~~Central~~ Docket
280-281

APR 2 5 1978

Docket No. 50-280/281

MEMORANDUM FOR: A. Schwencer, Chief, Operating Reactors Branch No. 1, DOR

FROM: J. T. Collins, Chief, Effluent Treatment Systems Branch, DSE

SUBJECT: DSE EVALUATION OF SURRY POWER STATION, UNIT NOS. 1 AND 2 WITH RESPECT TO APPENDIX I TO 10 CFR PART 50

Enclosed is DSE's detailed evaluation of the radioactive waste treatment systems installed at Surry Power Station, Unit Nos. 1 and 2, with respect to the requirements of Appendix I. The results of our evaluation are contained in the attached "Safety Evaluation and Environmental Impact Appraisal." We have also attached a draft "Notice of Issuance of Amendment to Facility Operating Licenses and Negative Declaration."

Based on our evaluation, we conclude that the radioactive waste treatment systems installed at Surry, Unit Nos 1 and 2 are capable of maintaining releases of radioactive materials in effluents to "as low as is reasonably achievable" levels in conformance with the requirements of 10 CFR Part 50.34a, and conforms to the requirements of Sections II.A, II.B, II.C, and II.D of Appendix I.

When the model effluent radiological Technical Specifications, currently under development, have been approved they will be forwarded to you for transmittal to the licensee.

ORIGINAL SIGNED BY
J. T. COLLINS

John T. Collins, Chief
Effluent Treatment Systems Branch
Division of Site Safety and
Environmental Analysis

Enclosure:
DSE Evaluation

cc: H. Denton
V. Stello
R. Vollmer
K. Goller

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Docket 50-280/281
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SAFETY EVALUATION AND ENVIRONMENTAL IMPACT APPRAISAL BY
THE OFFICE OF NUCLEAR REACTOR REGULATION
SUPPORTING AMENDMENT NO. TO FACILITY LICENSE NOS. DPR-32 AND DPR-37
VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION, UNIT NOS. 1 AND 2
DOCKET NO. 50-280/281

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 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."

In conformance with the requirements of Section V.B of Appendix I, the Virginia Electric and Power Company (VEPCO) filed with the Commission on June 4, 1976(2) and in subsequent submittals(3,4) the necessary information to permit an evaluation of the Surry Power Station, Unit Nos. 1 and 2, with respect to the requirements of Sections II.A, II.B, and II.C, of Appendix I. In this submittal, VEPCO chose to perform the detailed cost-benefit analysis required by Section II.D of Appendix I to 10 CFR Part 50.

By letter dated , VEPCO submitted proposed changes to Appendix A Technical Specifications for Surry Power Station, Unit Nos. 1 and 2. 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 Surry Power Station, Unit Nos. 1 and 2: 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.

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 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's requests for additional information (3, 4);

4) the calculation of expected releases of radioactive materials in liquid and gaseous effluents (source terms) for the Surry Power Station, Unit Nos. 1 and 2, facility; 5) the calculation of airborne relative concentration (X/Q) and deposition (D/Q) values for the Surry Station 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 Surry Power Station, Unit Nos. 1 and 2, have previously been described in Section 3.1.8 of the staff's Safety Evaluation Report (SER) dated February 1972,[7] and in Section III.D. of the Final Environmental Statement (FES) for Unit No. 1 dated May 1972[8] and of the Final Environmental Statement (FES) for Unit No. 2 dated June 1972.[9]

Based on more recent operating data at other operating nuclear power reactors, which are applicable to Surry Power Station, Unit Nos. 1 and 2 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.[10] 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.

The staff also reviewed the operating experience accumulated at Surry Station, Unit Nos. 1 and 2, 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 December 1972 through December 1976. A summary of these releases is given in Table 4. Surry Power Station, Unit No. 1 reached initial criticality on July 1, 1972, and commercial operation in December 1972. Surry Power Station, Unit No. 2 reached initial criticality on March 7, 1973, and reached commercial operation in May 1973. 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 1973 through December 1976 were used in comparing actual releases from Surry Power Station, Unit No. 1 and 2.

