CHAPTER 6

ENGINEERED SAFETY FEATURES

TABLE OF CONTENTS

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

ASME	American Society of Mechanical Engineers
COL	Combined License
CPNPP	Comanche Peak Nuclear Power Plant
CRE	control room envelope
CSS	containment spray system
DCD	Design Control Document
ECCS	emergency core cooling system
ESF	engineered safety features
HVAC	heating, ventilation, and air conditioning
IDLH	Immediately dangerous to life and health
ISI	inservice inspection
MCR	main control room
NaTB	sodium tetraborate decahydrate
NEI	Nuclear Energy Institute
NPSH	net positive suction head
NRC	U.S. Nuclear Regulatory Commission
RCS	reactor coolant system
RG	Regulatory Guide
RWSP	refueling water storage pit
SI	safety injection
SIS	safety injection system
SSC	structures, systems, and components
TBE	thin bed effect

6.0 ENGINEERED SAFETY FEATURES

This section of the referenced Design Control Document (DCD) is incorporated by reference with no departures or supplements.

6.1 ENGINEERED SAFETY FEATURE MATERIALS

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

6.1.2 Organic Materials

STD COL 6.1(7) Replace the last sentence of the fifth paragraph in DCD Subsection 6.1.2 with the following.

Coatings program will be developed and implemented prior to procurement phase.

6.1.3 Combined License Information

Replace the content of DCD Subsection 6.1.3 with the following.

6.1(1) *Deleted from the DCD.*

6.1(2) *Deleted from the DCD.*

6.1(3) *Deleted from the DCD.*

6.1(4) *Deleted from the DCD.*

6.1(5) *Deleted from the DCD.*

6.1(6) *Deleted from the DCD.*

STD COL 6.1(7) ***6.1(7)*** *Preparation of a coating program*

This COL item is addressed in Subsection 6.1.2

6.2 CONTAINMENT SYSTEMS

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

6.2.2.3 Design Evaluation

STD COL 6.2(5) Replace the last sentence of the the first bullet of tenth paragraph in DCD Subsection 6.2.2.3 with the following.

Administrative procedures in Subsection 13.5.1 implement the containment cleanliness program.

The program includes the following:

- Organizational responsibilities for implementing the program
- Controls and limits on type and quantity of materials for all modes of operation (not limited to outages)
- Guidance documents used to develop the cleanliness program survey/sampling methods
- Inspection frequency
- Evaluation frequency
- Reporting requirements for degraded conditions or non-conforming results

Procedures to remove foreign materials and minimize the amount of debris that might be left in containment following refueling and maintenance outages address the following:

- Frequency of cleanliness control and inspection activities for operation and maintenance
- Restriction of materials introduced into the containment
- Accounting for materials introduced into and out of the containment (e.g., scaffold, tape, labels, plastic film, paper, cloth, keys, and pens)
- Cleaning of maintenance outage area, including areas associated with removal or replacement of insulation

- Cleanliness inspections and removal of debris/foreign material, including operation and maintenance areas, RWSP, debris interceptors, RWSP vent and drain lines (available for inspection), and strainer debris
- Preparation and review of entry/exit logs and inspection records

The containment cleanliness program including administrative procedures will be developed and implemented prior to initial fuel load.

6.2.6.1 Containment Integrated Leakage Rate Testing

STD COL 6.2(8) Replace the first and second sentences of the first paragraph in DCD Subsection 6.2.6.1 with the following.

The containment leakage rate test program requirements are defined by Technical Specifications Subsection 5.5.16. Implementation milestone of the containment leak rate tests program is provided in Table 13.4-201.

6.2.8 Combined License Information

Replace the content of DCD Subsection 6.2.8 with the following.

6.2(1) *Deleted from the DCD.*

6.2(2) *Deleted from the DCD*

6.2(3) *Deleted from the DCD.*

6.2(4) *Deleted from the DCD.*

STD COL 6.2(5) ***6.2(5)*** *Preparation of a cleanliness, housekeeping and foreign materials exclusion program*

This COL item is addressed in Subsection 6.2.2.3 and Table 6.2.2-2R.

6.2(6) *Deleted from the DCD.*

6.2(7) *Deleted from the DCD.*

STD COL 6.2(8) ***6.2(8)*** *Containment leakage rate testing program*

This COL item is addressed in Subsections 6.2.6.1.

