

12.4 DOSE ASSESSMENT

START HISTORICAL

This section discusses the estimated radiation exposures both in-plant and at locations outside the plant structures. Subsections 12.4.1 and 12.4.2 discuss direct radiation and airborne radiation exposures within the plant; Subsection 12.4.3 is concerned with exposures outside the plant structures; and Subsection 12.4.4 estimates the exposure to Unit 2 construction workers from the operation of Unit 1.

12.4.1 DIRECT RADIATION DOSE ESTIMATES FOR EXPOSURES WITHIN THE PLANT

To estimate the total annual man-rem dose from direct radiation to personnel within the plant, seven broad categories or job functions were defined and the annual man-rem dose for each category was evaluated. Where the functions and expected radiation levels were predictable or clearly defined, analytical methods were employed for the man-rem estimates. In other cases, the estimate basis was historical exposure data from operating BWR power plants. Subsection 12.4.1.1 provides the definitions and components of each of the seven broad categories while Subsection 12.4.1.2 describes briefly the estimation techniques used.

The resultant dose estimates are contained in Subsection 12.4.1.3, along with further discussion of the factors involved and the methodology used for each category and its related components.

12.4.1.1 Definition of Categories Used in Exposure Estimates

Seven broad categories were used in estimating the total annual man-rem dose. These categories are:

Routine Operations: This category is composed of three components or subcategories.

- a) Routine patrols and surveillances of the reactor building, turbine building and control structure, and radwaste building*
- b) Periodic tests and checks in the reactor building, turbine building and control structure, and radwaste building*
- c) Control room operations, specifically, the dose received by operators in the main and radwaste control rooms.*

Routine Maintenance: All maintenance that is scheduled. This does not imply that a particular date has been established, but rather that the maintenance is planned and will

occur at least annually. This category also includes the preventative maintenance performed in the radiation areas of the turbine, reactor, and radwaste buildings.

In-service Inspections: These are inspections normally performed by quality assurance, NDT personnel, and outside contractors. Such inspections normally occur during outages on piping and systems that cannot be checked while at power.

Special Maintenance: All maintenance that has not been scheduled. This maintenance will not have been planned in advance and normally cannot be predicted.

Waste Processing: Includes any work with solid or liquid radwaste: movement of casks and liners; radwaste, condensate system, or fuel pool filter changes; resin moving; compacting of low-level radwaste. Maintenance of radwaste equipment is covered by the maintenance categories and is not included in this job function.

Refueling: All work with fuel or reactor components performed in the reactor and pool area.

Health Physics: This covers all health physics activities.

12.4.1.2 Exposure Estimate.Methodology

The analytical method used for man-rem estimation is based upon the product of estimated exposure time and estimated ambient dose rate. Initially, a review of equipment in plant radiation areas is performed. Estimates of the occupancy time requirements for operations associated with that equipment (e.g., maintenance time or surveillance time) are developed. An applicable frequency of occurrence is then factored in to provide the exposure time for that operation. For areas with no significant radiation sources, an estimated dose rate of 0.25 mRem/hr is used. Where radiation sources are present, 2.5 mRem/hr is assumed for Zone II and 15.0 mRem/hr for most Zone III areas. All other estimated dose rates are based on either calculations or actual radiation levels encountered at operating plants. The analytical method was used in determining the exposure estimates for the routine maintenance and routine operations categories.

In the historical method, the annual man-rem is estimated from the exposures received at operating BWR power plants. This method was used for all other categories (special maintenance, inservice inspection, waste processing, refueling, health physics). The data sources are the annual and semi-annual BWR operating reports and plant correspondence with regulatory agencies. Included are a total of sixty-one (61) reactor years of operation for sixteen (16) nuclear units. The average licensed power level of these units is 747 MWe with the smallest rated at 514 MWe, see Table 12.4-1. The data was collected and assembled using the following guidelines:

- a) No data before the first calendar year which contained less than nine (9) months of commercial operation was used.

- b) *In multiple unit plants, each unit was assumed to contribute equally to the annual exposures.*
- c) *If exposure contributions from two or more job functions could not be separated, a conservative approach was taken by assigning all the exposure to one function and having no entry in the data base for the other.*

Table 12.4-2 contains the results of the historical data compilation and includes both the number of reactor years contributing and the standard deviations associated with each job function. The large standard deviations, which range from about 60 to 160 percent of the mean values, are indicative of the wide spread of data that has been reported within each exposure category.

12.4.1.3 Results of Annual Direct Radiation Dose Estimates

The annual man-rem estimates for each category and subcategory are detailed below in Subsections 12.4.1.3.1 through 12.4.1.3.7. The methods used in their determination are as described previously, with any additional assumptions or information included below where required.

In each of the following subsections, the annual exposure estimates are reported for two plant configurations: single unit operational and two units operational. In general, the "two-unit dose" is twice the "single-unit dose"; however, the exposures associated with certain job functions are assumed to be independent of the number of units in operation since the functions will be performed regardless of whether one or two units are operational. These specific job functions are:

- Main Control Room operations*
- Radwaste Control Room operations*
- Radwaste building routine surveillances*
- Radwaste building periodic testing*
- Radwaste building routine maintenance*

For these estimates, the single-unit doses are conservatively assumed to be the same as the two-unit dose.

A summary of the direct radiation dose estimates is given in Subsection 12.4.1.3.8 and in Table 12.4-9.

12.4.1.3.1 Routine Operations Dose Estimate

During normal operations, routine patrols and surveillances are performed by plant operators. The majority of items checked are rotating equipment (pumps, fans, etc), and

each is viewed to verify the absence of leaks, excessive vibrations, or other abnormal conditions. For the man-rem exposure estimation, the following assumptions were made:

- a) Dose rates were estimated as outlined in Subsection 12.4.1.2. Additionally, because of the high potential dose rates associated with certain equipment, routine surveillances of such equipment will be performed from a remote location (such as the cell doorway) and credit was taken for the lower ambient radiation level at that point.*
- b) Exposure received during walking of patrol areas is based upon a walking speed of 200 ft per minute.*
- c) Patrol frequency for Zone II areas will be twice per shift, three shifts per day.*
- d) Patrol frequency for Zone III areas will be once per shift, three shifts per day.*
- e) Surveillance of equipment in Zones IV and V will not be performed regularly but only as required. A patrol frequency of once per month was used for the estimate.*
- f) Each patrol consists of only one man.*

The results of the routine patrol exposure estimate are contained in Table 12.4-3 through 12.4-5.

Similarly, the details and results of the exposure estimate for the periodic testing subcategory are also contained in Table 12.4-3 through 12.4-5. The estimated dose rates used are generally the same as for the routine patrol estimate. However, since periodic testing is assumed to occur during equipment shutdown, the estimated shutdown dose rate is used if it is different from the operating dose rate.

The remaining subcategory is control room operations exposures. This has been estimated from the estimated control room radiation levels and the staffing requirements for the main and radwaste control rooms. It is assumed that the staffing levels of both control rooms will be identical for either one or two units operational. Table 12.4-6 contains the details of the control room operations exposure estimate.

The total annual exposure estimate for the routine operations category is then the sum of the three subcategory annual exposures, see Table 12.4-7.

Annual Exposure Estimate: Routine Operations

117.4 man-rem (single unit operational)

168.1 man-rem (two units operational)

12.4.1.3.2 Routine Maintenance Dose Estimate

The estimated exposure to be received in this category was determined from a compilation of the estimated annual man-hours required for component maintenance and the estimated dose rate to which the maintenance personnel will be subjected. As with periodic testing, the estimated shutdown dose rate was used if applicable.

