March 19, 1992

Docket No. 50-289

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Mr. T. Gary Broughton, Vice President
and Director - TMI-1
GPU Nuclear Corporation
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Dear Mr. Broughton:

SUBJECT: THREE MILE ISLAND UNIT 1 - TRANSMITTAL OF TECHNICAL EVALUATION REPORT ON THE OFFSITE DOSE CALCULATION MANUAL (TAC NO. M82167)

GPU Nuclear submitted Revision 0 of the Three Mile Island Unit 1 Offsite Dose Calculation Manual (ODCM) to the NRC for review. The purpose of this letter is to inform you that the staff has reviewed the ODCM and of the results of that review.

The review was performed with assistance by EG&G-Idaho and included the entire document. The ODCM uses methods that, in general, are consistent with staff guidance. However, as the enclosed Technical Evaluation Report (TER) indicates, some questions exist regarding the methodology used to determine the setpoints for the liquid effluent monitors. These comments relate to sections 1.2 and 1.3 of the ODCM and the staff hereby requests your prompt written response to the comments. The description of the setpoint methodology needs to be clarified or corrected. The TER also contains other recommendations that are minor in nature and should be considered in future ODCM revisions.

If you have any questions on this matter, please contact me.

The requirements of this letter affect fewer than 10 respondents, and therefore, are not subject to Office of Management and Budget review under P.L. 96-511.

Sincerely,

/s/

Ronald W. Hernan, Sr. Project Manager
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Office of Nuclear Reactor Regulation

Enclosure:
TER No. EGG-PHY-10011

cc w/enclosure:
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TECHNICAL REPORT

TECHNICAL EVALUATION REPORT FOR THE EVALUATION OF ODCM REVISION) (MARCH 1991) THREE MILE ISLAND NUCLEAR STATION, UNIT 1

T. E. Young
T. S. Bohn
D. W. Akers

EG&G Idaho

Work performed under
DOE Contract
No. DE-AC07-76ID01570

Prepared for the
U.S. NUCLEAR REGULATORY COMMISSION

EGG-PHY-10011

TECHNICAL EVALUATION REPORT

for the

EVALUATION OF ODCM REVISION 0 (March 1991) THREE MILE ISLAND NUCLEAR STATION, UNIT 1

NRC Docket No. 50 289 NRC License No. DPR-50

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ABSTRACT

The Offsite Dose Calculation Manual (ODCM) for the Three Mile Island Nuclear Station, Unit 1 (TMI-1) contains current methodology and parameters used to calculate offsite doses and effluent monitoring alarm/trip setpoints, and to conduct the radiological environmental monitoring program. The NRC transmitted the most recent complete TMI-1 ODCM, Revision 0, effective March 20, 1991, to the Idaho National Engineering Laboratory for review by EG&G Idaho, Inc. The ODCM was reviewed by EG&G, and the results are presented in this report. It was determined that the ODCM uses methods that are, in general, within the guidelines of NUREG-0133. However, the methodology to determine the setpoints of the liquid effluent monitors should be checked promptly. The description of the methodology needs to be either corrected or clarified. All other recommended changes are relatively minor, and should be considered in future ODCM revisions.

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.

CONTENTS

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 GPU Nuclear Corporation (GPUN), the licensee for Three Mile Island Nuclear Station, Unit 1 (TMI-1). The ODCM is a supplementary document for implementing the Radiological Effluent Technical Specifications (RETS) in compliance with 10 CFR 50, Appendix I requirements.[1] This review was performed to assess conformity of the TMI-1 ODCM to the technical specifications and current NRC guidelines.

1.2 Plant Specific Background

TMI-1 is an 808 MWe pressurized water reactor (PWR) located on the northern third of Three Mile Island, in the Susquehanna River about 10 miles southeast of Harrisburg, PA.

The Offsite Dose Calculation Manual (ODCM) for TMI-1 was determined to be acceptable as of August 6, 1981. Notification of the acceptance was transmitted from J. F. Stolz (NRC) to H. D. Hukill (GPUN), in a letter dated August 6, 1981.[2] After GPUN submitted revisions 1 through 8[3], the NRC transmitted the complete ODCM, updated through Revision 8, to the Idaho National Engineering Laboratory (INEL) for review by EG&G Idaho, Inc. (EG&G). The complete ODCM was reviewed, and a report evaluating the ODCM was transmitted to the NRC with a letter from F. B. Simpson (EG&G) to W. Meinke (NRC), dated October 4, 1988.[4] The NRC transmitted this report to GPUN with a request that a revision of the TMI-1 ODCM be submitted addressing the comments in the EG&C report.[5] On April 4, 1991, GPUN submitted a completely revised ODCM identified as Revision 0, with an effective date of March 20, 1991.[6] The NRC transmitted this ODCM revision to the INEL for review by EG&G.

2. REVIEW CRITERIA

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

NUREG-0472, "Standard Radiological Effluent Controls for PWRs"[7]
NUREG-0133, "Preparation of RETS for Nuclear Power Plants"[8]

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

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"[9]

Branch Technical Position, "General Contents of the Offsite Dose Calculation Manual (ODCM)"[10]

As specified in the current NUREG-0472, the ODCM shall contain the methodology and parameters used in the calculation of offsite doses resulting from radioactive gaseous and liquid effluents, in the calculation of gaseous and liquid effluent monitoring Alarm/Trip Setpoints, and in the conduct of the Environmental Radiological Monitoring Program. These requirements are consistent with an earlier revision of NUREG-0472[11], which was issued for guidance in preparing Radiological Effluent Technical Specifications (RETS) prior to issuance of Generic Letter 89-01.[12] 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 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.

