

**Comanche Peak Nuclear Power Plant, Units 3 & 4
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CHAPTER 12
RADIATION PROTECTION

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12.3-1R	Radiation Zones for Normal Operation/Shutdown Site

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ACRONYMS AND ABBREVIATIONS

A/B	auxiliary building
ALARA	as low as reasonably achievable
CFR	Code of Federal Regulations
COL	Combined License
CPNPP	Comanche Peak Nuclear Power Plant
DCD	Design Control Document
ESW	essential service water
FSAR	Final Safety Analysis Report
ISFSI	Independent spent fuel storage installation
NEI	Nuclear Energy Institute
RG	Regulatory Guide
TEDE	total effective dose equivalent

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12.0 RADIATION PROTECTION

12.1 ENSURING THAT OCCUPATIONAL RADIATION EXPOSURES ARE AS LOW AS REASONABLY ACHIEVABLE

This section of the referenced Design Control Document (DCD) is incorporated by reference with the following departures and/or supplements.

12.1.1.3.1 Compliance with Regulatory Guide 1.8

CP COL 12.1(1) Replace the paragraph in **DCD Subsection 12.1.1.3.1** with the following.

The administrative programs and procedures demonstrate compliance with Regulatory Guide (RG) 1.8, including the operation policies activities conducted by management personnel who have plant operational responsibility for radiation protection, by utilizing NEI 07-08 (Reference 12.1-2), in combination with existing or modified Comanche Peak Nuclear Power Plant (CPNPP) Units 1 and 2 site program information. These are addressed in the operational radiation protection program, described in **Section 12.5**.

12.1.1.3.2 Compliance with Regulatory Guide 8.8

CP COL 12.1(1) Replace the second paragraph in **DCD Subsection 12.1.1.3.2** with the following.

The administrative programs and procedures demonstrate compliance with RG 8.8, including the operation policies activities conducted by management personnel who have plant operational responsibility for radiation protection, by utilizing of NEI 07-08 (Reference 12.1-2), in combination with existing or modified CPNPP Units 1 and 2 site program information. These are addressed in the operational radiation protection program, described in **Section 12.5**.

12.1.1.3.3 Compliance with Regulatory Guide 8.10

CP COL 12.1(1) Replace the paragraph in **DCD Subsection 12.1.1.3.3** with the following.

The administrative programs and procedures demonstrate compliance with RG 8.10, including the operation policies activities conducted by management personnel who have plant operational responsibility for radiation protection, by utilizing of NEI 07-08 (Reference 12.1-2), in combination with existing or modified CPNPP Units 1 and 2 site program information. These are addressed in the operational radiation protection program, described in **Section 12.5**.

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12.1.3 Operational Considerations

CP COL 12.1(3) Replace the first and second paragraphs in **DCD Subsection 12.1.3** with the following.

The operational radiation protection program for ensuring that operational radiation exposures are as low as reasonably achievable (ALARA) is discussed in **Section 12.5**, by utilizing of NEI 07-03A (Reference 12.1-25) in combination with existing or modified CPNPP Units 1 and 2 site program information. The program follows the guidance of RG 8.2, 8.4, 8.6, 8.7, 8.9, 8.13, 8.15, 8.25, 8.27, 8.28, 8.29, 8.34, 8.35, 8.36, and 8.38.

CP COL 12.1(6) Replace the last sentence of third paragraph in **DCD Subsection 12.1.3** with the following.
CP COL 12.1(7)

To achieve this objective, two kinds of operational procedures are developed. First operational procedures are developed to perform periodic review of operational practices to ensure that operating procedures are revised to reflect the installation of new or modified equipment, personnel qualification and training are kept current, and facility personnel are following the operating procedures. The other operational procedures are developed to track implementation of requirements for record retention according to 10 CFR 50.75(g) and 10 CFR 70.25(g) as applicable. This record, containing facility design and construction, facility design changes, site conditions before and after construction, onsite waste disposal and contamination, and results of radiological surveys, is used to facilitate decommissioning. These procedures are addressed in the Plant Radiation Protection Procedures, described in **13.5.2.2**.

12.1.4 Combined License Information

Replace the content of **DCD Subsection 12.1.4** with the following.