The first step in this estimate consisted of a detailed review of plant radiation areas to produce a listing of the types and quantities of selected equipment present in each area. Next, total annual maintenance manhours were estimated for each equipment type identified based on a combination of operating experience and engineering judgement. These total estimated manhours are shown in Table 12.4-8 and are intended to include all expected routine activities for each equipment type such as valve repacking, valve relapping, pump seal replacement, fan overhaul, etc.

In any area, the total annual manhours for routine maintenance was then the summation of the quantity-manhour products for all equipment types found in the area. Multiplying the area annual maintenance manhours by the anticipated area dose rate produced the estimated man-rem by area. These were then summed to yield the routine maintenance man-rem by building and for the plant. Tables 12.4-3 through 12.4-5 contain the details and results of the routine maintenance exposure estimate.

A "total annual" maintenance approach was used for each component since currently available data generally does not contain sufficient information to provide a basis for manhour breakdowns by maintenance activity. In addition, the area-by-area methodology employed makes estimate compilations by system unnecessary since locations where high man-rem expenditures are expected are clearly indicated.

Annual Exposure Estimate: Routine Maintenance

237.7 man-rem (single unit operational)

395.0 man-rem (two units operational)

12.4.1.3.3 In-service Inspection Dose Estimate

The annual exposure estimate for in-service inspection is based upon the data from operating BWRs given in Table 12.4-2.

Annual Exposure Estimate: In-Service Inspection

27.5 man-rem (single unit operational)

55.0 man-rem (two units operational)

12.4.1.3.4 Special Maintenance Dose Estimate

The annual exposure estimate for special maintenance is based upon the data from operating BWRs given in Table 12.4-2.

Annual Exposure Estimate: Special Maintenance

273.1 man-rem (single unit operational)

546.2 man-rem (two units operational)

12.4.1.3.5 Waste Processing Dose Estimate

Most of the operations in the plant associated with the waste processing category are performed remotely and are therefore not suitable for evaluation by the analytical estimation technique. Consequently, the annual man-rem estimate for waste processing is more properly taken from the historical BWR operating data of Table 12.4-2 since this will provide a conservative estimate of the anticipated exposure.

Annual Exposure Estimate: Waste Processing

37.0 man-rem (single unit operational)

74.0 man-rem (two units operational)

12.4.1.3.6 Refueling Dose Estimate

The annual exposure estimate for refueling is based upon the data from operating BWRs given in Table 12.4-2.

Annual Exposure Estimate: Refueling

19.2 man-rem (single unit operational)

38.4 man-rem (two units operational)

12.4.1.3.7 Health Physics Dose Estimate

The annual exposure estimate for health physics monitoring is based upon the data from operating BWRs given in Table 12.4-2.

Annual Exposure Estimate: Health Physics

29.3 man-rem (single unit operational)

58.6 man-rem (two units operational)

12.4.1.3.8 Summary of Direct Radiation Dose Estimates

The annual dose estimates in the preceding seven subsections are summarized and totaled in Table 12.4-9. As shown in this table, the estimate of total annual in-plant exposure from direct radiation is:

Annual Exposure Estimate: Total

736.9 man-rem (single unit operational)

1331.0 man-rem (two units operational)

12.4.1.3.9 Methods for Estimating Doses

The contribution to the estimated cumulative station exposure from Routine Operations (RO) and Routine Maintenance (RM) in areas where radiation zone maximum design dose rates were used in the estimate are summarized below:

Calculated Manrem

Calculated Manrem

<u>Bldg</u>	<u>One Unit Operation</u>		<u>Two Unit Operation</u>	
	<u>RM</u>	<u>RO</u>	<u>RM</u>	<u>RO</u>
Turbine	3.8	0.7	7.6	1.4
Reactor	7.2	1.9	14.4	3.8
Radwaste	11.2	1.7	11.2	1.7
Total	22.2	4.3	33.2	6.9

It can be seen that the calculated man-rem in those areas where radiation zone maximum design dose rates were used in the estimate comprise 3.6 percent and 3.0 percent of the total estimated man-rem for one unit and two unit operations, respectively. Since the expected radiation levels would be less than the maximum design dose rates, the impact of using expected radiation levels on the total estimated

station man-rem would not be significant due to the low contribution to the total from the exposure categories discussed.

Dose estimates for Inservice Inspection, Waste Processing, Special Maintenance, and Refueling were based on historical data from operating facilities. Any further breakdown of the dose estimate by individual task (such as was made for Routine Operations and Routine Maintenance) would rely primarily on historical information available. The resultant dose estimate would not be any more precise than would be an estimate based solely on reported radiation exposures. In all four areas where historical data was used in the dose estimate, the SSES design includes design features which will reduce actual exposures received by plant personnel. Due to the lack of sufficiently detailed information to allow the precise quantification of the dose reduction the calculation of the reduction cannot be performed. For example, the following design features have been incorporated to facilitate Inservice Inspection:

- a) Quick removal insulation around the reactor vessel nozzles.*
- b) Access panels in the shield wall to the bottom head welds.*
- c) Side access panels in the shield wall to the core region of the reactor vessel.*
- d) The use of a remote, trackless vehicle for vessel weld inspection.*
- e) The use of remote automatic weld inspection of the vessel nozzle welds.*
- f) During the pre-service inspection access will be thoroughly evaluated.*

In view of the attendant uncertainties in the available data, precise quantification of the dose reduction benefit of these design features is not possible. Therefore the methodology employed in Section 12.4 gives a reasonable and conservative estimate of exposures from all activities.

12.4.2 AIRBORNE RADIOACTIVITY DOSE ESTIMATES FOR EXPOSURES WITHIN THE PLANT

The estimated exposures to plant personnel from airborne radioactivity are based upon the source distributions and radionuclide concentrations presented in Subsection 12.2.2 and Tables 12.2-30 through 12.2-37. Because of the limited geometry afforded by the finite room sizes within the plant, personnel exposures due to noble gas immersion are expected to be insignificant when compared to inhalation exposures and have therefore not been estimated.

In order to determine whether exposure contributions from airborne radioactive particulates are significant, an evaluation was made in each area of the ratio of total

particulate MPC fractions to total radioiodine MPC fractions (which is equivalent to the ratio of particulate MPC-HOURS to iodine MPC-HOURS). For the turbine building areas and the reactor building areas, the particulate-to-iodine ratios were approximately 0.02 and 0.05, respectively, indicating that the particulate inhalation exposures are not significant in those areas. In the radwaste building areas, however, the particulate-to-iodine ratio was approximately 1.11. Since over 75 percent of the total particulate MPC fraction was attributable to Cobalt-60, both the thyroid inhalation dose due to radioiodines and the lung inhalation dose due to Cobalt-60 were estimated for the radwaste building (the thyroid and the lung are the critical organs for iodines and Cobalt-60, respectively).

Tables 12.4-10 through 12.4-12 are the compilations of the estimated annual occupancy times and the estimated annual exposures for each of the areas identified in Subsection 12.2.2 as being potential sources of airborne radioactivity. The occupancy times are based upon detailed reviews of each area and the determination of the operations which might occur in those areas. The exposures are based upon the estimated concentrations in Tables 12.2-35 through 12.2-37, dose factors from Table C-1 of USNRC Regulatory Guide 1.109, and an assumed breathing rate of 3.47×10^{-4} cubic meters per second.

12.4.3 EXPOSURES AT LOCATIONS OUTSIDE PLANT STRUCTURES

The radiation exposures at locations outside the plant structures were estimated for two areas: the site boundary and the visitor's center. Subsection 12.4.3.1 discusses direct radiation exposure at these locations while Subsection 12.4.3.2 deals with airborne exposures.