3. EVALUATION

As stated by the licensee, "The OFFSITE DOSE CALCULATION MANUAL (ODCM) is a supporting document of the GPUN Three Mile Island Nuclear Station Technical Specifications. The ODCM describes the methodology and parameters to be used in the calculation of off site doses due to radioactive liquid and gaseous effluents and in the calculation of liquid and gaseous effluent monitoring instrumentation alarm/trip setpoints. The ODCM contains a list and graphical description of the specific sample locations for the radiological environmental monitoring program. Liquid and Gaseous Radwaste Treatment System configurations are also included."

The ODCM is generally well organized and complete. However, a few changes are needed to correct or clarify specific sections.

3.1 Liquid Effluent Release Routes

Main condenser cooling for the TMI-1 reactor is provided by water circulated through natural draft cooling towers. Cooling water for use at the station is taken from the Susquehanna River. The cooling tower blowdown is returned to the river via the Station Effluent Discharge. All liquid effluents that may contain radioactive material are diluted in the cooling tower blowdown.

Technical Specification 3.21.1 requires monitors providing automatic termination of release for the following radioactive liquid effluent lines at TMI-1:

1. Unit 1 Liquid Radwaste Effluent Line (RM-L6),
2. IWTS/IWFS Discharge Line (RM-L12).

Section 1.2.3 of the ODCM also requires a monitor on the Turbine Building Sump (RM-L10), which is not required by the technical specifications. These monitors are shown in Figure 1 (duplicated from Figure 1.2 of the ODCM). In this figure the monitors are labeled RML-6, RML-10, and RML-12, respectively, instead of RM-L6, RM-L10, and RM-L12.

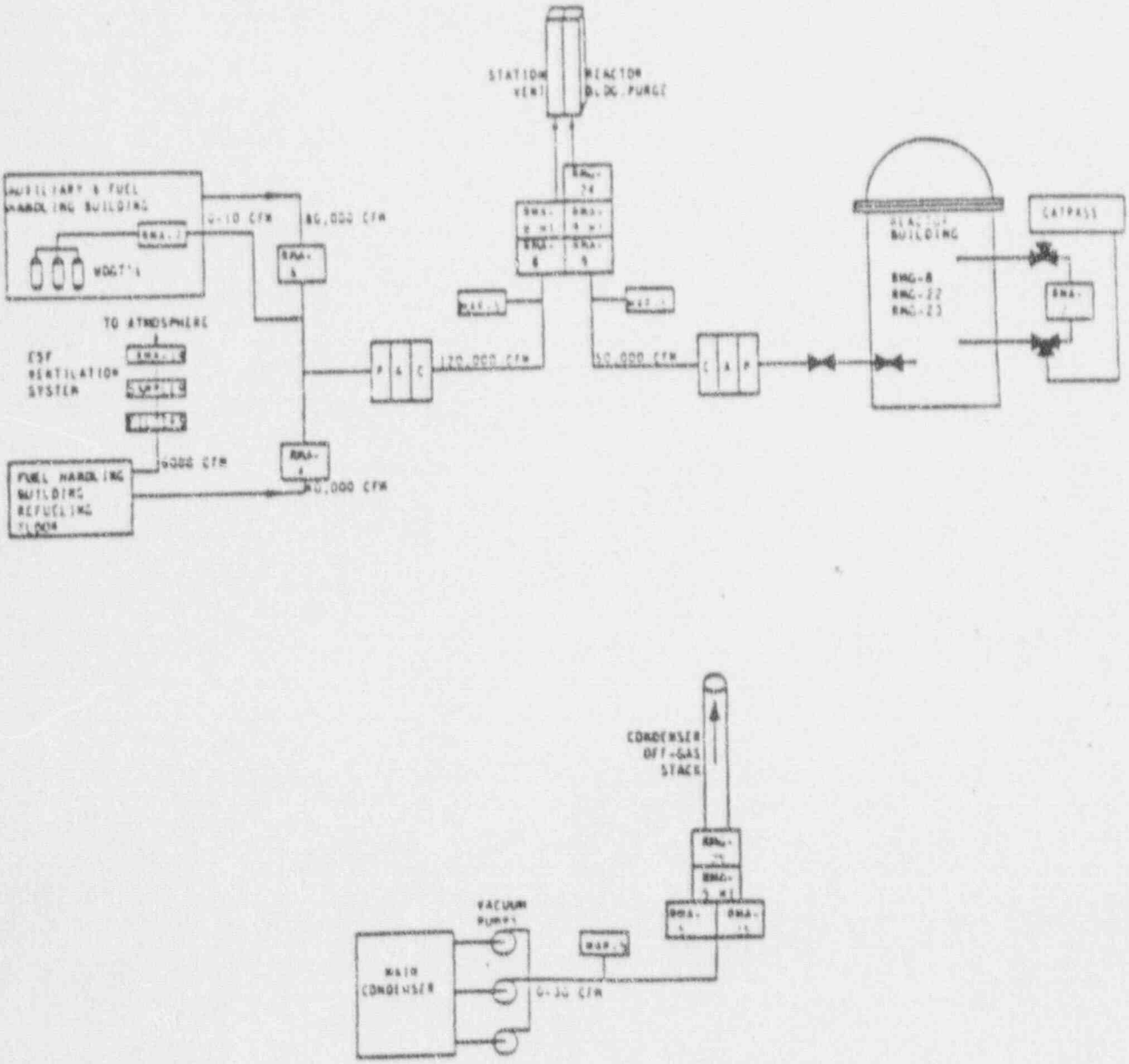

Figure 1. Liquid effluent release routes at TMI-1. (Reproduced from Figure 1.2 of the TMI-1 ODCM, Revision 0, effective March 20, 1991.)