The observed combined releases of mixed fission and activation products released from the shared liquid radwaste systems from 1973 through 1976 (combined releases from Unit Nos. 1 and 2) averaged 12 Ci/yr, with a maximum of 29 Ci/yr. Our calculated release was 21 Ci/yr/unit. The observed average and maximum combined releases from Unit Nos. 1 and 2, from the shared gaseous radwaste system for the years 1973 through 1976 were as follows: (annual average releases shown first, with maximum annual releases in parentheses): 1) Noble gases: 7,400 Ci/yr (19,300 Ci/yr); 2) Particulates: 0.05 Ci/yr (0.072 Ci/yr); 3) Iodine-131: 0.24 Ci/yr (0.57 Ci/yr); and 4) Tritium: 190 Ci/yr (370 Ci/yr). The calculated releases for each unit are 4,700 Ci/yr, 0.0025 Ci/yr, 0.032 Ci/yr, and 490 Ci/yr for noble gases, particulates, iodine-131, and tritium, respectively.

The differences between the actual and calculated releases are not considered significant. The average releases for noble gases and particulates are reasonably close to the calculated values. Reported iodine releases are a factor of eight higher than calculated which can be attributed to the high rate of steam generator leakage experienced at both units and the venting of the blowdown flashtank to the atmosphere. The blowdown system has now been modified to cool the blowdown stream to prevent flashing to eliminate this source of gaseous iodine-131 release. VEPCO has also proposed to replace the leaking steam generators. Our source terms were calculated asssuming replacement of the steam generators and use of the modified blowdown system. Average tritium releases were lower than our calculated values; however, we anticipate a gradual increase in annual releases until an equilibrium is reached at about the 5th to 7th year of operation. 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 the Surry site using the atmosphere dispersion model presented in NUREG-0324 [11] which is based on the "Straight-Line Trajectory Model" described in Regulatory Guide 1.111 [12]. Ventilation and turbine building releases at the Surry site were considered as ground-level, with adjustments for mixing in the building wake. Releases from process vents were considered to be partially elevated in accordance with the criteria described in Regulatory Guide 1.111. An estimate of increase in calculated relative concentration (X/Q) and relative deposition (D/Q) due to spatial and temporal variations in airflow, not considered in the straight-line model, was included as presented in NUREG-0324. The calculations also included consideration of intermittent releases during more adverse atmospheric conditions than indicated by an annual average calculation as a function of total duration of releases (NUREG-0324). Radioactive decay of effluents and depletion of the effluent plume were considered as described in Regulatory Guide 1.111. Two years (March 3, 1974-March 2, 1975 and May 1, 1975-April 30, 1976) of onsite meteorological data were used in the analysis.

All releases were evaluated using joint frequency distributions of wind speed and direction at the 10.6 m (35 ft) level by atmospheric stability (defined by the vertical temperature gradient measured between the 10.6 m (35 ft) and 45.1 m (150 ft) levels.

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 5.7 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 James River; 2) pathways associated with noble gases released to the atmosphere; and 3) pathways associated with radioiodines, particulates, 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. (13)

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 Surry Power Station Unit Nos. 1 and 2 into the James River.

The dose to the population living within fifty miles of the Surry Station, Unit Nos 1 and 2 due to the radioactive materials released in liquid effleunts was based on the following parameters: 1) at the year 1990, 2.04 million people will consume 12 million Kg of sport fish taken from the James River.

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 the highest dose. The maximum air doses at the site boundary were found at 0.33 mi NNE relative to the Surry Power Station, Unit Nos. 1 and 2. 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 at a residence with milk, meat, and vegtable pathways located 1.53 miles south relative to the Surry Station.

The calculated dose to the population living within fifty miles of Surry Power Station due to the releases of noble gases, radioiodines, particulates, carbon-14, and tritium to the atmosphere was based on the following parameters; 1) the year 1990 population within 50 miles of Surry Power Station, Unit Nos. 1 and 2, is estimated to be 2.04 million people; 2) annual food production for human consumption within 50 miles of the Surry Station consists of 62 million liters/yr of milk, 58 million kg of meat, and 28 million kg of produce.

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.

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].

