

SAFETY EVALUATION AND ENVIRONMENTAL IMPACT APPRAISAL BY
THE OFFICE OF NUCLEAR REACTOR REGULATION
SUPPORTING AMENDMENT NO. _____ TO FACILITY LICENSE NO. DPR-50
METROPOLITAN EDISON COMPANY
THREE MILE ISLAND NUCLEAR STATION, UNIT NO. 1
DOCKET NO. 50-289

INTRODUCTION

On May 5, 1975, the Nuclear Regulatory Commission announced its decision in the rulemaking proceeding concerning the numerical guides for design objectives and limiting conditions for operation to meet the criterion "as low as is reasonably achievable" for radioactive materials in light-water-cooled nuclear power reactor effluents. This decision is set forth in Appendix I to 10 CFR Part 50.⁽¹⁾

Section V.B of Appendix I to 10 CFR Part 50 requires the holder of a license authorizing operation of a reactor for which application was filed prior to January 2, 1971, to file with the Commission by June 4, 1976; 1) information necessary to evaluate the means employed for keeping levels of radioactivity in effluents to unrestricted areas "as low as is reasonably achievable", and 2) plans for proposed Technical Specifications developed for the purpose of keeping releases of radioactive materials to unrestricted areas during normal operation, including anticipated operational occurrences "as low as is reasonably achievable."

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In conformance with the requirements of Section V.B of Appendix I, the Metropolitan Edison Company (MEC) filed with the Commission on June 4, 1976,⁽²⁾ and in subsequent submittals^(3, 4) the necessary information to permit an evaluation of the Three Mile Island Nuclear Station, Unit No. 1, with respect to the requirements of Sections II.A, II.B, and II.C of Appendix I. In this submittal, MEC chose to perform the detailed cost-benefit analysis required by Section II.D of Appendix I to 10 CFR Part 50

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By letter dated _____, MEC submitted proposed changes to Appendix A Technical Specifications for Three Mile Island Nuclear Station, Unit No. 1. The proposed changes implement the requirements of Appendix I to 10 CFR Part 50 and provide reasonable assurance that releases of radioactive materials in liquid and gaseous effluents are "as low as is reasonably achievable" in accordance with 10 CFR Parts 50.34a and 50.36a.

DISCUSSION

The purpose of this report is to present the results of the NRC staff's detailed evaluation of the radioactive waste treatment systems installed at Three Mile Island Nuclear Station, Unit No. 1; 1) to reduce and maintain releases of radioactive materials in liquid and gaseous effluents to "as low as is reasonably achievable" levels in accordance with the requirements of 10 CFR Parts 50.34a and 50.36a, 2) to meet the individual dose design objectives set forth in Sections II.A, II.B, and II.C of Appendix I to 10 CFR Part 50, and 3) to meet the cost-benefit objective set forth in Section II.D of Appendix I to 10 CFR Part 50.

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I. Safety Evaluation

The NRC staff has performed an independent evaluation of the licensee's proposed method to meet the requirements of Appendix I to 10 CFR Part 50. The staff's evaluation consisted of the following: 1) a review of the information provided by the licensee in his June 4, 1976, and subsequent submittals^(2, 3, 4); 2) a review of the radioactive waste (radwaste) treatment and effluent control systems described in the licensee's Final Safety Analysis Report (FSAR)⁽⁵⁾; 3) a review of the licensee's response to the staff for additional information^(3, 4);

4) the calculation of expected releases of radioactive materials in liquid and gaseous effluent (source terms) for the Three Mile Island, Unit No. 1, facility; 5) the calculation of airborne relative concentration (X/Q) and deposition (D/Q) values for the Three Mile Island site region; 6) the calculation of individual doses in unrestricted areas; and 7) the calculation of the cost-benefit ratio for potential radwaste system augments, using the methods outlined in "Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactor."⁽⁶⁾ The staff's evaluation is discussed in detail in the following paragraphs.

