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October 14, 2010

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

**BELL BEND NUCLEAR POWER PLANT
BBNPP PLOT PLAN CHANGE COLA
SUPPLEMENT: PART 2 (FSAR) SECTION 12.3.5
BNP-2010-259 Docket No. 52-039**

- References: 1) BNP-2010-175, T. L. Harpster (PPL Bell Bend, LLC) to U.S. NRC, "July 2010 BBNPP Schedule Update," dated July 16, 2010
- 2) BNP-2010-155, R. R. Sgarro (PPL Bell Bend, LLC) to U.S. NRC, "Submittal of BBNPP RAI Schedule Information," dated August 4, 2010
- 3) BNP-2010-246, R. R. Sgarro (PPL Bell Bend, LLC) to U.S. NRC, "BBNPP Plot Plan Change Supplement Schedule Update," dated September 28, 2010

In References 1 and 2, PPL Bell Bend, LLC (PPL) provided the NRC with schedule information related to the intended revision of the Bell Bend Nuclear Power Plant (BBNPP) footprint within the existing project boundary which has been characterized as the Plot Plan Change (PPC). As the NRC staff is aware, the plant footprint relocation will result in changes to the Combined License Application (COLA) and potentially to new and previously responded to Requests for Additional Information (RAIs). PPL declassified this docketed schedule information from regulatory commitment status in Reference 3, with an agreement to update the staff via weekly teleconferences as the project moves forward.

PPL has committed to provide the NRC with COLA supplements, consisting of revised COLA Sections and associated RAI responses/revisions, as they are developed. These COLA supplements will only include the changes related to that particular section of the COLA and will not include all conforming COLA changes. Conforming changes for each supplement necessary for other COLA sections will be integrated into the respective COLA supplements and provided in accordance with the schedule, unless the supplement has already been submitted. In the latter case, the COLA will be updated through the normal internal change process. The revised COLA supplements will also include all other approved changes since the submittal of Revision 2. All COLA supplements and other approved changes will ultimately be incorporated into the next full COLA revision.

The enclosure provides the revised BBNPP COLA Supplement, Part 2 (Final Safety Analysis Report), Section 12.3.5, Revision 2a. The revised BBNPP COLA section supersedes previously submitted information in its entirety. No departures and/or exemptions to this BBNPP COLA section have been revised as a result of the PPC.

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Previously submitted NRC RAI responses which refer directly to the enclosed COLA section were also reviewed for impact from the PPC. The following previously submitted RAI responses were reviewed for impacts:

<u>RAI No.</u>	<u>Response Impacted? (Yes/No)</u>
12.03-12.04-1	No
12.03-12.04-2	No
12.03-12.04-3	No

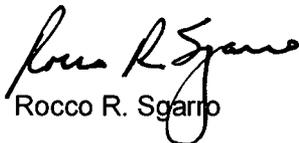
The only new regulatory commitments are to include the revised COLA sections (Enclosure) in the next COLA revision.

If you have any questions, please contact the undersigned at 570.802.8102.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on October 14, 2010

Respectfully,



Rocco R. Sgarro

RRS/kw

Enclosure: Revised BBNPP COLA Part 2 (FSAR); Section 12.3.5, Revision 2a

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Enclosure

Revised BBNPP COLA Part 2 (FSAR), Section 12.3.5, Revision 2a

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 onsite 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.

This COL Item is addressed as follows:

{This section discusses the exposure of construction workers building Bell Bend Nuclear Power Plant (BBNPP).

12.3.5.1.1 Site Layout

The physical location of BBNPP relative to the existing ~~SESSSES~~ Units 1 and 2 is presented in Figure 12.3-1. BBNPP will be located approximately 5000 ft (1524 m) west of SSES. BBNPP and SSES will have separate protected areas (See ER Section 3.1).

12.3.5.1.2 Radiation Sources at SSES Units 1 and 2

During the construction of BBNPP, the construction workers will be exposed to radiation sources from the routine operation of SSES Units 1 and 2. Sources that have the potential to expose construction workers are listed in Table 12.3-1. They are characterized as to location, inventory, shielding, and typical local dose rates. They are also characterized in terms of potential to expose BBNPP construction workers. Only those with significant potential are analyzed in detail. 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~~), (ODCM) (SSES, 2007a), the annual Radiological Effluent Release Report, Report (SSES, 2007b), the Radiological Environmental Operating Report, Report (SSES, 2007c), and the Final Safety Analysis Report, Report (SSES, 2006). The eight main sources of radiation to BBNPP construction workers are gaseous effluents, liquid effluents, the Independent Spent Fuel Storage Installation (ISFSI), the Condensate Storage Tanks (CSTs), the Low Level Radioactive Waste handling Facility (LLRWHRF), the SEALANDS, the Steam Dryer Storage Vault, and the Turbine Building. These are discussed below.

Airborne effluents are ~~released~~ released via four rooftop vents: ~~two on the reactor building and two on the turbine building~~. The releases are reported annually to the NRC. 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 Susquehanna River. All waterborne effluents are released in batch mode and are sampled and analyzed prior to release. Waterborne effluents from the site are released into the cooling tower blowdown line for dilution prior to release in the Susquehanna River. River (SSES, 2006).

There are five sources of direct radiation that could contribute to construction workers dose: the Independent Spent Fuel Storage ~~Facility~~ Installation (ISFSI), the Low Level Radioactive Waste Handling Facility (LLRWHRF), SEALAND containers, the Steam Dryer Storage Vault, and the Turbine Building. There are three sources identified that are not significant contributors to construction worker dose. These are listed in Table 12.3-1 along with a brief ~~discussion~~ discussion (SSES, 2006).

There are five sources of skyshine radiation that could contribute to construction workers dose: the Condensate Storage Tanks (CSTs), the Low Level Radioactive Waste Handling Facility (LLRWHRF), SEALAND containers, the Steam Dryer Storage Vault, and the Turbine Building. They are also listed in Table 12.3-1.

12.3.5.1.3 Historical Dose Rates

The historical annual dose rates reported to the NRC are summarized in Table 12.3-2.

12.3.5.1.4 Construction Worker Dose Estimates

Annual doses from all sources combined were calculated for each ~~40499~~ 32 (30 m) by 97 ft (30 m) foot square on the plant grid. For purposes of dose calculation, a 100% occupancy is

assumed. (For purposes of collective dose calculations, the occupancy for construction workers is 2,200 hours per year.) The annual doses are the sum of the dose rates from the eight main sources; gaseous effluents, liquid effluents, the independent Spent Fuel Storage Facility (ISFSI) Installation (ISFSI), the Condensate Storage Tanks (CSTs), the Low Level Radioactive Waste handling Facility (LLRWHF), SEALAND containers, the Steam Dryer Storage Vault, and the Turbine Building. The annual doses are shown in Figure 12.3-4 for the year 2017, 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.

The collective dose is the sum of all doses received by all workers. It is a measure of population risk. The number of workers (in terms of Full Time Equivalents) and their location by zone are given in Table 12.3-3. The zone locations are shown by squares in Figure 12.3-5. Figure 12.3-4. The details of the collective dose calculations are given in the following discussion. Dose rates from all sources combined were calculated for each square on the plant grid. The dose rates were the sum of the dose rate from the eight main sources and assume 100% occupancy.

The equation for dose rate during year t at location x,y on the plant grid is:

$$\dot{D}_{x,y} = \dot{D}_{\text{gas}} + \dot{D}_{\text{liq}} + \dot{D}_{\text{ISFSI},t} + \dot{D}_{\text{CST}} + \dot{D}_{\text{LLRWHF}} + \dot{D}_{\text{SEA}} + \dot{D}_{\text{SD}} + \dot{D}_{\text{TB}}$$

where the terms are explained in the ER subsections.

The equation for the average dose rate in a zone is:

$$\dot{D}_z = \frac{1}{N_z} \sum_{z(\text{all } x,y \text{ in } z)} \dot{D}_{x,y}$$

where N_z is the number of squares in the zone.

The equation for collective dose for the construction period is:

$$D = \frac{2200}{8760} \sum_t \sum_z \dot{D}_z \text{FTE}_{z,t}$$

where $\frac{2200}{8760}$ = fraction of work hours per year, \dot{D}_z is defined as above, and $\text{FTE}_{z,t}$ is the full time equivalent in zone z during year t, or

$$\text{FTE}_{z,t} = P_z C_t$$

The probability of a worker in each zone, P_z , reflects the average construction worker and is based on an approximation of how much time the average worker spends in each zone. The probability of a worker in each zone, P_z , results the average construction worker and is based on a rough idea of how much time the average worker spends in each zone, as shown in Table 12.3-13. The spatial distribution of zones on the site is shown (gold/red letters indicating

a zone code in each square) in Figure 12.3-4. There are many locations where construction workers are not expected to perform work activities, so they are not marked in the figure. These squares that are marked are chosen because of planned activities at those locations.

12.3.5.1.5 Gaseous Dose Rates

The construction worker dose due to SSES gaseous effluents depends upon the airborne effluents release and the atmospheric transport to the worker. The releases, which flow out of the SSES Units 1 and 2 plant vents, are reported annually to the NRC. Doses to the general population are also reported annually. The releases are modeled as ground level releases, which is conservative as it does not take credit for the height of the releases. Although there are two reactor building and two turbine building vents, the Radioactive Effluent Release Reports (e.g., SSES, 2007b) only give a total release. The releases were conservatively modeled assuming the vent ~~closest~~ closest to the workers.

The annual dose rate from gaseous effluents to construction workers on the BBNPP site is bounded by the following equation:

$$\dot{D}_{(j), \text{ gas}} = c_{(j)} r^b \quad (\text{mrem/year})$$

where,

$c_{(j)}$ = dose type coefficient,

j = dose type (TEDE, total body, organ, or thyroid),

r = distance from the release point to the target = from the release point to the target in feet =

$$\sqrt{(N - N_s)^2 - (E - E_s)^2}$$

N, E = location of receptor on plant grid in feet,

N_s, E_s = location of source on plant grid in feet, and

b = fitting parameter for atmospheric dispersion model = -1.6925.

The $c_{(j)}$ are documented in Table 12.3-4. The equation is based on annual average, undecayed, undepleted ground level χ/Q_s without credit for building wake from Susquehanna Steam Electric Station site meteorology for the years 2001 to 2006 2007 (See ER Table ~~2.7-157~~ 2.7-158) which are modeled as

$$\frac{\chi}{Q}(r) = 38.603r^{-1.6925}$$

where r is defined as above. The equation also assumes the most limiting gaseous effluent releases from the period 2001 to 2006. The model is based upon 100% occupancy.