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 $38,000 for the total body man-rem dose and $41,000 for the man-thyroid-rem dose. The most effective augment was a 30 gpm evaporator for the miscellaneous liquid radwaste treatment system. The calculated annual cost of $245,000 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 $2,000 for the total body man-rem dose and $3,200 for the man-thyroid-rem dose. The most effective augment was the addition of a charcoal adsorber and HEPA filtration system to the condenser air removal exhaust system. The calculated annual cost of $10,500 for this augment 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 Surry Power Station, Unit Nos. 1and 2 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 Surry Power Station, Unit Nos. 1 and 2. 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 Surry Power Station, Unit Nos. 1 and 2 that will effect a reduction in the dose to the population within a 50 mile radius of the station for a favorable cost-benefit ratio.

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 occurrence 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 Surry Power Station, Unit Nos. 1 and 2, located in the State of Virginia, in Surry County, at power levels up to 2441 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 Units. 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 Surry Power Station, Unit No. 1, Docket No. 50-280, and in the Commission's Final Environmental Statement (FES) for Surry Power Station, Unit No. 2, Docket No. 50-281.

The revised liquid and gaseous effluent limits will not significantly change the total quantities or types of radioactivity discharged to the environment from Surry Power Station, Unit Nos. 1 and 2.

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:

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: Surry Power Station, Unit Nos. 1 and 2. Letter of Transmittal, June 4, 1976. Enclosed Evaluation of Surry Power Station, Unit Nos. 1 and 2, to Demonstrate Conformance to the Design Objectives of 10 CFR Part 50, Appendix I, dated June 1976.

3. Additional Information for Appendix I Evaluation for Surry Power Station, Unit Nos. 1 and 2, Letter of Transmittal, September 12, 1976.

4. Additional Information for Appendix I Evaluation for Surry Power Station, Unit Nos. 1 and 2, Letter of Transmittal, July 12, 1977, Enclosed, "Appendix I Analysis, Surry Power Station, Unit Nos. 1 and 2, "June 1977, "Appendix I Cost/Benefit Analysis, Surry Units 1 and 2," June 1977, "Appendicies 2.4.A and 2.5.B of Appendix I Analysis", June 1977.

5. Virginia Electric and Power Company, Final Safety Analysis Report, Surry Power Station, Unit Nos. 1 and 2, March 20, 1967, Docket Nos. 50-280 and 50-281.

6. Staff of 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. Atomic Energy Commission "Safety Evaluation by the Division of Reactor Licensing, U.S. Atomic Energy Commission, in the Matter of Virginia Electric and Power Company, Surry Power Station, Units 1 and 2, Surry County, Virginia". Docket Nos. 50-280 and 50-281, February 23, 1972.

8. Staff of the U.S. Atomic Energy Commission, "Final Environmental Statement Related to Operation of Surry Power Station, Unit 1, Virginia Electric and Power Company". Docket No. 50-280, May 1972.

9. Staff of the U.S. Atomic Energy Commission, "Final Environmental Statement Related to Operation of Surry Power Station, Unit 2, Virginia Electric and Power Company". Docket No. 50-281, June 1972.

10. NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (PWR-GALE Code)," April 1976.

11. NUREG-0324, "XOQDOQ, 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. August 1977.

12. 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.

13. 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 Implementing Appendix I," March 1976.

UNITED STATES NUCLEAR REGULATORY COMMISSION

DOCKET NO. 50-280/281

VIRGINIA ELECTRIC AND POWER COMPANY

NOTICE OF ISSUANCE OF AMENDMENT TO FACILITY OPERATING LICENSES AND NEGATIVE DECLARATION

The U.S. Nuclear Regulatory Commission (the Commission) has issued Amendment No. to Facility Operating License No. DPR-32 and DPR-37 issued to Virginia Electric and Power Company, for revised Technical Specifications for operation of the Surry Power Station, Unit Nos. 1 and 2, located in Surry County, Virginia. The amendments are effective as of the date of issuance.

This amendment to the Technical Specifications will (1) implement the requirements of Appendix I to 10 CFR Part 50, (2) establish new limiting conditions for operation (LCO) for the quarterly and annual average release rates, and (3) revise environmental monitoring programs to assure conformance with Commission regulations.