CP COL 12.1(1) **12.1(1)** *Policy considerations regarding plant operations*

This Combined License (COL) item is addressed in Subsections 12.1.1.3.1, 12.1.1.3.2 and 12.1.1.3.3.

12.1(2) *Deleted from the DCD.*

CP COL 12.1(3) **12.1(3)** *Following the guidance regarding radiation protection*

This COL item is addressed in Subsection 12.1.3.

12.1(4) *Deleted from the DCD.*

CP COL 12.1(5) **12.1(5)** *Radiation protection program*

*This COL item is addressed in **Section 12.5**.*

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CP COL 12.1(6) **12.1(6)** *Periodic review of operational practices*

This COL item is addressed in Section 12.1.3.

CP COL 12.1(7) **12.1(7)** *Implementation of requirements for record retention*

This COL item is addressed in Section 12.1.3.

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12.2 RADIATION SOURCES

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

12.2.1.1.10 Miscellaneous Sources

- CP COL 12.2(2) Replace the second and third sentences of the sixth paragraph in **DCD Subsection 12.2.1.1.10** with the following.

CPNPP Units 3 and 4 have no additional storage space for radwaste inside the plant structures. An additional storage space for radwaste, to be named the Interim Radwaste Storage Building, is planned for the future construction outside the plant structures. The radiation protection program (see Section 12.5) associated with this additional radwaste storage space is in place to ensure compliance with Title 10, Code of Federal Regulations (CFR) Part 20, 40 CFR 190 and to be consistent with the recommendations of RG 8.8.

- CP COL 12.2(2) Replace the second sentence of the seventh paragraph in **DCD Subsection 12.2.1.1.10** with the following.

CPNPP Units 3 and 4 have no additional radwaste facilities for dry active waste.

- CP COL 12.2(1) Replace the last paragraph in **DCD Subsection 12.2.1.1.10** with the following.

Any additional solid, liquid and gaseous radiation sources that are not identified in Subsection 12.2.1, including radiation sources used for instruments calibration or radiography, will be provided when such site-specific information would become available in the procurement phase. These sources will be incorporated in the updated FSAR.

12.2.3 Combined License Information

Replace the content of **DCD Subsection 12.2.3** with the following.

- CP COL 12.2(1) **12.2(1) Additional sources**

This COL item is addressed in Subsection 12.2.1.1.10.

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CP COL 12.2(2) **12.2(2)** *Additional storage space and radwaste facilities*

*This COL item is addressed in Subsection 12.2.1.1.10 and **Section 12.5**.*

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12.3 RADIATION PROTECTION DESIGN FEATURES

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

12.3.1.2.1.1 Radiation Zoning

CP COL 12.3(4) Replace the fourth sentence of the fourth paragraph in **DCD Subsection 12.3.1.2.1.1** with the following.

Site radiation zones for CPNPP Units 3 and 4 plant arrangement plan under normal operation/shutdown conditions are shown in **Figure 12.3-1R** (COL information provided on Sheet 1 of 34).

12.3.1.2.2 Accident Conditions

CP SUP 12.3(1) Add the following information after the last sentence of the second paragraph in **DCD Subsection 12.3.1.2.2**.

The essential service water (ESW) pipe tunnel structure at elevation 793'-1" has been changed in the site-specific layout. However, the radiation protection design in DCD Chapter 12 is not affected by the modification of ESW pipe tunnel structure, and Figures 12.3-2 through 12.3-6 can be used except for the structure of ESW pipe tunnel. Thus, these figures are not replaced in Final Safety Analysis Report (FSAR) Chapter 12. The structure of the ESW pipe tunnel is shown on Figure 1.2-2R.

12.3.2.2.8 Spent Fuel Transfer Canal and Tube Shielding Design

CP COL 12.3(5) Replace the last paragraph in **DCD Subsection 12.3.2.2.8** with the following.

Administrative control of the fuel transfer tube inspection and the access control of the area near the seismic gap below the fuel transfer tube will be addressed in a radiation protection program, described in **Section 12.5**.

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12.3.4 Area Radiation and Airborne Radioactivity Monitoring Instrumentation

CP COL 12.3(1) Replace the last paragraph in **DCD Subsection 12.3.4** with the following.