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 Total Effective Dose Equivalent (TEDE) calculations according to Federal Guidance Reports 11 (EPA, 1988) and 12 (EPA, 1993). The gaseous releases are shown in Table 12.3-5. The 2006 releases gave the highest dose rates.

12.3.5.1.6 Liquid Dose Rates

The projected dose at the shoreline to a construction worker with a 2200 hours/year occupancy rate is 0.407 mrem/yr; for a person with a full-time occupancy (8760 hr/yr) the dose rate is 1.62 mrem/yr. This is based on releases and dilutions in Table 12.3-6 and Table 12.3-7. Table 12.3-8 lists the dose contributions by year.

12.3.5.1.7 ISFSI Dose Rates

For the purposes of this calculation the ISFSI is broken into north and south pieces. The north piece is assumed filled in 2010. Loading of the south piece is assumed to begin in 2009. The dose rate from the ISFSI is:

$$D_{ISFSI,t} = k[f_N(t)\omega_N e^{-\mu r_N} + f_S(t)\omega_S e^{-\mu r_S}]$$

where, D = annual dose,

ω_i = the solid angle between the ISFSI and receptor in steradians =

$$\pi \left(1 - \frac{r_i}{\sqrt{R^2 + r_i^2}} \right)$$

k = fitting parameter = 1500 ft,mrem/sr,

$f_i(t)$ = function describing loading with time dependence = $a_i + b_i t$,

μ = effective removal coefficient in air in ft^{-1} = 0.002056 ft^{-1} ,

r_i = distance from ISFSI piece i to receptor in ft =

$$\sqrt{(N - N_i)^2 + (E - E_i)^2}$$

t = time in years (i.e., 2007),

a_i = fitting parameter.

$$a_N = -233.88$$

$$a_S = -253.79$$

b_i = fitting parameter,

$$b_N = 0.177 \text{ yr}^{-1}$$

$$b_S = 0.126 \text{ yr}^{-1}$$

R = effective source radius = 116.52 ft, and

N_i, E_i = State plane coordinates of source and receptor

$$N_N = 341550 \text{ ft}$$

$$N_S = 341450 \text{ ft}$$

$$E_N = E_S = 2,440,600 \text{ ft.}$$

The equation is based upon TLD measurements in the vicinity of the ISFSI combined with historic loading data and a projected loading schedule. The incremental loading of the ISFSI is modeled as a linear function.

Figure 12.3-6 shows the effect of distance on dose and compares this to TLD measurements. Figure 12.3-7 shows a satellite image of the ISFSI, Figure 12.3-8 shows the locations of the TLDs. The effect of time on dose is shown in Figure 12.3-9. And the basic input data to the time equation (the load history and projections) are shown in Table 12.3-9.

12.3.5.1.8 Condensate Storage Tank Dose Rate

The Unit 1 Condensate Storage Tank (CST) is shielded on the west side by the Unit 1 Turbine Building, on the east by the Diesel Generator Building wall, on the north by the Refueling Water Storage Tank, and on the south by the Unit 1 Reactor Building (see Figure 12.3-2 and Figure 12.3-3). The Unit 2 CST is shielded on the west by the Unit 2 Turbine Building and on the north by the Unit 2 reactor Building. It is partially shielded on the east and south by an overflow berm which extends 10.5 ft (3.2 m) above grade, which means that 21.5 ft (6.6 m) is exposed above the berm height. When a line is projected from the top of the Unit 2 CST over the berm wall, it converges with grade 575 ft (175 m) from the CST, which means direct radiation is absorbed by the ground beyond that point. Since construction workers will spend the majority of their time on site west of SSSES and the remaining time further than 575 ft (175 m) east or south of the CSTs, additional analysis for the direct dose from the CSTs is not required. The skyshine dose rate from the Condensate Storage Tank is represented by the equation

$$\dot{D}_{\text{CST}} = 2\text{E-}05e^{-0.0018r}$$

where \dot{D}_{CST} is in mrem/yr (based on 8760 hr/yr occupancy) and r is in ft. This equation is based on the source terms listed in Table 12.3-10 and a source material of water with a density of 62 lb/ft³ (1 g/cm³). The effect of distance on dose is shown in Figure 12.3-10.

12.3.5.1.9 LLRWHF Dose Rate

The Low Level Radioactive Waste Handling Facility (LLRWHF) provides temporary storage for low level radioactive waste materials produced at SSSES. It stores dry active waste, dewatered

waste, and solidified waste. It is also used to temporarily store pieces of contaminated plant equipment and radioactive material. The LLRWHF source term, shown in Table 12.3-11, was conservatively developed based on 10,000 sq ft (283 m²) of storage in containers with a maximum dose rate of 100 μGy/hr (10 mR/hr) at 6.56 ft (2 m), the maximum allowable per 49CFR173.411, (CFR, 2008)2008c). The storage containers are condensate demineralizer radwaste containers in linear storage modules. The facility has a 23 x 2 ~~sq meters module~~ orientation to the east and a 7 x 2 ~~sq meters module~~ orientation to the south. The more conservative 23 x 2 was used in calculating the direct dose to construction workers.

The ~~direct-dose~~ rate from the LLRWHF is

$$D_{LLRWHF} = 15068653r^{-2.3}$$

where D_{LLRWHF} is in mrem/yr (based on 8760 hr/yr occupancy) and r is in ft. The effect of distance on dose is shown in Figure 12.3-11.

12.3.5.1.10 Sealand Container Dose Rate

The area due west of the Unit 2 Cooling Tower was selected as an area to store actual or potentially contaminated material in containers such as SEALAND containers. The area is surrounded by dirt embankments to the west, north, and south. The Unit 2 cooling Tower lies to the east. It is estimated that 80 SEALAND containers can be stored in the area. The ~~direct-dose~~ rate from the SEALAND Containers is

$$D_{SEA} = 5.7055e^{-0.0006r}$$

where D_{SEA} is in mrem/yr (based on 8760 hr/yr occupancy) and r is in ft. The source term used to develop the equation is given in Table 12.3-12. It is based on the restriction that the dose rate on the exterior of each SEALAND container shall not exceed 20 μGy/hr (2 mR/hr). The dirt embankment is assumed to provide 3 ft (0.91 m) of shielding with a density of that for dry packed earth (i.e., 93.6 lb/ft³ (1.5 g/cm³)). The effect of distance on dose is shown in Figure 12.3-12.

12.3.5.1.11 STEAM DRYER STORAGE VAULT DOSE RATE

The original SSES Units 1 and 2 steam dryers, which have been replaced, are stored on site in a concrete storage facility located east of the LLRWHF. Prior to placement in storage, the steam dryers were cut into halves. Each half was placed inside its own steel box with one inch (2.54 cm) thick walls. The ~~direct-dose~~ rate from the steam dryer storage vault is

$$D_{SD} = 14.37e^{-0.003r}$$

where \dot{D}_{SD} is in mrem/yr (based on 8760 hr/yr occupancy) and r is in ft. This is based on 708.3 Ci of Co-60 which is based on surveys performed by SSES. The effect of distance on dose is shown in Figure 12.3-13.

12.3.5.1.12 TURBINE BUILDING DOSE RATE

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. The following equipment components, located on or above the Turbine Building Operating Floor are considered in this analysis:

- ◆ High pressure turbine inlet piping
- ◆ High pressure turbines
- ◆ Moisture separators
- ◆ Low pressure turbines
- ◆ 42 inch cross-around piping from the moisture separators to the CIVs
- ◆ Combined intermediate valves and piping to low pressure turbines

Sources below the operating floor are not considered. Typically, these sources are pipes of smaller volume than the equipment above the Operating Floor, and hence, of smaller N-16 inventory. Their dose rate contributions are bounded by the equipment above the Operating Floor because the floor provides additional shielding to limit their contribution.

The dose rate from the turbine building is

$$\dot{D}_{TB} = 0.8744e^{-0.0009r}$$

where \dot{D}_{TB} is in mrem/yr (based on 8760 hr/yr occupancy) and r is in ft. This was developed using source terms based upon component volume, the density of the source within the volume (i.e., water or steam), and the N-16 concentration listed in Table 12.2-11 of the Susquehanna Steam Electric Station Final Safety Analysis Report, Report (SSES, 2006). The effect of distance on dose for both direct and skyshine sources is shown in Figure 12.3-14.

12.3.5.1.13 Collective Doses to BBNPP 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 ~~6.944E-02~~ 6.18E-02 person-rem (~~6.944E-02~~ 6.18E-02 person-Sieverts). This is a best estimate based upon the worker census and occupancy projections shown in Table 12.3-3, and Table 12.3-13. The breakdown of collective dose by construction year and occupancy zone is given in Table 12.3-15. This assumes 2200 hours per year occupancy for each worker.}

12.3.5.2 Post-Accident Access to Radiological Vital Areas

No departures or supplements.

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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SSES, 2007a. Susquehanna Steam Electric Station Units 1 & 2, Offsite Dose Calculation Manual, ODCM-QA-001, Revision 3, PPL Susquehanna, LLC, November 2007.

SSES, 2007b. Susquehanna Steam Electric Station Units 1 & 2, Radioactive Effluent Release Report, 2006 Annual Report, PPL Susquehanna, LLC, April 2007.

