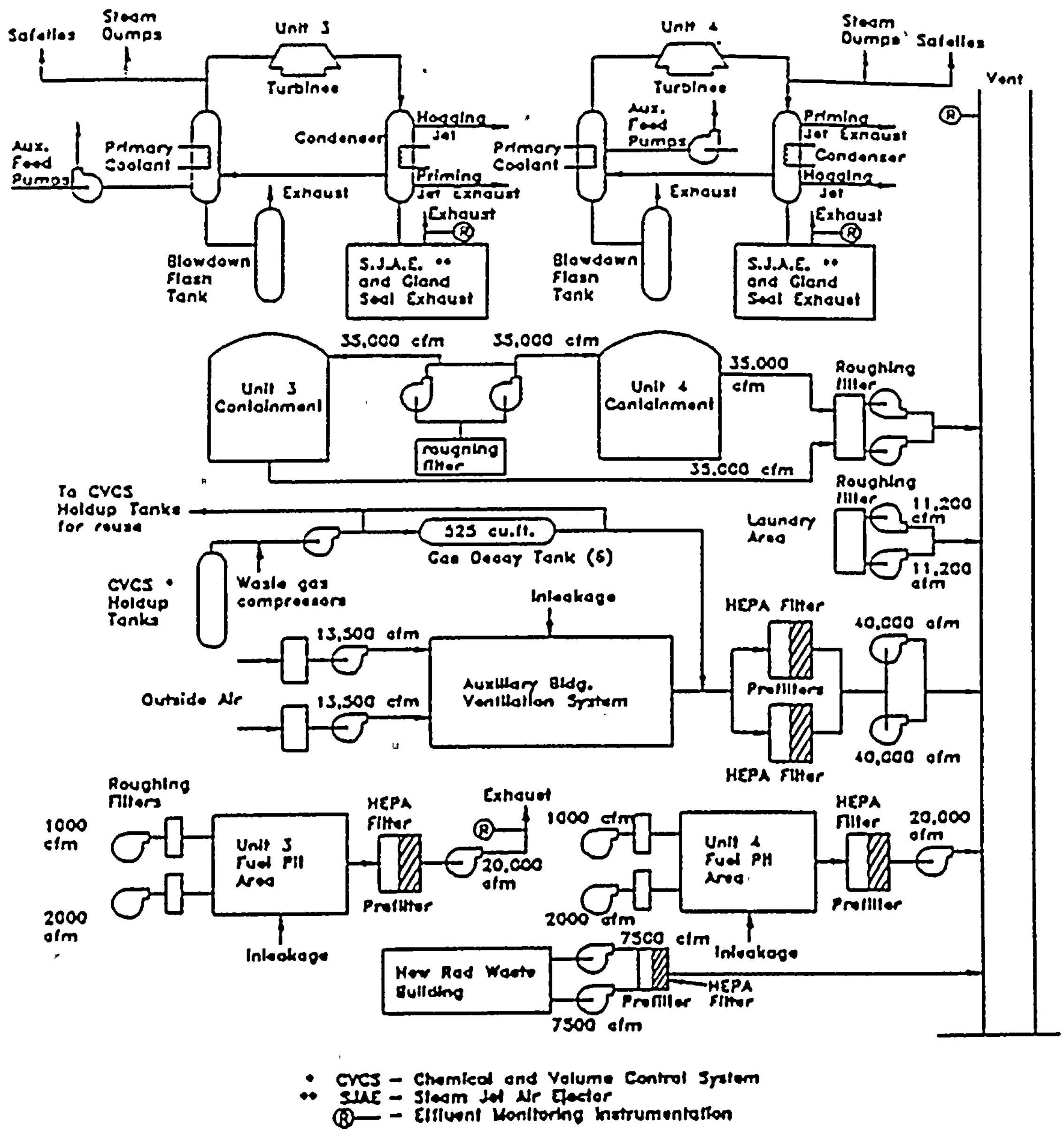

Figure 2. Gaseous effluent release routes at TPN.

