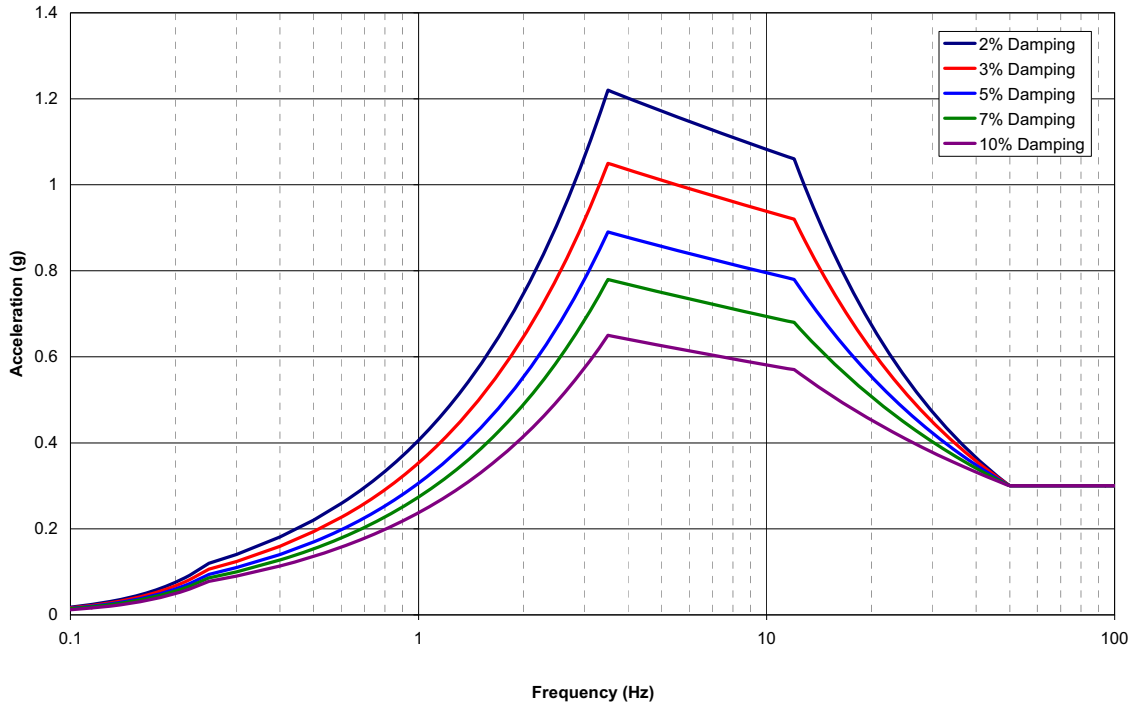


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Figure 2.1-1 US-APWR Certified Seismic Design Response Spectra (Horizontal)



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Figure 2.1-2 US-APWR Certified Seismic Design Response Spectra (Vertical)

2.2 STRUCTURAL AND SYSTEMS ENGINEERING

2.2.1 Building Structures Design Description

The US-APWR includes the reactor building (R/B), which contains the prestressed concrete containment vessel (PCCV) and containment internal structure, two power source buildings (PS/Bs), power source fuel storage vaults (PSFSVs), auxiliary building (A/B), turbine building (T/B), access building (AC/B), and essential service water pipe tunnel (ESWPT). The seismic classifications for these structures are provided in Table 2.2-1.

Seismic Category I structures are designed and constructed to withstand design-basis loads without loss of structural integrity. Design basis loads are:

- Normal plant operation (including dead loads, live loads, lateral earth pressure loads, equipment loads, hydrodynamic loads, temperature, and equipment vibration)
- External events (including rain, snow, flood, tornado, hurricane, tornado generated missiles, hurricane generated missiles, and earthquake)
- Internal events (including flood, pipe rupture, equipment failure, and equipment failure generated missiles).

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2.2.1.1 Reactor Building (R/B)

The R/B has five main floors and contains the PCCV near its center. ~~The R/B and PCCV are founded on a reinforced concrete common basemat, which is isolated from adjacent A/B, T/B, and PS/B basemats.~~ The R/B including the PCCV, the containment internal structure and the essential service water pipe chase (ESWPC), the PS/Bs including the ESWPC, and the A/B are founded on the common reinforced concrete basemat and compose a structurally integrated building, which is termed Reactor Building Complex (R/B Complex). The R/B roof, outer walls, and floor slabs are constructed of reinforced concrete.

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The PCCV includes the containment vessel, internal structure, and the containment penetration area annulus to provide an efficient leak-tight barrier and environmental radiation protection under all postulated design basis conditions, including LOCA.

2.2.1.2 Prestressed Concrete Containment Vessel (PCCV)

The PCCV is a vertically oriented cylindrical structure topped by a hemispherical dome. The structural form transitions from a cylinder to a dome without the use of a ring girder. The PCCV shell is constructed of reinforced concrete, pre-stressed by use of un-bonded tendons, and has the capacity to accept limiting design basis temperature and pressure loads while retaining design margin to inelastic deformation.

The PCCV inner surface is lined with SA-516 grade 60 or equivalent carbon steel plate, which is anchored to the concrete shell and dome by concrete embedments to form a leaktight pressure boundary. The liner plate is not credited in structural design load capacity calculations. The minimum concrete design compressive strengths (f'_c) for the PCCV and basemat are ~~76000~~ 76000 psi and ~~54000~~ 54000 psi, respectively. The PCCV internal pressure load capacity is based on the cumulative yield strength of steel structural elements, such as concrete reinforcement bars and pre-stressing tendons.

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2.2.1.3 Containment Internal Structure

The PCCV internal structure includes steel-concrete (SC) modules and provide support for reactor coolant system (RCS) components. SC module walls provide radiation shielding as well as sub-compartments within the PCCV.

