12.0 RADIATION PROTECTION

This chapter of the U.S. EPR Final Safety Analysis Report (FSAR) is incorporated by reference with supplements as identified in the following sections.

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12.1 ENSURING THAT OCCUPATIONAL RADIATION EXPOSURES ARE AS LOW AS IS REASONABLY ACHIEVABLE (ALARA)

This section of the U.S. EPR FSAR is incorporated by reference with the following ~~departures and/or~~ supplements.

12.1.1 POLICY CONSIDERATIONS

No ~~supplements or departures~~departures or supplements.

12.1.2 DESIGN CONSIDERATIONS

No ~~supplements or departures~~departures or supplements.

12.1.3 OPERATIONAL CONSIDERATIONS

The U.S. EPR FSAR includes the following COL Item in Section 12.1.3:

> A COL applicant that references the U.S. EPR design certification will fully describe, at the functional level, elements of the ALARA program for ensuring that occupational radiation exposures are ALARA. This program will comply with provisions of 10 CFR Part 20 and be consistent with the guidance in RGs 1.8, 8.2, 8.7, 8.8, 8.9, 8.10, 8.13, 8.15, 8.27, 8.28, 8.29, 8.34, 8.35, 8.36, 8.38, and the applicable portions of NUREG-1736.

This COL Item is addressed as follows:

This section incorporates by reference NEI 07-08, "Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures Are As Low As Is Reasonably Achievable (ALARA)" (NEI, 2007).

12.1.4 REFERENCES

{NEI, 2007. Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures Are As Low As Is Reasonably Achievable (ALARA), NEI 07-08, Revision 0, Nuclear Energy Institute, September 2007.}

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12.2 RADIATION SOURCES

This section of the U.S. EPR FSAR is incorporated by reference with the following supplements.

12.2.1 CONTAINED SOURCES

No ~~supplements or departures~~departures or supplements.

12.2.1.1 Reactor Core

No ~~supplements or departures~~departures or supplements.

12.2.1.2 Reactor Coolant System

No ~~supplements or departures~~departures or supplements.

12.2.1.3 Chemical and Volume Control System

No ~~supplements or departures~~departures or supplements.

12.2.1.4 Primary Coolant Purification System

No ~~supplements or departures~~departures or supplements.

12.2.1.5 Primary Coolant Degasification System

No ~~supplements or departures~~departures or supplements.

12.2.1.6 Secondary Coolant Cycle

No ~~supplements or departures~~departures or supplements.

12.2.1.7 Component Cooling Water and Essential Service Water Systems

No ~~supplements or departures~~departures or supplements.

12.2.1.8 Fuel Pool Cooling and Purification System

No ~~supplements or departures~~departures or supplements.

12.2.1.9 Liquid Waste Management System

No ~~supplements or departures~~departures or supplements.

12.2.1.10 Gaseous Waste Processing System

No ~~supplements or departures~~departures or supplements.

12.2.1.11 Solid Waste Management System

No ~~supplements or departures~~departures or supplements.

12.2.1.12 Post-LOCA ESF Filters

No ~~supplements or departures~~departures or supplements.

12.2.1.13 Miscellaneous Sources

The U.S. EPR FSAR includes the following COL Item in Section 12.2.1.13:

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A COL applicant that references the U.S. EPR design certification will provide site-specific information for required radiation sources containing byproduct, source, and special nuclear material that may warrant shielding design considerations. This site-specific information will include a listing of isotope, quantity, form, and use of all sources in this latter category that exceed 100 millicuries.

This COL Item is addressed as follows:

The following radiation sources have been identified to be required.

Isotope	Quantity	Form	Use
Cf-252	0.5 Ci	Sealed Source	Primary Start-up Source
Sb-Be	3E+06 Ci	Sealed Source	Secondary Source
Cs-137	400 Ci	Sealed Source	Calibration
Cs-137	~~{~~130 mCi~~}~~	Sealed Source	Calibration
~~Am-241~~	0.03 µCi	Sealed Source	Calibration

12.2.2 AIRBORNE RADIOACTIVE MATERIAL SOURCES

No departures or supplements.

12.2.3 REFERENCES

No departures or supplements.

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12.3 RADIATION PROTECTION DESIGN FEATURES

This section of the U.S. EPR FSAR is incorporated by reference with the following supplements.

12.3.1 FACILITY DESIGN FEATURES

No departures or supplements.

12.3.2 SHIELDING

No departures or supplements.

12.3.3 VENTILATION

No departures or supplements.

12.3.4 AREA RADIATION AND AIRBORNE RADIOACTIVITY MONITORING INSTRUMENTATION

No departures or supplements.

12.3.4.1 Area Radiation Monitoring Instrumentation

No departures or supplements.

12.3.4.2 Airborne Radioactivity Monitoring Instrumentation

No departures or supplements.

12.3.4.3 Portable Airborne Monitoring Instrumentation

No departures or supplements.

12.3.4.4 Criticality Accident Monitoring

No departures or supplements.

12.3.4.5 Implementation of Regulatory Guidance

The U.S. EPR FSAR includes the following COL Items in Section 12.3.4.5:

> A COL applicant that references the U.S. EPR design certification will describe the use of portable instruments, and the associated training and procedures, to accurately determine the airborne iodine concentration within the facility where plant personnel may be present during an accident, in accordance with requirements of 10 CFR 50.34(f)(2)(xxvii) and the criteria in Item III.D.3.3 of NUREG-0737. The procedures for locating suspected high-activity areas will be described.
>
> A COL applicant that references the U.S. EPR design certification will provide site-specific information on the extent to which the guidance provided by RG 1.21, 1.97, 8.2, 8.8, and ANSI/HPS-N13.1-1999 is employed in sampling, recording and reporting airborne releases of radioactivity.

These COL Items are addressed as follows:

Procedures detail the criteria and methods for obtaining representative measurement of radiological conditions, including in-plant airborne radioactivity concentrations in accordance

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with applicable portions of 10 CFR Part 20 (~~NRC, 2008~~CFR, 2008a) and consistent with the guidance in Regulatory Guides 1.21 Appendix A (NRC, 1974), 1.97 (NRC, 2006), 8.2 (NRC, 1973), 8.8 (NRC, 1978), and 8.10 (NRC,1977b) and ANSI/HPS-N13.1-1999 (ANSI, 1999). Additional discussion of radiological surveillance practices is included in the radiation protection program description provided in Section12.5.

Surveillance requirements are determined by the functional manager in charge of Radiation Protection based on actual or potential radiological conditions encountered by personnel and the need to identify and control radiation, contamination, and airborne radioactivity. These requirements are consistent with the operational philosophy in Regulatory Guide 8.10. Frequency of scheduled surveillances may be altered by permission of the functional manager in charge of Radiation Protection or their designee. Radiation Protection periodically provides cognizant personnel with survey data that identifies radiation exposure gradients in areas resulting from identified components. This data includes recent reports, with survey data, location and component information.

The following are typical criteria for frequencies and types of surveys:

Job Coverage Surveys

- Radiation, contamination, and/or airborne surveys are performed and documented to support job coverage.
- Radiation surveys are sufficient in detail for Radiation Protection to assess the radiological hazards associated with the work area and the intended/specified work scope.
- Surveys are performed commensurate with radiological hazard, nature and location of work being conducted.
- Job coverage activities may require surveys to be conducted on a daily basis where conditions are likely to change.

Radiation Surveys

- Radiation surveys are performed at least monthly in any radiological controlled area (RCA) where personnel may frequently work or enter. Survey frequencies may be modified by the functional manager in charge of Radiation Protection as previously noted.
- Radiation surveys are performed prior to or during entry into known or suspected high radiation areas for which up to date survey data does not exist.
- Radiation surveys are performed prior to work involving highly contaminated or activated materials or equipment.
- Radiation surveys are performed at least semiannually in areas outside the RCA. Areas to be considered include shops, offices, and storage areas.
- Radiation surveys are performed to support movement of highly radioactive material.
- Neutron radiation surveys are performed when personnel may be exposed to neutron emitting sources.

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Contamination Surveys

- Contamination surveys are performed at least monthly in any RCA where personnel may frequently work or enter. Survey frequencies may be modified by the functional manager in charge of Radiation Protection as previously noted.

- Contamination surveys are performed during initial entry into known or suspected contamination area(s) for which up to date survey data does not exist.

- Contamination surveys are performed at least daily at access points, change areas, and high traffic walkways in RCAs that contain contaminated areas. Area access points to a High Radiation Area or Very High Radiation Area are surveyed prior to or upon access by plant personnel or if access has occurred.

- Contamination surveys are performed at least semiannually in areas outside the RCA. Areas to be considered include shops, offices, and storage areas.

- A routine surveillance is conducted in areas designated by the functional manager in charge of Radiation Protection or their designee likely to indicate alpha radioactivity. If alpha contamination is identified, frequency and scope of the routine surveillance is increased.

Airborne Radioactivity Surveys

- Airborne radioactivity surveys are performed during any work or operation in the RCA known or suspected to cause airborne radioactivity (e.g., grinding, welding, burning, cutting, hydrolazing, vacuuming, sweeping, use of compressed air, using volatiles on contaminated material, waste processing, or insulation).

- Airborne radioactivity surveys are performed during a breach of a radioactive system, which contains or is suspected of containing significant levels of contamination.

- Airborne radioactivity surveys are performed during initial entry (and periodically thereafter) into any known or suspected airborne radioactivity area.

- Airborne radioactivity surveys are performed immediately following the discovery of a significant radioactive spill or spread of radioactive contamination, as determined by the functional manager in charge of Radiation Protection.

- Airborne radioactivity surveys are performed daily in occupied radiological controlled areas where the potential for airborne radioactivity exists, including containment.

- Airborne radioactivity surveys are performed any time respiratory protection devices, alternative tracking methods such as derived air concentration-hour (DAC-hr), and/or engineering controls are used to control internal exposure.

- Airborne radioactivity surveys are performed using continuous air monitors (CAMs) for situations in which airborne radioactivity levels can fluctuate and early detection of airborne radioactivity could prevent or minimize inhalations of radioactivity by workers. Determination of air flow patterns are considered for locating air samplers.

- Airborne radioactivity surveys are performed prior to use and monthly during use on plant service air systems used to supply air for respiratory protection to verify the air is free of radioactivity.

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- Tritium sampling is performed near the spent fuel pit when irradiated fuel is in the pit and in other areas of the plant where primary system leaks occur and tritium is suspected.

Appropriate counting equipment is used based on the sample type and the suspected identity of the radionuclides for which the sample is being done. Survey results are documented, retrievable, and processed per site document control and records requirements consistent with Regulatory Guide 8.2. Completion of survey documentation includes the update of room/area posting maps and revising area or room postings and barricades as needed.

Air samples indicating activity levels greater than a procedure specified percentage of DAC are forwarded to the radiochemistry laboratory for isotopic analysis. Samples which cannot be analyzed on-site are forwarded to a contractor for analysis; or, the DAC percentage may be hand calculated using appropriate values from 10 CFR Part 20, Appendix B.

The responsible Radiation Protection personnel review survey documentation to evaluate if surveys are appropriate and obtained when required, records are complete and accurate, and adverse trends are identified and addressed.