6.2(9) *Deleted from the DCD.*

6.2(10) *Deleted from the DCD.*

Table 6.2.2-2R (Sheet 7 of 22)

Comparison of RWSP Recirculation Intake Debris Strainer Design to RG 1.82 Requirements

	No.	Regulatory Position	US-APWR Design
	1.1.1.14	All drains from the upper regions of the containment building, as well as floor drains, should terminate in such a manner that direct streams of water, which may contain entrained debris, will not discharge downstream of the sump screen, thereby, bypassing the sump screen.	The US-APWR design of engineered safety features (ESF) structures, systems, or components (SSCs) does not include a containment spray system (CSS) or safety injection system (SIS) suction flow path that bypasses the RWSP suction strainers.
	1.1.1.15	Advanced strainer designs (e.g., stacked disc strainers) have demonstrated capabilities that are not provided by simple flat plate or cone-shaped strainers or screens. For example, these capabilities include built-in debris traps where debris can collect on surfaces while keeping a portion of the screen relatively free of debris. The convoluted structure of such strainer designs increases the total screen area, and these structures tend to prevent the condition sometimes referred to as the TBE. It may be desirable to include these capabilities in any new sump strainer/screen designs. The performance characteristics and effectiveness of such designs should be supported by the appropriate test data for any particular intended application.	An advanced strainer design is planned for the US-APWR. Thin Bed Effects (TBE) are addressed in the US-APWR Sump Strainer Performance document (Ref. 6.2-34).
	1.1.2	**Minimizing Debris** The debris (see Regulatory Position 1.3.2) that could accumulate on the sump screen should be minimized.	**Design Features and Capabilities** The design features and capabilities employed to minimize debris are presented below.
STD COL 6.2(5)	1.1.2.1	Cleanliness programs should be established to clean the containment on a regular basis, and plant procedures should be established for the control and removal of foreign materials from the containment.	Cleanliness programs are addressed in Subsection 6.2.2.3.

Table 6.2.2-2R (Sheet 16 of 22)

Comparison of RWSP Recirculation Intake Debris Strainer Design to RG 1.82 Requirements

STD COL 6.2(5)

No.	Regulatory Position	US-APWR Design
1.3.2.5	The cleanliness of the containment during plant operation should be considered when estimating the amount and type of debris available to block the ECC sump screens. The potential for such material (e.g., thermal insulation other than piping insulation, ropes, fire hoses, wire ties, tape, ventilation system filters, permanent tags or stickers on plant equipment, rust flakes from unpainted steel surfaces, corrosion products, dust and dirt, latent individual fibers) to impact head loss across the ECC sump screens should also be considered.	The cleanliness of the containment during plant operation will be done with programs addressed in Subsection 6.2.2.3.
1.3.2.6	In addition to debris generated by jet forces from the pipe rupture, debris created by the resulting containment environment (thermal and chemical) should be considered in the analyses. Examples of this type of debris would be disbondment of coatings in the form of chips and particulates or formation of chemical debris (precipitants) caused by chemical reactions in the pool.	Principal measures taken by the US APWR design to preclude adverse chemical effects include the use of the buffering agent, NaTB, and minimizing the use of aluminum.
1.3.2.7	Debris generation that is due to continued degradation of insulation and other debris when Subjected to turbulence caused by cascading water flows from upper regions of the containment, or near the break overflow region should be considered in the analyses.	Break properties and debris production considerations are based on Nuclear Energy Institute (NEI) 04-07 methodology and are addressed in the US-APWR Sump Strainer Performance document (Ref. 6.2-34).

6.3 EMERGENCY CORE COOLING SYSTEMS

This section of the referenced DCD is incorporated by reference with no departures or supplements.

6.4 HABITABILITY SYSTEMS

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

6.4.3 System Operational Procedures

STD COL 6.4(2) Replace the third paragraph in DCD Subsection 6.4.3 with the following.

The analyses of control room habitability during postulated release of toxic chemicals described in Subsection 6.4.4.2 identify no hazardous chemical that exceeds the IDLH criteria of RG 1.78, so that no specific automatic action of MCR HVAC system is required to protect operators within the CRE against toxic gas release event. The emergency isolation mode may be initiated by manual action as described in Subsection 6.4.4.2.