Portable instruments to be used in the event of an accident are placed so as to be readily available to personnel responding to an emergency.

The use of portable instruments and the associated training and procedures to accurately determine the airborne iodine concentration in areas within the facility where plant personnel may be present during an accident, in accordance with the requirements of 10 CFR 50.34(f)(2)(xxvii) and the criteria in Item III.D.3.3 of NUREG-0737 will be addressed in radiation protection program, described in Section 12.5.

Procedures for locating suspected high-activity areas are part of the radiation protection program that is described in **Section 12.5**.

12.3.6 Combined License Information

Replace the content of **DCD Subsection 12.3.6** with the following.

CP COL 12.3(1) **12.3(1) Portable instruments**

*This COL item is addressed in Subsection 12.3.4 and **Section 12.5**.*

12.3(2) Deleted from the DCD.

12.3(3) Deleted from the DCD.

CP COL 12.3(4) **12.3(4) Site radiation zones**

*This COL item is addressed in Subsection 12.3.1.2.1.1 and **Figure 12.3-1R** (sheet 1 of 34).*

CP COL 12.3(5) **12.3(5) Administrative control of the fuel transfer tube inspection**

*This COL item is addressed in Subsection 12.3.2.2.8 and **Section 12.5**.*

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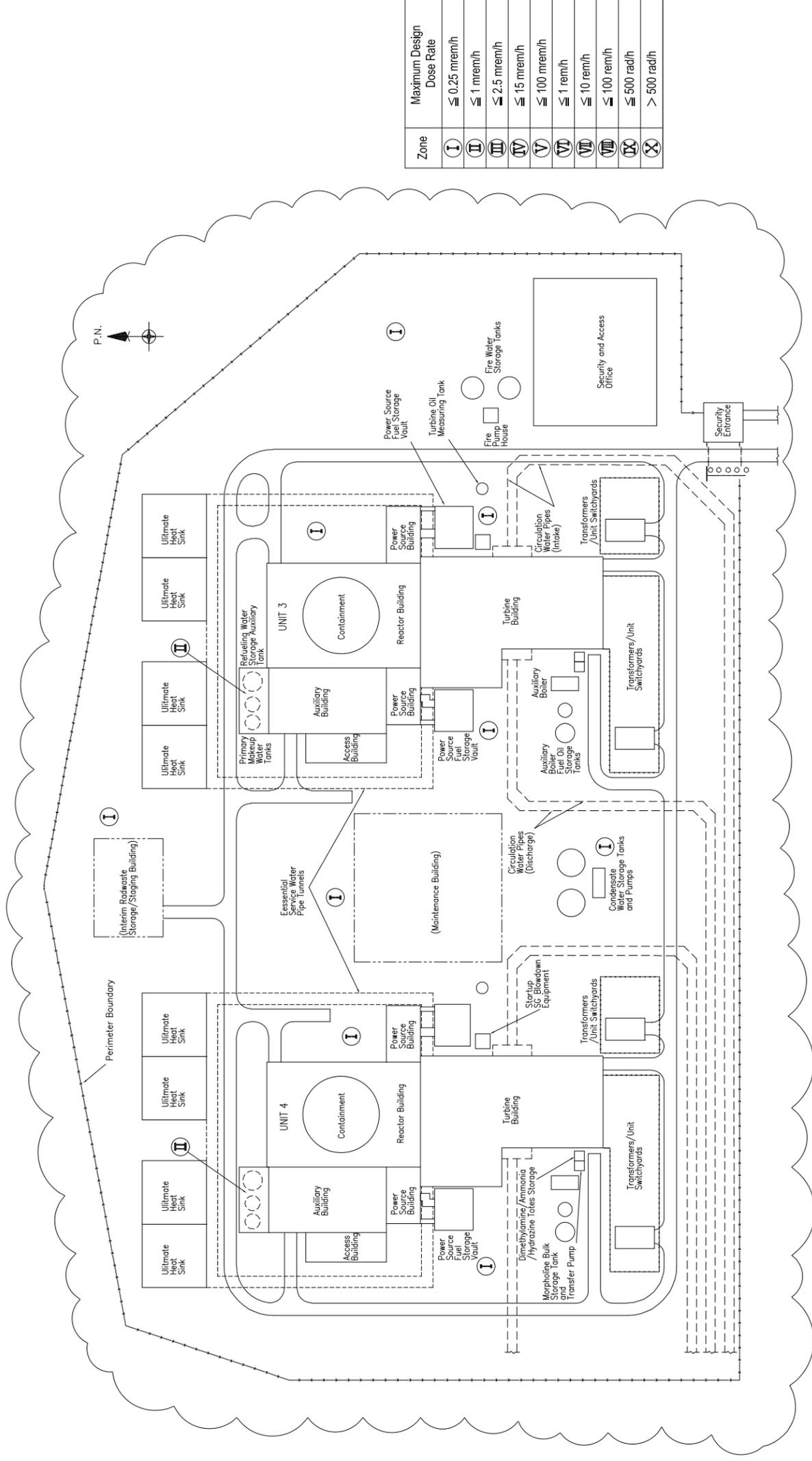