An in-plant radiation monitoring program maintains the capability to accurately determine the airborne iodine concentration in areas within the facility where personnel may be present under accident conditions. This program includes the training of personnel, procedures for monitoring, and provisions for maintenance of sampling and analysis equipment consistent with Regulatory Guides 1.21 (Appendix A) and 8.8. Training and personnel qualifications are discussed in Section 12.5.

A portable monitor system meeting the requirements of NUREG-0737 (NRC, 1980), Item III.D.3.3, is available. The system uses a silver zeolite or charcoal iodine sample cartridge and a single-channel analyzer. The use of this portable monitor is incorporated in the emergency plan implementing procedures. The portable monitor is part of the in-plant radiation monitoring program. It is used to determine the airborne iodine concentration in areas where plant personnel may be present during an accident. Accident monitoring instrumentation complies with applicable parts of 10 CFR Part 50, Appendix A (CFR, 2008b).

Sampling cartridges are removed to a low background area for further analysis. These cartridge samples are purged of any entrapped noble gases, when necessary, prior to being analyzed.

12.3.5 DOSE ASSESSMENT

~~{~~No departures or supplements.~~}~~

12.3.5.1 Overall Plant Doses

The U.S. EPR FSAR includes the following COL Item in Section 12.3.5.1:

> A COL applicant that references the U.S. EPR design certification will provide site-specific information on estimated annual doses to construction workers in a new unit construction area as a result of radiation from onsite radiation sources from the existing operating plant(s). This information will include bases, models, assumptions, and input parameters associated with these annual doses.

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~~Radiation Exposure to Construction Workers~~

{This section discusses the exposure of construction workers building CCNPP Unit 3

Site Layout

The physical location of CCNPP Unit 3 relative to the existing CCNPP Units 1 and 2 on the CCNPP site is presented on Figure 12.3-1. As shown, except for the CCNPP Unit 3 UHS Makeup Water Intake Structure and Circulating Water System Intake Structure, CCNPP Unit 3 will be located southeast of the protected area from CCNPP Units 1 and 2. Hence, the majority of construction activity will take place outside the protected area for the existing units, but inside the Owner Controlled Area for the CCNPP site.

Radiation Sources at CCNPP Units

During the construction of CCNPP Unit 3, the construction workers will be exposed to radiation sources from the routine operation of CCNPP Units 1 and 2. Sources that have the potential to expose CCNPP Unit 3 workers are listed in Table 12.3-1. They are characterized as to location, inventory, shielding, and typical local dose rates. Interior, shielded sources are not included. Figure 12.3-2 and Figure 12.3-3 show the locations of these sources. These sources are discussed in the Offsite Dose Calculation Manual (ODCM) (CCNPP, 2005), the annual Radiological Effluent Release Report (CCNPP, 2006a), and the Radiological Environmental Operating Reports (CCNPP, 2006b) (CCNPP, 2007b) for CCNPP Units 1 and 2. The four main sources of radiation to CCNPP Unit 3 workers are gaseous effluents, liquid effluents, the Independent Spent Fuel Storage Installation (ISFSI) and the Interim Resin Storage Area. These are discussed below.

All gaseous effluents flow out the CCNPP Units 1 and 2 plant stacks. The releases are reported annually to the NRC. For example, the annual gaseous releases from CCNPP Units 1 and 2 for 2006 were reported as 876 Ci (3.24E+13 Bq) of fission and activation gases, 3.28E-2 Ci (1.21E+09 Bq) of I-131, 1.62E-5 Ci (6.00E+05 Bq) of particulates with half-lives greater than eight days, and 4.79 Ci (1.77E+11 Bq) of tritium. Doses to the general population are also reported annually.

Effluents from the liquid waste disposal system produce small amounts of radioactivity in the discharge to the Chesapeake Bay. The annual liquid radioactivity releases for 2006 were reported as 487 Ci (1.80E+09 Bq) of fission and activation products, 1560 Ci (5.75E+13 Bq) of tritium, and 1.71 Ci (6.31E+10 Bq) of dissolved and entrained gases (CCNPP, 2007a).

There are two main direct radiation sources, the ISFSI and the Interim Resin Storage Area. This is because they are closer to CCNPP Unit 3 than all the other direct sources. There are radiation monitors at the perimeter of each. Radiation from minor direct sources from CCNPP Units 1 and 2 would be picked up by the ISFSI and Resin Storage Area monitoring programs, and thus, would be included in the dose estimates below.

Historical Dose Rates

The historical measured and calculated dose rates that were used to estimate worker dose are presented below.

Offsite Gaseous and Liquid Effluent Doses

The doses listed in Table 12.3-2 are to the maximally exposed member of the public due to the release of gaseous and liquid effluents from CCNPP Units 1 and 2 and are calculated in accordance with the existing units' ODCM (CCNPP, 2005). The maximum individual doses are from historical CCNPP Units 1 and 2 Annual Radiological Environmental Operating Reports and, prior to that, the Radiological Environmental Monitoring Program Annual Reports. While these

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off-site doses provide perspective on the variation of effluent releases through the history of the operation of CCNPP Units 1 and 2, on-site workers will be exposed to fewer pathways. For example, workers will not ingest food (edible plants or fish) grown in effluent streams as part of their work activity. Therefore, only external and inhalation pathways will be considered in the calculation of dose to workers.

ISFSI Historical Measurements

Figure 12.3-4 provides thermoluminescent dosimeter (TLD) measurements made adjacent to the ISFSI in 2005 as well as a conservative extrapolation of dose over distance. Table 12.3-3 contains the average monthly ISFSI TLD dose and the average monthly control location dose from 1990 to 2005. The locations used to determine the background are locations DR 1, 7, 8, 20, 21, 22, and 23 as described in the 2005 Radiological Environmental Monitoring Program (REMP) report (CCNPP, 2006b). Table 12.3-4 provides the time trend for the ISFSI net annual dose since spent fuel was initially placed into storage at the ISFSI in 1993.

Resin Storage Area Historical Measurements

Table 12.3-5 provides historical Resin Storage Area TLD readings from 2001 through 2005. Figure 12.3-5 provides the ISFSI and Resin Storage Area TLD readings, averaged over all detectors and over each year of data. Figure 12.3-6 extrapolates the 2005 dose rate over distance from the center of the Resin Area.

Projected Dose Rates at CCNPP Unit 3

Dose rates from all sources combined were calculated for each 100 x 100 foot square on the plant grid. These dose rates were in terms of mrem/year. For purposes of dose rate calculations, a 100% occupancy is assumed. (For purposes of collective dose calculations, the occupancy for construction workers is 2,200 hours per year.) The dose rates were the sum of the dose rate from the four main sources; gases, liquids (only on the shoreline), ISFSI, and Resin Storage Area. They are shown in Figure 12.3-7 for the year 2015, the last year of construction. It is this year that the dose rate will be greatest, primarily because the ISFSI will have the largest number of spent fuel storage casks. No credit is taken in the calculations for any additional shielding other than that present in measured doses.

Gaseous Dose Rates

The annual Total Effective Dose Equivalent (TEDE) dose rate from gaseous effluents to construction workers on the CCNPP Unit 3 site is bounded by the following equation:

$$D(r) = 220256\ r^{-1.8}\ \text{(mrem/year)}$$

where r is the distance from the stack to the worker location in feet

The skin dose rate equation bounds organ doses from Iodines and particulates.

$$D(r) = 1066039\ r^{-1.8}\ \text{(mrem/year)}$$

where r is the distance from the stack to the worker location in feet

These parametric equations are based on annual average, undepleted, ground level χ/Qs that are based on CCNPP site specific meteorology for the years 2000 to 2006. Note that only those wind directions which could carry gaseous effluents from the stacks to the CCNPP Unit 3 workers were included in the present analysis. Thus, the directions from ENE through the SSW

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are included. The χ/Q data used are provided in Table 12.3-6. A bounding curve was then fitted to a power equation as shown in Figure 12.3-8.

The equation is:

$$\chi/Q\ (r) = 60\ r^{1.8}$$

where r is the distance from the stack to the worker location in feet

The dose rates were calculated for an onsite location with a known χ/Q for the years 2001 through 2006 according to the Regulatory Guide 1.109 (NRC, 1977a) method with TEDE calculations according to Federal Guidance Reports 11 (EPA, 1988) and 12 (EPA, 1993). The gaseous releases are shown in Figure 12.3-7. The 2006 releases gave the highest dose rates. This data was then used to establish the dose rate to χ/Q ratio which was used to derive a parametric equation to bound the dose rate from the 2006 releases.

Liquid Dose Rates

The dose from liquid effluents is conservatively calculated assuming all the exposure is from deposition on the shoreline. The historical liquid effluents and dilution rates for the years 2001 through 2006 are given in Figure 12.3-8, the dose at the shoreline is 0.32 mrem/yr (3.2 µSv/yr). The actual discharge from CCNPP Units 1 and 2 is 850 ft (259 m) away from shore. The dilution factor at the shore would provide a significant reduction but is conservatively ignored.

The LADTAPII computer code (NRC, 1986) was used to make these calculations. LADTAPII assumes a 12 hours/year occupancy rate which had to be scaled up by the factor 8766/12 for annual dose rate calculations.

ISFSI Dose Rates

The dose rate had to be calculated at various distances and directions from the ISFSI. The dose rate also had to be projected into the future as more spent fuel was loaded into storage canisters and stored at the ISFSI from CCNPP Units 1 and 2. TLD readings around the ISFSI as shown in Figure 12.3-9 were used to develop the following equation for 2005 dose rate as a function of location:

$$DR_{N,2005} = 76\omega e^{-0.00195x}\ (\text{mrem / year})$$

Where x = source surface to target distance (ft), and

ω = solid angle of the ISFSI bunkers and an equivalent air scattering source above it.

This is a reasonable approximation for the North end, i.e., ISFSI-N, which was about 72% loaded with spent fuel at the end of 2005. The exterior perimeter distance, x, to ISFSI-N is calculated assuming a source center at N9703, E7936. Then, it was assumed that all post-2005 spent fuel loading went into ISFSI-S whose source center was N9403, E7936. The source term for ISFSI-S was an extrapolation of the historic dose rate increase from ISFSI-N as shown in Figure 12.3-10. The dose rate from ISFSI-S as a function of calendar year after 2005 is:

$$DR_S(t) = DR_{N,2005}\ F_S(t)\ (\text{mrem/year})$$

where, $F_S(t) = -170.8456 + 0.08521\ t$

and where t is in absolute year (such as 2015).

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Note that these provide annual average dose rates. There are significant temporal variations, for example, during ISFSI loading operations the dose rate will go up. These variations are included in the annual average.

Resin Area Dose Rates

The resin dose rate equation is given below where, r, the distance in feet from the effective center of the Resin Area, i.e., N 10100 E 7600 on the plant grid in feet.

$$D = 2.23E6\ e^{-0.000951r} / r^2 \text{ (mrem/year)}$$

This is independent of direction. The Cobalt-60 photon energy spectrum is assumed because it typically dominates or bounds the exterior distance dose rate from resin beds. In reality, there is expected to be significant variation in the sources and their strengths from quarter to quarter. There is also expected to be some azimuthal variation in dose rate. However, this is a best estimate, which is suitable for the purpose of ALARA calculations.