SSES, 2007c. Susquehanna Steam Electric Station Units 1 & 2, Radioactive Environmental Operating Report, 2006 Annual Report, PPL Susquehanna, LLC, April 2007.}

Table 12.3-1— (Radiation Sources at SSES Units 1 and 2)

(Page 1 of 2)

Source	Location on Plant Grid	Radioactive Inventory	Shielding	Dose Rate	Significance to BBNPP Workers
Unit 1 and Unit 2 Reactor Building Vents	U1 N341,185, E2,442,025N 341,175 U2 N341,165, E2,442,025E 2,442,100	Gaseous effluents characterized in RETS	N/A (Airborne)	150 μSv/yr/unit (15 mrem/yr/unit)	The gaseous effluents from reactor building and turbine building vents are contributors to the dose to construction workers.
Unit 1 and Unit 2 Turbine Building Vents	N 341, 175 E 2,441,833	Gaseous effluents characterized in RETS	N/A (Airborne)	150 μSv/yr/unit (15 mrem/yr/unit)	
Liquid Waste Management System	N/A	Liquid Effluents characterized in RETS	N/A (waterborne)	<30 μSv/yr (3 mrem/yr/unit) total body <100 μSv/yr (10 mrem/yr) organ	No impact because BBNPP is a substantial distance (i.e., over 3000 ft) from the body of water into which the SSES liquid effluents are released. Direct source
Refueling Water Storage Tank (RWST)	N341,424, E2,442,000.5	Liquid Waste	Shielded by neighboring buildings	<15 μGy/hr μSv/hr (1.5 mR/hr) contact	No impact because shielded by Turbine building
Condensate Storage Tanks (CSTs)	U1 N341,371, E2,442,007.5 U2 N340,979.0, E2,442,007.5	Liquid Waste	Shielded by neighboring buildings	Turbine Building shields direct dose to construction workers from the CSTs	No impact because Turbine Building shields any dose to construction workers from the CSTs. Direct source
Low Level Radwaste Handling Facility	N341,400. E2,440,500	Temporary storage for low level radioactive waste and radioactive material	Concrete walls	<100 μSv/yr (10 mR/hr) at 6.6 ft (2 m)	Direct source.
Temporary Laundry Facility	Southwest of Unit 2 Turbine Building	Contaminated laundry	Shielded by neighboring buildings	79.4 μGy/hr <79.4 μSv/hr (7.94 mR/hr) at 1 ft (0.305 m) perimeter	No impact.
ISFSI	N341,500 E2,440,600	Spent fuel	Concrete walls	<70 mrem/hr <700 μSv/hr (70 mrem/hr) on surface	Time dependent source.
Turbine shine due to N-16 in the reactor steam	N 341,175 E 2,441,833	N-16	Shielding around each turbine train and a roof slab over each moisture separator	<0.5 mrem/hr <5 μSv/hr (0.5 mrem/hr)	Direct and skyshine source.

Table 12.3-1— (Radiation Sources at SSES Units 1 and 2)
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Source	Location on Plant Grid	Radioactive Inventory	Shielding	Dose Rate	Significance to BBNPP Workers
SEALAND Containers	N340,750, E2,441,050	LSA boxes, barrels, shield blocks, turbine rotor stands, etc.	Shielded by dirt embankment	$< 20 \mu\text{Gy/hr} < 20 \mu\text{Sv/hr}$ (2 mR/hr) at exterior surface	Direct and skyshine source.
Steam Dryers	N341,060.3, E 2,440,653.5	Original steam dryers	Concrete walls	$< 5 \mu\text{Sv/yr}$ (0.5 mrem/hr)	Direct and skyshine source.
Dry Active Waste Reduction System Facility	N341,700 E2,441,900	Equivalent of 30 mCi (1.11E+09 Bq) Co-60 <u>max</u>	None	Negligible	No impact because of low activity
For the purposes of this table and for the purpose of providing dual units, 1 mR/hr is assumed equal to 1 mrem/hr, i.e., 1 mR/hr = 10 $\mu\text{Sv/hr}$.					

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

Maximum Offsite Doses for 40CFR190 Compliance from Gas and Liquid Releases as Reported to the NRC in Annual REMP Reports						
Year	Dose in mrem/year (μSv/yr) from REMP Reports			Dose as Percent of 40CFR190 Limit		
	Thyroid	WB	Limiting Organs	WB	Thyroid	Limiting Organs
2006	5.27E-01 (5.27E+00)	5.27E-01 (5.27E+00)	5.27E-01 (5.27E+00)	2.11E-02	7.03E-03	2.11E-02
2005	8.38E-01 (8.38E+00)	8.38E-01 (8.38E+00)	8.38E-01 (8.38E+00)	3.35E-02	1.12E-02	3.35E-02
2004	1.22E+00 (1.22E+01)	1.22E+00 (1.22E+01)	1.22E+00 (1.22E+01)	4.88E-02	1.63E-02	4.88E-02
2003	1.21E+00 (1.21E+01)	1.21E+00 (1.21E+01)	1.21E+00 (1.21E+01)	4.84E-02	1.61E-02	4.84E-02
2002	1.31E+00 (1.31E+01)	1.31E+00 (1.31E+01)	1.31E+00 (1.31E+01)	5.24E-02	1.75E-02	5.24E-02
2001	2.20E-01 (2.20E+00)	2.20E-01 (2.20E+00)	2.20E-01 (2.20E+00)	8.80E-03	2.93E-03	8.80E-03
2000	1.73E-01 (1.73E+00)	1.73E-01 (1.73E+00)	1.73E-01 (1.73E+00)	6.92E-03	2.31E-03	6.92E-03
1999	9.82E-02 (9.82E-01)	9.82E-02 (9.82E-01)	9.82E-02 (9.82E-01)	3.93E-03	1.31E-03	3.93E-03
1998	1.38E-01 (1.38E+00)	1.38E-01 (1.38E+00)	1.38E-01 (1.38E+00)	5.52E-03	1.84E-03	5.52E-03
1997	1.63E-01 (1.63E+00)	1.63E-01 (1.63E+00)	1.63E-01 (1.63E+00)	6.52E-03	2.17E-03	6.52E-03
1996	5.64E-01 (5.64E+00)	5.64E-01 (5.64E+00)	5.64E-01 (5.64E+00)	2.26E-02	7.52E-03	2.26E-02
1995	2.31E-01 (2.31E+00)	2.31E-01 (2.31E+00)	2.31E-01 (2.31E+00)	9.24E-03	3.08E-03	9.24E-03
1994	1.41E-01 (1.41E+00)	1.41E-01 (1.41E+00)	1.41E-01 (1.41E+00)	5.64E-03	1.88E-03	5.64E-03
Maximum	1.31E+00 (1.31E+01)	1.31E+00 (1.31E+01)	1.31E+00 (1.31E+01)	5.24E-02	1.75E-02	5.24E-02
2002	1.31E+00 (1.31E+01)	1.31E+00 (1.31E+01)	1.31E+00 (1.31E+01)	5.24E-02	1.75E-02	5.24E-02
2001	2.20E-01 (2.20E+00)	2.20E-01 (2.20E+00)	2.20E-01 (2.20E+00)	8.80E-03	2.93E-03	8.80E-03
2000	1.73E-01 (1.73E+00)	1.73E-01 (1.73E+00)	1.73E-01 (1.73E+00)	6.92E-03	2.31E-03	6.92E-03

Table 12.3-3— {FTE for BBNPP Construction Workers}

Zone	2012	2013	2014	2015	2016	2017
B	0.5	2.3	4.0	4.0	4.0	3.2
C	353.1	1516.9	2660.0	2660.0	2660.0	2138.0
L	10.6	45.6	80.0	80.0	80.0	64.3
O	85.0	365.0	640.0	640.0	640.0	514.4
P	10.6	45.6	80.0	80.0	80.0	64.3
R	10.6	45.6	80.0	80.0	80.0	64.3
S	35.0	150.5	264.0	264.0	264.0	212.2
T	35.0	150.5	264.0	264.0	264.0	212.2
W	1.6	6.8	12.0	12.0	12.0	9.6
By Year	542.2	2328.9	4084.0	4084.0	4084.0	3282.5

Table 12.3-4— {Gaseous Dose Rate Type and Coefficients}

Dose Type	Pathway	Methodology	c(j)
TEDE	All	ICRP26	1259244
Total Body	External	ICRP2	692594.5
Skin	External	ICRP2	845547.4
Organ I & P	I & P	ICRP2	721931
Total Body	All	ICRP2	813007.5
Thyroid	All	ICRP2	812811.5
Organ	All	ICRP2	826407

Table 12.3-5— {Historic Gaseous Releases For 2001 Through 2006}

Nuclide	2001 Ci (Bq)	2002 Ci (Bq)	2003 Ci (Bq)	2004 Ci (Bq)	2005 Ci (Bq)	2006 Ci (Bq)
H 3	1.29E+02 (4.77E+12)	1.37E+02 (5.07E+12)	1.56E+02 (5.77E+12)	1.60E+02 (5.92E+12)	8.61E+01 (3.19E+12)	5.87E+01 (2.17E+12)
Ar 41		9.68E+00 (3.58E+11)	3.37E-03 (1.25E+08)	8.07E+00 (2.99E+11)		
Cr 51	6.48E-03 (2.40E+08)	3.31E-03 (1.22E+08)	1.09E-03 (4.03E+07)	2.52E-04 (9.32E+06)	2.22E-04 (8.21E+06)	2.07E-04 (7.66E+06)
Mn 54	5.96E-04 (2.21E+07)	1.21E-03 (4.48E+07)	2.61E-04 (9.66E+06)	2.74E-04 (1.01E+07)	2.33E-04 (8.62E+06)	1.93E-04 (7.14E+06)
Co 57					3.11E-06 (1.15E+05)	
Co 58	4.43E-05 (1.64E+06)	5.62E-05 (2.08E+06)	9.42E-06 (3.49E+05)	9.93E-06 (3.67E+05)	2.43E-05 (8.99E+05)	1.09E-05 (4.03E+05)
Co 60	2.27E-04 (8.40E+06)	1.48E-03 (5.48E+07)	8.83E-05 (3.27E+06)	1.79E-04 (6.62E+06)	2.54E-04 (9.40E+06)	3.82E-04 (1.41E+07)
Fe 59	6.40E-05 (2.37E+06)	2.32E-04 (8.58E+06)			1.69E-05 (6.25E+05)	
Kr 85m			7.68E-04 (2.84E+07)	6.02E-01 (2.23E+10)		
Kr 87			5.44E-03 (2.01E+08)			
Kr 88			3.01E-01 (1.11E+08)	2.48E-01 (9.18E+09)		6.94E-01 (2.57E+10)
Kr 89			6.03E-02 (2.23E+09)			
Sr 90		2.95E-05 (1.09E+06)				
Nb 95	5.39E-06 (1.99E+05)			4.11E-06 (1.52E+05)	6.43E-06 (2.38E05)	
Ag 110m	1.18E-05 (4.37E+05)	2.32E-06 (8.58E+04)				
I 131					9.71E-06 (3.59E+05)	1.41E+05 1.41E-05 (5.22E+05)
I 133					1.28E-05 (4.74E+05)	
Xe 133			2.36E+04 (8.73E+06)	6.04E-01 (2.23E+10)		
Xe 133m	1.27E-01 (4.70E+09)					
Xe 135	6.65E+00 (2.46E+11)		2.84E-03 (1.05E+08)			4.13E-02 (1.53E+09)
Xe 135m			1.52E-02 (5.62E+08)			
Xe 137			1.52E-01 (5.62E+09)			
Xe 138			6.73E-02 (2.49E+09)			
Cs 137		3.23E-06 (1.20E+05)				
Ce 141	1.76E-06 (6.51E+04)					
Ce 144	6.97E-06 (2.58E+05)				1.48E-05 (5.48E+05)	
Ba-La 140					8.73E-06 (3.23E+05)	
As 76	6.26E-03 (2.32E+08)	1.86E-03 (6.88E+07)				
Na 24	2.52E-04 (9.32E+06)	8.08E-05 (2.99E+06)				
Tc 99m	1.05E-03 (3.89E+07)	1.78E-04 (6.59E+06)				