4. EVALUATION

The TPN ODCM is a supporting document for the TPN TS. The ODCM should be a stand-alone document, and it should include a detailed presentation of the calculational methodology and models used, including a complete tabulation of all values assigned to each parameter used in the calculations. General comments are:

1. In Section 2.1 of the ODCM, one of the objectives for the ODCM Liquid Effluents section is stated as, "Verification of operability of Liquid Radwaste System by meeting Specifications 3.11.1.1 and 3.11.1.2." The ODCM does not explain or show the methodology for performing this verification.

2. Throughout the ODCM, calculational methods are presented and alternate methods are suggested but their methodologies are not described. The ODCM should clearly state the specific calculational methodologies used in preparing the semi-annual and annual reports.

4.1 Liquid Effluent Monitor Setpoints

TPN TS 3.3.3.5 requires that the radioactive liquid effluent monitoring instrumentation be operable with its alarm/trip setpoints set to ensure that the limits of TS 3.11.1.1 are not exceeded. Section 2.6 of the ODCM indicates that the alarm/trip setpoint for each liquid effluent radiation monitor is derived from 10 times the effluent concentration limit for each radioisotope listed in 10 CFR Part 20, Appendix B, Table 2, Column 2, Revision 1. Radiation monitoring and isolation points are located in the steam generator blowdown lines (R-3-19 and R-4-19) for Units 3 and 4, respectively, and in the liquid waste disposal system line (R-18).

Section 2.6 of the TPN ODCM describes the methodology for calculating the alarm/trip setpoints for radioactive liquid effluents. The alarm setpoint for each liquid effluent monitor is based upon the radioactivity measurements in a batch or continuous liquid release in accordance with TS Table 4.11-1. The alarm/trip setpoint methodology presented in the ODCM is generally correct, with the exception of the following concern:

1. Setpoint calculations, as presented in the TPN ODCM, indicate that they are for trip setpoint values only. The methodology used does not provide any conservatism. Alarm setpoints should have a lower value than trip setpoints. Consequently, alarm setpoints calculations are missing and should be included in the ODCM.

Specific comments on setpoint for radioactive liquid effluent batch and continuous releases are the following:

1. ODCM Section 2.6.1 states that "the liquid radwaste effluent line radiation monitor alarm setpoint for a batch release is determined with" Equation 9 "or a method which gives a lower setpoint value." This other method should be described and justified in the ODCM.

2. The term FEC_b or "fraction of unrestricted area EC present in the condenser cooling water mixing basin outflow due to a batch release as determined in Section 2.3.1 of the

ODCM" is not clearly defined. As indicated, it is calculated from Equation 2 (ODCM Section 2.3.1). This parameter is, in turn, calculated using Equation 1 (ODCM Section 2.3). The difficulty with Equation 1 lies in the definition of F_2, which should be based on actual total flow of condenser cooling water and not as "rated total condenser cooling water flow." This methodology should be clarified.

3. ODCM Section 2.3.1 provides three different methods to derive FEC_b. The ODCM should clearly state which method is actually used at TPN. The basis for using a value of 0.5 for term E_b in Equation 2 in this section should be provided. Also the methodology for the case where data from a previous quarter may be used should be clearly defined with equations.

4. ODCM Section 2.3.1, Equation 3: The ODCM must clearly define and list criteria for labeling unidentified radionuclides, show the method for calculating C_{zi} for unidentified radionuclides, and indicate that the I-131 (EC) value (1×10^{-7} μCi/ml) for unidentified radionuclides is conservative.

5. The factor S_f, which allows for "multiple sources from different or common release points," must be explained, and the methodology used to calculate its value should be shown in the ODCM.

6. Section 2.6.2 of the ODCM states that "the liquid effluent line radiation monitor alarm setpoint for a continuous release is determined with" equation 10 "or by a method which gives a lower setpoint value." The ODCM should contain the methodology for performing all the necessary calculations. Consequently, the methodology and calculational methods for any suggested methods should be presented in the ODCM together with its basis and justification.