This equation was fitted to TLDs located as shown in Figure 12.3-11. The data for 2005 was used. All the data for the years 2001 through 2005 are in Table 12.3-5. There has been one year in which the dose rate was higher than is predicted by this equation. For this reason, future TLD dose rates will be monitored to assure that this equation and associated results remain valid.

Cumulative Dose Rates

The maximum dose rates by zone are given in Table 12.3-9. For an occupational year, i.e., 2,200 hours onsite, the maximum dose would be on the road by the ISFSI or the Resin Storage Area where the dose would be 39 mrem/2200 hours (390 mSv/2200 hours) and less than 2 mrem (0.02 mSV) in any one hour.

The annual values are expressed to be clear that an occupancy of 2200 hours is assumed. The use of 2,200 hours assumes the worker takes 2 weeks vacation or sick time per year, works 40 hours per week for 50 weeks per year, and works 10% overtime per year. Note, that this dose rate is for the maximum dose rate locations adjacent to the ISFSI and Resin Storage Areas. The ALARA program described above will not allow workers to linger or work full shifts at these locations.

The maximum dose rates for all other Construction Zones are less than 25 mrem/year (0.25 mSv/year).This value is less than the limits specified above for members of the public.

Table 12.3-10 shows that the dose rate to workers from effluents does not exceed 1 mrem/year (10 µSv/year) in any construction zone.

Collective Doses to CCNPP Unit 3 Workers

The collective dose is the sum of all doses received by all workers. It is a measure of population risk. The total worker collective dose for the combined years of construction is 17.1 person-rem (0.171 person-Sieverts). This is a best estimate and is based upon the worker census and occupancy projections shown in Table 12.3-11 and Table 12.3-12. The breakdown of collective dose by construction year and occupancy zone is given in Table 12.3-13. This assumes 2,200 hours per year occupancy for each worker.}

12.3.5.2 Post-Accident Access to Radiological Vital Areas

No departures or supplements.

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12.3.5.3 Dose to the Public from Direct Radiation Exposure at the Exclusion Area Boundary

No departures or supplements.

12.3.6 MINIMIZATION OF CONTAMINATION

No departures or supplements.

12.3.7 REFERENCES

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Table 12.3-1—{Source List for CCNPP Units 1 and 2}

Source	Location	Radioactive Inventory	Shielding	Typical Dose Rates
CCNPP Unit 1 Stack	Side of CCNPP Unit 1 containment	There are two elevated vents, one for each of CCNPP Units 1 and 2. Their joint effluents are characterized in the annual RETS/REMP reports[(a)]	N.A., airborne effluent	Offsite doses generally less than few mrem/year (mSv/year)
CCNPP Unit 2 Stack	Side of CCNPP Unit 2 containment		N.A., airborne effluent	Offsite doses generally less than few mrem/year (mSv/year)
Circulating Water System Discharge	850 ft (259.1 m) from shore	Liquid effluents discharged to bay are characterized in annual RETS/REMP reports[(b)]	N.A., waterborne effluent	Offsite doses generally less than few mrem/year (mSv/year)
ISFSI	ISFSI Pad	Spent fuel characterized by TLD measurements listed in annual ISFSI REMP report	Vented concrete bunkers	Contact dose rates <20 mrem/hr (<0.2 mSv/hr)
Auxiliary Building	West of Turbine Building	Radwaste tanks and storage	Shielded building walls	Exterior contact <2.5 mrem/hr (<0.025 mSv/hr)
Refueling Water Tanks (RWT)	Adjacent to Auxiliary Building on 45 ft (13.7 m) elevation	Maximum inventory occurs when tanks have reactor water	None	<5.0 mrem/hr (<0.05 mSv/hr) at 15 ft (4.6 m) distance
Interim Resin Storage Area, Lake Davies	300 ft (91.4 m) west of ISFSI	Interim storage of spent resin and filters	None	<0.5 mrem/hr (<0.005 mSv/hr) at the storage area fence
Materials Processing Facility (MPF)	South of Turbine Building	Interim storage of dry active waste, and liquids being processed for shipment	Variety of shields built into structure	Exterior contact <0.5 mrem/hr (<0.005 mSv/hr)
Original Steam Generator Storage Facility	100 ft (30.5 m) north of north end of ISFSI	Lower assemblies of four original steam generators	Heavily shielded building	Exterior contact <0.5 mrem/hr (<0.005 mSv/hr)
West Road Cage	On 45 ft (13.7 m) Elevation ~120 ft (~36.6 m) Auxiliary Building rollup doors	Interim storage of spent resins and filters	None	< 5.0 mrem/hr (<0.05 mSv/hr) at the cage fence

Notes:

(a) The gaseous releases reported for 2006 were 876 Ci (3.24E+13 Bq) of fission and activation gases, 3.28E-2 Ci (1.21E+09 Bq) of I-131, 1.62E-5 Ci (6.00E+05 Bq) of particulates with half-lives greater than eight days, and 4.79 Ci (1.77E+11 Bq) of tritium. These are typical compared to recent years.

(b) Liquid effluents from the liquid waste disposal produce small amounts of radioactivity in the discharge to the Chesapeake Bay. The annual liquid radioactivity releases for 2006 were reported as 4.87E-2 Ci (1.80E+09 Bq) of fission and activation products, 1560 Ci (5.75E+13 Bq) of tritium, and 1.71 Ci (6.31E+10 Bq) of dissolved and entrained gases. These are typical compared to the last five years.

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Table 12.3-2— {Historical All-Source Compliance for Offsite General Public}

	Historical Site Boundary Doses Reported to NRC (mrem/year)/(mSv/year)			Percent of 40 CFR 190 Limit by Year of Operation		
Limits	**75**	**25**	**25**	**Percent of Limit**		
Year	**Thyroid**	**WB**	**Other Organs**	**Thyroid**	**WB**	**Other Organs**
2006	0.052/0.00052	0.004/0.00004	0.010/0.00010	0.07	0.02	0.04
2005	0.006/0.00006	0.005/0.00005	0.095/0.00095	0.01	0.02	0.38
2004	0.007/0.00007	0.002/0.00002	0.006/0.00006	0.01	0.01	0.02
2003	0.006/0.00006	0.004/0.00004	0.023/0.00023	0.01	0.02	0.09
2002	0.003/0.00003	0.007/0.00007	0.174/0.00174	0.00	0.03	0.70
2001	0.005/0.00005	0.010/0.00010	0.351/0.00351	0.01	0.04	1.40
2000	0.018/0.00018	0.018/0.00018	0.211/0.00211	0.02	0.07	0.84
1999	0.011/0.00011	0.013/0.00013	0.686/0.00686	0.01	0.05	2.74
1998	0.005/0.00005	0.005/0.00005	0.302/0.00302	0.01	0.02	1.21
1997	0.005/0.00005	0.009/0.00009	0.235/0.00235	0.01	0.04	0.94
1996	0.005/0.00005	0.012/0.00012	0.245/0.00245	0.01	0.05	0.98
1995	0.007/0.00007	0.017/0.00017	0.132/0.00132	0.01	0.07	0.53
1994	0.024/0.00024	0.039/0.00039	0.473/0.00473	0.03	0.15	1.89
1993	0.099/0.00099	0.125/0.00125	0.466/0.00466	0.13	0.50	1.86
1992	0.125/0.00125	0.114/0.00114	0.420/0.0042	0.17	0.46	1.68
1991	0.167/0.00167	0.045/0.00045	0.292/0.00292	0.22	0.18	1.17
1990	0.070/0.00070	0.070/0.00070	0.370/0.0037	0.09	0.28	1.48
1989	0.526/0.00526	0.113/0.00113	0.674/0.00674	0.70	0.45	2.70
1988	1.130/0.00113	0.120/0.00120	0.500/0.00500	1.51	0.48	2.00
1987	0.381/0.00381	0.250/0.00250	1.360/0.01360	0.51	1.00	5.44
1986	0.685/0.00685	0.093/0.00093	0.643/0.00643	0.91	0.37	2.57
1985	0.800/0.00800	0.010/0.00010	0.030/0.00030	1.07	0.04	0.12
1984	0.710/0.00710	0.110/0.00110	0.020/0.00020	0.95	0.44	0.08
1983	0.150/0.00150	0.060/0.00060	0.030/0.00030	0.20	0.24	0.12
1982	0.220/0.00220	0.034/0.00034	0.080/0.00080	0.29	0.14	0.32
1981	0.100/0.00100	0.002/0.00002	0.080/0.00080	0.13	0.01	0.32
1980	0.170/0.00170	0.009/0.00009	N/A/N/A	0.23	0.04	N/A

Note:
Historically the receptors have been offsite; therefore, the dose is dominated by gaseous and liquid effluents.

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Table 12.3-3—{Mean Historical ISFSI Exposures by Year}

Mean TLD Exposures by Year Digitized from Figure 7 of 2005 REMP Report (mRoentgen/30 days) (These are historical values and are listed as reported, in English units)		
Year	**ISFSI**	**Control**
1990	3.96	N/A
1991	3.95	4.11
1992	4.28	4.40
1993	3.99	4.19
1994	4.73	4.63
1995	5.14	4.69
1996	5.01	4.20
1997	5.56	4.31
1998	6.20	4.56
1999	6.07	4.47
2000	5.72	3.88
2001	6.88	4.15
2002	7.23	4.48
2003	8.46	4.60
2004	8.27	4.51
2005	8.14	4.02

Note: 1990 through 1992 provide baseline data before spent fuel stored at ISFSI in 1993.

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Table 12.3-4—{Historical ISFSI Net Trend}

Annual Gamma Dose Rate based on ISFSI TLDs						
Year	ISFSI	Control Adjusted[a]	Net ISFSI	ISFSI	Control Adjusted[a]	Net ISFSI
	mrem/y	mrem/y	mrem/y	uSv/y	uSv/y	uSv/y
1991	48.06	47.54	(b)	480.6	475.4	(b)
1992	52.10	51.11	(b)	521.0	511.1	(b)
1993	48.53	48.54	0.00	485.3	485.4	0.0
1994	57.55	53.93	3.62	575.5	539.3	36.2
1995	62.59	54.67	7.92	625.9	546.7	79.2
1996	61.00	48.61	12.39	610.0	486.1	123.9
1997	67.69	50.02	17.68	676.9	500.2	176.8
1998	75.38	53.08	22.30	753.8	530.8	223.0
1999	73.80	52.00	21.79	738.0	520.0	217.9
2000	69.56	44.78	24.77	695.6	447.8	247.7
2001	83.71	48.02	35.69	837.1	480.2	356.9
2002	87.92	52.08	35.84	879.2	520.8	358.4
2003	102.90	53.49	49.41	1029.0	534.9	494.1
2004	100.65	52.41	48.24	1006.5	524.1	482.4
2005	99.07	46.52	52.55	990.7	465.2	525.5

Notes:
(a) Slightly adjusted such that 1993 net TLD dose is zero.
(b) 1991 and 1992 provide baseline before first spent fuel stored at ISFSI in 1993.
(c) SI Units assume 1 Roentgen = 1 rem = 0.01 Sv which is correct to +/- 10%.