Table 12.3-6— (Historical Liquid Releases for Input to LADTAPII)

Isotope	2001 Ci (Bq)	2002 Ci (Bq)	2003 Ci (Bq)	2004 Ci (Bq)	2005 Ci (Bq)	2006 Ci (Bq)
Co-58	4.28E-04 (1.58E+07)	2.92E-04 (1.08E+07)	3.426E-04 (1.26E+07)	2.03E-04 (7.51E+06)	5.33E-05 (1.97E+06)	3.25E-05 (1.20E+06)
Co-60	3.90E-03 (1.44E+08)	3.27E-03 (1.21E+08)	5.14E-03 (1.90E+08)	1.32E-03 (4.88E+07)	9.01E-04 (3.33E+07)	2.67E-04 (9.89E+06)
Co-58	4.28E-04 (1.58E+07)	2.92E-04 (1.08E+07)	3.426E-04 (1.26E+07)	2.03E-04 (7.51E+06)	5.33E-05 (1.97E+06)	3.25E-05 (1.20E+06)
Co-60	3.90E-03 (1.44E+08)	3.27E-03 (1.21E+08)	5.14E-03 (1.90E+08)	1.32E-03 (4.88E+07)	9.01E-04 (3.33E+07)	2.67E-04 (9.89E+06)
Cr 51	1.25E-02 (4.61E+08)	1.15E-02 (4.27E+08)	8.16E-03 (3.02E+08)	2.67E-03 (9.86E+07)	8.43E-04 (3.12E+07)	7.08E-04 (2.62E+07)
Cs 137				6.57E-07 (2.43E+04)		4.45E-05 (1.64E+06)
F 18	1.82E-07 (6.72E+03)			1.96E-07 (7.25E+03)		
Fe 55	3.89E-03 (1.44E+08)	6.45E-03 (2.39E+08)	9.07E-03 (3.36E+08)	1.95E-02 (7.22E+08)		
Fe 59	3.03E-05 (1.12E+06)	6.12E-04 (2.26E+07)	1.29E-04 (4.77E+06)	4.90E-05 (1.81E+06)	4.63E-06 (1.71E+05)	1.24E-05 (4.58E+05)
H 3	2.44E+01 (9.04E+11)	6.61E+01 (2.45E+12)	7.75E+01 (2.87E+12)	6.21E+01 (2.30E+12)	7.40E+01 (2.47E+12)	8.29E+01 (3.30E+12)
I 33					2.45E-07 (9.07E+03)	
Mn 54	3.44E-03 (1.27E+08)	7.68E-03 (2.84E+08)	5.34E-03 (1.98E+08)	1.29E-03 (4.77E+07)	2.95E-04 (1.09E+07)	1.40E-04 (5.17E+06)
Na 24	2.48E-06 (9.18E+04)					
Nb 95			6.81E-07 (2.52E+04)	2.66E-06 (9.84E+04)		
P 32	1.18E-05 (4.36E+05)	3.06E-05 (1.13E+06)				
Sb 124	9.07E-07 (3.36E+04)		2.96E-06 (1.10E+05)	9.12E-07 (3.37E+04)	3.32E-06 (1.23E+05)	1.22E-05 (4.51E+05)
Tc 99m						1.17E-06 (4.33E+04)
Zn 65	1.20E-04 (4.42E+06)	4.28E-06 (1.58E+05)	4.63E-05 (1.71E+05)	3.61E-06 (1.34E+05)	1.88E-04 (6.96E+06)	9.77E-05 (3.61E+06)
Xe 133m	1.27E-01 (4.70E+09)					
Xe 135	6.65E+00 (2.46E+11)		2.84E-03 (1.05E+08)			4.13E-02 (1.53E+09)

Table 12.3-7— {Historical Dilutions for Input to LADTAPII}

Year	1 st Quarter L (ft ³)	2 nd Quarter L (ft ³)	3 rd Quarter L (ft ³)	4 th Quarter L (ft ³)	Total L (ft ³)	Release Duration min	Flow Rate L/ min (ft ³ /sec)
2001	6.84E+07 (2.42E+06)	6.39E+07 (2.26E+06)	3.36E+07 (1.19E+06)	2.20E+07 (7.77E+05)	1.88E+08 (6.64E+06)	6.28E+03	2.99E+04 (1.76E+01)
2002	7.70E+07 (2.72E+06)	2.07E+08 (7.31E+06)	1.58E+08 (5.58E+06)	1.33E+08 (4.70E+06)	5.75E+08 (2.03E+07)	1.90E+04	3.03E+04 (1.78E+01)
2003	9.05E+07 (3.20E+06)	6.54E+07 (2.31E+06)	2.13E+08 (7.52E+06)	1.38E+08 (4.87E+06)	5.07E+08 (1.76E+07)	1.49E+04	3.40E+04 (2.00E+01)
2004	1.04E+08 (3.67E+06)	1.54E+08 (5.44E+06)	1.17E+08 (4.13E+06)	2.18E+07 (7.07E+05)	3.97E+08 (1.40E+07)	1.15E+04	3.45E+04 (2.03E+01)
2005	8.91E+07 (3.15E+06)	2.43E+08 (8.58E+06)	1.63E+08 (5.76E+06)	7.86E+07 (2.78E+06)	5.74E+08 (2.03E+07)	1.81E+04	3.17E+04 (1.87E+01)
2006	1.43E+08 (5.05E+06)	1.03E+08 (3.64E+06)	9.69E+07 (3.42E+06)	2.63E+08 (9.29E+06)	6.06E+08 (2.14E+07)	1.88E+04	3.22E+04 (1.90E+01)

Table 12.3-8— {Historical Shoreline Dose}

Year	LADTAPII mrem/yr ($\mu\text{Sv}/\text{yr}$) with 12 hr/yr occupancy	Worker mrem/yr ($\mu\text{Sv}/\text{yr}$) with 2200 hr/yr occupancy	Full mrem/yr ($\mu\text{Sv}/\text{yr}$) with 8760 hr/yr occupancy
2001	1.95E-03 (1.95E-02)	0.358 (3.58)	1.424 (14.24)
2002	1.71E-03 (1.71E-02)	0.314 (3.14)	1.248 (12.48)
2003	2.22E-03 (2.22E-02)	0.407 (4.07)	1.621 (16.21)
2004	5.61E-04 (5.61E-03)	0.103 (1.03)	4.10 (0.410) 0.410 (4.10)
2005	4.04E-04 (4.04E-03)	0.074 (0.74)	0.295 (2.95)
2006	1.31E-04 (1.31E-03)	0.024 (0.24)	0.096 (0.96)

**Table 12.3-9— {Historic and Projected
Loading of SSES ISFSI}**

Year	Bundles Added	# of Bundles Total
1999	208	208
2000	208	416
2001	468	884
2002	416	1300
2003	0	1300
2004	409	1709
2005	244	1953
2006	305	2258
2007	305	2563
2008	427	2990
2009	366	3356
2010	732	4088
2011	0	4088
2012	488	4576
2013	488	5064
2014	0	5064
2015	488	5552
2016	488	6040
2017	122	6162

**Table 12.3-10— {Condensate
Storage Tank Source Terms}**

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Isotope	Curies (Bq)
Br 83	2.75E-02 (1.02E+09)
Br 84	2.42E-02 (8.95E+08)
I 131	3.80E-02 (1.41E+09)
I 132	2.18E-01 (8.07E+09)
I 133	2.39E-01 (8.84E+09)
I 134	2.90E-01 (1.07E+10)
I 135	3.07E-01 (1.14E+10)
Cr 51	5.66E-05 (2.09E+06)
Mc 56	2.97E-03 (1.10E+08)
Co 58	5.67E-04 (2.10E+07)
CO 60	5.68E-05 (2.10E+07)
Sr 89	3.78E-04 (1.40E+07)
Sr 91	9.45E-03 (3.50E+08)
Sr 92	8.54E-03 (3.16E+08)
Mo 99	2.41E-03 (8.92E+07)
Tc 99m	2.35E-02 (8.70E+08)
Te 132	5.40E-03 (2.00E+08)
Cs 138	2.87E-02 (1.06E+09)
Ba 139	2.56E-02 (9.47E+08)
Ba 140	1.12E-03 (4.14E+07)
Ba 141	4.72E-03 (1.75E+08)
Ba 142	1.78E-03 (6.59E+07)
Np 239	2.62E-02 (9.69E+08)
Cs 140	9.75E-03 (3.61E+08)
Y 92	3.44E-03 (1.27E+08)
Cs 139	2.91E-02 (1.08E+09)
Sr 93	7.89E-04 (2.92E+07)
Y 93	1.71E-04 (6.33E+06)
La 141	1.89E-03 (6.99E+07)
Br 85	1.77E-03 (6.55E+07)
Tc 101	1.32E-03 (4.88E+07)
Cs 134	9.08E-05 (3.36E+06)
Cs 136	6.20E-05 (2.29E+06)
Cs 137	1.36E-04 (5.03E+06)
Na 24	1.97E-04 (7.29E+06)
Ni 65	1.77E-05 (6.55E+05)
W 187	3.11E-04 (1.15E+07)
Cs 141	4.44E-04 (1.64E+07)
Sr 94	1.09E-05 (4.03E+05)
Y 94	2.85E-05 (1.05E+06)
Y 95	1.06E-05 (3.92E+05)
Rb 91	1.05E-02 (3.89E+08)
Rb 90	2.03E-02 (7.51E+08)
Rb 89	1.42E-02 (5.25E+08)
Rb 88	2.13E-03 (7.88E+07)
La 142	1.23E-03 (4.55E+07)

**Table 12.3-10— {Condensate
Storage Tank Source Terms}**
(Page 2 of 2)

Isotope	Curies (Bq)
Y 91m	5.11E-03 (1.89E+08)
Y 91	1.46E-05 (5.40E+05)
Sr 90	2.61E-05 (9.66E+05)
La 140	6.12E-05 (2.26E+06)