4.2 Gaseous Effluent Monitor Setpoints

The TPN TS 3.3.3.6 requires that the radioactive gaseous effluent monitoring instrumentation be operable with its alarm/trip setpoints set to ensure that the limits of TS 3.11.2.1 are not exceeded. Section 3.6 of the ODCM indicates that the alarm/trip setpoint for each radioactive noble gas effluent monitor setpoint is derived on the basis of either total body dose equivalent rate or noble gas concentration in the radioactive gaseous effluent at or beyond the site boundary. The calculations assume ground-level noble gas releases.

General comments regarding gaseous effluent monitor setpoints are the following:

1. Setpoint calculations, as presented in the TPN ODCM, indicate that they are for trip setpoint values only. The methodology used does not provide any conservatism. Alarm setpoints should have a lower value than trip setpoints. Consequently, alarm setpoint calculations are missing and should be included in the ODCM. Setpoint calculations should be clarified, and some conservatism should be included in their calculations.

2. The ODCM should provide methods to ensure that gaseous effluents from the steam dumps and blowdown flash tanks are monitored or accounted for in dose calculations.

Specific comments on the noble gas effluent monitor setpoint calculations:

1. The TPN ODCM directs the use of noble gas release fractions shown in Table 3-2 for calculating setpoints when gaseous effluent gamma ray analysis results are not available. These data are based on measured discharges from TPN Units 3 and 4 from 1978 through 1980. The values in these tables should reflect current conditions. The calculational method for using these values to calculate setpoints should be shown in the ODCM.

2. In the calculation of noble gas effluent monitor setpoints using Equations 27 or 28, the method for calculating the S_f factor should be shown in the ODCM.

3. Section 3.6 of the TPN ODCM provides two methods for calculating noble gas effluent monitor setpoints: Equation 27, which is based on dose rates, and Equation 28, which is based on radionuclide concentrations. The ODCM should explicitly state which method is used and under which circumstances the alternate method may be used.

4.3 Concentrations in Liquid Effluents

TPN TS 3.11.1 requires that:

> The concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS to be limited to 10 times the concentrations specified in 10 CFR Part 20, Appendix B, Table 2, Column 2 for nuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2×10^{-4} µCi/ml total activity. The radioactive liquid wastes shall be sampled and analyzed according to the requirements in Table 4.11-1. The results of the radioactivity analyses shall be used to assure that the concentrations at the point of release are maintained within the limits of TS 3.11.1.1.

Section 2.3 of the TPN ODCM describes the methodology for calculating radioactive liquid effluents concentrations. Specific comments on the liquid effluents concentrations are the following:

1. Liquid effluent concentrations are calculated using Equation 1 in Section 2.3 of the TPN ODCM. The definition of F_2 should be based on actual total flow of condenser cooling water and not as "rated total condenser cooling water flow." Otherwise, using the rated total water flow should be justified in the ODCM.

2. A conservative value of 0.5 is used in the ODCM for the term E_b. The basis and justification for this assumption should be shown in the ODCM.

3. Two alternate methods (Equations 2 or 3) are proposed in Section 2.3.1 of the ODCM for calculating radionuclide concentrations. The ODCM should clearly state which equation is actually used, and for which conditions the alternate method is used.

4. The ODCM should state the reference and basis for using 1×10^{-7} µCi/ml as the unidentified radionuclide concentration in water for unrestricted area purposes. It should also indicate that this value is to be used for each radionuclide. Moreover, the ODCM should include the methodology for labeling the unidentified radionuclides mentioned in the ODCM.

4.4 Dose Rates Due to Gaseous Effluents

TPN TS 3.11.2 requires that the dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the SITE BOUNDARY shall be limited to less than or equal to 500 mrems/yr to the whole body and less than or equal 3,000 mrems/yr to the skin for noble gases, and to less than or equal to 1,500 mrems/yr to any organ for I-131, tritium, and for all radionuclides in particulate form with half-lives greater than 8 days. Section 3.3 of the TPN ODCM describes the methodology for calculating dose rates due to gaseous effluents.