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Table 12.3-5— {Historical Resin Storage Area TLD Readings for 2001 through 2005}

Quarter	RPDR05	RPDR06	RPDR07	RPDR08	RPDR09	RPDR10	RPDR11	RPDR12
1st Qtr 2001	16.07	16.88	27.94	16.66	32.02	29.56	11.82	21.36
2nd Qtr 2001	51.86	129.45	166.45	124.63	113.28	48.70	17.39	29.98
3rd Qtr 2001	38.54	50.32	154.74	146.91	122.34	52.91	16.91	32.08
4th Qtr 2001	17.54	20.19	23.16	19.72	19.62	21.49	12.68	21.98
1st Qtr 2002	20.91	23.04	38.04	37.08	28.29	28.45	13.96	24.30
2nd Qtr 2002	19.07	18.71	15.78	17.54	19.28	20.96	13.43	21.78
3rd Qtr 2002	15.83	16.20	19.20	18.68	21.08	23.75	16.27	27.98
4th Qtr 2002	16.87	17.04	23.38	18.94	18.91	21.48	17.89	29.63
1st Qtr 2003	16.48	17.21	23.87	18.31	18.11	22.52	18.06	19.73
2nd Qtr 2003	17.75	17.74	31.33	18.73	16.34	25.52	21.06	21.49
3rd Qtr 2003	15.44	15.87	20.96	20.52	16.98	19.31	17.58	24.81
4th Qtr 2003	18.01	16.93	18.63	17.39	19.97	21.78	17.29	26.26
1st Qtr 2004	16.32	16.75	17.88	17.64	18.75	20.89	17.38	25.82
2nd Qtr 2004	36.25	33.89	18.85	36.51	24.17	22.40	16.14	23.34
3rd Qtr 2004	30.26	30.32	24.27	50.34	28.67	30.49	14.84	32.10
4th Qtr 2004	59.47	72.37	74.41	77.07	43.09	46.48	21.50	48.46
1st Qtr 2005	33.37	42.40	34.46	37.28	31.26	33.52	17.03	52.83
2nd Qtr 2005	57.76	53.64	35.03	44.53	45.42	33.16	18.67	60.40
3rd Qtr 2005	30.16	33.09	23.84	42.11	25.38	24.47	15.03	46.03
4th Qtr 2005	17.97	16.71	20.91	38.71	20.81	18.56	14.62	39.27

Note:
(Exposure Rates to TLDs are expressed in milli-Roentgen/90 days. Note that for photons, a Roentgen is approximately equal to a rem.)

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Table 12.3-6—{Historical Annual Average χ/Q (sec/m3) In CCNPP Unit 3 Directions}

Normal Effluent Annual Average, Undecayed, Undepleted χ/Q Values for Ground Level Release Without Building Wake Using CCNPP Meteorological Data for Directions that Could Affect CCNPP Unit 3 Workers				
	Distance from Stacks to CCNPP Unit 3 Location			
Wind Direction	**0.5 mi (0.8 km)**	**0.62 mi (1.0 km)**	**1.5 mi (2.4 km)**	**2.5 mi (4.0 km)**
ENE	3.32E-05	2.24E-05	2.85E-06	9.19E-07
E	2.51E-05	1.69E-05	2.15E-06	6.94E-07
ESE	2.26E-05	1.53E-05	1.94E-06	6.22E-07
SE	1.63E-05	1.11E-05	1.39E-06	4.39E-07
SSE	1.05E-05	7.17E-06	8.96E-07	2.80E-07
S	1.16E-05	7.87E-06	9.75E-07	3.03E-07
SSW	1.05E-05	7.13E-06	8.81E-07	2.72E-07

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Table 12.3-7—{Historical Gaseous Releases for 2002 through 2005}

Nuclide	Release Ci (Bq)				
	2002	2003	2004	2005	2006
H-3	7.33E+00 (2.71E+11)	1.20E+01 (4.44E+11)	5.86E+00 (2.17E+11)	6.48E+00 (2.40E+11)	4.79E+00 (1.77E+11)
Ar-41	1.06E-02 (3.92E+08)	1.68E-02 (6.21E+08)	4.32E-01 (1.60E+10)	2.87E-03 (1.06E+08)	2.72E-03 (1.01E+08)
Fe-55	None Detected	None Detected	2.52E-04 (9.33E+06)	None Detected	None Detected
Co-58	None Detected	None Detected	1.24E-05 (4.59E+05)	7.09E-06 (2.62E+05)	8.99E-06 (3.33E+05)
Co-60	None Detected	None Detected	None Detected	None Detected	7.19E-06 (2.66E+05)
Br-82	None Detected	None Detected	1.10E-05 (4.07E+05)	None Detected	None Detected
Kr-85 m	1.78E-02 (6.60E+08)	6.67E-02 (2.47E+09)	5.48E-02 (2.03E+09)	2.18E-02 (8.06E+08)	8.60E-02 (3.18E+09)
Kr-85	3.33E+01 (1.23E+12)	2.99E+01 (1.11E+12)	2.31E+01 (8.54E+11)	2.22E+01 (8.23E+11)	1.88E+02 (6.94E+12)
Kr-87	3.09E-04 (1.14E+07)	2.87E-03 (1.06E+08)	7.08E-05 (2.62E+06)	None Detected	None Detected
Kr-88	6.65E-04 (2.46E+07)	9.07E-03 (3.36E+08)	4.90E-03 (1.81E+08)	9.06E-03 (3.35E+08)	2.33E-02 (8.61E+08)
Sr-89	None Detected	None Detected	None Detected	1.24E-07 (4.59E+03)	9.08E-09 (3.36E+02)
Sr-90	None Detected	None Detected	4.48E-10 (1.66E+01)	9.43E-07 (3.49E+04)	None Detected
I-131	5.75E-04 (2.13E+07)	1.82E-03 (6.72E+07)	1.54E-03 (5.71E+07)	1.36E-03 (5.03E+07)	3.28E-02 (1.21E+09)
I-132	None Detected	None Detected	None Detected	None Detected	4.28E-03 (1.58E+08)
I-133	2.96E-03 (1.10E+08)	3.80E-03 (1.41E+08)	1.42E-03 (5.25E+07)	3.06E-03 (1.13E+08)	2.32E-02 (8.57E+08)
I-135	None Detected	None Detected	None Detected	None Detected	3.87E-03 (1.43E+08)
Xe-131 m	1.00E-01 (3.71E+09)	9.53E-01 (3.53E+10)	8.35E-01 (3.09E+10)	6.57E-01 (2.43E+10)	1.51E+01 (5.60E+11)
Xe-133 m	2.84E-01 (1.05E+10)	1.83E+00 (6.78E+10)	1.75E+00 (6.49E+10)	6.11E-01 (2.26E+10)	6.49E+00 (2.40E+11)
Xe-133	6.03E+01 (2.23E+12)	1.12E+02 (4.15E+12)	1.22E+02 (4.52E+12)	1.55E+02 (5.72E+12)	2.58E+02 (9.53E+12)
Xe-135 m	6.12E-04 (2.26E+07)	5.29E-03 (1.96E+08)	1.29E-04 (4.77E+06)	None Detected	None Detected
Xe-135	2.75E+00 (1.02E+11)	5.77E+00 (2.13E+11)	9.23E+00 (3.41E+11)	1.29E+01 (4.77E+11)	2.67E+01 (9.87E+11)
Xe-138	1.34E-04 (4.96E+06)	3.71E-04 (1.37E+07)	7.15E-09 (2.64E+02)	None Detected	None Detected

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Table 12.3-8— {Historical Liquid Releases 2001 through 2006}
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Isotope	Release Ci (Bq)					
	2001	2002	2003	2004	2005	2006
Ag-110M	3.45E-02 (1.28E+09)	2.03E-02 (7.49E+08)	2.22E-03 (8.22E+07)	2.65E-04 (9.81E+06)	9.78E-06 (3.62E+05)	1.77E-04 (6.55E+06)
Ba-140	None Detected	2.88E-05 (1.07E+06)	None Detected	None Detected	None Detected	None Detected
Be-7	None Detected	3.94E-04 (1.46E+07)	None Detected	None Detected	None Detected	None Detected
Ce-144	1.19E-03 (4.40E+07)	None Detected	2.25E-04 (8.33E+06)	None Detected	None Detected	None Detected
Co-57	1.19E-03 (4.39E+07)	3.50E-04 (1.30E+07)	7.61E-05 (2.82E+06)	1.62E-05 (5.99E+05)	1.39E-06 (5.14E+04)	1.79E-05 (6.64E+05)
Co-58	3.04E-01 (1.13E+10)	4.29E-02 (1.59E+09)	1.44E-02 (5.33E+08)	5.90E-03 (2.18E+08)	2.39E-03 (8.85E+07)	3.23E-03 (1.19E+08)
Co-60	1.95E-02 (7.22E+08)	1.94E-02 (7.19E+08)	3.64E-03 (1.34E+08)	1.77E-03 (6.53E+07)	5.94E-04 (2.20E+07)	1.43E-03 (5.31E+07)
Cr-51	5.64E-02 (2.09E+09)	1.09E-02 (4.03E+08)	1.54E-03 (5.71E+07)	6.88E-04 (2.55E+07)	3.89E-04 (1.44E+07)	5.01E-04 (1.85E+07)
Cs-134	3.30E-03 (1.22E+08)	2.35E-04 (8.68E+06)	7.95E-05 (2.94E+06)	2.78E-04 (1.03E+07)	7.55E-05 (2.79E+06)	4.48E-04 (1.66E+07)
Cs-136	None Detected	None Detected	None Detected	None Detected	None Detected	1.09E-05 (4.03E+05)
Cs-137	9.39E-03 (3.48E+08)	4.44E-04 (1.64E+07)	3.17E-04 (1.17E+07)	7.34E-04 (2.71E+07)	1.32E-04 (4.89E+06)	5.60E-04 (2.07E+07)
Eu-154	6.99E-04 (2.59E+07)	3.32E-04 (1.23E+07)	2.03E-04 (7.51E+06)	None Detected	None Detected	None Detected
Eu-155	2.23E-04 (8.25E+06)	3.63E-04 (1.34E+07)	1.47E-04 (5.44E+06)	None Detected	None Detected	None Detected
Fe-55	1.07E-01 (3.96E+09)	1.19E-01 (4.41E+09)	2.71E-02 (1.00E+09)	1.51E-02 (5.59E+08)	8.67E-02 (3.21E+09)	2.27E-02 (8.39E+08)
Fe-59	5.02E-03 (1.86E+08)	2.25E-03 (8.33E+07)	5.80E-05 (2.14E+06)	5.35E-06 (1.98E+05)	1.66E-05 (6.13E+05)	5.15E-05 (1.90E+06)
I -131	1.42E-03 (5.26E+07)	3.51E-04 (1.30E+07)	6.04E-04 (2.24E+07)	2.93E-04 (1.08E+07)	1.58E-04 (5.86E+06)	4.10E-03 (1.52E+08)
I -132	None Detected	2.40E-04 (8.88E+06)	None Detected	None Detected	None Detected	None Detected
I -133	8.97E-05 (3.32E+06)	4.95E-05 (1.83E+06)	1.57E-05 (5.80E+05)	3.55E-05 (1.31E+06)	1.59E-05 (5.86E+05)	8.91E-05 (1.90E+06)
La-140	None Detected	9.69E-05 (3.59E+06)	None Detected	None Detected	None Detected	None Detected
Mn-54	5.75E-03 (2.13E+08)	4.66E-03 (1.72E+08)	7.45E-04 (2.76E+07)	1.81E-04 (6.68E+06)	4.11E-05 (1.52E+06)	2.21E-04 (8.18E+06)
Na-24	4.66E-03 (1.72E+08)	None Detected	2.49E-06 (9.21E+04)	None Detected	None Detected	None Detected
Nb-95	5.96E-02 (2.20E+09)	2.16E-02 (7.98E+08)	2.65E-03 (9.82E+07)	3.06E-04 (1.13E+07)	1.60E-04 (5.93E+06)	2.89E-04 (1.07E+07)
Nb-97	3.54E-05 (1.31E+06)	None Detected	None Detected	None Detected	None Detected	None Detected
Ni-63	None Detected	None Detected	None Detected	2.17E-03 (8.03E+07)	6.16E-03 (2.28E+08)	7.47E-04 (2.76E+07)
Ru-103	5.42E-04 (2.01E+07)	7.10E-05 (2.63E+06)	None Detected	None Detected	None Detected	None Detected