3.2 Liquid Effluent Monitor Setpoints

Pursuant to Technical Specification 3.21.1, Sections 1.1, 1.2, and 1.3 of the ODCM contain methodology to determine the setpoints of the liquid effluent radioactivity monitors. Technical Specification 3.21.1 requires that the alarm/trip setpoints of the liquid effluent monitors identified in Technical Specification Table 3.21-1 shall be determined in accordance with the ODCM, with their setpoints set to ensure that the limits of Technical Specification 3.22.1.1 are not exceeded. Technical Specification 3.22.1.1 limits the concentration of radioactive material released at any time to unrestricted areas to the concentrations specified in 10 CFR 20, Appendix B, Table II, Column 2[13] for radioactive material other than dissolved or entrained noble gases, and to 3×10^{-3} µCi/mL total activity for noble gases.

As explained in Section 1.3, liquid effluent monitor setpoints are intended to limit releases of radioactive materials so that concentrations in the unrestricted area do not exceed 60% of the technical specification limits. It is not clear that the methodology of Sections 1.1 and 1.2 accomplish that is intended. These sections should be edited and/or corrected. Several changes are recommended in the following paragraphs.

In Section 1.1, "proportional" and "inversely proportional" should be interchanged in the definition of c. This definition is now identical to that in the Addendum to NUREG-0133, which contains the error.

Setpoint for RM-L6. Section 1.2.1 does not clearly describe the methodology for the limitation described in the first paragraph of Section 1.3 (i.e., that releases past the monitor RM-L6 are limited so their contribution to the concentration of radioactive material in the unrestricted area is less than 10% of the 10 CFR 20 limit). As now written, Section 1.2.1 apparently permits any number of radionuclides to be released at rates such that each individual radionuclide contributes up to 10% of the 10 CFR 20 limit. This does not appear to be acceptably conservative, so the methodology should be revised, or the ODCM should be corrected to reflect the methodology actually used. To describe limitation of releases consistent with Section 1.3, the third sentence of Section 1.2.1 could be rewritten to say: "The release rate is based on releasing

one of two Waste Evaporator Condensate Storage Tanks (WECST) at a flow which will add less than 10% of the 10 CFR 20 limit to radionuclide concentrations in the unrestricted area, including conservative default values for Sr-89, Sr-90, and Fe-55." With this change, Equation 1.2 should be rewritten as:

$$\sum_i (C_i/MPC_i) \quad \leq \quad 0.10 \qquad \text{(eq 1.2)}$$

The ALERT and HIGH ALARM setpoints are, respectively, set at 1.5 and 2.0 times the concentration in the undiluted effluent (plus background). Although Section 1.2.1 currently mentions the "release rate," which implies a flow or a flow combined with a concentration, there is no methodology included to determine the flow of undiluted effluent from the WECST. Section 1.2.1 should contain methodology to determine this flow. The methodology should be based on Equation 1.1 and the 10%-of-MPC limit on offsite concentrations. This can be done with the following steps (with all summations over the index i):

1. Evaluate "$\Sigma(c_i/MPC_i)$" for the undiluted effluent, using the analysis required by the RETS and ODCM Section 1.2.1, where c_i is the concentration of the i^{th} radionuclide in the undiluted effluent. This gives the ratio of the concentration of radioactive material in the undiluted effluent to the 10 CFR 20 limit, the MPC, for the same mixture of radionuclides in the unrestricted area.

   Note that this ratio is equal to "c/C", where c and C are from ODCM Equation 1.1. Also, $c = \Sigma c_i$ and $C = \Sigma C_i$, where c_i is defined above and C_i would be the concentration of the i^{th} radionuclide if the effluent were diluted to the 10 CFR 20 concentration limit.

2. To implement the requirement that releases from the WECST contribute only 10% of the 10 CFR 20 limit to the radionuclide concentration offsite, Equation 1.1 can be written:

$$\frac{c * f}{F + f} \leq 0.10 * C, \text{ or } \quad \frac{F + f}{f} \geq \frac{10 * c}{C} = 10 * \Sigma(c_i/MPC_i)$$

   Solving for f gives: $$f \leq \frac{F}{(10 * \Sigma(c_i/MPC_i) - 1)} ,$$

   where all symbols are defined above or in the ODCM.

Using the above expression for the flow rate limit, f, for effluents from the WECST, and the radiation monitor setpoint equations from Section 1.2.1 would restrict the release rate so that this source would contribute ≤ 10% of the 10 CFR 20 limit to the offsite concentration before automatic termination of the release.

The ODCM should include the above expressions or some other consistent methodology to determine the maximum flow rate in the line releasing undiluted effluent from the WECST.