6.4.4.1 Radiological Protection

CP SUP 6.4(1) Add the following text after the paragraph in DCD Subsection 6.4.4.1:

The impact of a post-accident release on the maximum control room dose for the same US-APW R unit at Comanche Peak has been evaluated and addressed in the DCD. The DCD analysis credits operation of the main control room HVAC system in the pressurization mode. The dose to the control room operation at an adjacent US-APWR unit due to a radiological release from the other US-APWR unit is bounded by the dose to control room operators in the affected unit. While it is possible that the other US-APWR unit may be downwind in an unfavorable location, the dose at the downwind unit would be bounded by what has already been evaluated for a single US-APWR unit in the DCD. In addition, because the shortest distance between existing Comanche Peak Unit 1 or Unit 2 and US-APWR Unit 3 or Unit 4 is several times the separation between Unit 3 and Unit 4, the dose to either US-APWR unit control room from either existing operating unit would be bounded by a release at the same US-APWR Unit. Simultaneous post-accident radiological releases from multiple units at a single site are not considered to be credible.

6.4.4.2 Toxic Gas Protection

CP COL 6.4(1)
CP COL 6.4(2) Replace the second paragraph in DCD Subsection 6.4.4.2 with the following.

The control room habitability analyses consider postulated releases of toxic chemicals from mobile and stationary sources in accordance with the

requirements of RG 1.78. Chemicals, including chemicals in Comanche Peak Nuclear Power Plant (CPNPP) Units 1 and 2, are identified and screened as described in Subsection 2.2.3.1.3.

Several hazardous chemicals exceed the screening criteria provided in RG 1.78 and an analysis is required to determine control room concentrations. Toxic chemicals that do not meet RG 1.78 screening criteria are identified in Table 2.2-214, and calculated maximum control room concentrations of each chemical are also described in Table 2.2-214. Using conservative assumptions and input data for chemical source term, CPNPP Units 3 and 4 control room parameters, site characteristics, and meteorology inputs, postulated chemical releases are analyzed for maximum value concentration to the MCR using the HABIT code, version 1.1. RG 1.78 specifies the use of HABIT 1.1 software for evaluating control room habitability. HABIT software includes modules that evaluate radiological and toxic chemical transport and exposure. For this analysis of chemical release concentrations, EXTRAN, and CHEM modules are utilized in the code. EXTRAN models toxic chemical transport from the selected release point to the heating, ventilation, and air conditioning (HVAC) intake for the MCR. CHEM is then applied by HABIT to model chemical exposure to control room personnel, based on EXTRAN output and MCR design parameters.

The meteorological conditions assumed for these cases were initially set at G stability and 2.5 m/s wind speed, which is more extreme than 95th percentile for the CPNPP site. The 2.5 m/s wind speed is higher than would be expected for G stability but is conservative in that it introduces the chemical gas into the intakes faster than at lower speeds. The analyses are thus bounding. Lower concentrations are calculated on average using F stability and results for a range of wind speeds and worst case conditions are also presented below as a sensitivity analysis.

The HABIT-based analysis determines the peak concentration in the MCR and compares this level to the RG 1.78 criterion, the specific chemical listed immediately dangerous to life and health (IDLH). In the cases that were analyzed, all postulated releases led to concentrations that are well below the IDLH level. Values of IDLH for various chemicals are found in NUREG/CR-6624 (Reference 6.4-201).

The most limiting case, or the one that leads to the highest control room concentration relative to the IDLH, is the tanker truck release of chlorine on Highway FM 56, at a distance of closest approach to CPNPP Units 3 and 4 MCR intake of 1.4 miles. Chlorine is used for this case because it is one of the most hazardous Department of Transportation approved chemicals, and bounds other chemicals by toxicity, dispersibility, and quantity that may use public transportation such as Highway FM 56. Using the methodology prescribed by RG 1.78, the HABIT initial analysis for G stability and 2.5 m/s wind speed showed MCR concentration remains below 5.7 ppm at equilibrium in the MCR. This concentration (5.7ppm) is less than the IDLH concentration for chlorine (10 ppm). The concentration at the MCR HVAC intakes, that is the concentration of outside,

will exceed the IDLH (10 ppm) at about 2.5 minutes, remain elevated until approximately 7 minutes, and then start decreasing slowly on a scale based on the volume and ventilation rates in the MCR.

For Class F stability and the worst case sensitivity analysis conditions of an intake height of 0 m, solar radiation of 1150 W/m^2, a wind speed of 6 m/s, air and ground temperature of 115 °F, and cloud cover of 0 tenths, the concentration in the MCR reaches the human detection threshold for chlorine (0.08 ppm) at approximately 0.25 minutes and reaches the maximum concentration (8.0 ppm) in approximately 16 minutes.

RG 1.78 states that it is expected that a control room operator will don a respirator and protective clothing, or take other mitigating action within two minutes after detection. Also during a toxic gas emergency, the control room operators have the option of manually actuating the emergency isolation mode of the MCR HVAC System.