Figure 12.3-1R Radiation Zones for Normal Operation/Shutdown Site (Sheet 1 of 34)

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12.4 DOSE ASSESSMENT

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

12.4.1.9 Dose to Construction Workers

CP COL 12.4(1) Replace the paragraph in **DCD Subsection 12.4.1.9** with the following.

RG 1.206 requires that an annual dose to construction workers be estimated in a new unit construction area for multi-unit plants. This subsection evaluates the potential radiological dose impacts to construction workers at the CPNPP Units 3 and 4 resulting from the operation of CPNPP Units 1 and 2. Because the CPNPP Units 3 and 4 construction period occurs while CPNPP Units 1 and 2 are operating, construction workers at CPNPP Units 3 and 4 would be exposed to direct radiation and gaseous radioactive effluents from CPNPP Units 1 and 2. Doses to CPNPP Unit 4 construction workers from operation of CPNPP Unit 3 are not evaluated because the CPNPP Unit 4 construction will be substantially complete and many of the construction workers gone before CPNPP Unit 3 begins commercial operation. Gaseous effluent releases from CPNPP Unit 3 during fuel loading and low power testing, less than 5 percent power, are not expected to be significant, and are bounded by the conservatisms in the following dose estimate. During CPNPP Unit 3 testing, the overall work force, as well as outdoor construction activities on CPNPP Unit 4, would be reduced.

12.4.1.9.1 Site Layout

The CPNPP Units 3 and 4 power block areas are shown on **Figure 1.2-1R**. As shown, the additional units would be located northwest of the protected area for the existing units. Construction activity for CPNPP Units 3 and 4 would be outside the protected area for CPNPP Units 1 and 2, but inside the restricted area boundary.

12.4.1.9.2 Radiation Sources

Workers constructing CPNPP Units 3 and 4 could be exposed to direct radiation and to gaseous and liquid radioactive effluents emanating from the routine operation of CPNPP Units 1 and 2 as described in the following paragraphs.

12.4.1.9.2.1 Direct Radiation

The refueling water storage tanks are the principal contained sources that could contribute to direct radiation exposure at the construction site. This source is not significant at CPNPP because a 2 ft.-6 in. thick concrete wall is used instead of a thin steel shell wall for the refueling water storage tanks. CPNPP Units 1 and 2 do not have an independent spent fuel storage installation (ISFSI); therefore, this source of direct radiation is not considered. In general, the dose rate at the ISFSI protected area fence would be below 5 mrem/hr. The radiation intensity from the

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ISFSI decreases with distance from the source, varying as the inverse square of the distance. For a point source, the following relation expresses the inverse square spreading effect:

$$\phi = \frac{S}{4\pi R^2}$$

Where ϕ is the intensity at a surface of a sphere of radius R, and S is the source strength. The energy twice as far from the source is spread over 4 times the area; therefore, it has one-fourth the intensity. Any point source that spreads its influence equally in all directions without limits to its range would obey the inverse square law. The distance from the CPNPP Units 3 and 4 construction area to any potential ISFSI site is well over 1000 ft. For conservatism, a distance of 1000 ft is assumed. Neglecting attenuation in the air and applying the inverse square relation, a 5 mrem/hr dose rate within the confines of the ISFSI (at an assumed distance of 1 ft from the source) is reduced to 5.0E-06 mrem/hr at 1000 ft from the ISFSI facility. Considering an exposure period of 2500 hr/yr, the annual dose to a construction worker from direct radiation emanating from the ISFSI is 1.25E-02 mrem/yr.