Setpoint for RM-L12. Section 1.2.2 contains methodology to determine the setpoint for the radiation monitor on the release line transporting undiluted waste from the Industrial Waste Treatment System/Industrial Waste Filtration System (IWTS/IWFS) and the Turbine Building Sump to the Station Discharge. The methodology to determine the setpoint of this monitor indicates that Equation 1.1 is applied by substituting values from Table 1.2, as applicable, and establishing the high alarm setpoint so the release will be terminated if the maximum concentration in the unrestricted area due to this release would be 50% or more of the 10 CFR 20 limit. The use of the MPC for I-131 in this methodology is not completely clear. If the total activity in the undiluted effluent is determined ($c=\Sigma c_i$) and then the entire radionuclide concentration (c) is assumed to be I-131, the methodology is as conservative as implied by the discussion. In this case, using flows from Table 1.2 in Equation 1.1 gives:

$$\frac{c * f}{F + f} = \frac{c * 300}{15000 + 300} = 0.5*3E-7 \ \mu Ci/mL,$$

or c = 7.65E-6 µCi/mL.

In this case, the mixture determined by analysis could be used with the concentration of 7.65E-6 µCi/mL to determine the setpoint.

If only the actual concentration of I-131 alone is considered, the methodology does not appear to be acceptable.

Setpoint for RM-L12. Section 1.2.3 contains methodology to determine the setpoint of the monitor on the release line transporting effluent

from the Turbine Building Sump to the IWTS. The methodology is identical to that for RM-L6, discussed above.

Information given in the ODCM concerning the flow rate of dilution water (F) is incomplete or confusing. ODCM Figure 1.2 shows effluents monitored by RM-L6, RM-L10, and RM-L12 being released at the same point. However, the on-site dilution given in ODCM Table 1.2 for effluents monitored by RM-L6, RM-L10, and RM-L12 are, respectively, 5000 gpm, 15,000 gpm, and 15,000 gpm. This apparent discrepancy should be explained or corrected.

Due to lack of clarity and completeness in the methodology to determine setpoints, it is uncertain whether this methodology is within NRC guidelines. If the setpoints established for RM-L6 permit each radionuclide to contribute 10% of the 10 CFR 20 limit to offsite concentrations or if only I-131 releases are considered for RM-L12 and RM-L10, these deficiencies should be addressed promptly. If the limits described in Section 1.3 are implemented in practice, Sections 1.1 and 1.2 should be edited to clarify the meaning. More detailed methodology to determine the undiluted liquid waste flow should be added to Section 1.1 and/or Section 1.2. Also, the differences in on-site dilution given in Table 1.2 should be corrected or clarified.

3.3 Gaseous Effluent Release Routes

Technical Specification 3.21.2 requires the following radioactivity monitors on gaseous effluent release routes:

1. Waste Gas Holdup System (RM-A7)
2. Containment Purge Monitoring System (RM-A9)
3. Condenser Vent System (RM-A5Lo and Suitable Equivalent)
4. Auxiliary and Fuel Handling Building Ventilation System (RM-A8) or (RM-A4 and RM-A6)
5. Fuel Handling Building ESF Air Treatment System (RM-A14 or Suitable Equivalent)

The release routes and radioactivity monitors are shown in Figure 2 (duplicated from Figure 4.1 of the ODCM). In this figure the monitors are labeled using RMA-7 instead of RM-A7, RMA-9 instead of RM-A9, etc.