All of the FSAR Table 2.2-214 assumed chemical releases were analyzed with the HABIT code, and produce maximum control room concentration values well below the IDLH. Therefore, there will be no procedure requiring operator action, either donning respirators and protective clothing or manually isolating the control room HVAC System. Both of these response actions will be considered at the discretion of the operators in the event of a toxic gas release. The CPNPP Units 3 and 4 Emergency Plan includes provisions for maintaining self-contained breathing apparatuses (SCBAs) in the control room. A toxic gas release is within the scope of procedures addressed by FSAR Subsection 13.5.2. Training is addressed in the CPNPP Emergency Plan and in Subsection 13.2 of the FSAR.

Periodic surveys are conducted for onsite chemicals annually and for offsite at least once every three years for stationary and mobile sources of hazardous chemicals within a five mile radius of the plant in accordance with Regulatory Guide 1.196 Regulatory Position 2.5. In addition, prior to use, chemicals and chemicals of potential impact (halogenated gas or liquid products to be purchased in quantities of 100 pounds or greater) require a Control Room Habitability assessment. Procedures to implement these periodic surveys and chemical evaluations are developed per Subsection 13.5.2.2.

ITAAC (Tier 1 Section 2.7.5.1.2) and pre-operational tests (Tier 2 Subsection 14.2.12.1.101) address CRE integrity and verify the functional arrangement of MCR HVAC equipment and systems in adjacent areas with the design description, in accordance with RG 1.196. Operating and maintenance procedures as mentioned in FSAR Section 13.5 address periodic assessment of the control room habitability system material condition, configuration controls, safety analyses and operating and maintenance procedures in accordance with the guidance in RG 1.196.

6.4.6 Instrumentation Requirement

STD COL 6.4(5) Replace the last paragraph in DCD Subsection 6.4.6 with the following.

Instrumentation to detect and alarm a hazardous chemical release in the vicinity, and to automatically isolate the control room envelope (CRE) from such releases is not required based on analyses described in Subsection 6.4.4.2. No hazardous chemicals concentrations in the MCR exceeded the IDLH criteria of RG 1.78.

6.4.7 Combined License Information

Replace the content of DCD Subsection 6.4.7 with the following.

CP COL 6.4(1) ***6.4(1)*** *Toxic chemicals of mobile and stationary sources and evaluation of the control room habitability*

This COL item is addressed in Subsection 6.4.4.2.

CP COL 6.4(2)
STD COL 6.4(2) ***6.4(2)*** *Automatic and manual action for the MCR HVAC system that are required in the event of postulated toxic gas release*

This COL item is addressed in Subsection 6.4.3 and Subsection 6.4.4.2.

6.4(3) *Deleted from the DCD.*

6.4(4) *Deleted from the DCD.*

STD COL 6.4(5) ***6.4(5)*** *Toxic gas detection requirements necessary to protect the CRE*

This COL item is addressed in Subsection 6.4.6.

6.4.8 References

Add the following reference after the last reference in DCD Subsection 6.4.8.

6.4-201 U.S. Nuclear Regulatory Commission, *Recommendations for Revision of Regulatory Guide 1.78*, NUREG/CR-6624, Washington, DC, 1999.

6.5 FISSION PRODUCT REMOVAL AND CONTROL SYSTEMS

This section of the referenced DCD is incorporated by reference with no departures or supplements.

6.6 INSERVICE INSPECTION OF CLASS 2 AND 3 COMPONENTS

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

STD COL 6.6(1) Replace the second sentence of the second paragraph in DCD Section 6.6 with the following.

A preservice inspection program (non-destructive base line examination) and an Inservice inspection program for American Society of Mechanical Engineers (ASME) Code Section III Class 2 and 3 systems, components (pumps and valves), piping, and supports will be developed and implemented in accordance with Table 13.4-201.

6.6.8 Augmented ISI to Protect Against Postulated Piping Failures

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STD COL 6.6(2) Replace the first sentence of the second paragraph in DCD Subsection 6.6.8 with the following.

Implementation milestones of the augmented ISI program are the same as that specified for inservice inspection of Class 2 and 3 components provided in Table 13.4-201.

6.6.9 Combined License Information

Replace the content of DCD Subsection 6.6.9 with the following.

STD COL 6.6 (1) ***6.6(1)*** *Preparation of a preservice inspection program and an inservice inspection program*

This COL item is addressed in Section 6.6.

STD COL 6.6(2) ***6.6(2)*** *Preparation of an augmented inservice inspection program for high-energy fluid system piping*

This COL Item is addressed in Subsection 6.6.8.