12.4.3.1 Direct Radiation Dose Estimates Outside Structures

At locations outside plant structures, the direct radiation exposure has two principal components:

- a) Sources of activity stored outside the structures, specifically, the refueling water storage tanks (RWST) and the condensate storage tank (CST).*
- b) Turbine shine due to the N-16 present in the reactor steam.*

Based on the calculated surface dose rates for the RWST and CST given in Subsection 12.2.1.8, the dose contribution at locations outside the plant structures due to these tanks is considered negligible.

The N-16 present in the reactor steam in the primary steam lines, turbines, and moisture separators provides a dose contribution to locations outside the plant structure as a result of the high energy gamma rays which it emits as it decays. To reduce the

turbine shine doses, radiation shielding was provided around each turbine train and a roof slab was constructed over each moisture separator.

The resultant annual exposure due to turbine shine was calculated with the SKYSHINE (Section 12.3, Ref 12.4-1) computer program. Point sources were used to represent the components on the turbine deck and the source strengths are given in Table 12.2-28.

With an assumed 100 percent occupancy factor and an 80 percent capacity factor, the maximum calculated dose rate occurs at the south site boundary (see Figure 12.4-1) and is 5.6 mRem/year.

The dose rate in the visitor's center was calculated by the SKYSHINE program to be 3.50×10^{-6} mRem/hr. Assuming a visitor will visit the plant one day a year for eight hours, the estimated dose for the visitor is 2.80×10^{-5} mRem/year.

12.4.3.2 Airborne Radioactivity Dose Estimates Outside Structures

Doses at the site boundary due to released activity are given in Subsection 11.3.4.

12.4.4 REFERENCES

- 12.4-1 M. G. Wells, D. G. Collins, R. B. Small and J. M. Newell, SKYSHINE, a computer procedure for evaluations effect of the Structure Design on N-16 Gamma Ray Dose Rates, RRA-T7209, (November 1, 1972).

END HISTORICAL

START HISTORICAL**TABLE 12.4-1****SUMMARY OF HISTORICAL DATA USED IN COMPILATION OF EXPOSURES RECEIVED AT OPERATING BOILING WATER REACTORS**

PLANT	UNIT	NET ⁽¹⁾ Mwe	DATE OF COMMERCIAL OPERATION	(2) TOTAL OPERATING YEARS	NUMBER OF OPERATING YEARS ACTUALLY CONTRIBUTING TO DATA BASE								ANNUAL TOTAL	
					ROUTINE OPERATIONS	ROUTINE MAINTENANCE	IN-SERVICE INSPECTION	SPECIAL MAINTENANCE	WASTE PROCESSING	REFUELING OPERATIONS	HEALTH PHYSICS			
BRUNSWICK	2	821	11/75	1	1	1	1	1	1	1	1	1	1	1
COOPER	-	778	7/74	2	2	2	2	2	2	2	2	2	2	2
DRESDEN	2	809	8/70	6	4	4	0	4	4	4	4	3	6	6
DRESDEN	3	809	10/71	5	4	4	0	4	4	4	4	3	5	5
DUANE ARNOLD	1	538	1/75	2	1	1	1	1	1	1	1	1	2	2
EDWIN I. HATCH	1	786	5/75	1	1	1	1	1	1	1	1	1	1	1
MILLSTONE	1	690	3/71	6	3	3	1	3	3	1	1	2	6	6
MONTICELLO	-	545	6/71	5	4	4	2	4	4	3	4	2	5	5
NINE MILE POINT	1	610	12/69	7	5	5	1	5	5	1	5	5	6	6
OYSTER CREEK	1	650	12/69	7	7	7	3	4	4	3	2	6	7	7
PEACH BOTTOM	2	1065	7/74	2	2	1	1	1	1	1	2	2	2	2
PEACH BOTTOM	3	1065	12/74	2	2	1	1	1	1	1	2	2	2	2
PILGRIM	1	655	12/72	4	3	3	2	3	3	2	3	2	4	4
QUAD-CITIES	1	809	8/72	4	4	4	0	4	4	4	4	3	4	4
QUAD-CITIES	2	809	10/72	4	4	4	0	4	4	4	4	3	4	4
VERMONT YANKEE	-	514	11/72	4	2	2	2	2	2	2	2	2	4	4
			TOTALS:	62	49	47	18	44	35	42	40	61	61	61

(1) Source – “U.S. Central Station Nuclear Electric Generating Units: Significant Milestones”, ERDA77-30/1, January 1, 1977.

(2) Total number of operating years available to the data base beginning with the first calendar year that includes at least nine months of commercial operation.

END HISTORICAL

START HISTORICAL

TABLE 12.4-2

**OCCUPATIONAL EXPOSURES BY JOB FUNCTION FOR
OPERATING BOILING WATER REACTORS**

	NUMBER REACTOR YEARS AVERAGED	AVERAGE MAN-REM PER REACTOR YEAR	STANDARD DEVIATION (MAN-REM PER REACTOR YEAR)
<i>Total Reported Annual Exposure:</i>	61	511.4	454.8
<i>Job Functions: ⁽¹⁾</i>			
<i>Routine Operations</i>	49	60.1	43.8
<i>Routine Maintenance</i>	47	110.8	103.4
<i>In-Service Inspection</i>	18	27.5	29.1
<i>Special Maintenance</i>	44	273.1	285.7
<i>Waste Processing</i>	35	37.0	38.0
<i>Refueling</i>	42	19.2	30.1
<i>Health Physics</i>	40	29.3	17.0

(1) Total exposure by job function differs from the annual reported total exposure due to conservatisms employed in compilation of job function exposures.

END HISTORICAL

START HISTORICAL**TABLE 12.4-3****EXPOSURE ESTIMATES FOR THE TURBINE BUILDING AND CONTROL STRUCTURE**

Room or Area No.	Estimated Dose Rate (mRem/hr)	Routine Maintenance ⁽¹⁾		Routine Surveillances ⁽¹⁾		Periodic Testing ⁽¹⁾	
		Estimated Annual Man-hours ⁽⁵⁾	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem
<u>E1656' 0"</u>							
54	0.25	150	0.038	-	-	-	-
53	0.25	266	0.067	18	0.005	-	-
44, 45	0.25	156	0.039	18	0.005	20	0.005
51	0.25	467	0.117	18	0.005	26	0.007
51A	2.5	35	0.088	-	-	-	-
151	2	66	0.132	0.05 ⁽⁴⁾	0.001	2	0.004
52	0.25	3,583	0.896	46	0.012	153	0.038
42, 42A	2	860	1.720	-	-	144	0.288
42A	60	-	-	0.05 ⁽⁴⁾	0.003	-	-
C-10	0.25	639	0.160	23	0.006	95	0.024
C-11	15	33 ⁽²⁾	0.495	2 ⁽²⁾	0.030	8 ⁽²⁾	0.120
30, 31	60	-	-	0.15 ⁽⁴⁾	0.009	-	-
30, 31	2	1,352	2.704	-	-	100	0.200
55	2.5	123	0.308	-	-	49	0.123
32, 34	60	32	1.920	-	-	-	-
56	15	70	1.050	-	-	17	0.255
33	15	-	-	5	0.075	-	-
33	2.5	164	0.410	-	-	38	0.095
36	50	-	-	0.10 ⁽⁴⁾	0.005	-	-
36, 40	4	1,152	4.608	-	-	255	1.020
Transit ⁽³⁾	3.60	-	-	139	0.500	-	-

TABLE 12.4-3 (Continued)