Table 12.3-11— {LLRWHF Source Term}

i1547057

Isotope	Activity in Ci (Bq)
Ba-137m	2.59E-02 (9.58E+08)
Ba 137m	2.59E-02 (9.58E+08)
Cr 51	3.17E-04 (1.17E+07)
Fe 59	9.49E-04 (3.51E+07)
Mn 54	1.66E-01 (6.14E+09)
Co 58	3.49E-03 (1.29E+08)
Cs 134	9.88E-03 (3.66E+08)
I 129	1.09E-03 (4.03E+07)
Sb 124	2.32E-05 (8.58E+05)
Co 60	1.12E+00 (4.14E+10)
Fe 55	1.40E+00 (5.18E+10)
I 131	8.45E-06 (3.13E+05)
Zn 65	5.67E-02 (2.10E+09)

Table 12.3-12— (SEALAND Container Source Term)

Isotope	Activity in Ci (Bq)
Ba 137m	3.15E-04 (1.17E+07)
Ba 137m	3.15E-04 (1.17E+07)
Co 58	2.95E-03 (1.09E+08)
Co 60	1.51E-01 (5.59E+09)
Cs137	3.33E-04 (1.23E+07)
Fe 55	4.00E+00 (1.48E+11)
Fe 59	5.35E-03 (1.98E+08)
I 129	1.30E-05 (4.81E+05)
Mn 54	2.26E-01 (8.36E+09)
Nb 95	3.10E-04 (1.15E+07)
Ni 59	2.21E-04 (8.18E+06)
Ni 63	1.33E-02 (4.92E+08)
Sb 125	5.62E-04 (2.08E+07)
Sr 89	4.74E-06 (1.75E+05)
Sr 90	2.42E-06 (8.95E+04)
Tc 99	7.07E-06 (2.62E+05)
Y 90	2.42E-06 (8.95E+04)

Table 12.3-13— (Occupancy by Construction Zone)

Zone Description	Zone Code	Conservative Occupancy Fractions Used in Calculation
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 <u>Shoreline, tunnel, barge, in/out flow</u>	S	0.066
Tower/Basin	T	0.066
Warehouse <u>Warehouse/Shops</u>	W	0.003
	TOTAL	1.021

Table 12.3-14 (Collective Dose to BBNPP Construction Workers)

Zone	Collective Dose by Zone person-Sievert (person-rem)						Zone
	2012	2013	2014	2015	2016	2017	
B	4.82E-06 (4.82E-04)	2.07E-05 (2.07E-03)	3.63E-05 (3.63E-03)	3.63E-05 (3.63E-03)	3.64E-05 (3.64E-03)	2.92E-05 (2.92E-03)	1.64E-04 (1.64E-02)
C	9.71E-04 (9.71E-02)	4.17E-03 (4.17E-01)	7.32E-03 (7.32E-01)	7.32E-03 (7.32E-01)	7.32E-03 (7.32E-01)	5.88E-03 (5.88E-01)	3.30E-02 (3.30E+00)
E	4.31E-05 (4.31E-03)	1.85E-04 (1.85E-02)	3.26E-04 (3.26E-02)	3.26E-04 (3.26E-02)	3.27E-04 (3.27E-02)	2.63E-04 (2.63E-02)	1.47E-03 (1.47E-01)
G	4.85E-04 (4.85E-02)	2.08E-03 (2.08E-01)	3.65E-03 (3.65-01)	3.65E-03 (3.65-01)	3.65E-03 (3.65-01)	2.94E-03 (2.94E-01)	1.65E-02 (1.65E+00)
P	5.29E-05 (5.29E-03)	2.27E-04 (2.27E-02)	3.98E-04 (3.98E-02)	3.98E-04 (3.98E-02)	3.98E-04 (3.98E-02)	3.20E-04 (3.20E-02)	1.80E-03 (1.80E-01)
R	9.18E-05 (9.18E-03)	4.11E-04 (4.11E-02)	7.84E-04 (7.84E-02)	7.77E-04 (7.77E-02)	8.05E-04 (8.05E-02)	6.70E-04 (6.70E-02)	3.50E-03 (3.50E-01)
S	2.47E-04 (2.47E-02)	1.06E-03 (1.06E-01)	1.86E-03 (1.86E-01)	1.86E-03 (1.86E-01)	1.86E-03 (1.86E-01)	1.50E-03 (1.50E-01)	8.40E-03 (8.40E-01)
T	1.29E-04 (1.29E-02)	5.56E-04 (5.56E-02)	9.76E-04 (9.96E-02)	9.76E-04 (9.76E-02)	9.77E-04 (9.77E-02)	7.85E-04 (7.85E-02)	4.40E-03 (4.40E-01)
W	8.12E-06 (8.12E-04)	3.49E-05 (3.49E-03)	6.12E-05 (6.12E-03)	6.12E-05 (6.12E-03)	6.12E-05 (6.12E-03)	4.92E-05 (4.29E-03)	2.76E-04 (2.76E-02)
By Year	2.03E-03 (2.03E-01)	8.75E-03 (8.75E-01)	1.54E-02 (1.54E+00)	1.54E-02 (1.54E+00)	1.54E-02 (1.54E+00)	1.24E-02 (1.24E+00)	6.94E-02 (6.94E+00)

Table 12.3-15— {Collective Dose to BBNPP Construction Workers}

Zone	Collective Dose by Zone person-Sievert (person-rem)						By ZONE
	2012	2013	2014	2015	2016	2017	
B	1.00E-05 (1.00E-03)	3.00E-05 (3.00E-03)	5.00E-05 (5.00E-03)	5.00E-05 (5.00E-03)	5.00E-05 (5.00E-03)	4.00E-05 (4.00E-03)	2.20E-04 (2.20E-02)
C	1.00E-03 (1.00E-01)	4.30E-03 (4.30E-01)	7.55E-03 (7.55E-01)	7.55E-03 (7.55E-01)	7.55E-03 (7.55E-01)	6.07E-03 (6.07E-01)	3.40E-02 (3.40E+00)
L	7.00E-05 (7.00E-03)	2.90E-04 (2.90E-02)	5.20E-04 (5.20E-02)	5.30E-04 (5.30E-02)	5.40E-04 (5.40E-02)	4.50E-04 (4.50E-02)	2.39E-03 (2.39E-01)
O	2.50E-04 (2.50E-02)	1.06E-03 (1.06E-01)	1.86E-03 (1.86E-01)	1.86E-036 (1.86E-01)	1.86E-03 (1.86E-01)	1.50E-03 (1.50E-01)	8.39E-03 (8.39E-01)
P	4.00E-05 (4.00E-03)	1.60E-04 (1.60E-02)	2.80E-04 (2.80E-02)	2.80E-04 (2.80E-02)	2.80E-04 (2.80E-02)	2.20E-04 (2.20E-02)	1.25E-03 (1.25E-01)
R	8.00E-05 (8.00E-03)	3.50E-04 (3.50E-02)	6.30E-04 (6.30E-02)	6.50E-04 (6.50E-02)	6.70E-04 (6.70E-02)	5.50E-04 (5.50E-02)	2.91E-03 (2.91E-01)
S	2.50E-04 (2.50E-02)	1.08E-03 (1.08E-01)	1.89E-03 (1.89E-01)	1.89E-03 (1.89E-01)	1.89E-03 (1.89E-01)	1.52E-03 (1.52E-01)	8.53E-03 (8.53E-01)
I	1.10E-04 (1.10E-02)	4.60E-04 (4.60E-02)	8.10E-04 (8.10E-02)	8.10E-04 (8.10E-02)	8.10E-04 (8.10E-02)	6.50E-04 (6.50E-02)	3.67E-03 (3.67E-01)
W	1.00E-05 (1.00E-03)	5.00E-05 (5.00E-03)	8.00E-05 (8.00E-03)	8.00E-05 (8.00E-03)	8.00E-05 (8.00E-03)	6.00E-05 (6.00E-03)	3.60E-04 (3.60E-02)
By YEAR	1.81E-03 (1.81E-01)	7.78E-03 (7.78E-01)	1.37E-02 (1.37E+00)	1.37E-02 (1.37E+00)	1.37E-02 (1.37E+00)	1.11E-02 (1.11E+00)	6.18E-02 (6.18E+00)

Figure 12.3-1— (Site Layout)