4.4.1 Dose Rates Due To Noble Gases

Sections 3.3.1 and 3.3.2 of the ODCM provide the methodology for dose rates and skin dose rates assessment due to noble gas releases. The methodology is in general agreement with Section 5.2.1 of NUREG-0133. Specific comments on this section are:

1. Justifications should be provided in the ODCM showing that a mixed mode single release point is a valid model for the various radioactive gaseous effluent release points for purposes of dose calculations since the ODCM should be a stand-alone document.

2. The basis and derivation of the value of X/Q (5.8×10^{-7} sec/m^3) used in Equations 13 and 14, Section 3.3.1 of the ODCM should be provided. Moreover, the reference table used for deriving X/Q was established during the 1976-1977 period. These values should be compared with data gathered from 1990 to 1994.

3. The methodology for the alternate method proposed in Section 3.3.1 for using "averaged meteorological data coincident with the period of release being evaluated" should be shown, and the conditions under which this alternate method may be used should be clearly stated.

4. The basis and justification for using a D/Q value of 5×10^{-10} m^{-2} should be provided.

5. The ODCM stipulates, "Principal gamma emitters for batch gaseous effluents which are released via pathways (i.e. the Plant vent) with continuous radioiodine and particulate radionuclide sample trains are considered to be Noble Gases." The basis and validation of this assumption should be provided in the ODCM.

6. The ODCM indicates that "Other steam losses concurrent with primary to secondary leakage are unmonitored and gaseous activity must be accounted for." However, no methodology is provided in the ODCM to account for or to calculate the contributions of these source terms to the dose/dose rate exposures to the public.

4.4.2 Radionuclides Other Than Noble Gases

The TPN ODCM Section 3.3.3 provides methodology to determine dose rates to any organ due to H^3, I^{131}, I^{133}, and radioactive materials in particulate form with half-lives greater than 8 days. The methodology presented is within NRC guidelines.

4.5 Dose Due To Liquid Effluents

TPN TS 3.11.1.2 requires the dose or dose commitment to a member of the public from radioactive materials released in liquid effluents from each unit to unrestricted areas be limited to ≤1.5 mrem to the whole body and ≤5 mrem to any organ during any calendar quarter, and limited to ≤3 mrem to the whole body and ≤10 mrem to any organ during any calendar year.

TPN TS 4.11.1.2 requires the dose or dose commitment to a member of the public due to radioactive material released in liquid effluents to be calculated on a quarterly and annual basis at least once per 31 days.

Section 2.4 of the ODCM provides the methodology for the calculation of doses due to radioactive liquid effluents. In general, the methodology is in agreement with guidelines in Regulatory Guide 1.113 for a steady-state concentration of a decaying substance in a completely mixed closed-loop cooling pond with a known blowdown rate. However, the following concerns with the methodology are noted:

1. The canal-groundwater interchange flow is reported at 2.25×10^5 gal/min. The basis for this value should be provided in the ODCM. Moreover, the canal does not discharge offsite but provides a hydrological shift toward the ocean. The TPN model assumes that potential exposure of a member of the public to radioactive material originating in aqueous effluent is limited to irradiation of persons by canal shoreline deposits. However, this approach does not consider radioactive materials in the liquid effluent carried by the canal-groundwater interchange through the hydrological shift into the ocean. This should be addressed in the calculational methodology.

2. The calculation of the pathway dose factors as listed in Appendix A should be checked for accuracy. A random check of the values of the Table in A-19 revealed errors (in particular, the first and second values in the third column). The second number is off by an order of magnitude. The method by which the various tables in Appendix A were calculated should be shown in the ODCM in accordance with NUREG-0133, Section 4.3.1.

3. Appendix A states that the transfer factors are calculated in accordance with NUREG-0133. The source of these data should be referenced, and differences should be justified. Guidance for calculating A_i is provided in Regulatory Guide 1.109.