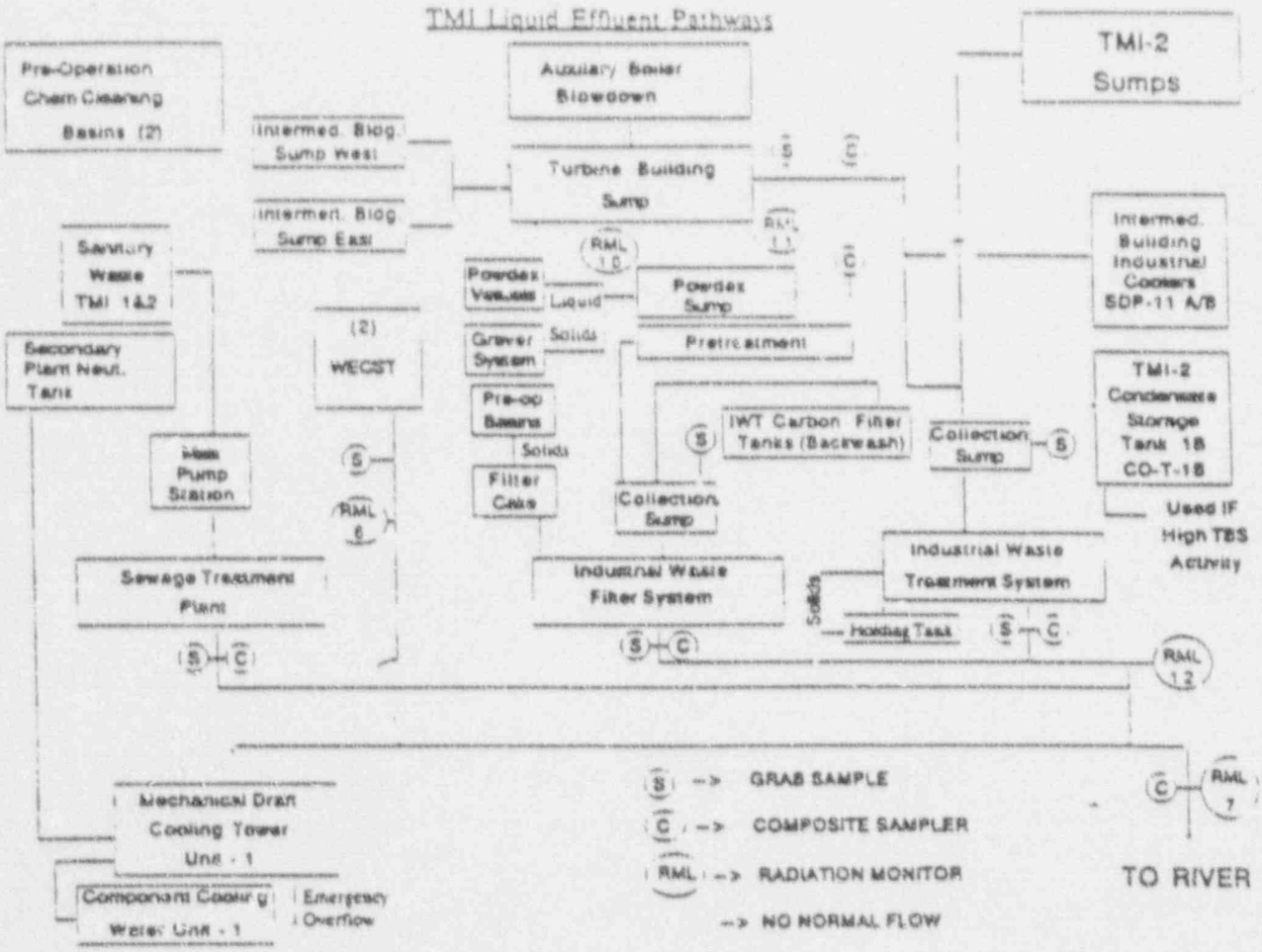

Figure 2. Gaseous effluent release routes at TMI-1. (Reproduced from Figure 4.3 of the TMI-1 ODCM, Revision 0, effective March 20, 1991.)

3.4 Gaseous Effluent Monitor Setpoints

Pursuant to Technical Specification 3.21.2, Section 4.1 of the ODCM contains methodology to determine effluent monitor setpoints to ensure that the dose rate limits of Technical Specification 3.22.2.1 are not exceeded. Technical Specification 3.21.2 requires that the alarm/trip setpoints of the gaseous effluent monitors identified in Table 3.21-2 be determined in accordance with the ODCM.

ODCM Section 4.3 describes the location and function of each of the noble gas monitors required by the technical specifications plus RM-A15, which is an alternate for RM-A5. Each of the monitors except the RM-A5/RM-A15 combination provides automatic termination of the associated releases. The RM-A5/RM-A15 combination initiates the MAP-5 Radioiodine Processor Station.

Sections 4.1 and 4.4 contain the methodology to determine setpoints for the noble gas radioactivity effluent monitors required by the technical specifications. Sections 4.2 and 4.4 contain corresponding methodology for particulate and radioiodine monitors. Equations 4.1.1, 4.1.2, and 4.2, which are used to determine setpoints, are basically correct. However, the analyses used to determine the mixture used to evaluate the right sides of the equations should be specified. Also, a discussion is needed requiring that the monitors be calibrated to the mixture used to evaluate the right sides of the equations, and stating that the total concentration measured by the monitors are given by: $c = \sum_i c_i$.

The methodology to determine setpoints is generally complete and acceptable according to the NRC guidelines. However, the following items should be added or corrected: (a) the ODCM should identify the analyses used to determine the radionuclide mixture to which the effluent monitors are calibrated, (b) an equation should be included giving the total concentration to which the monitors are calibrated, (c) the 500, 3000, and 1500 in the definitions for Equations 4.1.1, 4.1.2, and 4.2, respectively, should be identified as dose rates instead of doses; and (d) references to "Controls" and "Section II..." in Section 4.4 (and also in Sections 1.3, 2.2, and 5.3) should be replaced or supplemented with proper technical specification references.

3.5 Concentrations in Liquid Effluents

Technical Specification 4.22.1.1 requires that the sampling and analyses required by Technical Specification Table 4.22-1 be used to assure that the concentration of radioactive material released in liquid effluents is maintained within the limits of Technical Specification 3.22.1.1 (i.e., the concentrations specified in 10 CFR 20, Appendix B, Table II, Column 2 for radionuclides other than dissolved or entrained noble gases, and to not more than 3×10^{-3} μCi/mL for noble gases.)

Section 1.3 contains requirements that the methodology of the ODCM be used to implement all of the requirements of Technical Specification 4.22.1.1. If the methodology in Sections 1.1 and 1.2 is corrected or clarified as recommended in Section 3.2 of this review, it is sufficient to meet the intent of current NRC guidelines (i.e., NUREG-0472) for assuring that concentrations of radioactive material in liquids released to unrestricted areas are maintained within the limits of Technical Specification 3.22.1.1. However, Section 1.3 should be more specific about what parts (equations, etc) of Sections 1.1 and 1.2 are used to implement the requirements.