2.2.1.4 Power Source Buildings (PS/Bs)

The two PS/Bs are located immediately adjacent to the R/B. ~~These are freestanding buildings founded on separate reinforced concrete basemats.~~ The two PS/Bs are reinforced concrete structures on a common basemat with the R/B and the A/B. The east PS/B is structurally integrated with the R/B and the west PS/B is structurally integrated with the R/B and the A/B.

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2.2.1.5 Power Source Fuel Storage Vaults (PSFSVs)

The PSFSVs are reinforced concrete structures of a site-specific design that contain the fuel tanks for the emergency power generators.

2.2.1.6 Essential Service Water Pipe Tunnel (ESWPT)

~~The ESWPT is a reinforced concrete structure of a site specific design that runs from beneath the T/B to the ultimate heat sink related structure (UHSRS). The ESWPT is isolated from other structures to prevent seismic structural interaction.~~ The ESWPT is comprised of reinforced concrete structures that run from the ESWPC in the R/B Complex to the Ultimate Heat Sink Related Structures (UHSRS). The ESWPT is isolated from other structures.

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2.2.1.7 Auxiliary Building (A/B)

The A/B is located immediately adjacent to the R/B ~~and is founded on a separate reinforced concrete basemat.~~

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The A/B is a reinforced concrete structure on a common basemat with the R/B and the PS/Bs. The A/B is structurally integrated with the R/B and the west PS/B.

2.2.1.8 Turbine Building (T/B)

The T/B is located adjacent to the R/B and is founded on a separate reinforced concrete basemat.

2.2.1.9 Access Building (AC/B)

The AC/B is located adjacent to the A/B.

2.2.2 Protection Against Hazards

2.2.2.1 Internally Generated Missiles (Inside and Outside Containment)

One or more of the following methods provide missile protection for safety-related SSCs:

- Locating the system or component in a missile-proof structure
- Separating redundant systems or components

Table 2.2-2 Definition of Wall Thicknesses for Seismic Category I Structures: Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 2 of 17)

Wall or Section Description	Column Lines ⁽¹⁾	Floor Elevation or Elevation Range ⁽¹⁾	Concrete Thickness ⁽³⁾ (5)	Applicable Radiation Shielding Wall (Yes/No)
Refueling Water Storage Pit Wall	Not Applicable	From 1'-11" to 21'-11"	3'-3"	Yes
North side of floor	Not Applicable	25'-3"	3'-4"	No
South side of floor	Not Applicable	25'-3"	3'-4"	Yes
East side of floor	Not Applicable	25'-3"	4'-3"	No
West side of floor	Not Applicable	25'-3"	4'-3"	No
Floor	Not Applicable	50'-2"	1'-4"	Yes
Floor	Not Applicable	76'-5"	2'-0"	No
Reactor Building				
Fuel Storage and Handling Area (Spent Fuel Pit, New Fuel Pit, Cask Pit, Cask Washdown Pit, Fuel Inspection Pit)				
Column Line AR wall	From 48R to 29aR	From -26'-4" to 3'-7"	3'-4"	Yes
Column Line AR wall	From 29aR to 411R	From -26'-4" to -8'-7"	4'-0"	Yes

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Table 2.2-2 Definition of Wall Thicknesses for Seismic Category I Structures: Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 3 of 17)

Wall or Section Description	Column Lines ⁽¹⁾	Floor Elevation or Elevation Range ⁽¹⁾	Concrete Thickness ⁽⁵⁾	Applicable Radiation Shielding Wall (Yes/No)
Column Line AR wall	From 29aR to 411R	From -8'-7" to 3'-7"	3'-8"	Yes
Column Line AR wall	From 411R to 13'-2" east of 613aR	From -26'-4" to 3'-7"	3'-8"	Yes
Column Line AR wall	From 13'-2" east of 613aR to 815R	From -26'-4" to 3'-7"	3'-4"	Yes
Column Line AR wall	From 815R to 6'-8" east of 815aR	From -26'-4" to 3'-7"	4'-0"	Yes
Column Line AR wall	From 6'-8" east of 815aR to 4418R	From -26'-4" to 3'-7"	3'-4"	Yes
Column Line AR wall	From 48R to 29aR	From 3'-7" to 25'-3"	35'-40"	Yes
Column Line AR wall	From 29aR to 411R	From 3'-7" to 25'-3"	3'-8"	Yes
Column Line AR wall	From 411R to 913'-42" east of 613aR	From 3'-7" to 25'-3"	7'-9"	Yes
Column Line AR wall	From 913'-42" east of 613aR to 4418R	From 3'-7" to 25'-3"	3'-4"	Yes
Column Line AR wall	From 48R to 29aR	From 25'-3" to 50'-2"	35'-40"	Yes
Column Line AR wall	From 29aR to 411R	From 25'-3" to 50'-2"	5'-9"	Yes
Column Line AR wall	From 411R to 512aR	From 30'-1" to 76'-5"	7'-9"	Yes
Column Line AR wall	From 613R to 913'-42" east of 613aR	From 27'-4" to 76'-5"	7'-9"	Yes
Column Line AR wall	From 913'-42" east of 613aR to 4418R	From 25'-3" to 50'-2"	3'-4"	Yes
Column Line AR wall	From 48R to 8'-3" east of 2bR9aR	From 50'-2" to 76'-5"	35'-40"	Yes
<u>Column Line AR wall</u>	<u>From 9aR to 11R</u>	<u>From 50'-2" to 76'-5"</u>	<u>3'-4"</u>	<u>Yes</u>

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Table 2.2-2 Definition of Wall Thicknesses for Seismic Category I Structures: Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 4 of 17)