The application for the amendment complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations. The Commission has made appropriate findings as required by the Act and the Commission's rules and regulations in 10 CFR Chapter I, which are set forth in the license amendment. Prior public notice of this amendment was not required since the amendment does not involve a significant hazard consideration.

The Commission has prepared an environmental impact appraisal for the revised Technical Specifications and has concluded that an environmental impact statement for the particular action is not warranted because there will be no significant effect on the quality of the human environment beyond that which has already been predicted and described in the Commission's Final Environmental Statement for the facility dated .

For further details with respect to this action, see (1) the application for amendments dated , (2) Amendment No. to License No. DPR-32, and DPR-37 and (3) the Commission's related Safety Evaluation and Environmental Impact Appraisal. All of these items are available for public inspection at the Commission's Public Document Room, 1717 H Street, N. W., Washington, D. C., and at the Swem Library of the College of William and Mary, Williamsburg, Virginia. A copy of items (2) and (3) may be obtained upon request addressed to the U.S. Nuclear Regulatory Commission, Washington, D. C. 20555, Attention: Director, Division of Operating Reactors.

Dated at Bethesda, Maryland this day of

FOR THE NUCLEAR REGULATORY COMMISSION

Albert Schwencer, Chief
Operating Reactors Branch #1
Division of Operating Reactors

TABLE 1

CALCULATED RELEASES OF RADIOACTIVE MATERIALS IN GASEOUS EFFLUENTS FROM SURRY POWER STATION UNIT NOS. 1 AND 2

Ci/yr/unit

Nuclide	Gas Decay System	Reactor Building	Auxiliary Building	Turbine Building	Air Ejector Exhaust	TOTAL
Kr-83m	a	a	a	a	a	a
Kr-85m	a	1	2	a	2	5
Kr-85	270	31	1	a	a	300
Kr-87	a	a	1	a	a	1
Kr-88	a	1	5	a	3	9
Kr-89	a	a	a	a	a	a
Xe-131m	2	29	2	a	1	34
Xe-133m	a	27	5	a	3	35
Xe-133	4	3800	330	a	210	4300
Xe-135m	a	a	a	a	a	a
Xe-135	a	8	8	a	5	21
Xe-137	a	a	a	a	a	a
Xe-138	a	a	a	a	a	a
TOTAL NOBLE GASES						4700
I-131	a	0.0022	0.0038	0.002	0.024	0.032
I-133	a	0.00073	0.0057	0.0022	0.036	0.045
TOTAL IODINE						0.077
Mn-54	4.5(-5)[b]	5.6(-5)	1.8(-4)	c	c	2.8(-4)
Fe-59	1.5(-5)	1.9(-5)	6(-5)	c	c	9.4(-5)
Co-58	1.5(-4)	1.9(-4)	6(-4)	c	c	9.4(-4)
Co-60	7(-5)	8.7(-5)	2.7(-4)	c	c	4.3(-4)
Sr-89	3.3(-6)	4.4(-6)	1.3(-5)	c	c	2.1(-5)
Sr-90	6(-7)	7.7(-7)	2.4(-6)	c	c	3.8(-6)
Cs-134	4.5(-5)	5.6(-5)	1.8(-4)	c	c	2.8(-4)
Cs-137	7.5(-5)	9.7(-5)	3(-4)	c	c	4.7(-4)
TOTAL PARTICULATES						2.5(-3)
Tritium	-	-	-	-	-	490
C-14	8	1	a	a	a	9
Ar-41	a	25	a	a	a	25

a= less than 1.0 Ci/yr for noble gases and carbon-14, less than 10^{-4} Ci/yr for iodine.
b= exponential notation; 4.5(-5) = 4.5×10^{-5}
c= less than 1% of total for this nuclide.