3.6 Dose Rates Due to Gaseous Effluents

Technical Specification 3.22.2.1 requires that the dose rate due to radioactive materials released in gaseous effluents from the site be limited to the following:

1. For noble gases: less than or equal to 500 mrem/yr to the total body and less than or equal 3000 mrem/yr to the skin, and
2. For I-131, I-133, tritium and all radionuclides in particulate form with half lives greater than 8 days: less than or equal to 1500 mrem/yr to any organ.

3.6.1 Dose Rates Due to Noble Gases.

Technical Specification 4.22.2.1.1 requires that, "The dose rate due to noble gases in gaseous effluents shall be determined to be within the limits of Specification 3.22.2.1.a in accordance with the methods and procedures of the ODCM." Sections 4.1, 4.3, and 4.4 contain the

methodology to ensure that this requirement is satisfied. Although the present meaning is obvious, the references "Control 3.22.2.1" and "Section II Table 4.22-2" in Section 4.4 should be corrected or supplemented with the proper technical specification references. Nevertheless, the methodology to determine that the dose rates due to noble gases are within the limits of Technical Specification 3.22.2.1 are considered to be within NRC guidelines.

3.6.2 Dose Rates Due to Other Than Noble Gases.

Technical Specification 4.22.2.1.2 requires that, "The dose rate of radioactive materials, other than noble gases, in gaseous effluents shall be determined to be within the limits of Specification 3.22.2.1.b in accordance with methods and procedures of the ODCM by obtaining representative samples and performing analyses in accordance with the sampling and analysis program, specified in Table 4.22-2." Sections 4.2, 4.3, and 4.4 contain the methodology to ensure that this requirement is satisfied. The TMI-1 ODCM requires both effluent monitors and the sampling and analyses specified in Technical Specification Table 4.22-2 to accomplish this (assuming that "Section II Table 4.22-2" should be the "Technical Specification Table 4.22-2." in Section 4.4.) Section 5.1.2 contains a more detailed description of the dose calculation, and is apparently used with the results of sampling and analyses to verify that dose rates are within the prescribed limits.

Sections 4.2 and 5.1.2 identify the dose rate to the thyroid of an infant via the inhalation pathway as the controlling dose rate for determining that the dose limit of 1500 mrem/yr to any organ is not exceeded. This is not consistent with the licensee's basis statement for Technical Specification 3.22.2.1 or recent revisions of NUREG-0472. The controlling age group should be changed from infant to child.

The sampling and analysis requirements are stated very concisely in Section 4.4, but apparently require that each analysis required by Technical Specification Table 4.22.2 be used individually to verify that dose rate limits are not exceeded. Therefore, the methodology to determine that the dose rates due to radioactive materials other than noble gases are within the limits of Technical Specification 3.22.2.1 is considered to be within NRC guidelines.

3.7 Dose Due To Liquid Effluents

Pursuant to Technical Specification 4.22.1.2, Section 2.1 of the ODCM contains methodology to determine cumulative dose contributions from liquid effluents. This methodology is applicable to the calculation of doses to assess compliance with Technical Specification 3.22.1.2. Technical Specification 3.22.1.2 requires that the dose or dose commitment to a member of the public from radioactive materials in liquid effluents released from the unit to the site boundary shall be limited:

1. During any calendar quarter to $\leq$ 1.5 mrem to the total body and to $\leq$ 5 mrem to any organ.
2. During any calendar year to $\leq$ 3 mrem to the total body and to $\leq$ 10 mrem to any organ.

The methodology of Section 2.1 is consistent with the guidance of NUREG-0133, and is therefore considered acceptable. However, to more completely describe the methodology, the following information should be added to Section 2.1: (a) the definition of FD should specify the period over which the plant dilution water flowrate is determined, e.g., during the period of release, (b) the definition of FR should specify the period over which the river flowrate is determined (e.g., minimum annual flow, minimum flow during release, average flow during release), the definition of Δt should indicate the periods used (e.g., periods of actual release for batch releases, months or period of report for continuous releases). Section 2.3 should contain a commitment to include a comprehensive statement of differences from the methodology of Section 2.1 with reported doses if an alternate method is used for a comprehensive assessment of doses due to liquid effluents.

3.8 Dose Due to Gaseous Effluents

3.8.1 Dose Due To Noble Gases

Pursuant to Technical Specification 4.22.2.2, Section 5.2.1 contains methodology to determine dose contributions from noble gas effluents for the current calendar quarter and current calendar year. Technical Specification 3.22.2.2 requires that the air dose due to noble gases released in gaseous effluents from the unit to areas at and beyond the site boundary shall be limited to the following:

1. During any calendar quarter: $\leq$ 5 mrad for gamma radiation and $\leq$ 10 mrad for beta radiation and,

2. During any calendar year: $\leq$ 10 mrad for gamma radiation and $\leq$ 20 mrad for beta radiation.

Examination of Table 4.3 indicates that the maximum offsite X/Q for the station vent is 7.17E-7 sec/m^3 at 2413 m in the NNE sector. Therefore, this is the value of X/Q that should be given for the station vent in Section 5.2.1. Otherwise, the methodology to calculate offsite gamma and beta air doses is considered to be within NRC guidelines.