Room or Area No.	Estimated Dose Rate (mRem/hr)	Routine Maintenance ⁽¹⁾			Routine Surveillances ⁽¹⁾		Periodic Testing ⁽¹⁾	
		Estimated Annual Man-hours ⁽⁵⁾	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem	
<u>EI 676' 0"</u>								
126	0.25	102	0.026	-	-	3	0.001	
127	0.25	1,016	0.254	73	0.018	104	0.026	
125	60	126	7.560	-	-	15	0.900	
117-121, 123, 124	2.3	812	1.868	-	-	38	0.087	
128, C-100	0.25	3,522	0.881	46	0.012	119	0.030	
110	2.5	510	1.275	-	-	-	-	
122	0.25	208	0.052	18	0.005	-	-	
114-116	1.6	1,518	2.429	-	-	144	0.230	
113	4	419	1.676	-	-	198	0.792	
111	10	168	1.680	-	-	62	0.620	
Transit ⁽³⁾	0.25	-	-	142	0.036	-	-	
<u>EI 699' 0"</u>								
216	0.25	295	0.074	15	0.004	45	0.011	
217	0.25	1,026	0.257	21	0.005	96	0.024	
213, 218	0.25	1,150	0.288	-	-	47	0.012	15
212, 214, 215	3	1,166	3.498	-	-	480	1.440	
210	0.25	808	0.202	42	0.011	-	-	1
220	0.25	480	0.120	18	0.005	-	-	
211	4	1,326	5.304	-	-	678	2.712	
Transit ⁽³⁾	0.25	-	-	131	0.033	-	-	
<u>EI 686' 6"</u>								1
C-130	15	10 ⁽²⁾	0.150	-	-	-	-	

TABLE 12.4-3 (Continued)

Room or Area No.	Estimated Dose Rate (mRem/hr)	Routine Maintenance ⁽¹⁾		Routine Surveillances ⁽¹⁾		Periodic Testing ⁽¹⁾	
		Estimated Annual Man-hours ⁽⁵⁾	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem
<u>EI714'0"</u>							
301	0.25	360	0.090	-	-	9	0.002
300	29	28	0.812	-	-	-	-
Transit ⁽³⁾	0.25	-	-	15	0.004	-	-
<u>EI729'0"</u>							
416	3	283	0.849	-	-	45	0.135
418, C-400	0.25	3,577	0.894	110	0.028	213	0.053
415	0.25	852	0.213	27	0.007	15	0.004
420	1.6	1,500	2.400	-	-	81	0.130
Transit ⁽³⁾	0.25	-	-	82	0.021	-	-
<u>EI762'0"</u>							
530	0.25	2,172	0.543	84	0.021	72	0.018
531, 532	1.3	10	0.013	-	-	-	-
Transit ⁽³⁾	0.25	-	-	71	0.018	-	-
<u>EI783'0"</u>							
C-700 to C-703	0.25	937 ⁽²⁾	0.234	17 ⁽²⁾	0.004	275 ⁽²⁾	0.069
Transit ⁽³⁾	0.25	-	-	29 ⁽²⁾	0.007	-	-

TABLE 12.4-3 (Continued)

Room or Area No.	Estimated Dose Rate (mRem/hr)	Routine Maintenance ⁽¹⁾		Routine Surveillances ⁽¹⁾		Periodic Testing ⁽¹⁾	
		Estimated Annual Man-hours ⁽⁵⁾	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem
<u>E1806'0"</u>							
C-900, C-912	2.5	5 ⁽²⁾	0.013	-	-	3 ⁽²⁾	0.008
C-900A, C-912A	2.5	25 ⁽²⁾	0.063	9 ⁽²⁾	0.023	14 ⁽²⁾	0.035
C-901 to C-911	0.25	360 ⁽²⁾	0.090	15 ⁽²⁾	0.004	202 ⁽²⁾	0.051
Transit ⁽³⁾	0.56	-	-	33 ⁽²⁾	0.018	-	-
Totals		33,919	48.560	1,267	0.940	3,865	9.569

(1) All values are on a per-unit basis.

(2) Entries referencing this note are for common facilities or equipment and the man-hours are shown as one-half the estimated quantity for the room or area to reflect the per-unit basis of the table.

(3) The "transit" entries account for the estimated time spent and dose received while walking the patrol areas during routine surveillances. For elevations which entail exposures to multiple radiation levels, the estimated dose rate is the distance weighted average of the dose rates encountered. All transit times are based on an assumed walking speed of 200 feet per minute.

(4) From surveillances performed once per month.

(5) The estimates exposures in this table assume all man-hours are expended in the area in which they appear. Portions of these man-hours may actually be spent at lower radiation levels within the area. Components may also be removed to a lower background area for maintenance.

END HISTORICAL

START HISTORICAL

TABLE 12.4-4 EXPOSURE ESTIMATES FOR THE REACTOR BUILDING							
Room or Area No.	Estimated Dose Rate (mRem/hr)	Routine Maintenance ⁽¹⁾		Routine Surveillances ⁽¹⁾		Periodic Testing ⁽¹⁾	
		Estimated Annual Man-hours ⁽⁶⁾	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem
<u>El 645' 0"</u>							
15	0.25	415	0.104	18	0.005	12	0.003
15A	2.5	58	0.145	-	-	-	-
10, 17	0.25	796	0.199	24	0.006	138	0.035
11	2.5	555	1.388	18	0.045	105	0.263
12	2.5	336	0.840	18	0.045	75	0.188
13, 14	15	1,087	16.305	0.10 ⁽⁵⁾	0.002	196	2.940
Transit ⁽³⁾	0.93	-	-	119	0.111	-	-
<u>El 670' 0"</u>							
103, 104	15	378	5.670	0.05 ⁽⁵⁾	0.001	88	1.320
105	0.25	529	0.132	-	-	95	0.024
109	0.25	709	0.177	37	0.009	86	0.022
106	2.5	83	0.208	-	-	16	0.040
107	2.5	40	0.100	-	-	19	0.048
Transit ⁽³⁾	0.35	-	-	15	0.005	-	-
Walk-up ⁽⁴⁾	0.25	-	-	73	0.018	-	-
<u>El 683' 0"</u>							
203	0.25	1,778	0.445	5	0.001	420	0.105
204	2.5	97	0.243	-	-	44	0.110
202	15	633	9.495	-	-	275	4.125
205	2.5	76	0.190	-	-	15	0.038
200, 201	0.25	1,573	0.393	18	0.005	232	0.058
Transit ⁽³⁾	0.25	-	-	68	0.017	-	-
<u>El 719' 1"</u>							
412	0.25	84	0.021	-	-	2	0.001
401	0.25	3,648	0.912	18	0.005	74	0.019
401A	2.5	600	1.500	37	0.093	327	0.818
472	2.5	95	0.238	18	0.045	1	0.003
402	0.25	70	0.018	-	-	2	0.001
413	0.25	10	0.003	-	-	1	0.001
406	0.25	360	0.090	-	-	62	0.016
471	15	100	1.500	5	0.075	10	0.150
407	0.25	420	0.105	-	-	62	0.016
410	0.25	120	0.030	9	0.002	24	0.006
480	13	-	-	-	-	222 ⁽⁷⁾	2.886
Transit ⁽³⁾	1.64	-	-	139	0.228	-	-