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Table 12.3-8— {Historical Liquid Releases 2001 through 2006}
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Isotope	Release Ci (Bq)					
	2001	2002	2003	2004	2005	2006
Sb-124	3.42E-03 (1.26E+08)	6.43E-05 (2.38E+06)	5.50E-04 (2.04E+07)	None Detected	None Detected	None Detected
Sb-125	2.15E-02 (7.96E+08)	1.70E-02 (6.30E+08)	8.85E-03 (3.27E+08)	1.44E-04 (5.33E+06)	8.57E-06 (3.17E+05)	6.83E-05 (2.53E+06)
Sn-113	5.45E-03 (2.02E+08)	2.18E-03 (8.06E+07)	5.27E-05 (1.95E+06)	None Detected	None Detected	None Detected
Sn-117M	3.77E-04 (1.40E+07)	3.86E-04 (1.43E+07)	1.08E-03 (3.98E+07)	3.20E-05 (1.18E+06)	1.28E-04 (4.74E+06)	None Detected
Sr-89	7.63E-04 (2.82E+07)	9.51E-06 (3.52E+05)	4.84E-04 (1.79E+07)	None Detected	3.83E-04 (1.42E+07)	None Detected
Sr-90	2.12E-05 (7.84E+05)	None Detected	1.89E-06 (7.00E+04)	None Detected	None Detected	None Detected
Te-125M	None Detected	None Detected	None Detected	None Detected	1.27E-02 (4.70E+08)	1.38E-02 (5.11E+08)
Te-132	None Detected	1.44E-04 (5.33E+06)	None Detected	None Detected	None Detected	None Detected
W -187	None Detected	7.15E-06 (2.65E+05)	None Detected	None Detected	None Detected	None Detected
Zn-65	1.54E-06 (5.70E+04)	None Detected	None Detected	None Detected	None Detected	None Detected
Zr-95	3.59E-02 (1.33E+09)	1.12E-02 (4.15E+08)	1.46E-03 (5.41E+07)	1.59E-04 (5.88E+06)	1.17E-04 (4.34E+06)	1.58E-04 (5.84E+06)
Zr-97	5.61E-05 (2.08E+06)	None Detected	None Detected	None Detected	None Detected	None Detected
Total	6.82E-01 (2.52E+10)	2.75E-01 (1.02E+10)	6.65E-02 (2.46E+09)	2.81E-02 (1.04E+09)	1.10E-01 (4.08E+09)	4.86E-02 (1.80E+09)
Dilution Flow ft^3/sec (L/sec)	3,705.3 (104,922)	2,738.4 (77,543)	4,924.0 (139,431)	5,147.8 (145,769)	5147.8 (145,769)	5003.4 (141,681)

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Table 12.3-9—{Projected Dose Rates from all Sources by Construction Zone}

Maximum Construction Zone Dose Rates (mrem/year) Assuming 2,200 Hours per Year Occupancy		
Zone	**Zone Description**	**Dose Rate mrem/2,200 hours (mSv/2,200 hours)**
B	Batch Plant	0.07 (0.0007)
C	Construction on main structures	1.35 (0.0135)
L	Laydown	21.49 (0.2149)
O	Office/Trailer	0.04 (0.0004)
P	Parking	20.32 (0.2032)
R	Roads	38.87 (0.3887)
S	Shoreline, tunnel, barge, in/out flow	0.48 (0.0048)
T	Tower/Basin/Desalinization	0.02 (0.0002)
W	Warehouse	0.04 (0.004)

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Table 12.3-10—{Projected Dose Rates from Effluents by Construction Zone}

Maximum Dose Rate Assuming Full Time Occupancy mrem/year (mSv/year)				
Zone	**Zone Description**	**Gaseous Effluents**	**Gaseous Effluents Organ**	**Liquid Effluents**
B	Batch Plant	0.10 (0.0010)	0.49 (0.0049)	0.00 (0.0000)
C	Construction on Main Structures	0.32 (0.0032)	1.54 (0.0154)	0.00 (0.0000)
L	Laydown	0.20 (0.0020)	0.98 (0.0098)	0.00 (0.0000)
O	Office/Trailer	0.11 (0.0011)	0.51 (0.0051)	0.00 (0.0000)
P	Parking	0.43 (0.0043)	2.09 (0.0209	0.00 (0.0000)
R	Roads	0.53 (0.0053)	2.56 (0.0256)	0.00 (0.0000)
S	Shoreline, Tunnel, Barge, In/Out Flow	1.55 (0.0155)	7.48 (0.0748)	0.32 (0.0032)
T	Tower/Basin/Desalinization	0.06 (0.0006)	0.29 (0.0029)	0.00 (0.0000)
W	Warehouse	0.09 (0.0009)	0.42 (0.0042)	0.00 (0.0000)

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Table 12.3-11—{Projected Construction Worker Census 2010 to 2015}

Year	Construction Workers on Site
2010	531
2011	2,281
2012	4,000
2013	4,000
2014	4,000
2015	3,215

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Table 12.3-12—{Projected Construction Worker Occupancy by Zone}

Zone Description	Zone Code	Occupancy Fraction
Batch Plant	B	0.001
Construction on Main Structures	C	0.665
Laydown	L	0.020
Office/Trailer	O	0.160
Parking	P	0.020
Roads	R	0.020
Shoreline, Tunnel, Barge, In/Out Flow	S	0.066
Tower/Basin/Desalinization	T	0.066
Warehouse	W	0.003
	Total	1.021

Note: Total of occupancy fractions is greater than 1 because the "Laydown" zone fraction was conservatively increased to match the occupancy fraction for parking and roads.

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Table 12.3-13—{Projected Collective Dose for Construction Worker by Zone}

		Collective Dose (person-rem) (person-Sv) by Zone						
Zone	**Zone Description**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**By Zone**
B	Batch Plant	0.000/ 0.00000	0.000/ 0.00000	0.001/ 0.00001	0.001/ 0.00001	0.001/ 0.00001	0.000/ 0.00000	**0.002/ 0.00002**
C	Construction on Main Structures	0.165/ 0.00165	0.749/ 0.00749	1.384/ 0.01384	1.454/ 0.01454	1.524/ 0.01524	1.281/ 0.01281	**6.556/ 0.06556**
L	Laydown	0.024/ 0.00024	0.103/ 0.00103	0.185/ 0.00185	0.188/ 0.00188	0.191/ 0.00191	0.156/ 0.00156	**0.847/ 0.00847**
O	Office/Trailer	0.008/ 0.00008	0.035/ 0.00035	0.061/ 0.00061	0.062/ 0.00062	0.062/ 0.00062	0.050/ 0.00050	**0.279/ 0.00279**
P	Parking	0.083/ 0.00083	0.385/ 0.00385	0.724/ 0.00724	0.773/ 0.00773	0.822/ 0.00822	0.701/ 0.00701	**3.488/ 0.03488**
R	Roads	0.133/ 0.00133	0.602/ 0.00602	1.107/ 0.01107	1.157/ 0.01157	1.208/ 0.01208	1.012/ 0.01012	**5.219/ 0.05219**
S	Shoreline, Tunnel, barge, In/Out Flow	0.021/ 0.00021	0.092/ 0.00092	0.162/ 0.00162	0.162/ 0.00162	0.162/ 0.00162	0.130/ 0.00130	**0.731/ 0.00731**
T	Tower/Basin/ Desalinization	0.002/ 0.00002	0.008/ 0.00008	0.014/ 0.00014	0.014/ 0.00014	0.014/ 0.00014	0.0011/ 0.00011	**0.063/ 0.00063**
W	Warehouse	0.000/ 0.00000	0.001/ 0.00001	0.001/ 0.00001	0.001/ 0.00001	0.001/ 0.00001	0.001/ 0.00001	**0.005/ 0.00005**
	By Year	**0.437/ 0.00437**	**1.976/ 0.01976**	**3.638/ 0.03638**	**3.812/ 0.03812**	**3.985/ 0.03985**	**3.343/ 0.03343**	**17.190/ 0.17190**

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Figure 12.3-1—{Site Layout of CCNPP Units 1, 2, and 3}

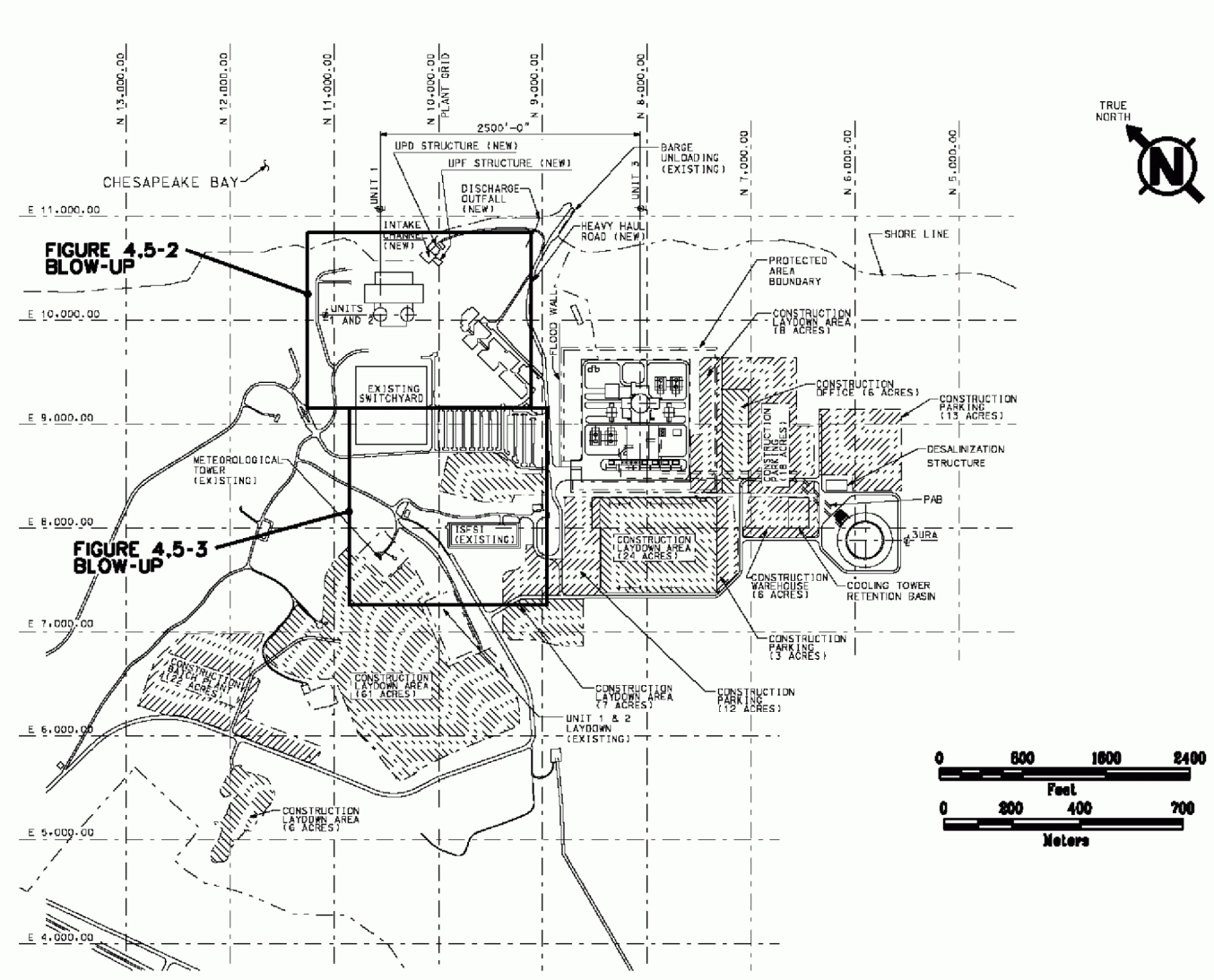

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Figure 12.3-2—{Sources on CCNPP Units 1 and 2 (Part 1 and 2)}