3.8.3 Dose Due To Other Than Noble Gases

Pursuant to Technical Specification 4.22.2.3, Section 5.2.2 contains methodology to determine dose contributions from Iodine-131, Iodine-133, Tritium, and radionuclides in particulate form with half lives greater than 8 days for the current calendar quarter and current calendar year. Technical Specification 3.22.2.3 requires that the dose to a member of the public due to these radioactive materials shall be limited to the following:

1. During any calendar quarter: $\leq$ 7.5 mrem to any organ, and

2. During any calendar year: $\leq$ 15 mrem to any organ.

The right side of Equation 5.2.2 should have a summation over dose pathways. (This summation is also missing from the corresponding equations in NUREG-0133.) Also, Section 5.4 should contain a

commitment to include a comprehensive statement of differences from the methodology of Section 5.2 if an alternate methodology is used for a comprehensive dose assessment. With these additions, the methodology of Section 5.2.2 is considered to be within NRC guidelines.

3.9 Dose Projections

Sections 2.2 and 5.3, respectively, contain methodology to project doses due to radioactive liquid and gaseous effluents. These projections are based on releases for the previous month. To be within NRC guidelines, the methodology should include a margin, based on operating data, for anticipated operational occurrences, as recommended by Sections 4.5 and 5.4 of NUREG-0133.

3.10 Diagrams of Effluent Release Routes

The ODCM contains comprehensive flow diagrams defining the treatment paths and components of the radioactive liquid and gaseous waste management systems. Therefore, the ODCM is considered to be within NRC guidelines with respect to diagrams of the liquid and gaseous waste management systems.

3.11. Total Dose

The ODCM contains no specific methodology to calculate the total (fuel cycle) dose to show compliance with 40 CFR 190.[14] There is no requirement in the technical specifications for such methodology to be included. For the licensee's technical specifications and ODCM to be within current NRC guidelines: (a) a Surveillance Requirement 4.22.4.2, requiring doses due to direct radiation to be determined in accordance with the methodology and parameters in the ODCM, should be added to the technical specifications, and (b) the required methodology and data should be added to the ODCM. For completeness, the dose contributions due to other nearby uranium fuel cycle sources should be addressed in the ODCM.

3.12 Environmental Monitoring Program

Section 7.0 identifies specific parameters of distance and the direction sector from the site and additional information for all samples identified in Environmental Monitoring Table 3.23-1 of Technical Specification 3.23.1, as required by Technical Specification 4.23.1. Therefore, this section of the ODCM is considered acceptable.

3.13 Interlaboratory Comparison Program

The licensee's Surveillance Requirement 4.23.3 states, "A summary of the results obtained as part of the above required interlaboratory Comparison Program and in accordance with the ODCM shall be included in the Annual Radiological Environmental Operating Report." This statement, excerpted from Surveillance Requirement 4.12.3 of NUREG-0472, Revision 2, is unclear. Examination of NUREG-0472, Revision 2 and subsequent revisions shows that the intent of the statement is to require that the Interlaboratory Laboratory Program be described in the ODCM. For clarity, the licensee should consider replacing the present wording of Surveillance Requirement 4.23.3 with the corresponding wording from a recent revision of NUREG-0472 (e.g. Ref. 7). Whether or not the surveillance requirement is reworded, the Interlaboratory Comparison Program should be described in the ODCM in order for the ODCM to be within NRC guidelines.

4. SUMMARY

This section contains a summary of the deficiencies and suggestions identified by the review. The items in Category A identify the most serious deficiencies, including omissions that cause uncertainty as to whether the proper methodology is used in the ODCM. Category B contains less serious deficiencies, and Category C contains minor deficiencies and editorial recommendations. The number in parentheses at the end of each item [e.g., (3.5)] refers to the section in this review that contains a discussion of the item.

Category A. The items in this category should be addressed promptly, although it is not certain that anything is necessary except clarification of the present methodology.

1. Section 1.2.1 should be revised to correct or clarify the methodology to determine liquid effluent monitor setpoints and flow rates. The present methodology for monitor RM-L6 can be interpreted to permit each radionuclide to contribute 10% of the 10 CFR 20 limit to offsite concentrations. (3.2)

2. Sections 1.2.2 and 1.2.3 should be revised to unambiguously require that all radionuclides are accounted for, not I-131 only. (3.2)

Category B. The items below concern information that should be added to make the ODCM more complete, prevent erroneous interpretation of the methodology, or correct methodology that is erroneous. For some items it is not certain which of these characteristics they fit.

1. Section 1.1 should identify the analyses used to determine the mixture of radionuclides to which the noble gas effluent monitors are calibrated. (3.4)

2. In Sections 4.2 and 5.1.2, the controlling dose rate should be the dose rate to a child instead of an infant. (3.6.2)

3. In Section 2.1, the definitions of FD and FR, respectively, should identify the periods over which the plant dilution flowrate and river flowrate are determined. (3.7)

4. Based on Table 4.3, the maximum X/Q given for the station vent should apparently be 7.17E-7 sec/m^3 at 2413 m in the NNE sector.(3.8.1)

5. Section 2.3 should contain a commitment to include a comprehensive statement of differences from the methodology of Section 2.1 with reported doses if an alternate method is used for a comprehensive assessment of doses due to liquid effluents. (3.7)

6. Section 5.4 should contain a commitment to include a comprehensive statement of differences from the methodology of Section 5.2 with reported doses if an alternate method is used for a comprehensive assessment of doses due to gaseous effluents other than noble gases. (3.8.3)