TABLE 2

CALCULATED RELEASES OF RADIOACTIVE MATERIALS IN LIQUID EFFLUENTS FROM SURRY POWER STATION, UNIT NOS. 1 AND 2

Nuclide	Ci/yr/unit
Corrosion and Activation Products	
Cr-51	1.1(-2)[a]
Mn-54	2.9(-3)
Fe-55	9.9(-3)
Fe-59	6(-3)
Co-58	1(-1)
Co-60	2.1(-2)
Zr-95	1.4(-3)
Nb-95	2(-3)
Np-239	5.3(-3)
Fission Products	
Br-83	4.7(-3)
Br-84	2(-5)
Rb-86	1.9(-2)
Rb-88	1.6(-3)
Sr-89	2.1(-3)
[illegible]r-90	6(-5)
[illegible]-90	2(-5)
Sr-91	2.1(-3)
Y-91m	1.3(-3)
Y-91	4(-4)
Y-93	1.1(-4)
Zr-95	3.6(-4)
Nb-95	3.1(-4)
Mo-99	3.8(-1)
Tc-99m	3(-1)
Ru-103	4.1(-4)
Rh-103m	2.7(-4)
Ru-106	2.5(-3)
Rh-106	6(-5)
Ag-110m	4.4(-4)
Te-125m	1.7(-4)
Te-127m	1.7(-3)
Te-127	3.6(-3)
Te-129m	8.2(-3)
Te-129	5.5(-3)
I-130	7.2(-3)
Te-131m	1(-2)
Te-131	1.9(-3)
I-131	1.2
Te-132	1.2(-1)
I-132	2(-1)
I-133	1.5
I-134	4(-3)
Cs-134	5.5
I-135	5.1(-1)
Cs-136	2.9
Cs-137	4
Ba-137m	3.7
Ba-140	1.2(-3)
La-140	9.9(-4)
Ce-141	4.1(-4)
Ce-143	1.7(-4)
Pr-143	2.8(-4)
Ce-144	5.4(-3)
Pr-144	2(-4)
All others	0
Total, except tritium	21 0.35
Tritium	480 ~0.1

a= Exponential notation, 1.1(-2) = 1.1×10^{-2}

TABLE 3

PRINCIPAL PARAMETERS AND CONDITIONS USED IN CALCULATING RELEASES OF RADIOACTIVE MATERIAL IN LIQUID AND GASEOUS EFFLUENTS FROM SURRY POWER STATION, UNIT NOS. 1 AND 2

Reactor Power Level (MWt)	2441
Plant Capacity Factor	0.80
Failed Fuel	0.12%[a]
Primary System	
Mass of Coolant (lbs)	3.7×10^5
Letdown Rate (gpm)	60
Shim Bleed Rate (gpd)	2500
Leakage to Secondary System (lbs/day)	100
Leakage to Containment Building	b
Leakage to Auxiliary Buildings (lbs/day)	160
Frequency of Degassing for Cold Shutdowns (per year)	2
Secondary System	
Steam Flow Rate (lbs/hr)	1.1×10^7
Mass of Steam/Steam Generator (lbs)	7.2×10^3
Mass of Liquid/Steam Generator (lbs)	9.1×10^4
Secondary Coolant Mass (lbs)	1.5×10^6
Rate of Steam Leakage to Turbine Building (lbs/hr)	1.7×10^3
Containment Building Volume (ft^3)	1.8×10^6
Annual Frequency of Containment Purges (shutdown)	4
Annual Frequency of COntainment Purges (at power)	20
Iodine Partition Factors (gas/liquid)	
Leakage to Auxiliary Buidling	0.0075
Steam Generator	
Iodine	0.01
Nonvolatiles	0.001
Main Condenser Air Ejector (volatile species)	0.15

Decontamination Factors (liquid wastes)

	Shim Bleed And Eq. Drain	Miscellaneous Wastes	Blowdown	Laundry and Hot Shower Drain
I	1×10^4	1×10^3	1×10^3	1
Cs, Rb	1×10^3	20	1×10^2	1
Others	1×10^3	1×10^3	1×10^3	1

	All Nuclides Except Iodine	Iodine
Shim Bleed & Equipment Drain Evaporator DF	10^3	10^2

	Anions	Cs, Rb	Other Nuclides
Shim Bleed Anion Demineralizer DF	10^2	1	1

TABLE 3 (con't)

	Anions	Cs, Rb	Other Nuclides
Radwaste Demineralizer DF	10^2 (10)[a]	2(10)	10^2 (10)
Steam Generator Blowdown Demineralizers DF	10^2 (10)	10(10)	10^2 (10)

a= For demineralizers in series, the DF for the second demineralizer is given in parentheses.