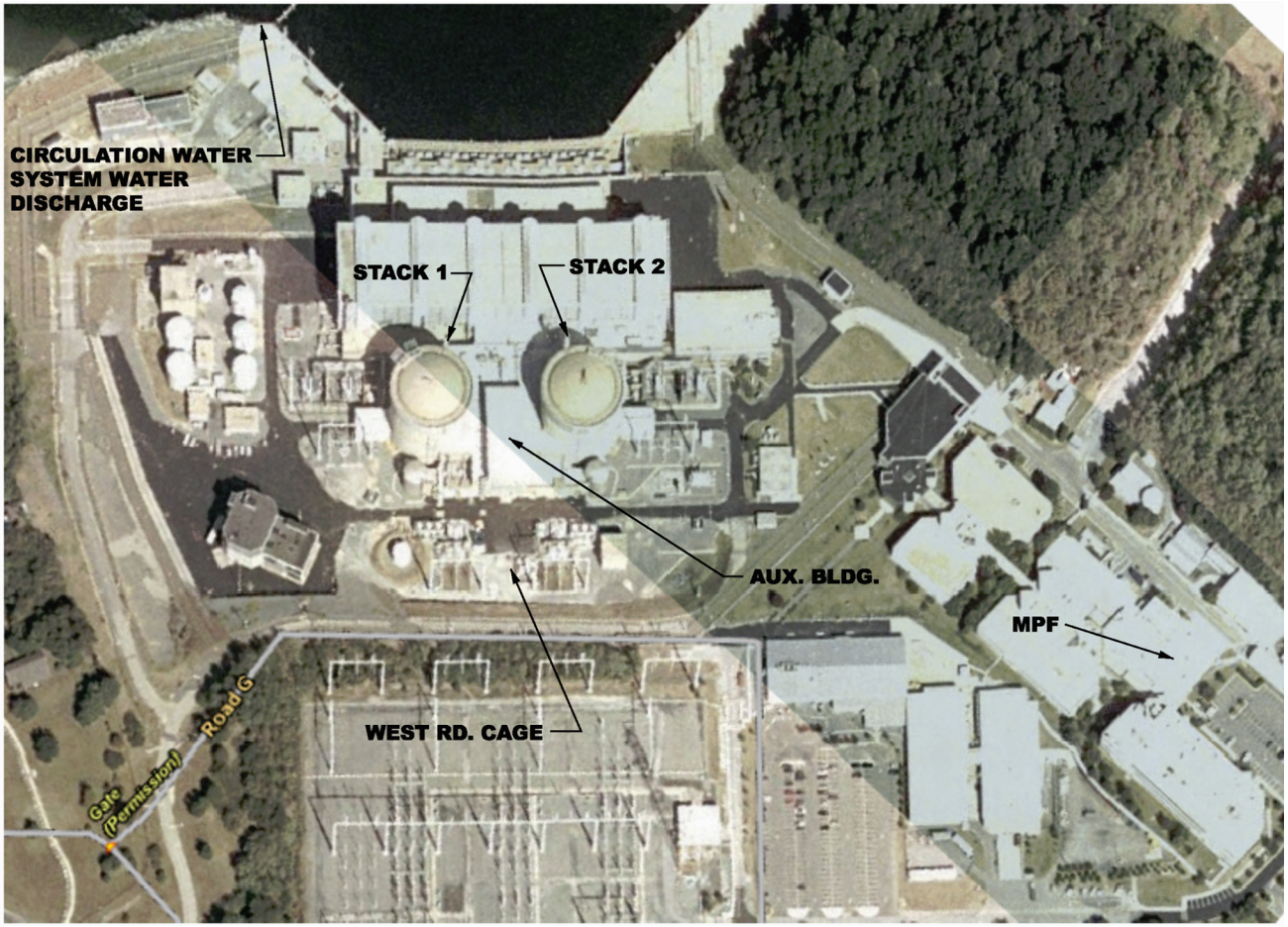

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Figure 12.3-3—{Sources on CCNPP Units 1 and 2 (Part 2 of 2)}

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Figure 12.3-4—{Historical ISFSI 2005 TLD Doses Versus Distance}

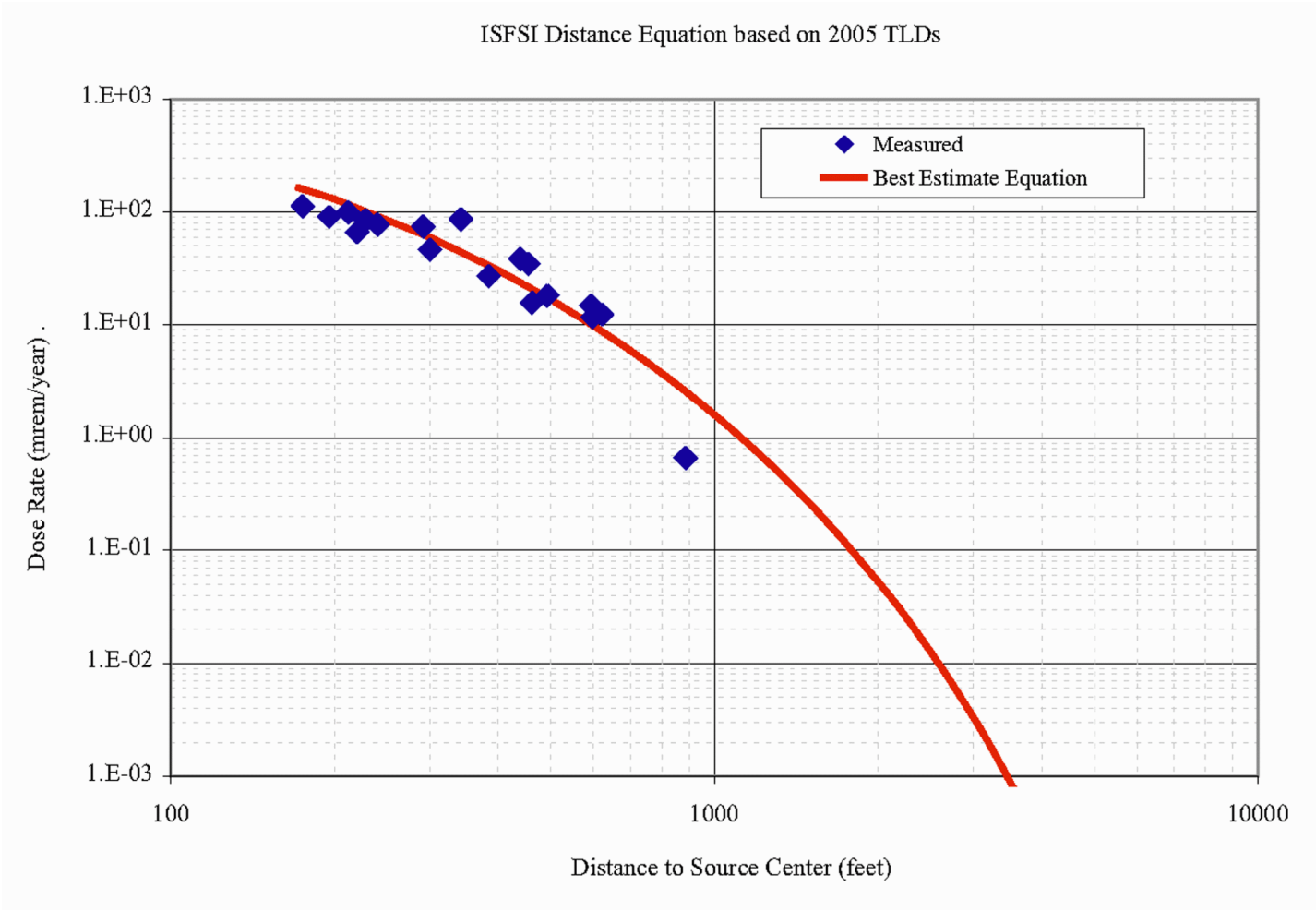

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Figure 12.3-5—{Resin Area and ISFSI Historical TLD Readings}