The radwaste treatment and effluent control systems installed at Three Mile Island Nuclear Station, Unit No. 1, have been previously described in Section 11.0 of the staff's Safety Evaluation Report (SER) dated June 1973⁽⁷⁾, and in Section III.D of the Final Environmental Statement (FES) dated December 1972⁽⁸⁾.

Based on more recent operating data at other operating nuclear power reactors which are applicable to Three Mile Island Nuclear Station, Unit No. 1, and on changes in the staff's calculation models, new liquid and gaseous source terms have been generated to determine conformance with the requirements of Appendix I. The new source terms, shown in Tables 1 and 2, were calculated using the model and parameters described in NUREG-0017⁽⁹⁾. In making these determinations, the staff considered waste flow rates, concentrations of radioactive materials in the primary system and equipment decontamination factors consistent with those expected over the 30 year operating life of the plant for normal operation including anticipated operational occurrences. The principal parameters and plant conditions used in calculating the new liquid and gaseous source terms are given in Table 3.

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The staff also reviewed the operating experience accumulated at Three Mile Island Nuclear Station, Unit No. 1, in order to correlate the calculated releases given in Tables 1 and 2 with observed releases of radioactive materials in liquid and gaseous effluents. Data on liquid and gaseous effluents are contained in the licensee's Semi-Annual Operating Reports covering the period for September 1974 through December 1976. A summary of these releases is given in Table 4. Three Mile Island Nuclear Station, Unit No. 1, reached initial criticality on June 5, 1974, and commercial operation in September 1974. Since the staff does not consider data from the first year of operation to be representative of the long term operating life of the plant, only effluent release data from January 1976 through December 1976 were used in comparing actual releases from Three Mile Island, Unit No. 1.

The observed release of mixed fission and activation products released from the liquid waste system for 1976 was 0.1 Ci/yr and the calculated release was 0.25 Ci/yr. The observed releases from the gaseous radwaste system for 1976 were as follows: 1) Noble gases: 2,700 Ci/yr; 2) Particulates: < 0.004 Ci/yr; 3) Iodine-131: 0.0048 Ci/yr; and 4) Tritium: 720 Ci/yr. The calculated releases are 6,900 Ci/yr, 0.002 Ci/yr, 0.037 Ci/yr and 510 Ci/yr for noble gases, particulates, iodine-131, and tritium, respectively.

The differences between the actual and calculated values are not considered significant and can be attributed to better fuel performance than was assumed in the calculations. The staff believes that the calculational model reasonably characterizes the actual releases of radioactive material from this system.

The staff has made reasonable estimates of average atmospheric dispersion conditions for Three Mile Island, Unit No. 1, using our atmospheric dispersion model for long-term releases⁽¹⁰⁾ and 100-foot level onsite data collected from October 7, 1972 through October 6, 1973 and November 8, 1974 through November 7, 1975. The model used by the staff is based on the Straight-Line Trajectory Model described in Regulatory Guide 1.111⁽¹¹⁾. The model adjusts the measured winds to represent winds at the heights of release and assumes a mixture of elevated and ground-level releases, based on the criteria established in Regulatory Guide 1.111. The reactor building vent releases were considered to be mixed mode (elevated part of the time and ground level the remaining time) and the turbine building release was considered to be completely ground level. Non-continuous and intermittent gaseous releases from the reactor building vent were evaluated separately from continuous releases. The calculations also include an estimate of maximum increase in calculated relative concentration and deposition due to open terrain recirculation of airflow not considered in the straight-line trajectory model.

Table 5 presents calculated values of relative concentration (X/Q) and relative deposition (D/Q) for specific points of interest. The summary of calculated doses given in Table 6 are different from and replace those given in Table 14 of the FES.