Wall or Section Description	Column Lines ⁽¹⁾	Floor Elevation or Elevation Range ⁽¹⁾	Concrete Thickness ⁽⁵⁾	Applicable Radiation Shielding Wall (Yes/No)
Column Line AR wall	From 512aR to 613R	From 50'-2" to 76'-5"	7'-9"	Yes
Column Line AR wall	From 9'-4" east of 613aR to 6'-8" east of 815R	From 48'-3" to 76'-5"	6'-10"	Yes
Column Line AR wall	From 6'-8" east of 815R to 4418R	From 50'-2" to 76'-5"	3'-4"	Yes
Column Line AR wall	From 48R to 7'-1" east of 2bR9aR	From 76'-5" to 101'-0"	35'-40"	Yes
<u>Column Line AR wall</u>	<u>From 9aR to 3'-1" east of 9bR</u>	<u>From 76'-5" to 101'-0"</u>	<u>3'-4"</u>	<u>Yes</u>
Column Line AR wall	From 73'-1" east of 29bR to 4418R	From 76'-5" to 1547'-6"	1'-9"	Yes
Column Line 48R wall	From AR to CR	From -26'-4" to 50'-2"	3'-4"	Yes
Column Line 48R wall	From AR to CR	From 50'-2" to 76'-5"	2'-8"	Yes
Column Line 48R wall	From AR to CR	From 76'-5" to 101'-0"	2'-4"	Yes
Column Line 4418R wall	From AR to CR	From -26'-4" to 3'-7"	3'-4"	Yes
Column Line 4418R wall	From A23R to 6BR	From 3'-7" to 25'-3"	3'-4"	Yes
<u>Column Line 18R wall</u>	<u>From BR to CR</u>	<u>From 3'-7" to 50'-2"</u>	<u>5'-0"</u>	<u>Yes</u>
Column Line 4418R wall	From AR to 6BR	From 25'-3" to 50'-2"	3'-4"	Yes
Column Line 4418R wall	From AR to CR	From 50'-2" to 76'-5"	3'-4"	Yes
Column Line 4418R wall	From AR to CR	From 76'-5" to 125'-8"	34'-40"	Yes
Column Line 4418R wall	From AR to CR	From 125'-8" to 1547'-6"	23'-04"	Yes
Floor	From AR to CR and 48R to 4418R	-26'-4"	913'-114"	No

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Table 2.2-2 Definition of Wall Thicknesses for Seismic Category I Structures: Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 5 of 17)

Wall or Section Description	Column Lines ⁽¹⁾	Floor Elevation or Elevation Range ⁽¹⁾	Concrete Thickness ⁽⁵⁾	Applicable Radiation Shielding Wall (Yes/No)
Safety System Pumps Areas				
Column Line CR wall	From 48R to 29R	From -26'-4" to -83'-7"	3'-4"	No
Column Line CR wall	From 29R to 411bR	From -26'-4" to 3'-7"	3'-4"	Yes
Column Line CR wall	From 815R to 4017R	From -26'-4" to 3'-7"	3'-4"	Yes
Column Line CR wall	From 4017R to 4418R	From -26'-4" to -83'-7"	3'-4"	No
Column Line CR wall	From 29R to 3'-4" east of 411aR	From 3'-7" to 15'-9"	3'-10"	Yes
Column Line CR wall	From 28R to 3'-4" east of 411aR	From 15'-9" to 25'-3"	3'-2"	Yes
Column Line CR wall	From 3'-4" east of 411aR to 10'-1" east of 815R	From 3'-7" to 25'-3"	34'-20"	Yes
Column Line CR wall	From 10'-1" east of 815R to 4418R	From 3'-7" to 25'-3"	3'-10"	Yes
Column Line CR wall	From 48R to 411bR	From 25'-3" to 50'-2"	3'-2"	Yes
Column Line CR wall	From 411bR to 402'-56" east of 411bR	From 25'-3" to 50'-2"	3'-4"	Yes
Column Line CR wall	From 402'-56" east of 411bR to 613aR	From 25'-3" to 50'-2"	3'-10"	Yes
Column Line CR wall	From 613aR to 714aR	From 25'-3" to 50'-2"	3'-8"	Yes
Column Line CR wall	From 714aR to 2'-4" east of 815aR	From 25'-3" to 50'-2"	3'-2"	No
Column Line CR wall	From 2'-4" east of 815aR to 4418R	From 25'-3" to 50'-2"	2'-0"	Yes

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Table 2.2-2 Definition of Wall Thicknesses for Seismic Category I Structures: Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 6 of 17)