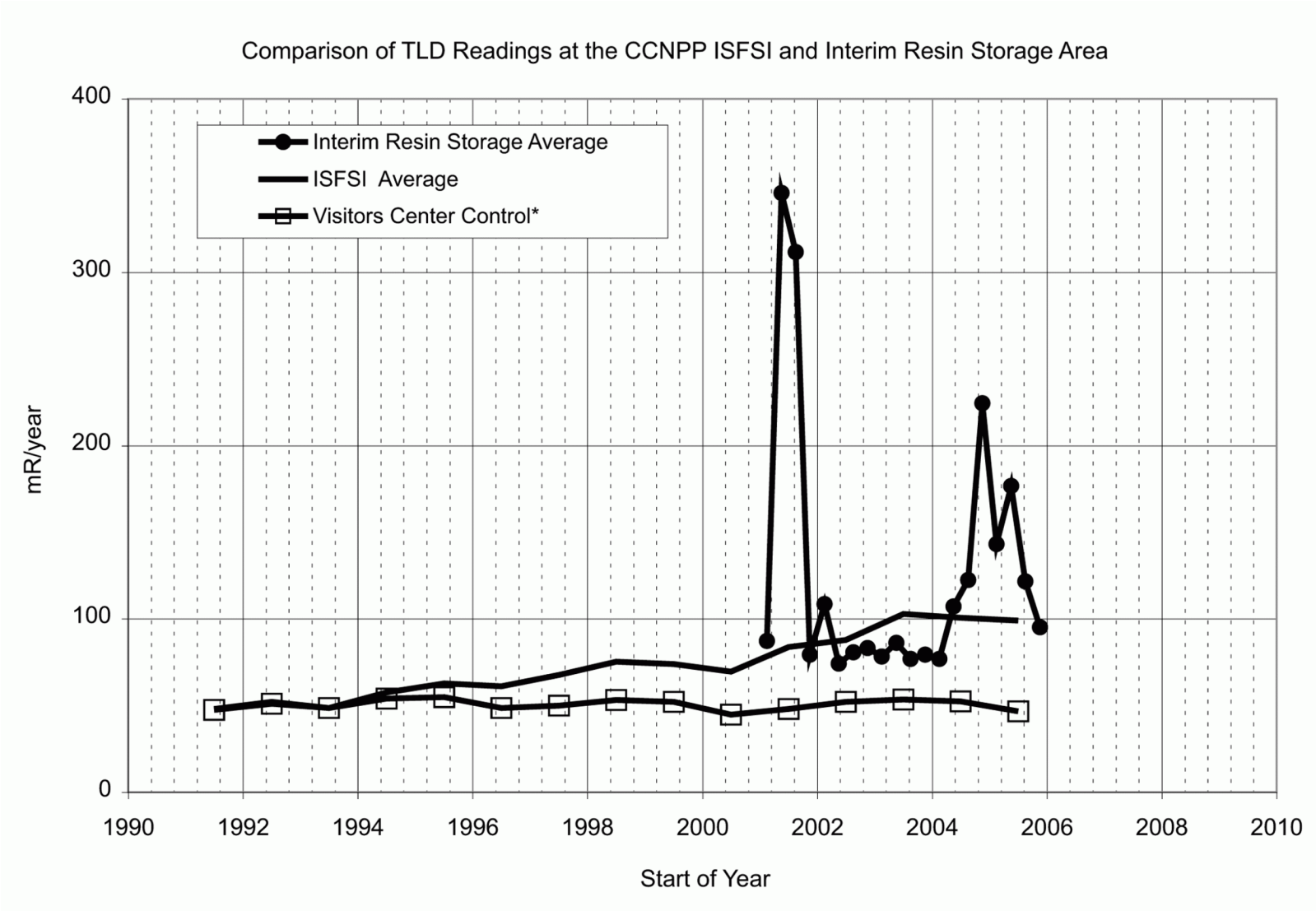

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Figure 12.3-6—{Resin Area Dose Rate for 2005}

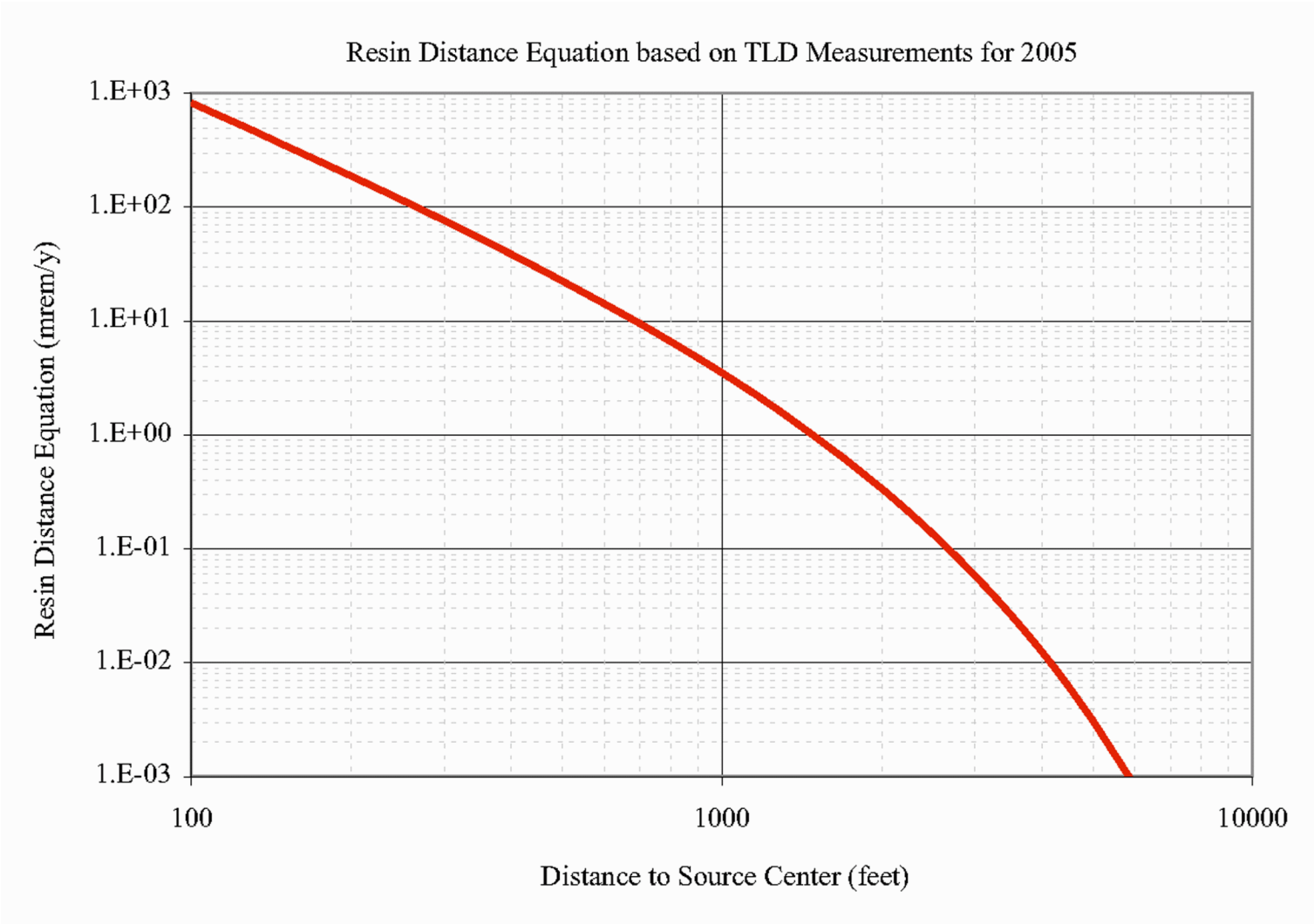

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Figure 12.3-7—{Dose Rate Estimated in 2015}

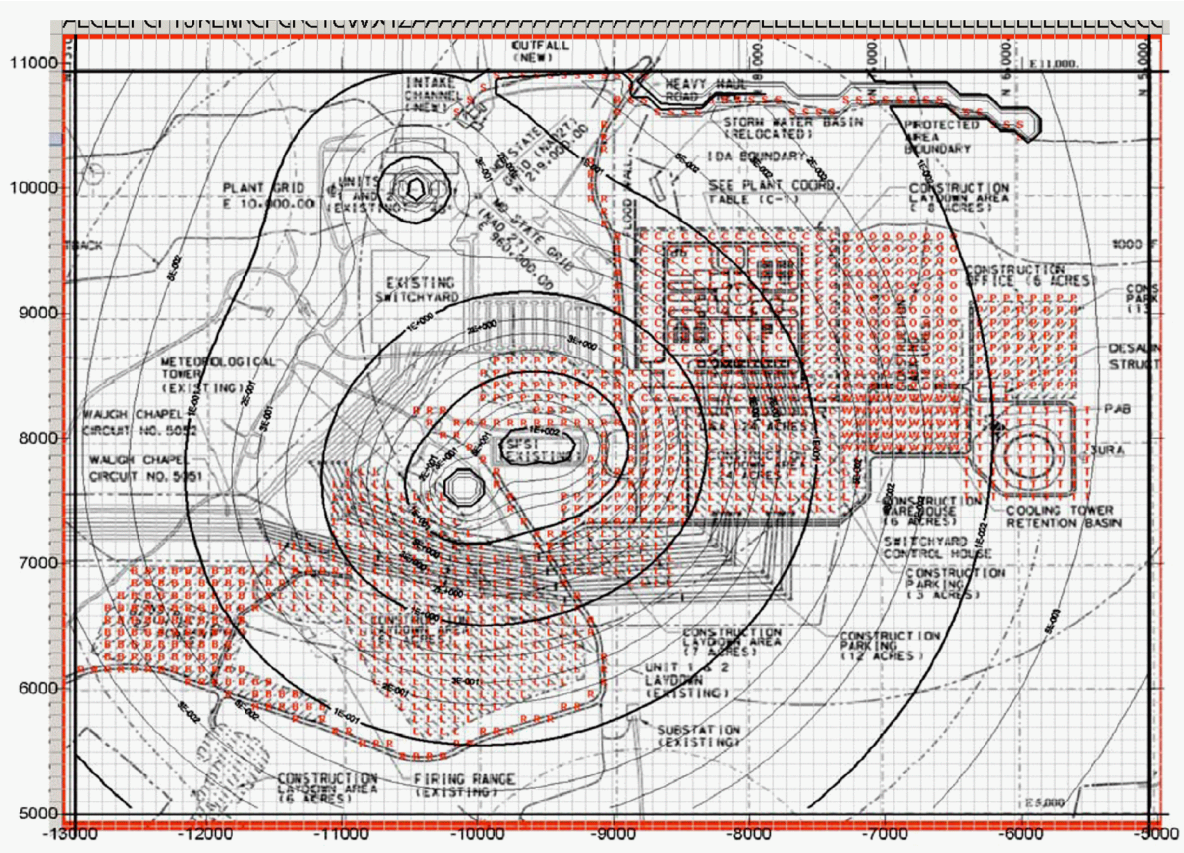

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Figure 12.3-8—{Bounding Annual Average X/Q in CCNPP Unit 3 Direction}