The staff's dose assessment considered the following three effluent categories: 1) pathways associated with radioactive materials released in liquid effluents to the Susquehanna River; 2) pathways associated with noble gases released to the atmosphere; and 3) pathways associated with radioiodines, particulates,

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carbon 14, and tritium released to the atmosphere. The mathematical models used by the staff to perform the dose calculations to the maximum exposed individual are described in Regulatory Guide 1.109⁽¹²⁾.

The dose evaluation of pathways associated with the release of radioactive materials in liquid effluents was based on the maximum exposed individual. For the total body dose, the staff considered the maximum exposed individual to be an adult whose diet included the consumption of fish (21 kg/yr) harvested in the immediate vicinity of the discharge from the Three Mile Island, Unit No. 1, Plant into the Susquehanna River, drinking water (730 l/yr) from the nearest drinking water intake at Columbia, consumption of irrigated food crops, and use of the shoreline for recreational purposes (12 hr/yr).

The dose to the population living within fifty miles of the Three Mile Island Nuclear Plant due to the radioactive materials released in liquid effluents was based on the following parameters; 1) at the year 2010, 5.5 thousand people will consume 32 thousand Kg of sport fish taken from the Susquehanna River, 2) 2,000,000 people will consume 660 million liters of drinking water from the Susquehanna River and, 3) food production using Susquehanna irrigation water (Vegetation - 27 million Kg, Meat - 5.4 million Kg and Milk - 53 million liters).

The dose evaluation of noble gases released to the atmosphere included a calculation of beta and gamma air doses at the site boundary sector having the highest dose and total body and skin doses at the site boundary sector having

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the highest dose. The maximum air doses at the site boundary were found at 0.11 mi W relative to the Three Mile Island Plant, Unit No. 1. The location of maximum total body and skin doses was determined to be at the same location.

The dose evaluation of pathways associated with radioiodine, particulates, carbon-14, and tritium released to the atmosphere was also based on the maximum exposed individual. For this evaluation, the staff considered the maximum exposed individual to be an infant whose diet included the consumption of milk (330 l/yr) from a goat grazing at 1.0 miles N of the Three Mile Island Plant, Unit No. 1. The evaluation further considered that the goat grazing at this location received pasture equivalent to 12 months per year total diet.

The calculated dose to the population living within fifty miles of Three Mile Island due to the releases of noble gases, radioiodines, particulates, carbon-14, and tritium was based on the following parameters; 1) the year 2010 population within 50 miles of Three Mile Island, Unit No. 1, is estimated to be 3.2 million people; 2) annual food production for human consumption within 50 miles of Three Mile Island consists of 1.3 billion liters of milk, 312 million kilograms of meat, and 1.9 billion kilograms of vegetation crops.

Using the dose assessment parameters noted above and the calculated releases of radioactive materials in liquid effluents given in Table 1, the staff calculated the annual dose or dose commitment to the total body or to any organ of an individual, in an unrestricted area, to be less than 3 mrem/reactor and 10 mrem/reactor, respectively, in conformance with Section II.A of Appendix I.

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Using the dose assessment parameters noted above, the calculated releases of radioactive materials in gaseous effluents given in Table 2, and the appropriate relative concentration (X/Q) value given in Table 5, the staff calculated the annual gamma and beta air doses at or beyond the site boundary to be less than 10 mrad/reactor and 20 mrad/reactor, respectively, in conformance with Section II.B of Appendix I.

Using the dose assessment parameters noted above, the calculated releases of radioiodine, carbon-14, tritium, and particulates given in Table 2, and the appropriate relative concentration (X/Q) and deposition (D/Q) values given in Table 5, the staff calculated the annual dose or dose commitment to any organ of the maximum exposed individual to be less than 15 mrem/reactor in conformance with Section II.C of Appendix I.