4.6 Doses Due to Gaseous Effluents

TPN TS 3.11.2.2 requires that the air dose per reactor at and beyond the site boundary due to noble gases released in gaseous effluents shall be limited during any calendar quarter to ≤5 mrad for gamma radiation and ≤10 mrad for beta radiation, and during any calendar year to ≤10 mrad for gamma radiation and ≤20 mrad for beta radiation. Section 3.4.1 of the ODCM provides the methodology for calculating noble gas gamma radiation dose, Section 3.4.2 includes the methodology for calculating doses due to beta radiation from noble gases, and Section 3.5.2 includes the methodology for calculating the dose due to radioiodine, tritium, and particulates in gaseous effluents.

Sections 3.4.1, 3.4.2, and 3.5.2 of the ODCM show the methodology used to calculate the dose due to gamma radiation; beta radiation; and iodine, tritium, and particulates; respectively, in gaseous releases. The calculational methods as shown in Equations 16, 17, 18, 19, and 22 are in general agreement with Section 5.3.1 of NUREG-0133. However, the method and basis for determining the effective dose transfer factors as shown in Appendix B are questionable. The concerns with calculating the dose transfer factors as shown in Appendix B are:

1. The data are based on a sampling of data gathered in 1978, 1979, and 1980. Plant conditions during these years may differ from current (1995) conditions.

2. Considering a canal-groundwater transfer rate of 2.25×10^5 gall/min, and a hydrological shift towards the ocean, a major pathway for dose exposure has been neglected and should be justified.

3. The methodology does not clearly state that scaling factors are used to calculate doses due to gaseous effluents. These scaling factors should be assessed and evaluated for validity since they were probably obtained during 1980.

4. The ODCM should clearly show the calculational methods for obtaining the dose transfer factors.

4.7 Dose Projections

TPN TS 3.11.1.3 requires that the liquid radwaste treatment system be operable and that its appropriate subsystems be used to reduce the radioactive materials in liquid waste prior to discharge when the projected doses from each unit to unrestricted areas due to liquid effluents, when averaged, over a 31 day period, would exceed 0.06 mrem to the total body or 0.2 mrem to any organ.

TS 4.11.1.3.1 requires the doses to unrestricted areas due to radioactive materials released in liquid effluents be projected at least once per 31 days when the liquid radwaste treatment system is not being fully used.

TS 4.11.2.4 requires that the doses to areas at and beyond the site boundary due to radioactive materials released in gaseous effluent be projected at least once per 31 days. Liquid and gaseous effluents dose projections are discussed below.

4.7.1 Liquid Effluent Dose Projections

Section 2.5 of the ODCM describes the methodology for calculating liquid effluent dose projections. The method entails extrapolating the dose-to-date during the current month to include the entire month. The concern with this approach is the uncertainty in the dose-to-date value if the projection is required early in the current month. The calculations, as described, could not yield a valid projected value if performed in the early part of the month. It is suggested to use data from the previous 31 days.

4.7.2 Gaseous Effluent Dose Projections

Section 3.7 of the ODCM describes the methodology for calculating dose projections due to gaseous effluent releases. The method entails extrapolating the dose-to-date during the current month to include the entire month. The concern with this approach is the uncertainty in the dose-to-date value if the projection is required early in the current month. It is suggested to use data from the previous 31 days.

4.8 Diagrams Of Effluent Release Routes

The ODCM contains three diagrams in the main body of the document and two diagrams in Appendix E. The first diagram in the main body clearly shows the liquid effluent pathways with the omission of the condenser cooling water mixing basin. The storm drains are not shown in the radioactive liquid effluent pathways diagram. These pathways should be included in the diagrams. The second diagram in the ODCM shows the gaseous effluent pathways. The third diagram adequately shows the locations at which doses due to airborne effluents from TPN are calculated. Appendix E includes two adequate diagrams depicting the site and plant areas.

4.9 Total Dose

TPN TS 3.11.4 requires the annual (calendar) dose or dose commitment to any member of the public from all uranium fuel cycles to be limited to ≤75 mrem to the thyroid and 25 mrem to the total body or any other organ.