Auxiliary and Fuel Handling Building Charcoal Adsorber DF and Containment Recirculating Cleanup System Charcoal Adsorber DF (iodine removal)	10
HEPA Filter and Containment Recirculating Cleanup System HEPA Filter DF	100

TABLE 4

SUMMARY OF OPERATING DATA FOR
SURRY POWER PLANT, UNIT NOS. 1 AND 2
(Ci/yr) (Combined Releases)

LIQUID EFFLUENTS	1972[a,c]	1973[b,c]	1974[c]	1975[c]	1976[c]
Total Fission and Activation Products	2.5(-2)	1.5(-1)	29	9.3	10.3
Total Tritium	5	448	246	443	782
GASEOUS EFFLUENTS					
Total Noble Gases	1.3(-2)	866	1,270	8,040	19,300
Total Iodine-131	5.7(-5)	4.2(-2)	5.7(-1)	1.2(-1)	2.8(-1)
Total Particulates	d	d	d	d	d
Total Tritium	d	42.4	61	293	372

a= Unit No. 1 went critical in July 1972, and went into commercial operation in December 1972.

b= Unit No. 2 went critical in March 1973 and went into commercial operation in May 1973.

c= Source: Semi-Annual Effluent Release Reports

d= No value reported

TABLE 5

SUMMARY OF ATMOSPHERIC DISPERSION FACTORS AND DEPOSITION VALUES FOR SELECTED LOCATIONS NEAR THE SURRY POWER STATION, UNIT NOS. 1 AND 2

Location	Source	X/Q (sec/m^3)	Relative Deposition (M^{-2})
Nearest site boundary (0.33 mi NNE)	A	1.1E -06	3.4E-08
	B	2.2E-06	6.7E-08
	C	1.3E-04	2.7E-07
	D	8.8E-05	1.8E-07
Nearest residence (1.53 mi. S)	A	4.4E-07	1.8E-09
	B	1.3E-06	5.2E-09
	C	3.7E-06	9.4E-09
	D	1.7E-06	4.2E-09

Source A is plant vent continuous releases

Source B is gas decay tank intermittent releases

Source C is containment intermittent purge releases

Source D is turbine building vent continuous releases

TABLE 6

COMPARISION OF CALCULATED DOSES FROM OPERATION
WITH SECTIONS II.A, II.B, AND II.C, OF APPENDIX I TO 10 CFR PART 50
(Dose to Maximum Individual)

Criterion	Appendix I Dose Design Objectives	Calculated Doses
Liquid Effluents		
Dose to total body from all pathways	3 mrem/yr	0.64 mrem/yr
Dose to any organ from all pathways	10 mrem/yr	2.6 mrem/yr
Noble Gas Effluents		
Gamma dose in air	10 mrad/yr	6.7 mrad/yr
Beta Dose in Air	20 mrad/yr	18 mrad/yr
Dose to total body of an individual	5 mrem/yr	4 mrem/yr
Dose to skin of an individual	15 mrem/yr	11 mrem/yr
Radioiodine and Particulates[a]		
Dose to any organ from all pathways	15 mrem/yr	0.73 mrem/yr

[a]Carbon-14 and Tritium have been added to this category.

TABLE 7

CALCULATED POPULATION DOSES (MAN-REM) FOR
COST-BENEFOT ANALYSIS, SECTION II.D OF
APPENDIX I TO 10 CFR PART 50*

Pathway	Total Body	Thyroid
Liquid	38	41
Gaseous	2	3.2

*Based on the population reasonably expected to be within a 50 mile radius of the reactor.

TABLE 8

PRINCIPAL PARAMETERS USED IN THE COST-BENEFIT ANALYSIS

Labor Cost Correction Factor, FPC Region III[a]	1.0
Cost of Money[b]	10%
Capital Recovery Factor[a]	0.1061

a) From Regulatory Guide 1.110, Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Reactors (March 1976).

b) Licensee Appendix I Submittal, July 12, 1977.