Wall or Section Description	Column Lines ⁽¹⁾	Floor Elevation or Elevation Range ⁽¹⁾	Concrete Thickness ⁽⁵⁾	Applicable Radiation Shielding Wall (Yes/No)
Column Line CR wall	From 48R to 8'-3" east of 29bR	From 50'-2" to 76'-5"	2'-6"	Yes
Column Line CR wall	From 48R to 3'-1" east of 29bR	From 76'-5" to 101'-0"	2'-8"	No
Column Line CR wall	From 3'-9 1/2" east of 29bR to 411bR	From 76'-5" to 101'-0"	2'-8"	Yes
<u>Column Line CR wall</u>	<u>From 11bR to 13aR</u>	<u>From 76'-5" to 101'-0"</u>	<u>2'-4"</u>	<u>Yes</u>
Column Line CR wall	From 3'-9 1/2" east of 29bR to 4b13aR	From 101'-0" to 154 7/8"-6"	1'-9"	Yes
<u>Column Line CR wall</u>	<u>From 13aR to 18R</u>	<u>From 76'-5" to 112'-0"</u>	<u>2'-4"</u>	<u>Yes</u>
Column Line CR wall	From 4b13aR to 4418R	From 76 11/2"-50" to 154 7/8"-6"	1'-9"	Yes
Column Line JR wall	From 48R to 512R	From -26'-4" to 3'-7"	3'-8"	Yes
Column Line JR wall	From 714R to 4418R	From -26'-4" to 3'-7"	3'-8"	Yes
Column Line JR wall	From 48R to 449aR	From 3'-7" to 26'-11"	3'-8"	Yes
<u>Column Line JR wall</u>	<u>From 9aR to 16bR</u>	<u>From 3'-7" to 26'-11"</u>	<u>4'-4"</u>	<u>Yes</u>
<u>Column Line JR wall</u>	<u>From 16bR to 18R</u>	<u>From 3'-7" to 26'-11"</u>	<u>5'-0"</u>	<u>Yes</u>
Column Line JR wall	From 48R to 4418R	From 26'-11" to 50'-2"	3'-4"	Yes
Column Line JR wall	From 48R to 512R	From 50'-2" to 76'-5"	3'-4"	No
Column Line JR wall	From 512R to 714R	From 50'-2" to 65'-0"	3'-4"	No
Column Line JR wall	From 714R to 4418R	From 50'-2" to 76'-5"	3'-4"	No
Column Line JR wall	From 48R to 512R	From 76'-5" to 101'-0"	3'-4"	No
Column Line JR wall	From 714R to 4418R	From 76'-5" to 101'-0"	3'-4"	No
Column Line 48R wall	From CR to JR	From -26'-4" to 3'-7"	3'-4"	Yes

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Table 2.2-2 Definition of Wall Thicknesses for Seismic Category I Structures: Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 7 of 17)

Wall or Section Description	Column Lines ⁽¹⁾	Floor Elevation or Elevation Range ⁽¹⁾	Concrete Thickness ⁽⁵⁾	Applicable Radiation Shielding Wall (Yes/No)
Column Line 48R wall	From CR to 12'-7" south of D2R	From 3'-7" to 25'-3"	3'-4"	Yes
Column Line 48R wall	From 12'-7" south of D2R to 10'-8" south of GR	From 3'-7" to 17'-8"	3'-4"	Yes
Column Line 48R wall	From 12'-7" south of D2R to 10'-8" south of GR	From 17'-8" to 25'-3"	4'-2"	Yes
Column Line 48R wall	From 10'-8" south of GR to JR	From 3'-7" to 25'-3"	3'-4"	Yes
Column Line 48R wall	From CR to 11'-11" south of D2R	From 25'-3" to 50'-2"	3'-4"	Yes
Column Line 48R wall	From 11'-11" south of D2R to 11'-4" south of GR	From 25'-3" to 42'-4"	3'-4"	Yes
Column Line 48R wall	From 11'-11" south of D2R to 11'-4" south of GR	From 42'-4" to 50'-2"	4'-2"	Yes
Column Line 48R wall	From 10'-8" south of GR to JR	From 25'-3" to 50'-2"	3'-4"	Yes
Column Line 48R wall	From CR to 15'-7" south of HR	From 50'-2" to 76'-5"	2'-8"	Yes
Column Line 48R wall	From 15'-7" south of HR to JR	From 50'-2" to 76'-5"	3'-4"	No
Column Line 48R wall	From CR to JR	From 76'-5" to 101'-0"	2'-4"	Yes
Column Line 29R wall	From CR to 8'-7" south of CR	From -26'-4" to -8'-7"	3'-4"	Yes
Column Line 29R wall	From 17'-7" south of CR to 6'-10" south of D2R	From -26'-4" to -8'-7"	2'-8"	Yes
Column Line 29R wall	From 16'-5" south of GR to 15'-7" south of HR	From -26'-4" to -8'-7"	2'-8"	Yes

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Table 2.2-2 Definition of Wall Thicknesses for Seismic Category I Structures: Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 8 of 17)

Wall or Section Description	Column Lines ⁽¹⁾	Floor Elevation or Elevation Range ⁽¹⁾	Concrete Thickness ⁽⁵⁾	Applicable Radiation Shielding Wall (Yes/No)
Column Line 29R wall	From 4'-1" south of H1R to JR	From -26'-4" to 3'-7"	5'-0"	Yes
Column Line 29R wall	From CR to 6'-10" south of D2R	From -8'-7" to 3'-7"	3'-4"	Yes
Column Line 29R wall	From 16'-5" south of GR to 4'-1" south of H1R	From -8'-7" to 3'-7"	3'-4"	Yes
Column Line 29R wall	From CR to DR	From 3'-7" to 25'-3"	3'-10"	Yes
Column Line 29R wall	From DR to ER	From 3'-7" to 25'-3"	3'-6"	Yes
Column Line 29R wall	From ER to GR	From 3'-7" to 17'-8"	2'-8"	Yes
Column Line 29R wall	From ER to GR	From 17'-8" to 25'-3"	4'-2"	Yes
Column Line 29R wall	From GR to HR	From 3'-7" to 25'-3"	3'-6"	Yes
Column Line 29R wall	From HR to JR	From 3'-7" to 25'-3"	3'-10"	Yes
Column Line 29R wall	From CR to DR	From 25'-3" to 50'-2"	3'-2"	Yes
Column Line 29R wall	From DR to ER	From 25'-3" to 50'-2"	3'-10"	Yes
Column Line 29R wall	From ER to GR	From 25'-3" to 50'-2"	2'-8"	Yes
Column Line 29R wall	From GR to HR	From 25'-3" to 50'-2"	3'-10"	Yes
Column Line 29R wall	From HR to H1R	From 25'-3" to 50'-2"	2'-8"	No
Column Line 29R wall	From CR to H1R	From 50'-2" to 76'-5"	2'-8"	Yes

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Table 2.2-2 Definition of Wall Thicknesses for Seismic Category I Structures: Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 9 of 17)