Section 4.1 of the ODCM describes the methodology to assess the total dose from uranium cycle at TPN. The methodology is in agreement with the guidance in Appendix E of Regulatory Guide 1.109 with the exceptions of comments made earlier in this review and pertaining to Equations 7, 16, 17, and 22. The verbal description in the ODCM should be augmented with a mathematical expression to show the calculational methodology for total dose calculation.

The dose due to gamma rays as "shine" due to the radwaste system and the containment building should be included in the assessment of total dose.

4.10 Environmental Monitoring Program

The Environmental Monitoring Program and associated sampling locations are in Appendix C of the ODCM.

Section 4.2 of the ODCM should reference the Environmental Monitoring Program and the sampling locations. No reference is made to Appendix C of the ODCM in the body of the ODCM.

4.11 Land Use Census

There are no references to performing a Land Use Census in the TPN ODCM, and no justification is provided for the omission.

4.12 Interlaboratory Comparison Program

There are no references to performing an Interlaboratory Comparison Program in the TPN ODCM, and no justification is provided for the omission.

5. TECHNICAL FINDINGS

Primary deficiencies and suggestions are summarized below in four categories of decreasing importance. Items in Category A identify the most serious deficiencies, including omissions that cause uncertainty about the methodology used in the ODCM. Category B contains deficiencies that are less serious than Category A, and Category C contains minor deficiencies and editorial recommendations. Category D contains suggestions for changes the licensee may wish to make to simplify calculations, update data, or remove excess conservatism from the methodology.

Category A

The items in this category should be addressed promptly. Some items identify errors or omissions that result in erroneous calculated doses and dose rates. Others identify omissions or inappropriate values that may result in exceeding release rate limits or insufficiently documenting reported doses.

1. The ODCM suggests two methods to apportion the radioisotopic concentrations in liquid effluents but does not state which method is actually used in the calculations or the calculational details of either method. The description of the methodology as presented does not allow its review or evaluation. However, the validity of both methods are questionable. As presented, the methods can lead to non-conservative results. For example, apportioning radioisotopic concentration on the basis of reactor coolant radioisotopic concentrations does not take into account the actual contribution from each unit. If the unit with a higher radioisotopic concentration contributes a larger volume to the liquid effluent pathway, the method will show a lower radioisotopic concentration for the liquid effluent than the actual values.

2. The height of the plant vent stack, the release point of the air ejectors, and the Unit 3 spent fuel vent should be specified in the ODCM to support dispersion modalities used in the calculation of air doses since the ODCM should be a stand-alone document.

3. Setpoint calculations, as presented in the TPN ODCM, indicate that they are for trip setpoint values only. The methodology used does not provide any conservatism. Alarm setpoints should have a lower value than trip setpoints. Consequently, alarm setpoints calculations are missing and should be included in the ODCM. Setpoints calculations should be clarified and some conservatism should be included in their calculations.

4. ODCM Section 2.6.1 states that "the liquid radwaste effluent line radiation monitor alarm setpoint for a batch release is determined with" Equation 9 "or a method which gives a lower setpoint value." This other method should be described and justified in the ODCM.

5. The term FEC_b or "fraction of unrestricted area EC present in the condenser cooling water mixing basin outflow due to a batch release as determined in Section 2.3.1 of the ODCM" is not clearly defined. As indicated, it is calculated from Equation 2 (ODCM Section 2.3.1). This parameter is, in turn, calculated using Equation 1 (ODCM Section 2.3). The difficulty with Equation 1 lies in the definition of F_2, which should be

based on actual total flow of condenser cooling water and not as "rated total condenser cooling water flow." This methodology should be clarified.

6. ODCM Section 2.3.1 provides three different methods to derive FEC_b. The ODCM should clearly state which method is actually used at TPN. The basis for using a value of 0.5 for term E_b in Equation 2 in this section should be provided. The calculational methodology should be clearly defined with equations for the case where data from a previous quarter may be used.