Other direct radiation sources could potentially affect construction workers at the proposed CPNPP Units 3 and 4 site locations and the modification to the existing Sanitary Sewage Treatment Facility. These other direct radiation sources include the existing Warehouse C Dry Active Waste and Fixed Contamination Tool area, the planned Outage Laydown Area east of the CPNPP Units 1 and 2 Fuel Building, and the existing Storage Level "D" Zone where Class B and C radioactive waste is stored.

All of these areas will be maintained at the fence area boundary with dose rates <2 mrem/hr in accordance with the current site Radiation Protection Program entitled "General Health Physics Plan" STA-650. Distances from these areas to the CPNPP Units 3 and 4 proposed construction area are much greater than 1000 feet. Distances between these facilities and a proposed modification to the Sanitary Sewage Treatment Facility to accommodate additional volume, range from approximately 1100 to 1600 feet. As a result, and considering that the dose rates will be maintained <2 mrem/hr at the source fence boundary, the construction worker will not be affected by any of these other direct radiation sources.

12.4.1.9.2.2 Gaseous Effluents

Some radioactive gaseous effluents are released on a batch basis from CPNPP Units 1 and 2 to the environment. Release pathways in this category include intentional discharges from the containment purge exhaust and the waste gas decay tanks via the plant vent stacks. Radioactive gaseous effluents are released continuously from CPNPP Units 1 and 2 to the environment from the fuel buildings, safeguards buildings, and auxiliary building (A/B) ventilation exhaust systems, and the condenser off-gas system via the plant vent stacks.

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The CPNPP Units 1 and 2 annual releases for 2006 have been reported as 148 Ci of fission and activation gases, 4.23E-04 Ci of iodines, 0.00 Ci of particulates with half-lives greater than eight days, and 47 Ci of tritium (Reference 12.4-201). The annual releases for 2006 are higher than normal for the existing units (Reference 12.4-201).

12.4.1.9.2.3 Liquid Effluents

Effluents from the liquid waste disposal system introduce small amounts of radioactivity into Squaw Creek Reservoir and the low volume waste pond. The annual liquid radioactivity releases for 2006 have been reported as 5.9E-03 Ci of fission and activation products, 1522 Ci of tritium, and 0.54 Ci of dissolved and entrained gases (Reference 12.4-201). The annual releases for 2006 are typical for the existing units; however, the tritium production is dependent on fuel type, power production, and core power history.

12.4.1.9.3 Measured and Calculated Dose Rates

12.4.1.9.3.1 Direct Radiation

CPNPP Units 1 and 2 have a general area monitoring program that monitors various points inside the protected area. The limiting cumulative dose rate is 0.001 mrem/hr from the protected area fence thermoluminescent dosimeter readings for 2006. This dose rate bounds the CPNPP Units 3 and 4 construction worker direct radiation dose rate from CPNPP Units 1 and 2 because this location is closer to CPNPP Units 1 and 2 than to the CPNPP Units 3 and 4 construction area.

12.4.1.9.3.2 Gaseous Effluents

The Annual Radioactive Effluent Release Report for 2006 (Reference 12.4-201) provides continuous and batch mode releases for CPNPP Units 1 and 2. The total combined 2006 gaseous effluent releases are conservative when compared to historic average gaseous effluent release data (Reference 12.4-201).

The CPNPP Unit 3 construction area is approximately 1900 ft. (579 m) NW of the closest corner of the CPNPP Unit 2 turbine building. This distance is conservative relative to any actual gaseous effluent release point for either CPNPP Unit 1 or Unit 2. Use of the distance to the CPNPP Unit 3 construction area is also conservative because the CPNPP Unit 4 construction area is farther away. To ensure that the limiting dose at the construction area is captured, atmospheric dispersion factors were also calculated for the WNW and NNW directions at a distance of 1900 ft. The XOQDOQ computer code (Reference 12.4-202) was used with the 2001 – 2006 CPNPP meteorological data to determine the atmospheric dispersion and deposition from this assumed release location to the CPNPP Unit 3 construction area.