Section II.D of Appendix I to 10 CFR Part 50⁽¹⁾ requires that liquid and gaseous radwaste systems for light-water-cooled nuclear reactors include all items of reasonably demonstrated technology that, when added to the system sequentially and in order of diminishing cost-benefit return, can, for a favorable cost-benefit ratio, effect reductions in dose to the population reasonably expected to be within 50 miles of the reactor. The staff's cost-benefit analysis was performed using: 1) the dose parameters stated above and in Table 7; 2) the analysis procedures outlined in Regulatory Guide 1.110⁽⁶⁾; 3) the cost parameters given in Table 8; and 4) the capital costs as provided in Regulatory Guide 1.110.⁽⁶⁾

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For the liquid radwaste system, the calculated total body and thyroid doses from liquid releases to the projected population within a 50 mile radius of the station, when multiplied by \$1,000 per total body man-rem and \$1000 per man-thyroid-rem, resulted in cost-assessment values of \$6,800 for the total body man-rem dose and \$12,000 for the man-thyroid-rem dose. The most effective augment was evaporation of all liquid wastes with release of vapor to the atmosphere to effect a net reduction in tritium relative to the liquid pathway dose. The calculated cost of \$200,000 for this augment exceeded the cost assessment values for the liquid radwaste system. The staff concludes, therefore, that there are no cost-effective augments to reduce the cumulative population dose at a favorable cost-benefit ratio, and that the liquid radwaste system meets the requirements of Section II.D of Appendix I to 10 CFR Part 50.

For the gaseous radwaste system, the calculated total body and thyroid doses from gaseous releases to the projected population within a 50 mile radius of the station, when multiplied by \$1000 per total body man-rem and \$1000 per man-thyroid rem, resulted in cost-assessment values of \$6,600 for the total body man-rem dose and \$14,000 for the man-thyroid-rem dose. The most effective augment was the addition of a 4" deep bed charcoal adsorber and HEPA filtration system to the condenser air removal exhaust system. The augment resulted in a calculated dose reduction of 5.9 man-thyroid-rem by decreasing releases of radioiodines. The cost-assessment value of the dose reduction, based on \$1,000 per man-thyroid-rem, was \$5,900. Since the total annualized cost of the augment was \$10,200, the cost benefit ratio exceeded unity and the augment cannot be cost-beneficial. The calculated cost of all other augments

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considered exceeded the cost assessment values for the gaseous radwaste system. The staff concludes, therefore, that there are no cost-effective augments to reduce the cumulative population dose at a favorable cost-benefit ratio, and that the gaseous radwaste system meets the requirements of Section II.D of Appendix I to 10 CFR Part 50.

CONCLUSION

Based on the foregoing evaluation, the staff concludes that the radwaste treatment systems installed at Three Mile Island Nuclear Station, Unit No. 1, are capable of reducing releases of radioactive materials in liquid and gaseous effluents to "as low as is reasonably achievable" levels in accordance with the requirements of 10 CFR Part 50.34a, and therefore, are acceptable.

In addition, the staff's evaluation has shown that the liquid and gaseous radwaste systems meet the cost-benefit objectives set forth in Section II.D of Appendix I to 10 CFR Part 50.

The staff has performed an independent evaluation of the radwaste systems installed at Three Mile Island Nuclear Station, Unit No. 1. This evaluation has shown that the installed systems are capable of maintaining releases of radioactive materials in liquid and gaseous effluents during normal operation including anticipated operational occurrences such that the calculated individual doses are less than the numerical dose design objectives of Section II.A, II.B, and II.C of Appendix I to 10 CFR Part 50. In accordance with Section II.D of Appendix I, the staff has performed a cost-benefit analysis which shows that no additional augments can be added to the systems now installed at Three Mile Island Nuclear Station, Unit No. 1, that will effect a reduction in dose to the population within a 50 mile radius of the station for a favorable cost-benefit ratio.