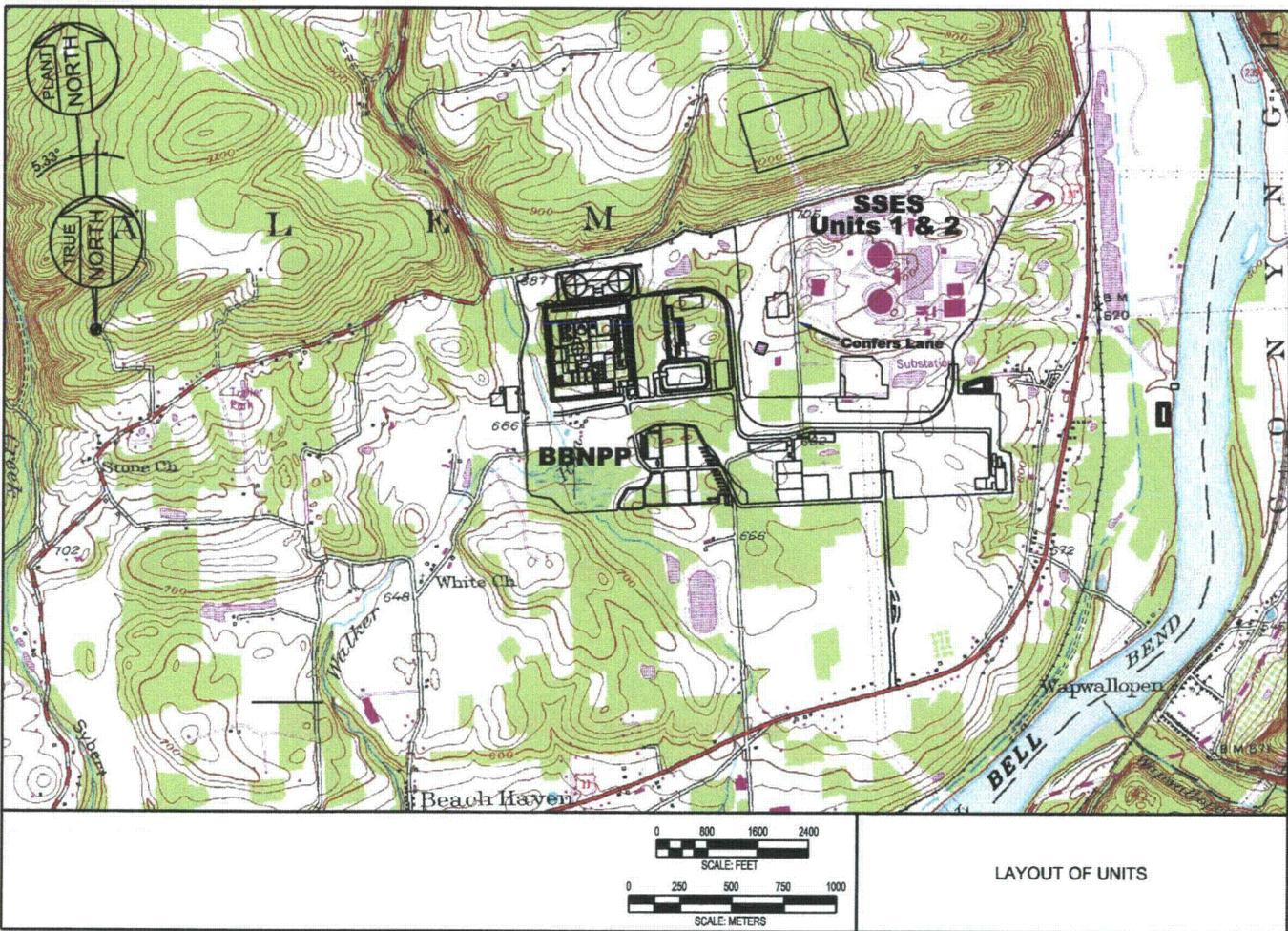


Figure 12.3-2— {CST and RWST Locations on Plant Grid}
(Background image for illustration purposes only. Pertinent information is labeled in red)

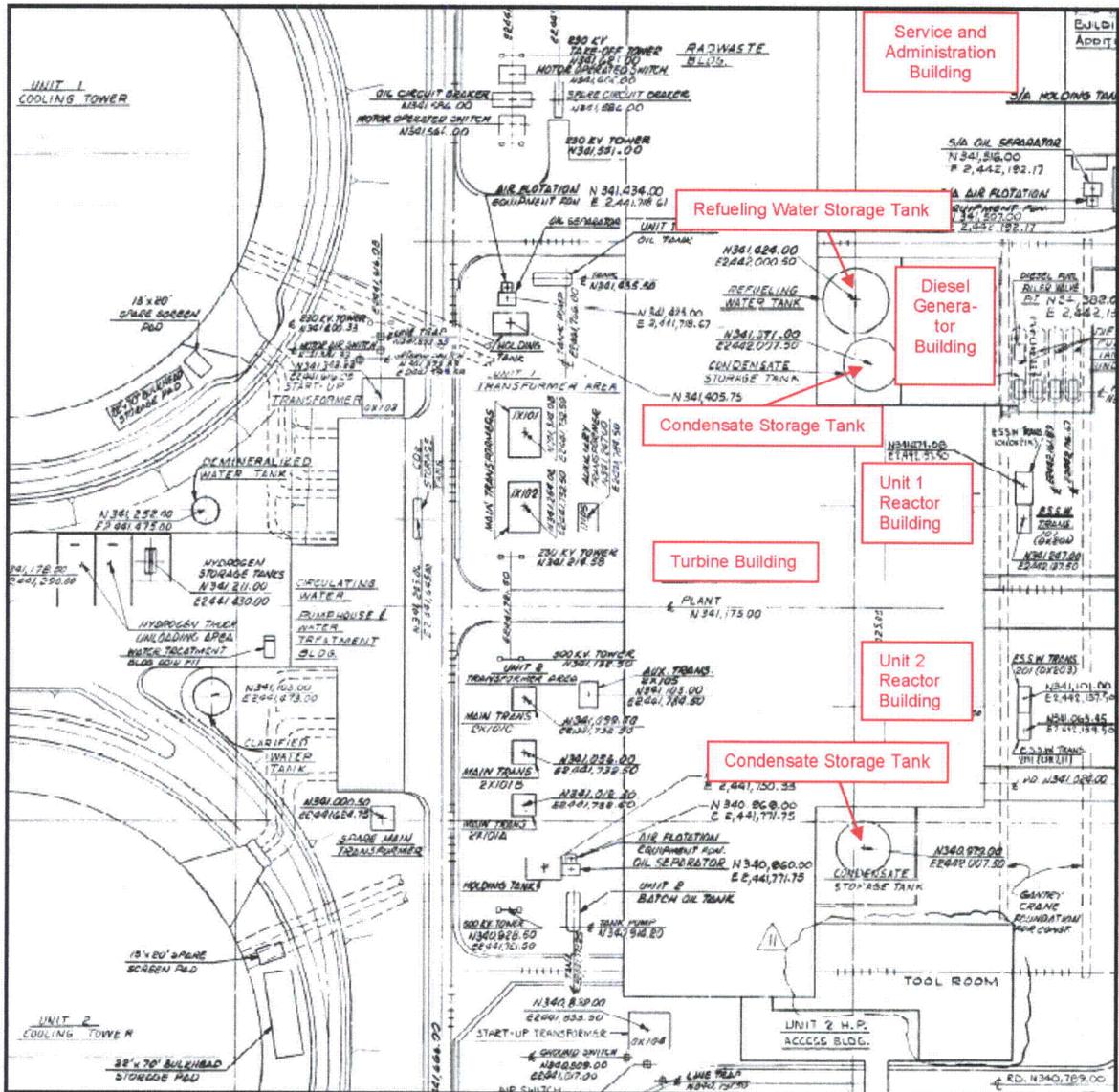


Figure 12.3-3— {Source Location}



Figure 12.3-4— {Annual Dose Rate in 2017 in Units of mrem 8760 hours}
 Background image for illustration purposes only. Illegible data is not pertinent.