The GASPAR computer code (Reference 12.4-203) was then used, with the calculated atmospheric dispersion factors, to determine the CPNPP Unit 3

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construction worker dose due to gaseous effluent releases from CPNPP Units 1 and 2. The gaseous effluent releases from CPNPP Units 1 and 2 were conservatively modeled as ground level releases because the release height is not more than 2 times the height of adjacent buildings. The release elevation of the plant vent stack is approximately 58 m above plant grade. The assumed area for calculation of building wake effects was 3193 m². This represents the cross sectional area of the CPNPP Unit 1 containment building. This is conservative because the gaseous effluent releases are from both operating units. The building height used was 260 ft (79m) above grade.

12.4.1.9.3.3 Liquid Effluents

The Annual Radioactive Effluent Release Report for 2006 ([Reference 12.4-201](#)) reports a total body dose of 0.103 mrem and a critical organ dose of 0.103 mrem to the maximally exposed member of the public due to the release of liquid effluents from CPNPP Units 1 and 2, calculated in accordance with the existing units' Offsite Dose Calculation Manual.

12.4.1.9.4 Construction Worker Doses

Construction worker doses were conservatively estimated using the following information:

- The estimated maximum dose rate for each pathway
- An exposure time of 2500 hr/yr (50 hr/week * 50 week/yr)
- A peak loading of 4300 construction workers per year

The estimated maximum annual dose for each pathway as well as the total dose is discussed below.

12.4.1.9.4.1 Direct Radiation

Using the protected area fence cumulative dose rate of 0.001 mrem/hr from [Subsection 12.4.1.9.3.1](#), the annual dose due to direct radiation at the CPNPP Units 1 and 2 protected area fence would be 2.5 mrem based on an exposure of 2500 hr/yr. This is the dose at the CPNPP Units 1 and 2 protected area fence. Doses to the CPNPP Units 3 and 4 construction workers would be reduced due to the distance to the construction area.

12.4.1.9.4.2 Gaseous Effluents

The annual gaseous effluent doses to the maximally exposed member of the public are based on continuous occupancy. Adjusted for an exposure time of 2500 hr/yr, the estimated individual worker doses due to gaseous effluent releases from CPNPP Units 1 and 2 are 4.05E-03 mrem for the total body and 4.20E-03 mrem for the critical organ. Applying a weighting factor of 0.03 to the critical organ dose,

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as discussed in RG 1.183, page 1.183-9, and adding to the total body dose, a total effective dose equivalent (TEDE) of 4.18E-03 mrem is estimated.

12.4.1.9.4.3 Liquid Effluents

The annual liquid effluent doses to the maximally exposed member of the public are based on continuous occupancy and are adjusted for an exposure time of 2500 hr/yr. Although the liquid effluent dose rates to which the workers would be exposed are not expected to be as high as the dose to the maximally exposed member of the public, the doses calculated for the public are used. The resulting doses are 2.9E-02 mrem for the whole body and 2.9E-02 mrem for the critical organ. Applying a weighting factor of 0.03 to the organ dose and adding to the whole body dose, a TEDE of 3.0E-02 mrem is estimated.

12.4.1.9.4.4 Total Doses

The annual doses from all three pathways are compared to the public dose criteria of 10 CFR 20.1301 in [Table 12.4-201](#). Because the calculated doses meet the public dose criteria of 10 CFR 20.1301, the workers would not need to be classified as radiation workers. The maximum annual collective dose to the construction work force of 4300 workers is estimated to be 10.75 person-rem.

The calculated doses are based on available dose rate measurements and calculations. It is possible that these dose rates could increase in the future as site conditions change. The site will be continually monitored during the construction period, and appropriate actions would be taken as necessary to ensure that the construction workers are protected from radiation.

The annual estimated construction worker doses attributable to the operation of CPNPP Units 1 and 2 for the proposed construction areas for CPNPP Units 3 and 4 are below 10 CFR 20 limits. Therefore, in accordance with 10 CFR 20.1301 criteria, monitoring of individual construction workers is not required.