7. ODCM Section 2.3.1, Equation 3: The ODCM must clearly define and list criteria for labeling unidentified radionuclides, show the method for calculating C_{zi} for unidentified radionuclides, and provide the reference and basis for using 1×10^{-7} µCi/ml for unidentified radionuclides. Moreover, the ODCM should include the methodology for labeling the unidentified radionuclides mentioned in the ODCM.

8. The factor S_f, which allows for "multiple sources from different or common release points," must be explained. and the methodology to calculate its value must be shown in the ODCM.

9. Section 2.6.2 of the ODCM states that "the liquid effluent line radiation monitor alarm setpoint for a continuous release is determined with" equation 10 "or by a method which gives a lower setpoint value." The ODCM should contain the methodology for performing all the necessary calculations. Consequently, the methodology and calculational methods for any suggested methods should be presented in the ODCM together with its basis and justification.

10. The ODCM should provide methods to ensure that effluents from the steam dumps and blowdown flash tanks are monitored or accounted for in dose calculations.

11. The TPN ODCM directs the use of noble gas release fractions shown in Table 3-2 for calculating setpoints when gaseous effluent gamma-ray analysis results are not available. These data are based on measured discharges from TPN Units 3 and 4 from 1978 through 1980. The values in these tables should reflect current conditions. The calculational method for using these values to calculate setpoints should be shown in the ODCM.

12. Section 3.6 of the TPN ODCM provides two methods for calculating noble gas effluent monitors: Equation 27, which is based on dose rates, and Equation 28, which is based on radionuclide concentrations. The ODCM should explicitly state which method is used and under which circumstances the alternate method may be used.

13. The ODCM indicates that "other steam losses concurrent with primary to secondary leakage are unmonitored and gaseous activity must be accounted for." However, no methodology is provided in the ODCM to account for or to calculate the contributions of these source terms to the dose/dose rate exposures to the public.

14. The canal-groundwater interchange flow is reported at 2.25×10^5 gal/min. Moreover, the canal does not discharge offsite but provides a hydrological shift toward the ocean.

However, the TPN model assumes that potential exposure of a member of the public to radioactive material originating in aqueous effluent is limited to irradiation of persons by canal shoreline deposits. This approach does not consider radioactive materials in the liquid effluent carried by the canal-groundwater interchange through the hydrological shift into the ocean. The ODCM should justify neglecting dose contributions from the source term due to the hydrological shift mentioned.

15. The dose due to gamma rays as "shine" due to the radwaste system and the containment building should be included in the assessment of total dose.

Category B

The items below concern information that should be added to make the ODCM complete, prevent erroneous interpretation of the methodology, or correct erroneous methodology.

1. In Section 2.1 of the ODCM, one of the objectives for the ODCM Liquid Effluents section is stated as, "Verification of operability of Liquid Radwaste System by meeting Specifications 3.11.1.1 and 3.11.1.2." The ODCM should explain or show the methodology for performing this verification.

2. Throughout the ODCM, calculational methods are presented and alternate methods are suggested but their methodologies are not described. The ODCM should clearly state the specific calculational methodologies used in preparing the semi-annual and annual reports.

3. In the calculation of noble gas effluent monitor setpoints using Equation 27 or 28, the method for calculating the S_f factor must be shown in the ODCM.

4. Two alternate methods (Equations 2 or 3) are proposed in Section 2.3.1 of the ODCM for calculating radionuclide concentrations. The ODCM should clearly state which equation is actually used, and for which conditions the alternate method is used.

5. Justifications should be provided in the ODCM to show that the various radioactive gaseous effluent release points can be simulated by a mixed-mode single release point for purposes of dose calculations since the ODCM should be a stand-alone document.

6. The methodology for the alternate method proposed in Section 3.3.1 for using "averaged meteorological data coincident with the period of release being evaluated" should be shown, and the conditions under which this alternate method may be used should be clearly stated.

7. The ODCM stipulates, "Principal gamma emitters for batch gaseous effluents which are released via pathways (i.e. the Plant vent) with continuous radioiodine and particulate radionuclide sample trains are considered to be Noble Gases." The basis and validation of this assumption should be provided in the ODCM.