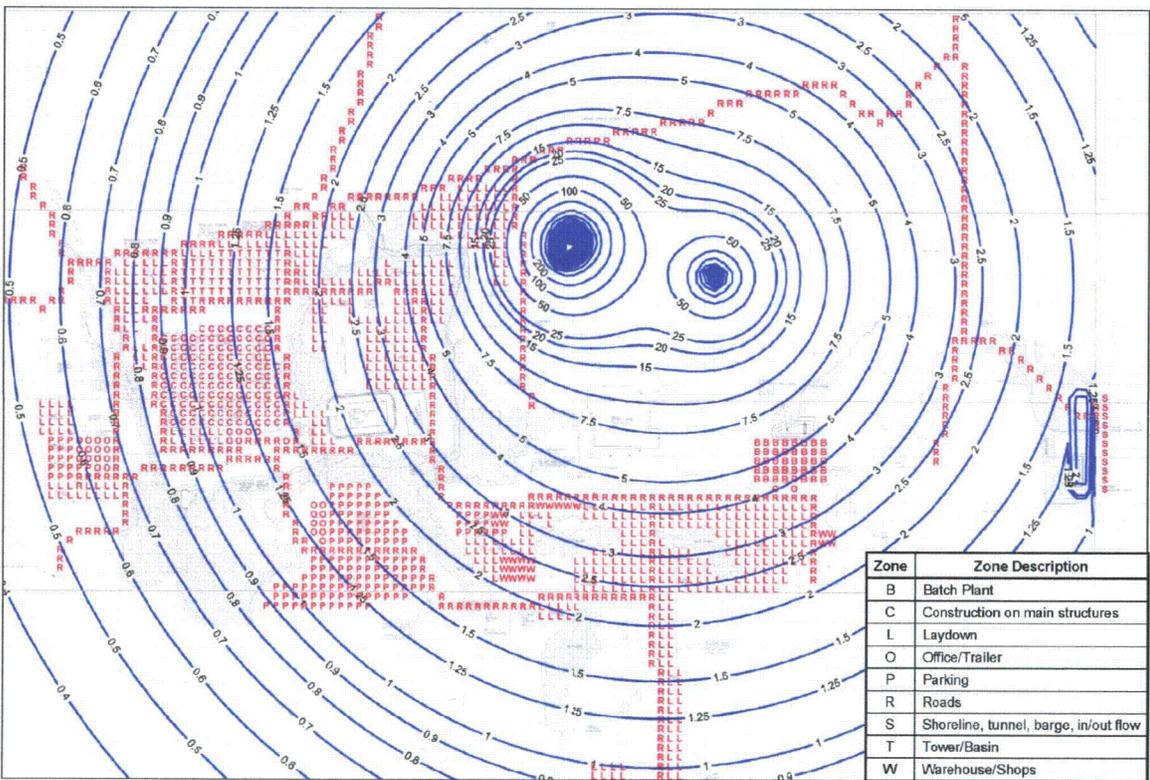


Figure 12.3-5—{Worker Zone Locations}

Figure 12.3-6— {ISFSI Distance Equation}

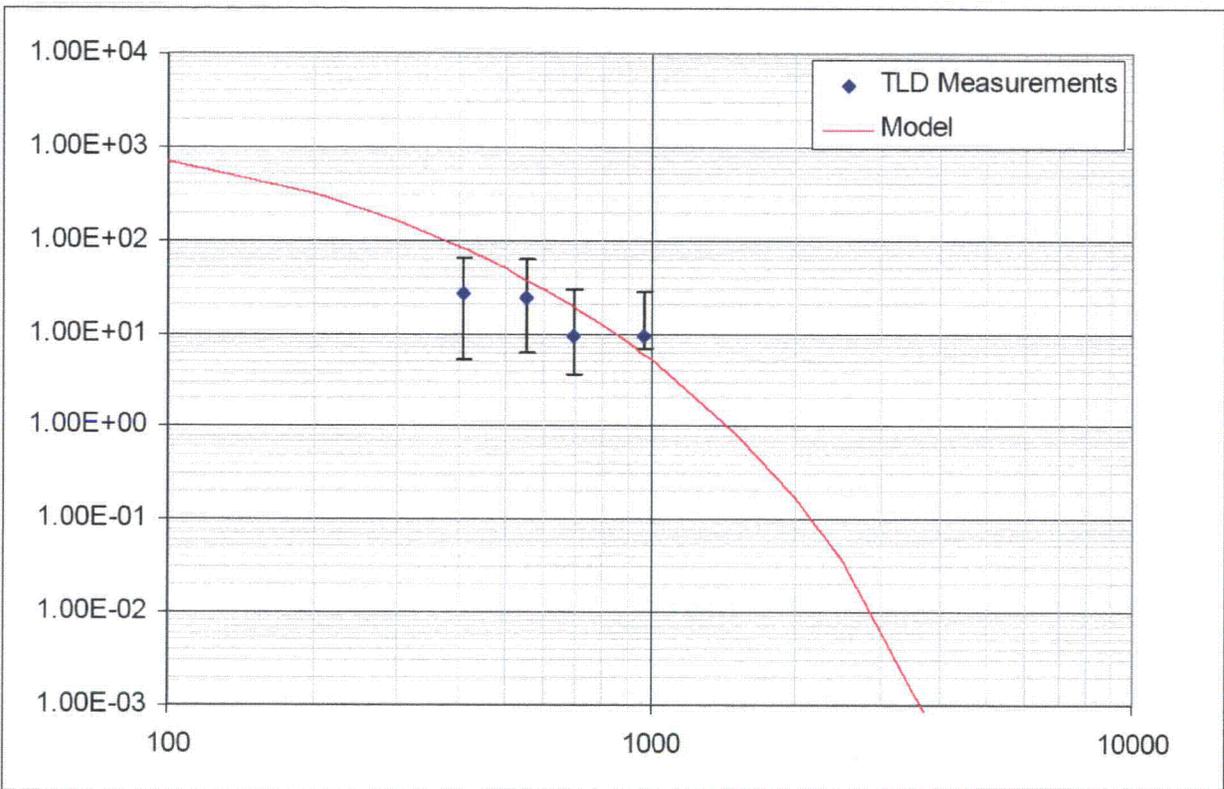


Figure 12.3-7— {ISFSI Satellite Image}



Figure 12.3-8— {SSES ISFSI (blue border) with TLDs and Grid}



Figure 12.3-9— {TLD (ID 1352) Data Verifying Time Correlation Function}

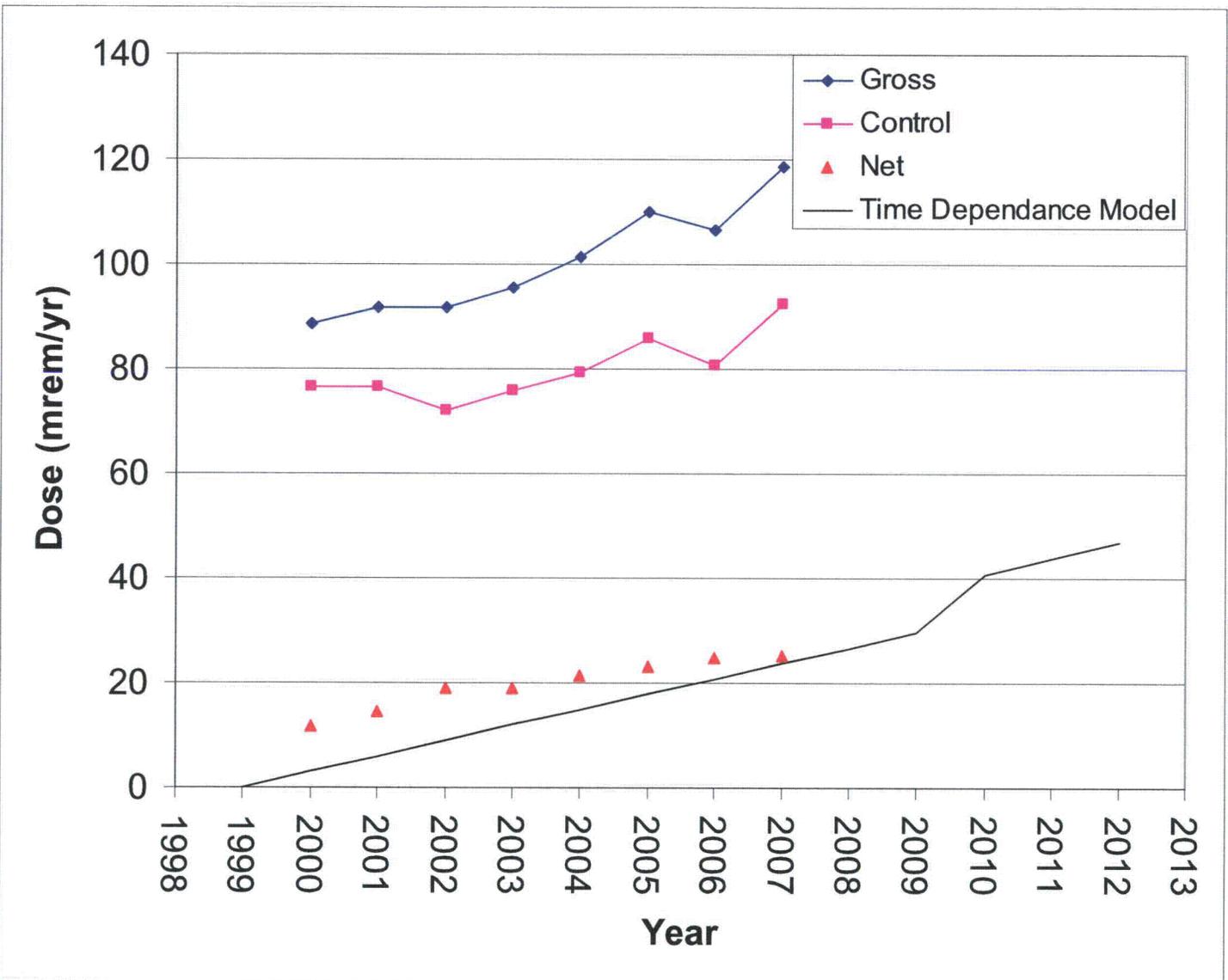


Figure 12.3-10— {Dose vs Distance for CSTs}