12.4.3 Combined License Information

Replace the content of [DCD Subsection 12.4.3](#) with the following.

CP COL 12.4(1)

12.4(1) *Estimated annual doses to construction workers*

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This COL item is addressed in *Subsection 12.4.1.9* and *Table 12.4-201*.

12.4.4 References

Add the following references after the last reference in *DCD Subsection 12.4.4*.

- 12.4-201 *Comanche Peak Steam Electric Station Units 1 and 2 Radioactive Effluent Release Report, January 1, 2006 - December 31, 2006.*

- 12.4-202 *U.S. Nuclear Regulatory Commission, XOQDOQ Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations, NUREG/CR-2919, September 1982.*

- 12.4-203 *U.S. Nuclear Regulatory Commission, GASPAR II Technical Reference and User Guide, NUREG/CR-4653, March 1987.*

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CP COL 12.4(1)

**Table 12.4-201
Construction Worker Dose Comparison to 10 CFR 20.1301
Criteria**

Type of Dose	Annual Dose Limits⁽¹⁾	Estimated TEDE Dose⁽²⁾
Annual dose (mrem)	100	2.5
Unrestricted area dose rate (mrem/hr)	2	0.001

Note:

- (1) 10 CFR 20.1301 criteria.
- (2) Dose due to direct radiation and liquid and gaseous effluent releases from CPNPP Units 1 and 2.

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12.5 OPERATIONAL RADIATION PROTECTION PROGRAM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

CP COL 12.1(5) Replace the contents in **DCD Section 12.5** with the following.

NEI 07-03A, Generic FSAR Template Guidance for Radiation Protection Program Description, Revision 0, is incorporated by reference. Site specific information in radiation protection program will be implemented in accordance with the milestones listed in **Table 13.4-201**, by utilizing of NEI 07-03A, and NEI 07-08, Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures are as Low as is Reasonably Achievable (ALARA), Revision 3, in combination with existing or modified CPNPP Units 1 and 2 site program Information.

Revise the contents of NEI 07-03A, with the following.

CP COL 12.2(2) Add the following information after the second paragraph in Subsection 12.5.3.3
CP COL 12.3(1) of NEI 07-03A.
CP COL 12.3(5)

In case the National Institute for Occupational Safety and Health/Mine Safety and Health Administration certified equipments are not used, equipments are used to be compliance with 10 CFR 20.1703(b) and 20.1705.

Add the following information after the paragraph in the discussion on Radwaste Handling in Subsection 12.5.4.2 of NEI 07-03A.

CPNPP Units 3 and 4 have a plan to store temporarily radioactive wastes/materials in Interim Radwaste Storage/Staging Building outside the plant structures. Entry into the radiologically controlled areas of this building is allowed only through the issuance of a Radiation Work Permit. Non-radiologically controlled areas allow for general access.

Add the following information after the third paragraph in Subsection 12.5.4.4 of NEI 07-03A.

The locations and radiological controls of the radiation zones on plant layout drawings are located in **DCD Subsection 12.3.1.2**. Administrative controls for restricting access to Very High Radiation Area are provided by Plant Manager's (or designee) approval. Access control for Very High Radiation Areas is controlled

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by the gates and entry to these areas is allowed only through the issuance of a Radiation Work Permit. Subsection 12.3.1.2 includes detailed drawings of the very high radiation areas and indicates the physical access controls. Radiation monitor locations for each area are indicated in **DCD Subsection 12.3.4**.

Add the following information after the sixth paragraph in Subsection 12.5.4.4 of NEI 07-03A.

The gates provide access control of the fuel transfer tube inspection (Very High Radiation Area) and the area near the seismic gap below the transfer tube. Access control for these areas is controlled by the gates and entry to these areas is allowed only the issuance of a Radiation Work Permit.

Replace the first and second paragraph in Subsection 12.5.4.12 of NEI 07-03A with the following.

The radiation protection program and procedures are established, implemented, maintained and reviewed consistent with the 10 CFR 20.1101 and the quality assurance program referenced in **Chapter 17**.