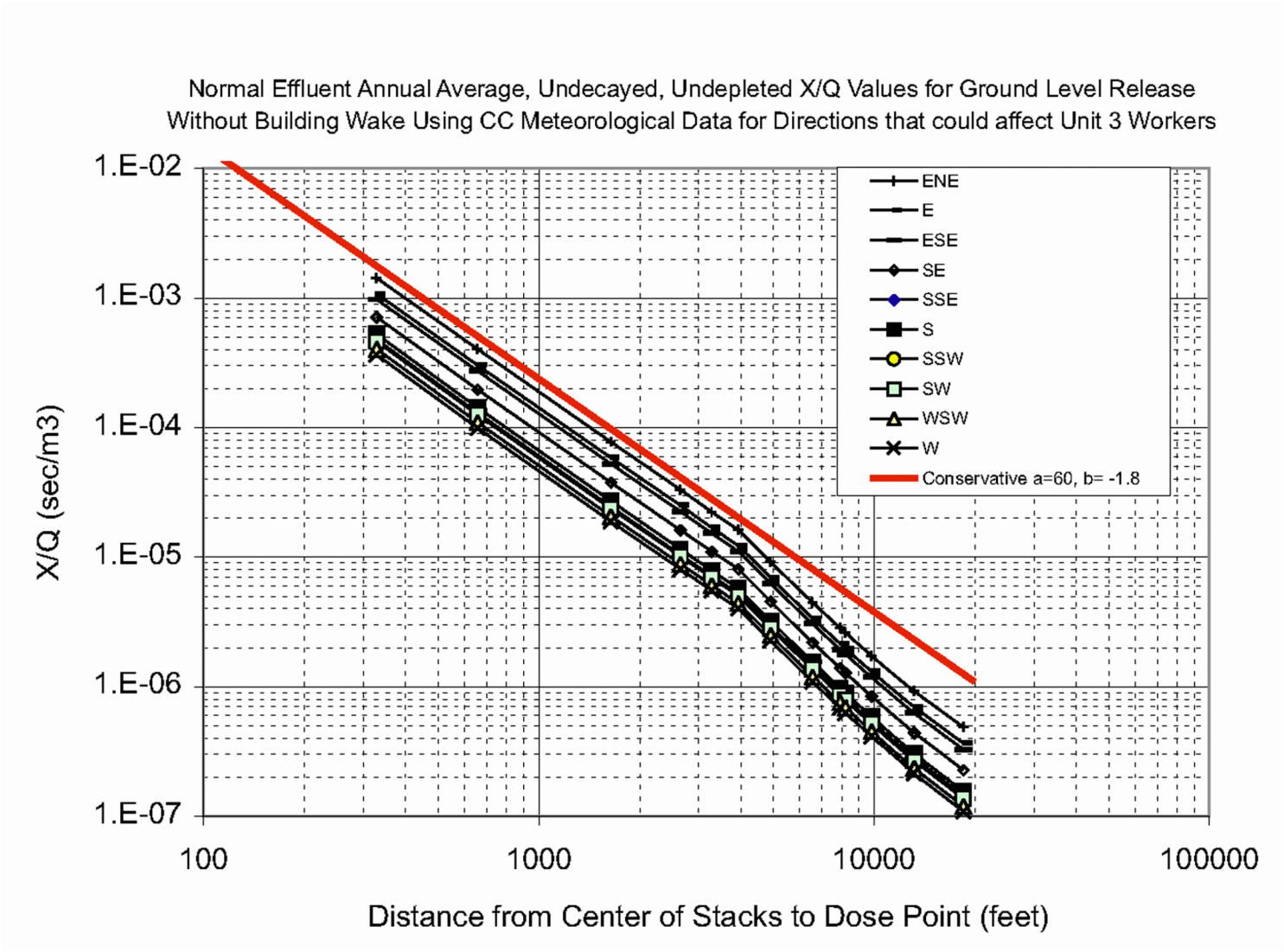

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Figure 12.3-9—{SFSI TLD Locations}

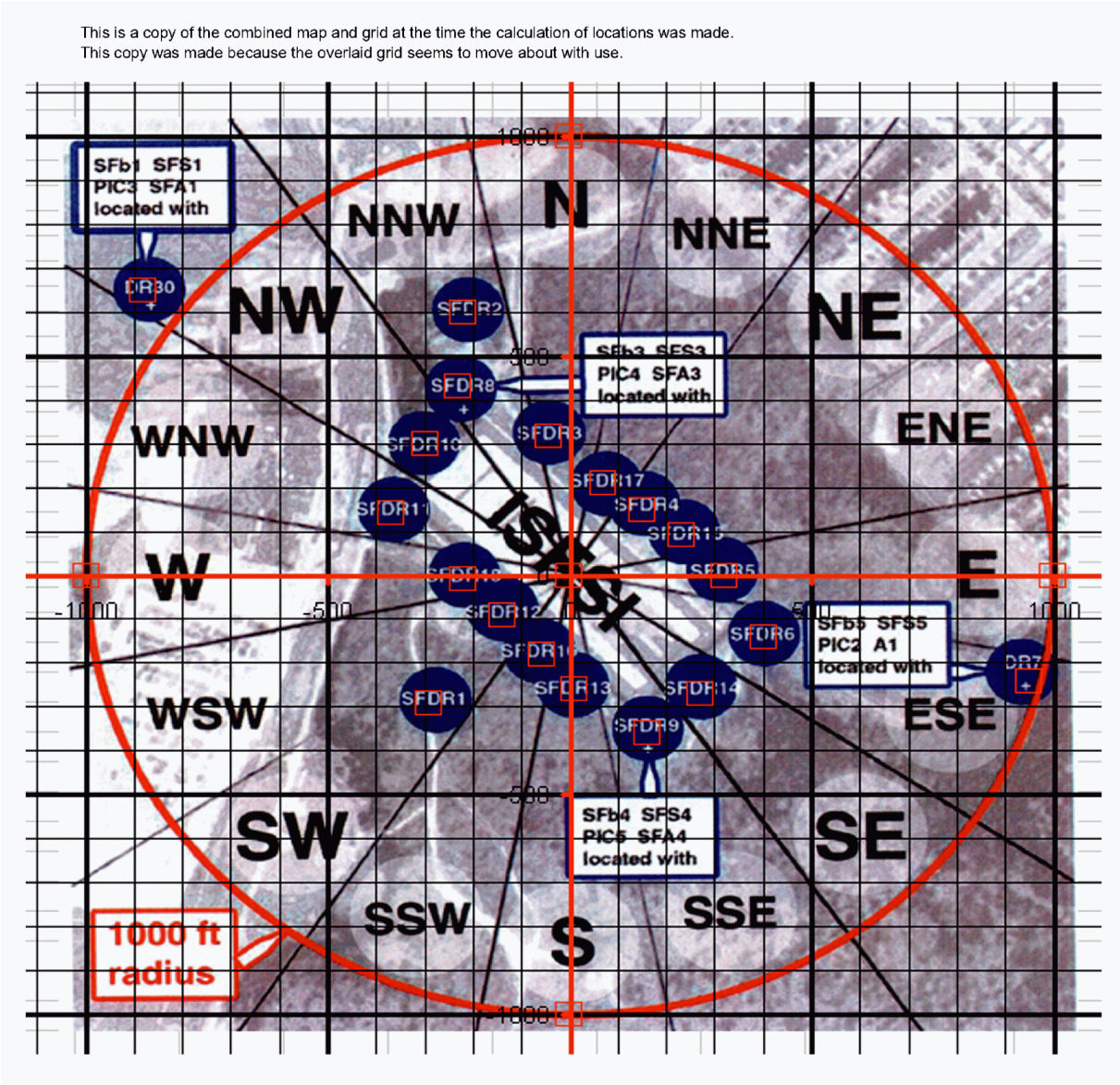

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Figure 12.3-10—{Annual Gamma Net ISFSI Dose Rate}

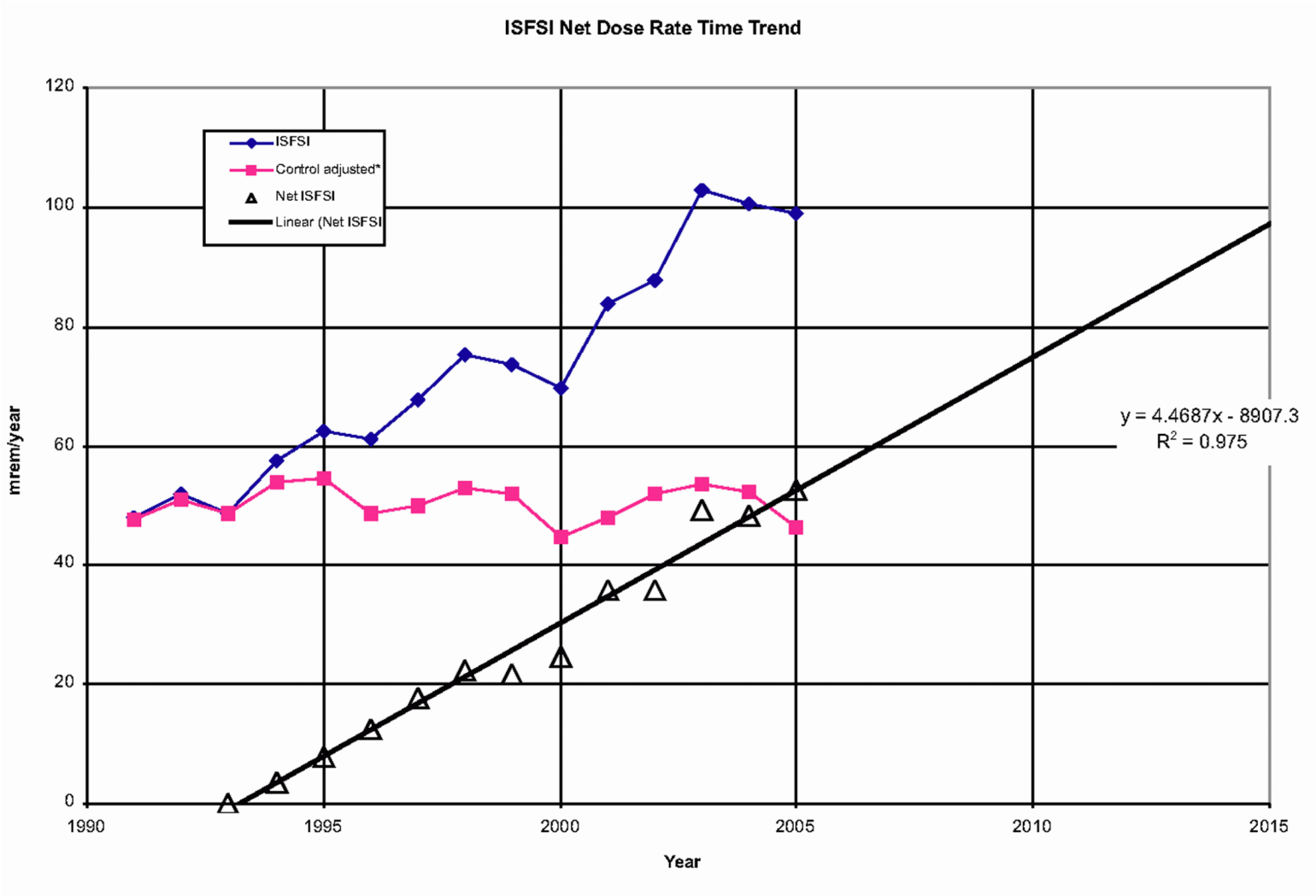

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Figure 12.3-11—{Resin Area TLD Locations}

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12.4 DOSE ASSESSMENT

This section of the U.S. EPR FSAR is incorporated by reference.

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12.5 OPERATIONAL RADIATION PROTECTION PROGRAM

This section of the U.S. EPR FSAR is incorporated by reference with the following supplements.

The U.S. EPR FSAR includes the following COL Item in Section 12.5:

> A COL applicant that references the U.S. EPR design certification will fully describe, at the functional level, elements of the Radiation Protection Program. The purpose of this Radiation Protection Program is to maintain occupational and public doses ALARA. The program description will identify how the program is developed, documented, and implemented through plant procedures that address quality requirements commensurate with the scope and extent of licensed activities. This program will comply with the provisions of 10 CFR Parts 19, 20, 50, 52, and 72 and be consistent with the guidance in RGs 1.8, 8.2, 8.4, 8.5, 8.6, 8.8, 8.9, 8.10, 8.13, 8.15, 8.20, 8.26, 8.27, 8.28, 8.29, 8.32, 8.34, 8.35, 8.36, 8.38, and the consolidated guidance in NUREG-1736.

This COL Item is addressed as follows:

This section incorporates by reference NEI 07-03, "Generic FSAR Template Guidance for Radiation Protection Description" (NEI, 2007).

12.5.1 REFERENCES

{**NEI, 2007**. Generic FSAR Template Guidance for Radiation Protection Program Description, NEI 07-03, Revision 3, Nuclear Energy Institute, October 2007.}

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