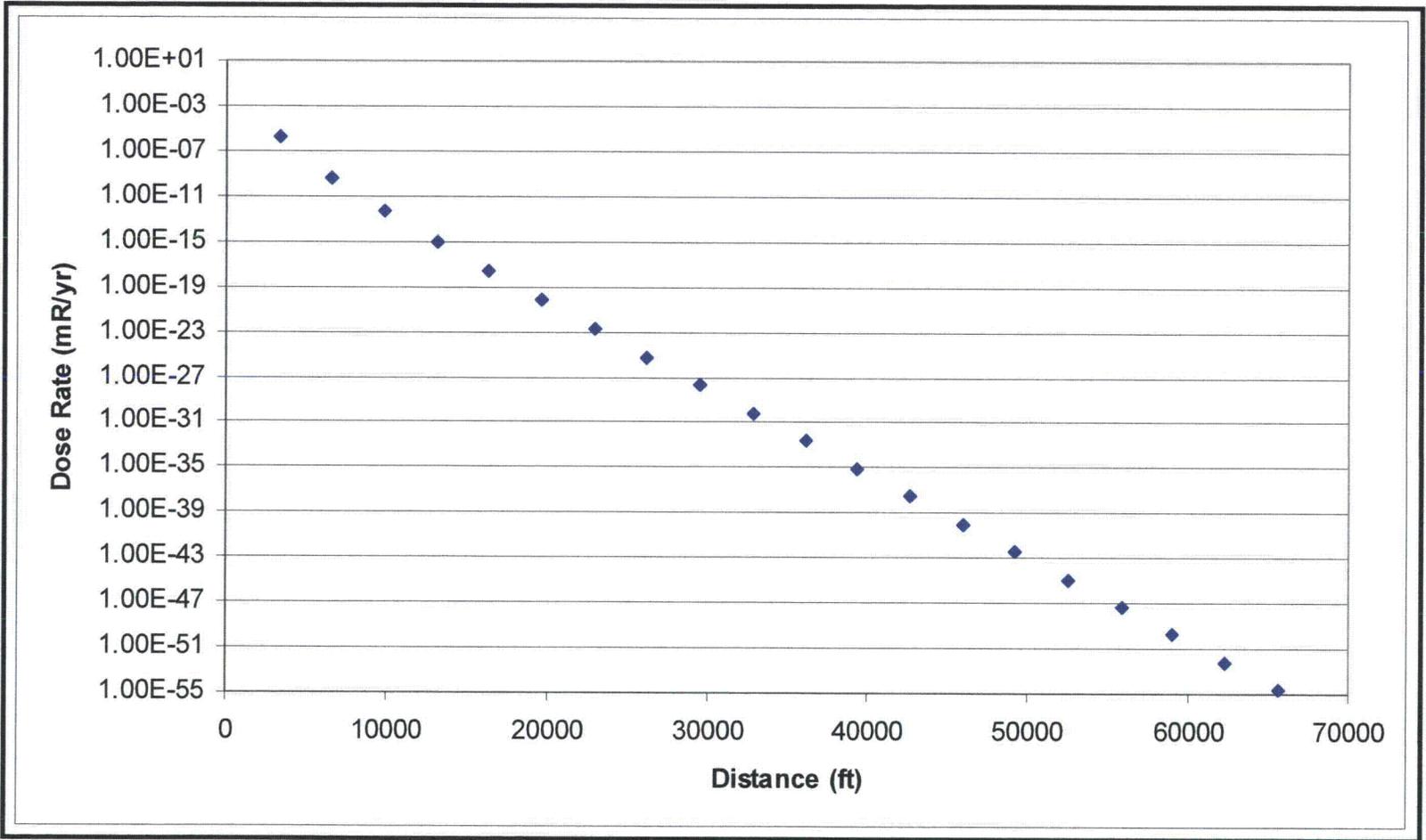


Figure 12.3-11— {Dose vs Distance for LLRWHF}

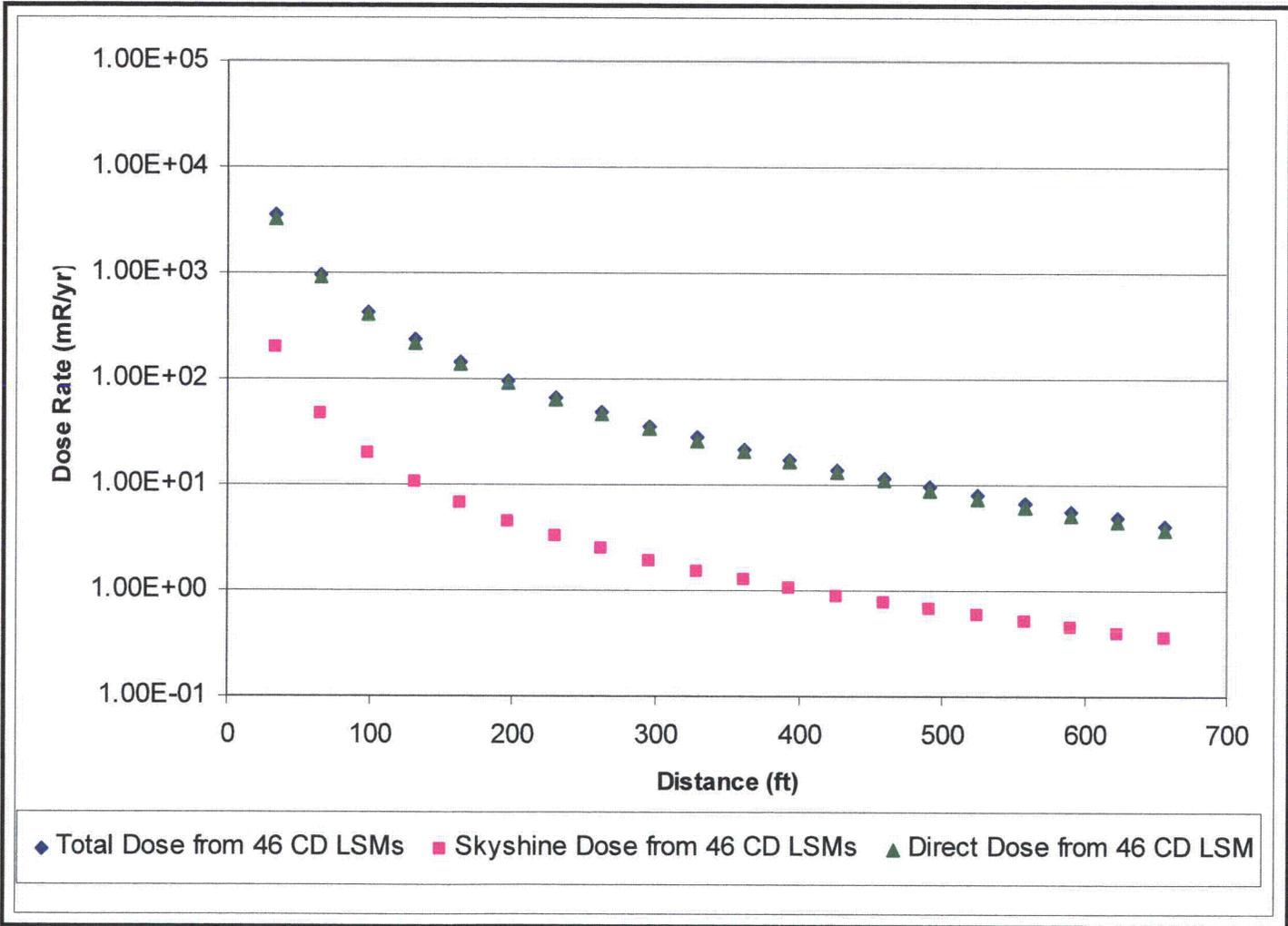


Figure 12.3-12— {Dose vs Distance for SEALAND Containers}

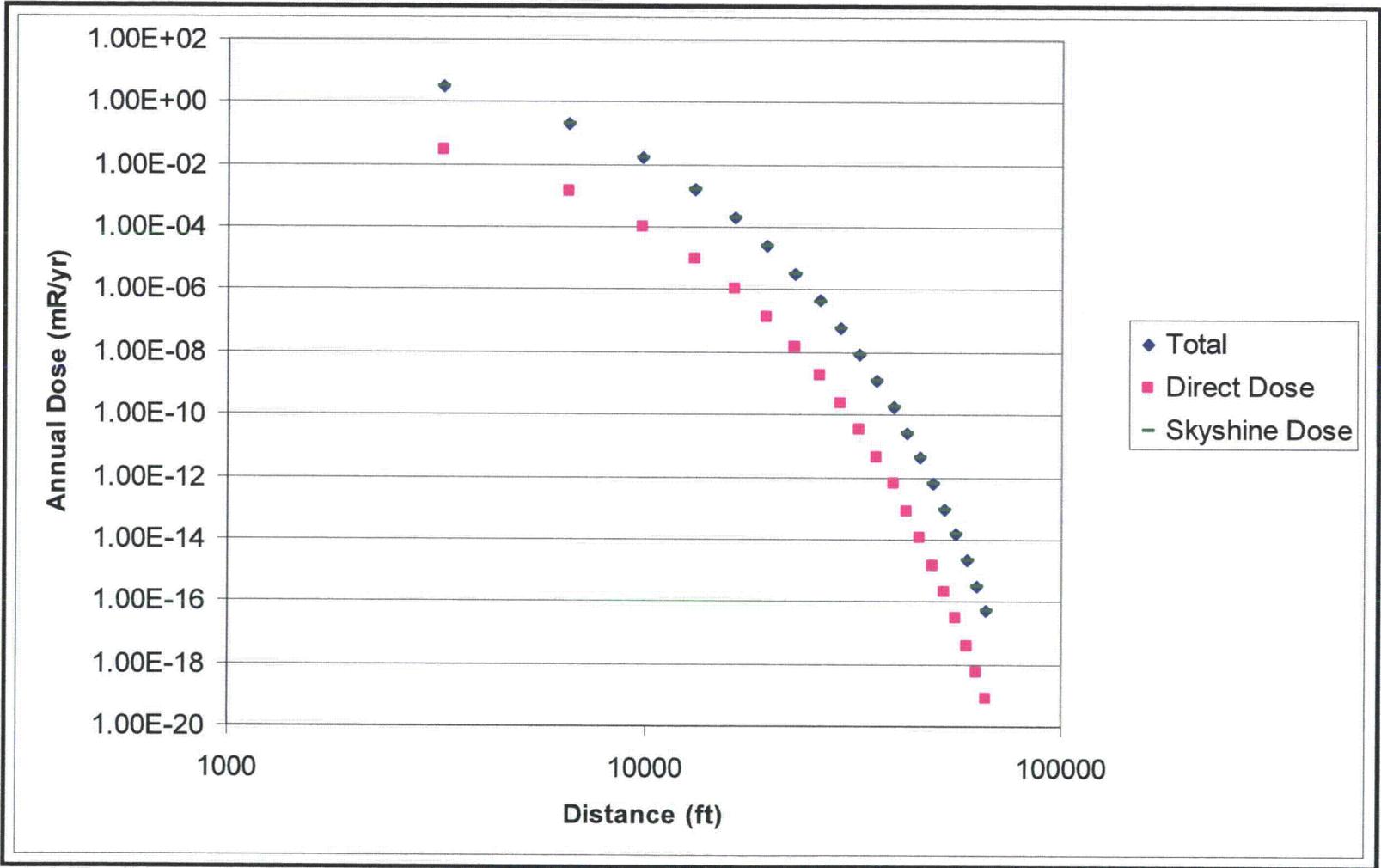


Figure 12.3-13— {Dose vs Distance for Steam Dryer Storage Vault}

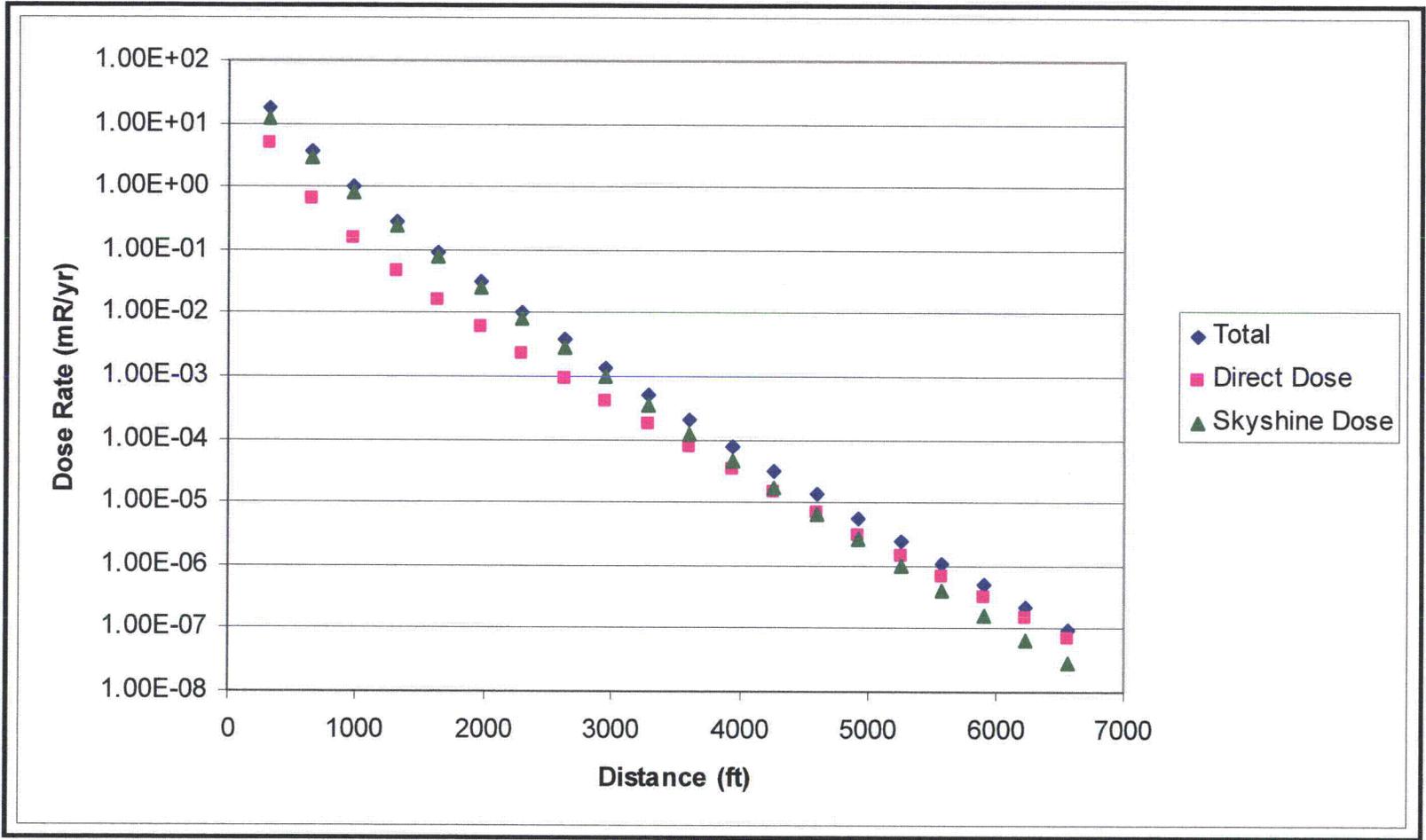


Figure 12.3-14— {Dose vs Distance for Turbine Building}