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The staff concludes, based on the considerations discussed above, that: (1) because the revised Technical Specifications do not involve a significant increase in the probability of consequences of accidents previously considered and does not involve a significant hazard consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

II. Environmental Impact Appraisal

The licensee is presently licensed to possess and operate the Three Mile Island Nuclear Station, Unit No. 1, located in the State of Pennsylvania, in Dauphin County, at power levels up to 2535 megawatts thermal (MWT). The proposed changes to the liquid and gaseous release limits will not result in an increase or decrease in the power level of the Unit. Since neither power level nor fuel burnup is affected by the action; it does not affect the benefits of electric power production considered for the captioned facility in The Commission's Final Environmental Statement (FES) for Three Mile Island Nuclear Station Unit No. 1, Docket No. 50-289.

The revised liquid and gaseous effluent limits will not significantly change the total quantities or types of radioactivity discharged to the environment from Three Mile Island Nuclear Station, Unit No. 1.

The revised Technical Specifications implement the requirements of Appendix I to 10 CFR Part 50 and provide reasonable assurance that releases of radio-

active materials in liquid and gaseous effluents will be "as low as is reasonably achievable." If the plant exceeds one-half the design objectives in a quarter, the licensee must: (1) identify the cases, (2) initiate a program to reduce the releases; and (3) report these actions to the NRC. The revised Technical Specifications specify that the annual average release be maintained at less than twice the design objective quantities set forth in Sections II.A, II.B, and II.C of Appendix I.

Conclusion and Basis for Negative Declaration

On the basis of the foregoing evaluation, it is concluded that there would be no significant environmental impact attributable to the proposed action. Having made this conclusion, the Commission has further concluded that no environmental impact statement for the proposed action need be prepared and that a negative declaration to this effect is appropriate.

Dated:

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REFERENCES

1. Title 10, CFR Part 50, Appendix I. Federal Register, V. 40, P. 19442, May 5, 1975.
2. Response to 10 CFR Part 50, Appendix I Correspondence: Three Mile Island Nuclear Station, Unit No. 1. Letter of Transmittal, June 4, 1976. Enclosed Evaluation of Three Mile Island, Unit No. 1, to Demonstrate Conformance to the Design Objectives of 10 CFR Part 50, Appendix I," dated June 1976, and Appendix 10.7-A, "Cost Estimating Methodology and Detail Cost Estimates," dated June 1976.
3. Responses to Additional Information Request for Meteorological Data for Three Mile Island Nuclear Station, Unit Nos. 1 and 2. Letter of Transmittal, July 14, 1976. Enclosed "Meteorological Information and Diffusion Estimates to Conform with Appendix I Requirements," dated July 1976.
4. Response to Additional Information Request for Three Mile Island Nuclear Station, Unit No. 1, Letter of Transmittal, January 14, 1977. Enclosed, "Response to Request for Additional Information," dated January 1977.
5. Metropolitan Edison Company, Final Safety Analysis Report, Three Mile Island Nuclear Station, Unit No. 1, March 1970.
6. Staff of the U.S Nuclear Regulatory Commission, Regulatory Guide 1.110, "Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Reactors", March 1976.
7. Staff of the U.S. Nuclear Regulatory Commission, "Safety Evaluation of the Three Mile Island Nuclear Station, Unit No. 1, Docket No. 50-289, Washington, D.C. July 11, 1973.
8. Staff of the U.S Nuclear Regulatory Commission, "Final Environmental Statement Related to the Operation of Three Mile Island Nuclear Station, Unit Nos 1 and 2, Docket Nos. 50-289 and 50-320, Washington, D.C., December 1972.
9. NUREG-0017, "Calculation of Releases of Radioactive Materials In Gaseous and Liquid Effluents from Pressurized Water Reactors (PWR-GALE Code)," April 1976.
10. Sagendorf, J.F. and Goll, J.T., 1976: X00D00, Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations, (DRAFT). U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C.
11. Staff of the U.S Nuclear Regulatory Commission, Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, July 1977.

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12. Staff of the U.S. Nuclear Regulatory Commission, Regulatory Guide 1.109, "Calculation of Annual Average Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977.

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