TABLE 12.4-4 (Continued)							
Room or Area No.	Estimated Dose Rate (mRem/hr)	Routine Maintenance ⁽¹⁾		Routine Surveillances ⁽¹⁾		Periodic Testing ⁽¹⁾	
		Estimated Annual Man-hours ⁽⁸⁾	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem
<u>El 749' 1"</u>							
507, 510	0.25	720	0.180	-	-	124	0.031
514	16	576	9.216	-	-	57	0.912
514	2.5 ⁽⁶⁾	-	-	0.03 ⁽⁵⁾	0.001	-	-
506	0.25	45	0.011	-	-	33	0.008
513	0.25	731	0.183	210	0.053	87	0.022
512	0.25	524	0.131	26	0.007	24	0.006
517	0.25	166	0.042	9	0.002	125	0.031
515	2.5	390	0.975	-	-	30	0.075
509	200	68	13.600	-	-	59	11.800
500	0.25	404	0.101	-	-	142	0.036
502, 503	28	264	7.392	-	-	8	0.224
502, 503	28 ⁽⁶⁾	-	-	0.10 ⁽⁵⁾	0.003	-	-
501	28	91	2.548	-	-	40	1.120
504	28	58	1.624	-	-	18	0.504
505	28	44	1.232	-	-	12	0.336
511	60	18	1.080	-	-	-	-
Transit ⁽³⁾	0.25	-	-	124	0.031	-	-
<u>El 779' 1"</u>							
614	0.25	270	0.068	9	0.002	14	0.004
613, 616	0.25	618	0.155	9	0.002	-	-
612	0.25	208	0.052	9	0.002	-	-
610	0.25	240	0.060	-	-	-	-
608	0.25	480	0.120	-	-	8	0.002
619	15	-	-	3	0.045	-	-
619	2.5	38	0.095	-	-	12	0.030
604	0.25	1,139 ⁽²⁾	0.285	45 ⁽²⁾	0.011	54 ⁽²⁾	0.014
620	2.5	461	1.153	5	0.013	6	0.015
621	15	-	-	4 ⁽²⁾	0.060	-	-
621	2.5	210 ⁽²⁾	0.525	-	-	34 ⁽²⁾	0.085
Transit ⁽³⁾	0.98	-	-	133	0.130	-	-
<u>El 799' 1"</u>							
701	0.25	85 ⁽²⁾	0.121	5 ⁽²⁾	0.001	-	-
700	6	26	0.156	-	-	-	-
702	6	26	0.156	-	-	-	-
703	0.25	50	0.013	9	0.002	-	-
704, 712	0.25	818	0.205	20	0.005	12	0.003
Transit ⁽³⁾	0.25	-	-	120	0.030	-	-

TABLE 12.4-4 (Continued)							
Room or Area No.	Estimated Dose Rate (mRem/hr)	Routine Maintenance ⁽¹⁾		Routine Surveillances ⁽¹⁾		Periodic Testing ⁽¹⁾	
		Estimated Annual Man-hours ⁽⁸⁾	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem
<u>EI 818' 1"</u>							
808, 810 Transit ⁽³⁾	0.25 0.25	813 -	0.203 -	- 4	- 0.001	153 -	0.038 -
<u>Drywell</u>							
607	10	67	0.670	-	-	67	0.670
516	10	159	1.590	-	-	47	0.470
490	10	447	4.470	-	-	164	1.640
400	10	327	3.270	-	-	306	3.060
206	10	749	7.490	-	-	470	4.700
206A	11	296	3.256	-	-	-	-
207	14	422	5.908	-	-	-	-
	Totals	26,698	108.687	1,383	1.119	4,709	39,072

⁽¹⁾All values are on a per-unit basis

⁽²⁾Where this note is referenced, the area or room contains some common facilities or equipment. Man-hour contributions for such equipment are included as one-half the estimated quantity to correspond with the per-unit basis on the table.

⁽³⁾The "transit" entries account for the estimated time spent and dose received while walking the patrol areas during routine surveillances. For elevations which entail exposures to multiple radiation levels, the estimated dose rate is the distance weighted average of the dose rates encountered. All transit times are based on an assumed walking speed of 200 feet per minute.

⁽⁴⁾This entry accounts for the transit between access control and the reactor building along turbine building elevation 676' 0" before and after each surveillance patrol.

⁽⁵⁾From surveillances performed once per month.

⁽⁶⁾Estimated dose rate is based upon surveillance being performed from a remote location.

⁽⁷⁾CRD rebuild, repair, and testing.

⁽⁸⁾The estimated exposures in this table assume all man-hours are expended in the area in which they appear. Portions of these man-hours may actually be spent at lower radiation levels within the area. Components may also be removed to a lower background area for maintenance.

END HISTORICAL

START HISTORICAL

TABLE 12.4-5
EXPOSURE ESTIMATES FOR THE RADWASTE BUILDING

Room or Area No.	Estimated Dose Rate (mRem/hr)	Routine Maintenance		Routine Surveillances		Periodic Testing	
		Estimated Annual Man-hours	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem
EI 646'0"							
R-38	15	176	2.640	-	-	-	-
R-2	2.5	450	1.125	11	0.028	70	0.175
R-36	2.5	12	0.030	-	-	-	-
R-3	13	22	0.286	-	-	4	0.052
R-4	2.5	376	0.940	3	0.008	22	0.055
R-5	20	124	2.480	-	-	-	-
R-9	2.5	674	1.685	8	0.020	360	0.900
R-6	2.5	64	0.160	3	0.008	64	0.160
R-7	2.5	186	0.465	-	-	22	0.055
R-8	20	12	0.240	-	-	22	0.440
R-50	20	18	0.360	-	-	-	-
R-50	2.5(4)	-	-	0.03 ⁽³⁾	0.001	-	-
R-10, R-21	0.25	746	0.187	18	0.005	6	0.002
R-34	7	52	0.364	3	0.021	-	-
R-20	3	188	0.564	5	0.015	96	0.288
R-17, R-18, R-19	42	56	2.352	-	-	18	0.756

TABLE 12.4-5
EXPOSURE ESTIMATES FOR THE RADWASTE BUILDING

Room or Area No.	Estimated Dose Rate (mRem/hr)	Routine Maintenance		Routine Surveillances		Periodic Testing	
		Estimated Annual Man-hours	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem
R-14	3	104	0.312	5	0.015	30	0.090
R-13	13	300	3.900	-	-	-	-
R-15, R-16	42	28	1.176	-	-	16	0.672
R-12	2.5	272	0.680	3	0.008	82	0.205
R-11	4	92	0.368	-	-	42	0.168
R-22	0.25	1,584	0.396	-	-	90	0.023
R-31, R-32	300	79	23.700	-	-	60	18,000
R-30	100	27	2.700	-	-	42	4.200
R-29	10	170	1.700	-	-	34	0.340
R-29	2.5 ⁽⁴⁾	-	-	0.12 ⁽³⁾	0.001	-	-
R-60	2.5	510	1.275	-	-	-	-
R-28	500	40	20.000	-	-	36	18,000
R-35	2.5	12	0.030	-	-	-	-
R-27	2.5	12	0.030	-	-	-	-
R-26	2.5	90	0.225	-	-	-	-
R-25	2.5	34	0.085	-	-	-	-
R-24	2.5	2	0.005	-	-	-	-
R-37	2.5	70	0.175	-	-	-	-
Transit ⁽¹⁾	0.83	-	-	128	0.106	-	-