Wall or Section Description	Column Lines ⁽¹⁾	Floor Elevation or Elevation Range ⁽¹⁾	Concrete Thickness ⁽⁵⁾	Applicable Radiation Shielding Wall (Yes/No)
Column Line 2 9R wall	From CR to DR	From 76'-5" to 101'-0"	2'-8"	No
Column Line 2 9R wall	From DR to ER	From 76'-5" to 101'-0"	3'-8"	Yes
Column Line 2 9R wall	From ER to 9'-5" south of G1R	From 76'-5" to 101'-0"	2'-8"	Yes
Column Line 4 0 1 7R wall	From CR to 8'-7" south of CR	From -26'-4" to -8'-7"	3'-4"	Yes
Column Line 4 0 1 7R wall	From 5'-9" south of C1R to 11'-3" south of D1R	From -26'-4" to -8'-7"	2'-8"	Yes
Column Line 4 0 1 7R wall	From 16'-5" south of GR to 13'-7" south of HR	From -26'-4" to -8'-7"	2'-8"	Yes
Column Line 4 0 1 7R wall	From 4'-1" south of H1R to JR	From -26'-4" to 3'-7"	5'-0"	Yes
Column Line 4 0 1 7R wall	From CR to 11'-3" south of D1R	From -8'-7" to 3'-7"	3'-4"	Yes
Column Line 4 0 1 7R wall	From 16'-5" south of GR to 4'-1" south of H1R	From -8'-7" to 3'-7"	3'-4"	Yes
Column Line 4 0 1 7R wall	From CR to DR	From 3'-7" to 25'-3"	3'-10"	Yes
Column Line 4 0 1 7R wall	From DR to ER	From 3'-7" to 25'-3"	3'-6"	Yes
Column Line 4 0 1 7R wall	From ER to GR	From 3'-7" to 17'-8"	2 3'- 8 4"	Yes
Column Line 4 0 1 7R wall	From ER to GR	From 17'-8" to 25'-3"	4'-2"	Yes
Column Line 4 0 1 7R wall	From GR to HR	From 3'-7" to 25'-3"	3'-6"	Yes
Column Line 4 0 1 7R wall	From HR to JR	From 3'-7" to 25'-3"	3'-10"	Yes

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Table 2.2-2 Definition of Wall Thicknesses for Seismic Category I Structures: Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 10 of 17)

Wall or Section Description	Column Lines ⁽¹⁾	Floor Elevation or Elevation Range ⁽¹⁾	Concrete Thickness ⁽⁵⁾	Applicable Radiation Shielding Wall (Yes/No)
Column Line 40 17R wall	From CR to DR	From 25'-3" to 50'-2"	2'-8"	No
Column Line 40 17R wall	From DR to ER	From 25'-3" to 50'-2"	3'-10"	Yes
Column Line 40 17R wall	From ER to GR	From 25'-3" to 50'-2"	2'-8"	Yes
Column Line 40 17R wall	From GR to HR	From 25'-3" to 50'-2"	3'-10"	Yes
Column Line 40 17R wall	From HR to H1R	From 25'-3" to 50'-2"	2'-8"	No
Column Line 40 17R wall	From CR to H1R	From 50'-2" to 76'-5"	2'-8"	Yes
Column Line 40 17R wall	From D1R to ER	From 76'-5" to 112'-0"	2'-8"	No
Column Line 40 17R wall	From ER to GR	From 76'-5" to 101'-0"	2'-8"	Yes
Column Line 40 17R wall	From GR to H1R	From 76'-5" to 101'-0"	3'-8"	Yes
Column Line 44 18R wall	From CR to JR	From -26'-4" to 3'-7"	3'-4"	Yes
Column Line 44 18R wall	From CR to 17'-0" south of D1R	From 3'-7" to 25'-3"	3'-4"	Yes
Column Line 44 18R wall	From 17'-0" south of D1R to 10'-8" south of GR	From 3'-7" to 17'-8"	3'-4"	Yes
Column Line 44 18R wall	From 17'-0" south of D1R to 10'-8" south of GR	From 17'-8" to 25'-3"	4'-2"	Yes
Column Line 44 18R wall	From 10'-8" south of GR to H J JR	From 3'-7" to 25'-3"	3'-4"	Yes
Column Line 11R wall	From HR to JR	From 3'-7" to 76'-5"	5'-0"	Yes

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Table 2.2-2 Definition of Wall Thicknesses for Seismic Category I Structures: Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 11 of 17)

Wall or Section Description	Column Lines ⁽¹⁾	Floor Elevation or Elevation Range ⁽¹⁾	Concrete Thickness ⁽⁵⁾	Applicable Radiation Shielding Wall (Yes/No)
Column Line 44 10R wall	From CR to 16'-4" south of D1R	From 25'-3" to 50'-2"	3'-4"	Yes
Column Line 44 18R wall	From 16'-4" south of D1R to 11'-4" south of GR	From 25'-3" to 42'-4"	3'-4"	Yes
Column Line 44 18R wall	From 16'-4" south of D1R to 11'-4" south of GR	From 42'-4" to 50'-2"	4'-2"	Yes
Column Line 44 18R wall	From 11'-4" south of GR to HR	From 25'-3" to 50'-2"	3'-4"	Yes
<u>Column Line 18R wall</u>	<u>From HR to JR</u>	<u>From 25'-3" to 101'-0"</u>	<u>5'-0"</u>	<u>Yes</u>
Column Line 44 18R wall	From CR to HR	From 50'-2" to 76'-5"	2'-8"	Yes
Column Line 44 18R wall	From D1R to ER	From 76'-5" to 112'-0"	2'-4"	Yes
Column Line 44 18R wall	From ER to HR	From 76'-5" to 101'-0"	2'-4"	Yes
Column Line 11R wall	From HR to JR	From 76'-5" to 101'-0"	5'-0"	No
Floor	From CR to JR and 48 R to 29 R	-26'-4"	913'-114"	No
Floor	From CR to JR and 40 17R to 44 18R	-26'-4"	913'-114"	No
Floor	From CR to JR and 48 R to 29 R	3'-7"	2'-8"	No
Floor	From CR to JR and 40 17R to 44 18R	3'-7"	2'-8"	No
Floor	From ER to GR and 48 R to 29 R	25'-3"	3'-10"	Yes
Floor	From ER to GR and 40 17R to 44 18R	25'-3"	3'-10"	Yes
Floor	From ER to GR and 48 R to 29 R	50'-2"	3'-10"	Yes