7. Sections 2.2 and 5.3, respectively, for projecting doses due to liquid and gaseous effluents, should include methodology to include a margin, based on operating data, for anticipated operational occurrences. (3.9)

8. A Surveillance Requirement 4.22.4.2, requiring doses due to direct radiation to be determined in accordance with the methodology and parameters in the ODCM, should be added to the technical specifications. (3.11)

9. The required methodology and data to determine the contribution of direct radiation to the dose limits of 40 CFR 190 should be added to the ODCM. For completeness, the dose contributions due to other nearby uranium fuel cycle sources should also be addressed in the ODCM. (3.11)

10. The Interlaboratory Comparison Program should be described in the ODCM. Also, to clarify the requirement, it would be advisable to reword the technical specification's Surveillance Requirement 4.23.3 to match Surveillance Requirement of recent revisions of NUREG-0472. (3.13)

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

1. In Section 1.1, "proportional" and "inversely proportional" should be interchanged in the definition of c. (3.2)

2. Section 1.1 should include an expression identifying the total concentration to which the effluent monitors are calibrated (i.e., $c = \Sigma c_i$). (3.4)

3. The 500 mrem/yr, 3000 mrem/yr, and 1500 mrem/yr in the definitions for Equations 4.1.1, 4.12, and 4.2, respectively, should be identified as dose rates instead of doses. (3.4)

4. References to "Controls" and "Section II..." should be replaced or supplemented with appropriate technical specification references. (3.4, 3.6.1)

5. Section 1.3 should be more specific about what parts of Section 1.1 and 1.2 are used to implement the requirements stated in Section 1.3. (3.5)

6. The right side of Equation 5.2.2 should contain a summation over dose pathways. (3.8.3)

7. For consistency with Section 1.2 of the ODCM and Technical Specification 3.2.1.1, the liquid effluent monitors shown if Figure 1.2 should be labeled RM-L6, RM-L10, and RM-L12, respectively, instead of RML-6, RML-10, and RML-12. (3.1)

8. For consistency with Section 4.3 of the ODCM and Technical Specification Table 3.21-2, the gaseous effluent monitors in ODCM Figure 4.1 should be labeled RM-7, RM-9,...,respectively, instead of RMA-7, RMA-9,....(3.3)

5. CONCLUSIONS

The TMI-1 ODCM, Revision 1, effective March 20, 1991, uses documented and approved methods that are, in general, consistent with the methodology and guidance of NUREG-0133, Regulatory Guide 1.109, Revision 1 and NUREG-0472. The ODCM is generally complete and well-written, and contains essentially all of the required methodology. Only Sections 1.1 and 1.2 appear to need prompt attention. It is uncertain whether the methodology in these sections, to determine the setpoints for the liquid effluent monitors, will ensure that offsite concentrations are maintained within 10 CFR 20 limits. The methodology to determine liquid effluent monitor setpoints should be revised or clarified, as necessary. Several less significant items should also be addressed by the licensee to correct and improve the ODCM.

6. REFERENCES

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

2. Letter from J. F. Stolz (NRC) to H. D. Hukill (GPUN); Subject: none; August 6, 1981.

3. Letter from H. D. Hukill (GPUN) to Document Control Desk (NRC); Subject: Three Mile Nuclear Station Unit 1 (TMI-1)/Operating License No. DPR-50/Docket No. 50-289/Semi Annual Effluent and Release Report; February 26,1988.

4. Letter from F. B. Simpson (EG&G) to W. W. Meinke (NRC); Subject: Review of the TMI-1 ODCM, Rev. 8; October 4, 1988.

5. Letter from R. W. Hernan (NRC) to H. D. Hukill (GPUN); Subject: TMI-1 Technical Specification Change Request (TSCR) No. 173 - Request for Withdrawal; March 15, 1989.

6. Letter from T. G. Broughton (GPUN) to Document Control Desk (NRC); Subject: Three Mile Island Nuclear Station, Unit 1 (TMI-1)/Operating License No. DPR-50/Docket No. 50-289/Offsite Dose Calculation Manual (ODCM); April 4, 1991.

7. "Standard Radiological Effluent Controls for Pressurized Water Reactors"; NUREG-0472, Revision 3, Draft 9, August 28, 1989.

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

9. "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, Revision 1, October 1977.

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

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

12. Letter from S. S. Varga (NRC) to All Power Reactor Licensees and Applicants; Subject: Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Offsite Dose Calculation Manual or to the Process Control Program (Generic Letter 89-01); January 31, 1989.

13. Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation."

14. Title 10, Code of Federal Regulations, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations"

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13. ABSTRACT (200 words or less)

The Offsite Dose Calculation Manual (ODCM) for the Three Mile Island Nuclear Station, Unit 1 (TMI-1) contains current methodology and parameters used to calculate offsite doses and effluent monitoring alarm/trip setpoints, and to conduct the radiological environmental monitoring program. The NRC transmitted the most recent complete TMI-1 ODCM, Revision 0, effective March 20, 1991, to the Idaho National Engineering Laboratory for review by EG&G Idaho, Inc. The ODCM was reviewed by EG&G, and the results are presented in this report. It was determined that the ODCM uses methods that are, in general, within the guidelines of NUREG-0133. However, the methodology to determine the setpoints of the liquid effluent monitors should be checked promptly. The description of the methodology needs to be either corrected or clarified. All other recommended changes are relatively minor, and should be considered in future ODCM revisions.

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