TABLE 12.4-5
EXPOSURE ESTIMATES FOR THE RADWASTE BUILDING

Room or Area No.	Estimated Dose Rate (mRem/hr)	Routine Maintenance		Routine Surveillances		Periodic Testing	
		Estimated Annual Man-hours	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem
EI 660'0"							
R-105	0.25	52	0.013	11	0.003	40	0.010
R-106, R-107	30	102	3.060	-	-	18	0.540
R-106, R-107	2.5 ⁽⁴⁾	-	-	0.09 ⁽³⁾	0.001	-	-
R-101	50	32	1.600	-	-	4	0.200
R-110	15	42	0.630	-	-	-	-
R-103	0.25	36	0.009	-	-	78	0.020
Transit ⁽¹⁾	0.25	-	-	22	0.006	-	-
EI 676' 0"							
R-201, R-229	2.5	276	0.690	-	-	24	0.060
R-207	2.5	142	0.355	-	-	-	-
R-206	0.25	1,650	0.413	-	-	11,680	2.920
R-226	0.25	420	0.105	18	0.005	16	0.004
R-220	0.25	972	0.243	5	0.001	48	0.012
R-225, R-227	4	114	0.456	-	-	-	-
R-250	4	280	1.120	-	-	104	0.416

TABLE 12.4-5
EXPOSURE ESTIMATES FOR THE RADWASTE BUILDING

Room or Area No.	Estimated Dose Rate (mRem/hr)	Routine Maintenance		Routine Surveillances		Periodic Testing	
		Estimated Annual Man-hours	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem
R-243, R-244	6.4	80	0.51	-	-	-	-
R-239, R-240, and R-241, R-242	6.4	152	0.97	-	-	-	-
R234A, R-235A, and R-236A, R-237A	76	180	14.0	-	-	-	-
R-234B, R-235B, and R-236B, R-237B	17	280	4.8	-	-	-	-
R-231	0.78	26	0.02	-	-	-	-
R-213, R-214	24	68	1.6	-	-	-	-
Transit(1)	0.25	-	-	53	0.013	-	-
Walk-up(2)	0.25	-	-	137	0.034	-	-
EI 691'6"							
R-310, R-313	0.25	1856	0.464	33	0.008	270	0.068
R-311, R-312	7.0	68	0.476	-	-	-	-
R-301	0.25	12	0.003	-	-	-	-
R-305	0.25	80	0.020	-	-	-	-
R-308	0.25	40	0.010	-	-	-	-
R-309	0.25	486	0.122	-	-	-	-

TABLE 12.4-5
EXPOSURE ESTIMATES FOR THE RADWASTE BUILDING

Room or Area No.	Estimated Dose Rate (mRem/hr)	Routine Maintenance		Routine Surveillances		Periodic Testing	
		Estimated Annual Man-hours	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem	Estimated Annual Man-hours	Estimated Annual Man-rem
Transit(1)	1.77	-	-	57	0.101	-	-
TOTALS		14,022	102.4	523	0.408	13,398	48.83
⁽¹⁾ The "transit" entries account for the estimated time spent and dose received while walking the patrol areas during routine surveillances. For elevations which entail exposures to multiple radiation levels, the estimated dose rate is the distance weighted average of the dose rates encountered. All transit times are based on an assumed walking speed of 200 feet per minute.							
⁽²⁾							
⁽³⁾ This entry accounts for the transit between access control and the radwaste building along turbine building EL 676'0" before and after each surveillance patrol.							
⁽⁴⁾ From surveillance performed once per month.							
⁽⁵⁾ Estimated dose rate is based upon surveillance being performed from a remote location.							
⁽⁶⁾ The estimated exposures in this table assume all man-hours are expended in the area in which they appear. Portions of these man-hours may actually be spent at lower radiation levels within the area. Components may also be removed to a lower back-ground area for maintenance.							

END HISTORICAL

START HISTORICAL**TABLE 12.4-6****ESTIMATED EXPOSURE FOR OPERATORS IN RESIDENCE
IN CONTROL ROOMS**

<i>Operator⁽¹⁾ Designation</i>	<i>Assumed⁽²⁾ Location</i>	<i>Number⁽³⁾ Per Shift</i>	<i>Manhours⁽⁴⁾ Per Year</i>	<i>Estimated Radiation Level</i>	<i>Estimated Annual Man- rem</i>
SS	MCR	1	8,760	0.25	2.19
SRO	MCR	1	8,760	0.25	2.19
RO	MCR	2	17,520	0.25	4.38
NLO	MCR	2	17,520	0.25	4.38
STA	MCR	1	8,760	0.25	2.19
NPO	RWCR	1	8,760	0.25	2.19
	TOTALS:	8	70,080		17.52

- (1) SS = Shift Supervisor
 SRO = licensed Senior Reactor Operator
 RO = licensed Reactor Operator
 NLO = Non-Licensed Operator
 STA = Shift Technical Assistant
 NPO = Nuclear Plant Operator

- (2) MCR = Main Control Room
 RWCR = Radwaste Control Room

- (3) Assumed to be independent of the number of operating units.

- (4) Based on 8 man-hours per shift, 1095 shifts per year.

END HISTORICAL

START HISTORICAL

<i>TABLE 12.4-7</i>		
<i>SUMMARY OF ROUTINE OPERATIONS EXPOSURE ESTIMATE</i>		
	<i>Annual Estimated Man-rem</i>	
	<i><u>Single Unit</u></i>	<i><u>Two Units</u></i>
<i>Routine Surveillances:</i>		
<i>Turbine bldg/control structure</i>	<i>0.9</i>	<i>1.8</i>
<i>Reactor building</i>	<i>1.1</i>	<i>2.2</i>
<i>Radwaste building</i>	<i><u>0.4</u></i>	<i><u>0.4</u></i>
	<i>2.4</i>	<i>4.4</i>
<i>Periodic Tests:</i>		
<i>Turbine bldg/control structure</i>	<i>9.6</i>	<i>19.2</i>
<i>Reactor building</i>	<i>39.1</i>	<i>78.2</i>
<i>Radwaste building</i>	<i><u>48.8</u></i>	<i><u>48.8</u></i>
	<i>97.5</i>	<i>146.2</i>
<i>Control Room Operations:</i>		
<i>Main Control room</i>	<i>15.3</i>	<i>15.3</i>
<i>Radwaste control room</i>	<i><u>2.2</u></i>	<i><u>2.2</u></i>
	<i>17.5</i>	<i>17.5</i>
<i>Total</i>	<i>117.4</i>	<i>168.1</i>

END HISTORICAL

START HISTORICALTABLE 12.4-8*ESTIMATE OF EXPECTED MAINTENANCE MAN-HOURS
FOR VARIOUS TYPES OF EQUIPMENT*

<u>EQUIPMENT TYPE OR ACTIVITY</u>	<u>ESTIMATED MAN-HOURS PER YEAR</u>
1. Computer	150
2. Switchgear	120
3. High Voltage Breaker (4.16KV)	30
4. Motor Control Center	5
5. Instrument Panel	150
6. Instrument Rack	150
7. Motor Generator	35
8. Main Generator	1000
9. Large Motor (≥ 200 hp)	
a. Continuous duty	30
b. Infrequent operation	10
10. Small Motor (<200 hp)	
a. Continuous duty	20
b. Infrequent operation	6
11. Transformer	10
12. Heat Exchanger	30
13. Evaporator	50
14. HVAC Prefilter	1
15. HEPA Filter (HVAC)	1
16. Offgas HEPA Filter	80
17. HVAC Charcoal Absorber (per ft ³)	5 man-minutes
18. Ion Exchangers	60
19. Cranes and Hoists	60
20. Refueling Machine, Pre-Op Check	200
21. Refrigeration Machine	30
22. Compressor	24