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Table 2.2-2 Definition of Wall Thicknesses for Seismic Category I Structures: Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 12 of 17)

Wall or Section Description	Column Lines ⁽¹⁾	Floor Elevation or Elevation Range ⁽¹⁾	Concrete Thickness ⁽⁵⁾	Applicable Radiation Shielding Wall (Yes/No)
Floor	From ER to GR and 40 17R to 44 18R	50'-2"	3'-10"	Yes
Floor	From CR to GR and 48 R to 29 R	76'-5"	2'-4"	No
Floor	From GR to HR and 48 R to 29 R	76'-5"	2'-8"	Yes
Floor	From CR to HR and 40 17R to 44 18R	76'-5"	3'-4"	Yes
Floor	From CR to GR and 48 R to 29 R	101'-0"	1'-3"	Yes
Floor	From 4'-0" south of CR to E D1R and 40 17R to 44 18R	112'-0"	43 - 3 4	Yes
<u>Floor</u>	<u>From D1R to ER and 17R to 18R</u>	<u>112'-0"</u>	<u>2'-8"</u>	<u>Yes</u>
Non-Radiological Control Area				
Column Line LR wall	From 48 R to 44 18R	From -26'-4" to 3'-7"	35 '- 80 "	No
Column Line LR wall	From 48 R to 3a 10R	From 3'-7" to 26'-11"	35 '- 80 "	No
Column Line LR wall	From 3a 10R to 8b 16R	From 3'-7" to 25'-3"	35 '- 08 "	No
Column Line LR wall	From 8b 16R to 44 18R	From 3'-7" to 26'-11"	35 '- 80 "	No
Column Line LR wall	From 48 R to 3a 10R	From 26'-11" to 50'-2"	35 '- 40 "	No
Column Line LR wall	From 3a 10R to 8b 16R	From 25'-3" to 50'-2"	35 '- 40 "	Yes
Column Line LR wall	From 8b 16R to 44 18R	From 26'-11" to 50'-2"	35 '- 40 "	No
Column Line LR wall	From 48 R to 5 12R	From 50'-2" to 76'-5"	35 '- 40 "	No

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Table 2.2-2 Definition of Wall Thicknesses for Seismic Category I Structures: Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 13 of 17)

Wall or Section Description	Column Lines ⁽¹⁾	Floor Elevation or Elevation Range ⁽¹⁾	Concrete Thickness ⁽⁵⁾	Applicable Radiation Shielding Wall (Yes/No)
Column Line LR wall	From <u>512R</u> to <u>714R</u>	From 50'-2" to 65'-0"	35'-40"	No
Column Line LR wall	From <u>714R</u> to <u>4418R</u>	From 50'-2" to 76'-5"	35'-40"	No
Column Line LR wall	From <u>48R</u> to <u>512R</u>	From 76'-5" to 115'-6"	35'-40"	No
Column Line LR wall	From <u>512R</u> to <u>714R</u>	From 65'-0" to 115'-6"	46'-40"	No
Column Line LR wall	From <u>714R</u> to <u>4418R</u>	From 76'-5" to 115'-6"	35'-40"	No
Column Line <u>48R</u> wall	From JR to KR	From -26'-4" to 101'-0"	3'-4"	No
Column Line <u>48R</u> wall	From KR to LR	From -26'-4" to 115'-6"	3'-4"	No
Column Line <u>4418R</u> wall	From JR to KR	From -26'-4" to 101'-0"	3'-4"	No
Column Line <u>4418R</u> wall	From KR to LR	From -26'-4" to 115'-6"	3'-4"	No
Floor	From JR to LR and <u>48R</u> to <u>4418R</u>	-26'-4"	913'-114"	No
Floor	From JR to LR and <u>48R</u> to <u>4418R</u>	3'-7"	4'-0"	No
Floor	From JR to <u>LKR</u> and <u>48R</u> to <u>39aR</u>	26'-11"	2'-4"	No
<u>Floor</u>	<u>From KR to LR and 8R to 10R</u>	<u>26'-11"</u>	<u>2'-4"</u>	<u>No</u>
<u>Floor</u>	<u>From JR to KR and 9aR to 12R</u>	<u>25'-3"</u>	<u>2'-4"</u>	<u>No</u>
<u>Floor</u>	<u>From KR to LR and 10R to 12R</u>	<u>25'-3"</u>	<u>2'-4"</u>	<u>No</u>
Floor	From JR to LR and <u>512R</u> to <u>714R</u>	25'-3"	3'-4"	Yes
Floor	From JR to <u>LKR</u> and <u>914R</u> to <u>4416bR</u>	26'25'-44'3"	2'-4"	No
<u>Floor</u>	<u>From KR to LR and 14R to 16R</u>	<u>25'-3"</u>	<u>2'-4"</u>	<u>No</u>
<u>Floor</u>	<u>From JR to KR and 16bR to 18R</u>	<u>26'-11"</u>	<u>2'-4"</u>	<u>No</u>
<u>Floor</u>	<u>From KR to LR and 16R to 18R</u>	<u>26'-11"</u>	<u>2'-4"</u>	<u>No</u>
Floor	From JR to LR and <u>48R</u> to <u>512R</u>	50'-2"	2'-4"	No