8. The calculation of the pathway dose factors as listed in Appendix A should be checked for accuracy. A random check of the values of the Table in A-19 revealed wrong numbers. In particular, the first and second values in the third column. The second number is off by an order of magnitude. The reasons for the discrepancies are not shown in the ODCM. The method by which the various tables in Appendix A were calculated should be shown in the ODCM in accordance with NUREG-0133, Section 4.3.1.

9. The method and basis for determining the effective dose transfer factors as shown in Appendix B are questionable. The concerns with calculating the dose transfer factors as shown in Appendix B are the following:

   a. The data are based on a sampling of data gathered in 1978, 1979, and 1980. Plant conditions during these years may differ from current (1995) conditions.

   b. Considering a canal-groundwater transfer rate of 2.25×10^5 gal/min, and a hydrological shift towards the ocean, a major pathway for dose exposure has been neglected and should be justified.

   c. The methodology does not clearly state that scaling factors are used to calculate doses due to effluents. These scaling factors should be assessed and evaluated for validity since they were probably obtained in 1980.

   d. The ODCM should clearly show the calculational methods for obtaining the dose transfer factors.

10. Sections 2.5 and 3.7 of the ODCM describe the methodology for calculating, respectively, liquid and gaseous effluents dose projections. The method entails extrapolating the dose-to-date during the current month to include the entire month. The concern with this approach is the uncertainty in the dose-to-date value if the projection is required early in the current month. The calculations, as described, could not yield a valid projected value if performed in the early part of the month. It is suggested to use data from the previous 31 days.

11. The basis and derivation of the value of X/Q (5.8×10^{-7} sec/m^3) used in Equations 13 and 14, Section 3.3.1 of the ODCM should be provided. Moreover, the reference table used for deriving X/Q was established during the 1976-1977 period. These values should be compared with data gathered from 1990 to 1994.

12. The basis and justification for using a D/Q value of 5×10^{-10} m^{-2} should be provided.

13. The first diagram in the main body clearly shows the liquid effluent pathways with the omission of the condenser cooling water mixing basin. The storm drains are not shown in the radioactive liquid effluent pathways diagram. These pathways should be included in the diagrams.

14. There are no references to performing a Land Use Census in the TPN ODCM and no justification is provided for the omission. Either include Land Use Census information or provide justification for leaving it out.

Category C

The items in this category indicate omissions and editorial deficiencies that are not likely to cause significant problems.

1. The filtration system associated with the containment buildings, the auxiliary building, the Unit 4 spent fuel pit, the radwaste building, and the laundry area should be described in the ODCM.

2. Section 3.2.1 of the ODCM indicates that "Other steam losses concurrent with primary to secondary leakage are unmonitored and their effluents must be accounted for." The ODCM should provide the methodology used to account for these releases.

3. Section 4.1 of the ODCM verbally describes the methodology for calculating the total dose. A mathematical expression should be added to show the actual calculations.

4. The ODCM should justify omission of the Interlaboratory Comparison Program.

5. Section 4.2 of the ODCM should reference the Environmental Monitoring Program and the sampling locations. No reference is made to Appendix C of the ODCM in the body of the ODCM.

Category D

The following items concern methodology and parameters that the licensee may wish to change because the change may simplify calculations, remove unnecessary conservatism in the calculations, or make use of more recent data.

1. Appendix A states that the transfer factors are calculated in accordance with NUREG-0133. The source of these data should be referenced, and differences should be justified. Guidance for calculating A_i is provided in Regulatory Guide 1.109.

6. REFERENCES

1. Title 10, Code of Federal Regulations, Part 50, "Domestic Licensing of Production and Utilization Facilities."

2. NUREG-1302, *Standard Operating Procedure for Radiological Effluent Controls for Pressurized Water Reactors*, August 1988.

3. NUREG-0133, *Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants, A Guidance Manual for Uses of Standard Technical Specifications*, October 1978.

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

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