<i>TABLE 12.4-8 (Continued)</i>	
<u>EQUIPMENT TYPE OR ACTIVITY</u>	<u>ESTIMATED MAN-HOURS PER YEAR</u>
23. <i>Large Nuclear Pump (ASME III) (≥ 1000 gpm)</i>	
<i>a. Continuous duty</i>	100
<i>b. Infrequent operation</i>	10
24. <i>Small Nuclear Pump (ASME III) (< 1000 gpm)</i>	
<i>a. Continuous duty</i>	60
<i>b. Infrequent operation</i>	8
25. <i>Large Commercial Pump (≥ 1000 gpm)</i>	
<i>a. Continuous duty</i>	150
<i>b. Infrequent operation</i>	15
26. <i>Small Commercial Pump (> 1000 gpm)</i>	
<i>a. Continuous duty</i>	60
<i>b. Infrequent operation</i>	12
27. <i>Fan, Blower</i>	25
28. <i>Turbine</i>	
<i>a. Main turbine</i>	1500
<i>b. Large turbine (≥ 1000 hp)</i>	300
<i>c. Small turbine (< 1000 hp)</i>	50
29. <i>Main Condenser, Inspection Per Shell</i>	150
30. <i>Valves</i>	
<i>a. 3 to 6 in.</i>	6.5
<i>b. 8 to 12 in.</i>	14
<i>c. 12 in. and larger</i>	24
31. <i>Reactor Vessel – Refueling Operation</i>	
<i>a. Detension vessel head studs</i>	160
<i>b. Remove vessel head studs, nuts, and washers</i>	100
<i>c. Tension vessel head studs</i>	200
<i>d. Install and inspect vessel “O” rings</i>	40
32. <i>Seismic Restraint and Snubber</i>	25

END HISTORICAL

START HISTORICAL

<i>TABLE 12.4-9</i>		
<i>SUMMARY OF IN-PLANT DIRECT RADIATION EXPOSURE ESTIMATES</i>		
	<i>Annual Estimated Man-rem</i>	
<i>Category</i>	<i>Single Unit</i>	<i>Two Units</i>
<i>Routine Operations</i>	117.4	168.1
<i>Routine Maintenance</i>	237.7	395.0
<i>In-Service Inspection</i>	27.5	55.0
<i>Special Maintenance</i>	273.1	546.2
<i>Waste Processing</i>	37.0	74.0
<i>Refueling</i>	19.2	38.4
<i>Health Physics</i>	<u>29.3</u>	<u>58.6</u>
<i>TOTAL</i>	741.2	1,335.3

END HISTORICAL

START HISTORICAL

TABLE 12.4-10
ESTIMATED TURBINE BUILDING INHALATION EXPOSURES DUE TO
AIRBORNE RADIOACTIVITY

	Estimated Annual Man-Hours					Total	Estimated ⁽⁴⁾ Thyroid Dose (Man-rem/yr)	Estimated ⁽⁵⁾ Tritium Dose (Man-rem/yr)
	Maintenance	Surveillance ⁽²⁾	Testing					
Condenser Areas								
30,31	1,352	8	100		1,460	5.8-1	5.4-3	
32,34	32	0	0		32	1.3-2	1.2-4	
36,40	1,152	1	255		1,480	5.6-1	5.2-3	
56	70	0	17		87	3.5-2	3.2-4	
113	419	0	198		617	2.5-1	2.2-3	
211	1,326	0	678		2,004	8.0-1	7.4-3	
SJAE Areas								
111	168	0	62		230	9.7-2	9.2-4	
MVP Areas								
55	123	0	49		172	1.7-2	1.5-4	
Turbine Hall Areas								
415	852	47	15		914	1.0-2	9.6-5	
416	283	0	45		328	3.6-3	3.4-5	
417,418,C-400	3,577	172	213		3,962	4.4-2	4.2-4	
419,420,421	1,500	0	81		1,581	1.7-2	1.6-4	

TABLE 12.4-10
ESTIMATED TURBINE BUILDING INHALATION EXPOSURES DUE TO
AIRBORNE RADIOACTIVITY

Estimated Annual Man-Hours						
	Maintenance	Surveillance(2)	Testing	Total	Estimated (*) Thyroid Dose (Man-rem/yr)	Estimated (5) Tritium Dose (Man-rem/yr)
Other Equipment Areas						
33,35	164	10	38	212	5.9-3	5.6-5
42,42A	860	1	144	1,005	2.8-2	2.6-4
43,151,152	66	1	2	69	1.9-3	1.9-5
110	510	0	0	510	1.4-2	1.3-4
114,115,116	1,518	0	144	1,662	4.7-2	4.4-4
117-121,123,124	812	0	38	850	2.4-2	2.2-4
125	126	0	15	141	3.9-3	3.6-5
212,214,215	1,166	0	480	1,646	4.6-2	4.2-4
300	28	0	0	28	7.8-4	7.2-6
530	2,172	155	72	2,399	6.7-2	6.2-4
531,532	10	0	0	10	2.8-4	2.6-6
C-10	639	52	95	786	2.2-2	2.0-4
C-11	33	4	8	45	1.3-3	1.2-5
C-130	10	0	0	10	2.8-4	2.6-6
C-900,C-912	5	0	3	8	2.2-4	2.0-6
C-900A,C-912A	25	20	14	59	1.7-3	1.5-5
TURBINE BUILDING TOTALS	18,998	471	2,766	22,235	2.7+0	2.5-2

TABLE 12.4-10
 ESTIMATED TURBINE BUILDING INHALATION EXPOSURES DUE TO
 AIRBORNE RADIOACTIVITY

- (1) All values in the table are on a per-unit basis. Occupancy times for common areas within the building are shown as one-half the estimated value to agree with the per-unit basis of the table.
- (2) Surveillance man-hours include transit time spent by operators walking in the area.
- (3) $5.8 \cdot 10^{-1}$
- (4) Thyroid dose attributable only to inhalation of radioiodines.
- (5) Uniform dose to the total body from uptake of tritium. Turbine building releases were reduced by a factor of five to take credit for the leakage collection system installed for valves in lines 2-1/2" and larger.

END HISTORICAL

START HISTORICAL

Estimated Annual Man-Hours						
	Maintenance	Surveillance ⁽²⁾	Testing	Total	Estimated ⁽¹⁾ Thyroid Dose (Man-rem/yr)	Estimated ⁽⁸⁾ Tritium Dose (Man-rem/yr)
TABLE 12.4-11 ESTIMATED REACTOR BUILDING INHALATION EXPOSURES DUE TO AIRBORNE RADIOACTIVITY ⁽¹⁾						
RWCU Pump Areas						
501	91	0	40	131	4.8-1 ⁽³⁾	--
502,503	264	1	8	273	1.0-0	--
504	58	0	18	76	2.8-1	--
505	44	0	12	56	2.1-1	--
RWCU F/D Areas						
509	68	0	59	127	3.8-1	--
619	38	7	12	57	1.7-1	--
800,801	0 ⁽⁴⁾	0	0	0	0.0+0	--
Refueling Areas						
804,807,808,810,806	2,978 ⁽⁶⁾	0	153	3,131	5.3-1	3.0-2
ECCS Areas						
10,17	796	104	138	1,038	6.5-1	--
11	555	38	105	698	4.4-1	--
12	336	25	75	436	2.7-1	--
13,14	1,087	1	196	1,284	8.1-1	--
103,104	378	1	88	467	2.9-1	--
106	83	0	16	99	6.2-2	--