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Table 2.2-2 Definition of Wall Thicknesses for Seismic Category I Structures: Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 14 of 17)

Wall or Section Description	Column Lines ⁽¹⁾	Floor Elevation or Elevation Range ⁽¹⁾	Concrete Thickness ⁽⁵⁾	Applicable Radiation Shielding Wall (Yes/No)
Floor	From JR to LR and 512R to 714R	50'-2"	3'-4"	Yes
Floor	From JR to LR and 714R to 4418R	50'-2"	2'-4"	No
Floor	From JR to KR and 48R to 512R	76'-5"	2'-4"	No
Floor	From KR to LR and 48R to 512R	76'-5"	4'-4"	No
Floor	From JR to KR and 714R to 4418R	76'-5"	2'-4"	No
Floor	From KR to LR and 714R to 4418R	76'-5"	4'-4"	No
Floor	From JR to KR and 48R to 512R	101'-0"	2'-4"	No
Floor	From JR to KR and 714R to 4418R	101'-0"	2'-4"	No

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Table 2.2-2 Definition of Wall Thicknesses for Seismic Category I Structures: Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 15 of 17)

Wall or Section Description	Column Lines ⁽¹⁾	Floor Elevation or Elevation Range ⁽¹⁾	Concrete Thickness ⁽⁵⁾	Applicable Radiation Shielding Wall (Yes/No)
West Power Source Buildings				
Column Line AP JR wall	From 1 P R to 5 P 3R	From -26'-4" to 30'-72"	24'-82"	No Yes
Column Line JR wall	From 1R to 3R	From 30'-2" to 39'-6"	3'-4"	No
Column Line CP JR wall	From 4 P 3R to 5 P 8R	From -26'-4" to 39'-76"	23'-84"	No Yes
Column Line 4 P LR wall	From AP 1R to CP 7R	From -26'-4" to 39'-76"	23'-84"	No
Column Line 5 P LR wall	From AP 7R to CP 8R	From -26'-4" to 324'-72"	23'-84"	No
Column Line AP LR wall	From 4 P 7R to 5 P 8R	From 324'-72" to 39'-6"	14'-90"	No
Column Line CP 1R wall	From 4 P JR to 5 P LR	From 326'-74" to 39'-6"	13'-94"	No
Column Line 1P wall	From AP to CP	From 3'-7" to 39'-6"	1'-9"	No
Column Line 5P wall	From AP to CP	From 3'-7" to 39'-6"	2'-8"	No
Floor	From AP JR to CP LR and 1 P R to 5 P 8R	-26'-4"	913'-114"	No
Floor	From AP JR to CP LR and 1 P R to 2 P 3R	3'-7"	3'-4"	No
Floor	From AP JR to CP LR and 2 P 3R to 5 P 8R	3'-7"	2'-8"	No
Floor	From AP JR to CP LR and 1 P R to 5 P 8R	39'-6"	1'-3"	No

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Table 2.2-2 Definition of Wall Thicknesses for Seismic Category I Structures: Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 16 of 17)

Wall or Section Description	Column Lines ⁽¹⁾	Floor Elevation or Elevation Range ⁽¹⁾	Concrete Thickness ⁽⁵⁾	Applicable Radiation Shielding Wall (Yes/No)
East Power Source Building				
Column Line F1R wall	From 18R to 20R	From -26'-4" to 39'-6"	3'-4"	No
Column Line JR wall	From 18R to 20R	From -26'-4" to 3'-7"	3'-4"	No
Column Line JR wall	From 18R to 20R	From 3'-7" to 39'-6"	3'-4"	No
Column Line LR wall	From 18R to 19R	From -26'-4" to 3'-7"	3'-4"	No
Column Line LR wall	From 18R to 19R	From 3'-7" to 39'-6"	4'-0"	No
Column Line LR wall	From 19R to 20R	From -26'-4" to 39'-6"	3'-4"	No
Column Line 20R wall	From F1R to LR	From -26'-4" to 39'-6"	3'-4"	No
Floor	From F1R to LR and 18R to 20R	-26'-4"	13'-4"	No
Floor	From F1R to G4R and 18R to 20R	3'-7"	3'-4"	No
Floor	From G4R to LR and 18R to 20R	3'-7"	2'-8"	No
Floor	From F1R to LR and 18R to 20R	39'-6"	1'-3"	No

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Table 2.2-2 Definition of Wall Thicknesses for Seismic Category I Structures: Containment Internal Structure, Reactor Building, and Power Source Building (Sheet 17 of 17)

Wall or Section Description	Column Lines ⁽¹⁾	Floor Elevation or Elevation Range ⁽¹⁾	Concrete Thickness ⁽⁵⁾	Applicable Radiation Shielding Wall (Yes/No)
<u>Essential Service Water Pipe Chase</u>				
South wall	From 1R to 8R	From -26'-4" to -9'-8"	3'-0"	No
South wall	From 8R to 6'-10" west of 19R	From -26'-4" to -15'-8"	3'-0"	No
South wall	From 6'-10" west of 19R to 8'-8" east of 20R	From -26'-4" to -9'-8"	3'-0"	No
Floor	From 1R to 8'-8" east of 20R	-26'-4"	13'-4"	No
Floor	From 1R to 8R	-9'-8"	2'-0"	No
Floor	From 8R to 6'-10" west of 19R	-15'-8"	2'-0"	No
Floor	From 6'-10" west of 19R to 8'-8" east of 20R	-9'-8"	2'-0"	No

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NOTES:

1. The column lines and floor elevations are identified and included on Figures 2.2-3 through 2.2-13.
2. Deleted.
3. For walls that are part of structural modules, the concrete thickness also includes the steel face plates.
4. ~~The concrete thickness values shown are minimum design required for radiation shielding.~~ This dimension is the smallest nominal wall thickness and exceeds minimum radiation shielding requirements.
5. Concrete thickness values are nominal dimensions.