TABLE 12.4-11
ESTIMATED REACTOR BUILDING INHALATION EXPOSURES DUE TO
AIRBORNE RADIOACTIVITY⁽¹⁾

Estimated Annual Man-Hours						
	Maintenance	Surveillance ⁽²⁾	Testing	Total	Estimated ⁽¹⁾ Thyroid Dose (Man-rem/yr)	Estimated ⁽³⁾ Tritium Dose (Man-rem/yr)
107	40	0	19	59	3.7-2	--
202	633	0	275	908	5.7-1	--
204	97	0	44	141	8.9-2	--
205	76	0	15	91	5.7-2	--
206,206A	1,045	0	470	1,515	4.4+1	--
207	422	0	0	422	1.2+1	--
400	327	0	306	633	1.8+1	--
490	447	0	164	611	1.8+1	--
516	159	0	47	206	6.0+0	--
607	67	0	67	134	3.9+0	--
Other Equipment Areas						
15	415	29	12	456	2.8-1	--
15A	58	0	0	58	3.6-2	--
401	3,648	80	74	3,802	2.4+0	--
401A	600	92	327	1,019	6.3-1	--
403,471	100	10	10	120	7.4-2	--
411,515,710	390	0	30	420	2.6-1	--
506	45	0	33	78	4.8-2	--
511	18	0	0	18	1.1-2	--
514	576	1	57	634	3.9-1	--
620	461	12	6	479	3.0-1	--

TABLE 12.4-11
ESTIMATED REACTOR BUILDING INHALATION EXPOSURES DUE TO
AIRBORNE RADIOACTIVITY⁽¹⁾

Estimated Annual Man-Hours						
	Maintenance	Surveillance ⁽²⁾	Testing	Total	Estimated ⁽⁷⁾ Thyroid Dose (Man-rem/yr)	Estimated ⁽⁸⁾ Tritium Dose (Man-rem/yr)
621	210	7	34	251	1.6-1	--
700	26	0	0	26	1.6-2	--
702	26	0	0	26	1.6-2	--
703	50	9	0	59	3.72	--
704,712	818	130	12	960	6.0-1	--
802, C-801	0 ⁽⁴⁾	0	0	0	0.0+0	--
REACTOR BUILDING TOTALS	17,530	547	2,922	20,999	1.8+2 ⁽⁶⁾	3.0-2

⁽¹⁾ All values in the table are on a per-unit basis. Occupancy times for common areas within the building are shown as one-half the estimated value to agree with the per-unit basis of the table.

⁽²⁾ Surveillance man-hours include transit time spent by operators walking in the area.

⁽³⁾ $4.8-1 = 4.8 \times 10^{-1}$

⁽⁴⁾ Maintenance assumed to be remote. Maintenance hours were included in area numbers 704 and 712.

⁽⁵⁾ Maintenance man-hours include 2,165 man-hours for refueling operations

⁽⁶⁾ The total thyroid dose of 1.8+2 man-rem takes no credit for respiratory protection.

⁽⁷⁾ Thyroid dose attributable only to inhalation of radiiodines.

⁽⁸⁾ Uniform dose to the total body from uptake of tritium.

END HISTORICAL

START HISTORICAL

TABLE 12.4-12 ESTIMATED RADWASTE BUILDING INHALATION EXPOSURES DUE TO AIRBORNE RADIOACTIVITY ⁽¹⁾						
	Estimated Annual Man-Hours					
	Maintenance	Surveillance ⁽²⁾	Testing	Total	Estimated Thyroid Dose (Man-rem/yr)	Estimated Lung Dose (Man-rem/yr)
Solid Radwaste Handling Areas						
R-24	2	0	0	2	5.0-4 ⁽³⁾	2.4-4
R-25	34	0	0	34	8.5-3	4.1-3
R-26	90	0	0	90	2.3-2	1.1-2
R-27	12	0	0	12	3.0-3	1.4-3
R-28	40	0	36	76	1.9-2	9.1-3
R-29	170	1	34	205	5.1-2	2.5-2
R-30	27	0	42	69	1.7-2	8.3-3
R-31, R-32	79	0	60	139	3.5-2	1.7-2
R-35	12	0	0	12	3.0-3	1.4-3
R-37	70	0	0	70	1.8-2	8.4-3
R-105	52	11	40	103	2.6-2	1.2-2
R-106, R-107	102	1	18	121	3.0-2	1.5-2
R-222, R-223, R-224	4,000	0	0	4,000	1.0+0	4.8-1
Liquid Radwaste Handling Areas						
R-3	22	0	4	26	2.2-2	1.0-2
R-4	376	6	22	404	3.4-1	1.6-1
R-5	124	0	0	124	1.0-1	5.0-2

TABLE 12.4-12
ESTIMATED RADWASTE BUILDING INHALATION EXPOSURES DUE TO
AIRBORNE RADIOACTIVITY⁽¹⁾

	Estimated Annual Man-Hours				Total	Estimated Thyroid Dose (Man-rem/yr)	Estimated Lung Dose (Man-rem/yr)
	Maintenance	Surveillance ⁽²⁾	Testing				
Solid Radwaste Handling Areas							
R-6	64	7	64		135	1.1-1	5.4-2
R-7	186	0	22		208	1.7-1	8.3-2
R-8	12	0	22		34	2.9-2	1.4-2
R-9	674	8	360		1,042	8.8-1	4.2-1
R-11	92	0	42		134	1.1.-1	5.4-2
R-12	272	8	82		362	3.0-1	1.5-1
R-13	300	0	0		300	2.5-1	1.2-1
R-14	104	9	30		143	1.2-1	5.7-2
R-15, R-16	28	0	16		44	3.7-2	1.8-2
R-17, R-18, R-19	56	0	18		74	6.2-2	3.0-2
R-20	188	10	96		294	2.5-1	1.2-1
R-34	52	4	0		56	4.7-2	2.2-2
R-101	32	0	4		36	3.0-2	1.4-2
R-225, R-227	114	0	0		114	9.2-2	4.6-2
R-250	280	0	104		384	3.2-1	1.5-1
Other Equipment Areas							
R-2	450	24	70		544	1.0-1	5.0-2
R-36	12	0	0		12	2.3-3	1.1-3
R-201, R-229	276	0	24		300	5.7-2	2.7-2
R-207	142	0	0		142	2.7-2	1.3-2

TABLE 12.4-12
ESTIMATED RADWASTE BUILDING INHALATION EXPOSURES DUE TO
AIRBORNE RADIOACTIVITY⁽¹⁾

	Estimated Annual Man-Hours			Total	Estimated Thyroid Dose (Man-rem/yr)	Estimated Lung Dose (Man-rem/yr)
	Maintenance	Surveillance ⁽²⁾	Testing			
Solid Radwaste Handling Areas						
R-310	50	17	0	67	1.3-2	6.1-3
R-311, R-312	68	13	0	81	1.5-2	7.4-3
R-243, R-244	80	0	0	80	1.5-2	7.3-3
R-239, R-240 R-241, R-242	152	0	0	152	2.9-2	1.4-2
R-234A, R-235A, R-236A, R-237A	180	0	0	180	3.4-2	1.6-2
R-234B, R-235B, R-236B, R-237B	280	0	0	280	5.3-2	2.5-2
R-236B, R-237B R-231	26	0	0	26	4.9-3	2.4-3
R-213, R-214	68	0	0	68	1.3-2	6.2-3
RADWASTE BUILDING TOTALS	9,444	119	1,210	10,773	4.9+0	2.3+0

⁽¹⁾ All values are on a per-plant basis.

⁽²⁾ Surveillance man-hours include transit time spent by operators walking in the area.

⁽³⁾ 5.0-4 = 5.0X10⁻⁴

⁽⁴⁾ Solid radwaste processing, container handling, and radwaste shipping

END HISTORICAL

Security-Related Information

Figure Withheld Under 10 CFR 2.390