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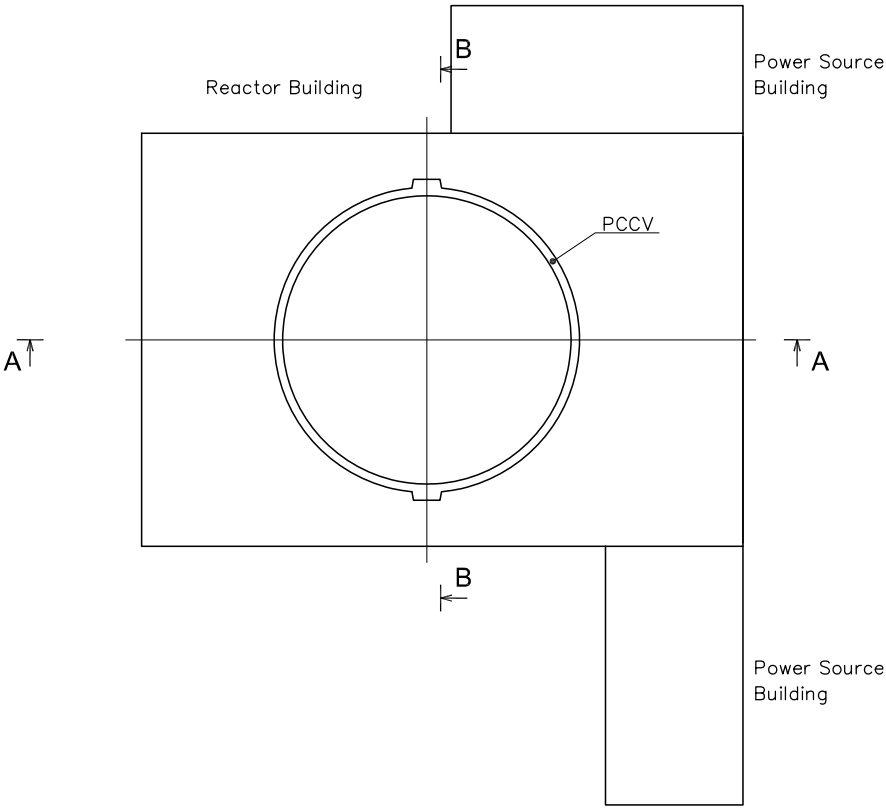
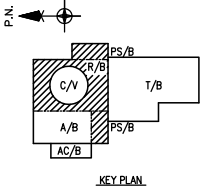


Figure 2.2-1 US-APWR Building Configuration (Plan View)

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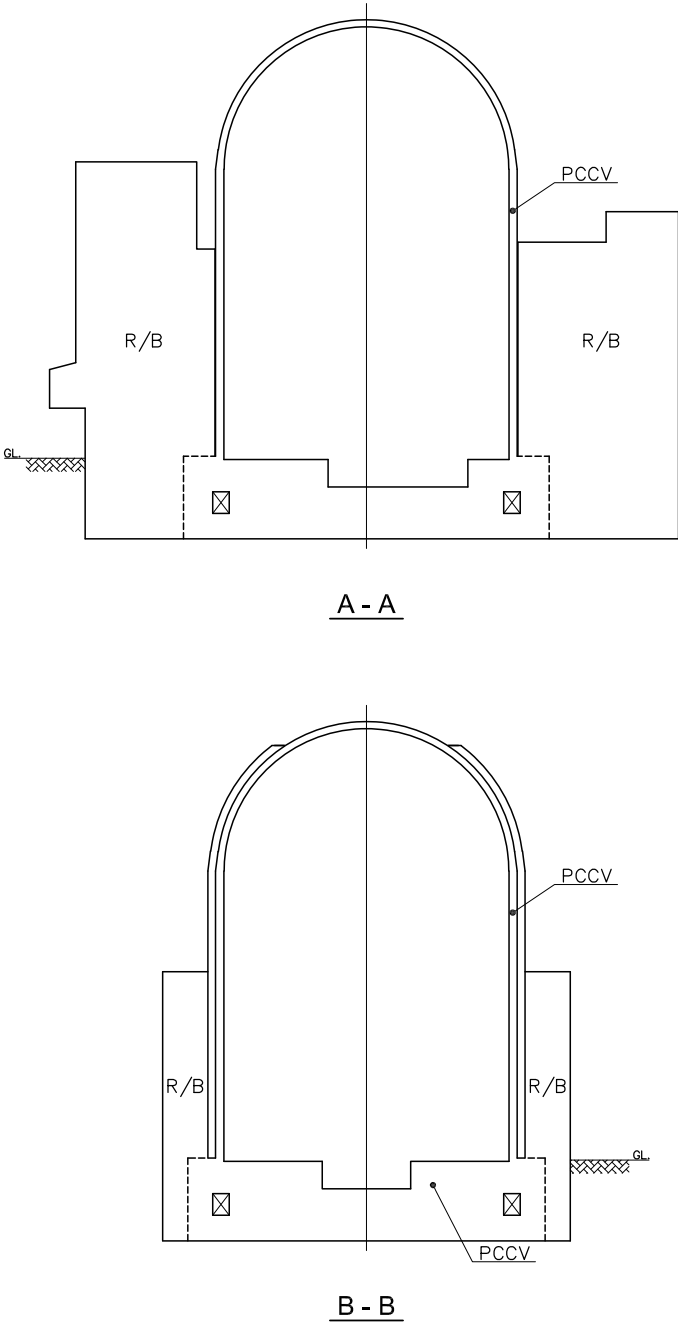


Figure 2.2-2 US-APWR Building Configuration (Section Views)

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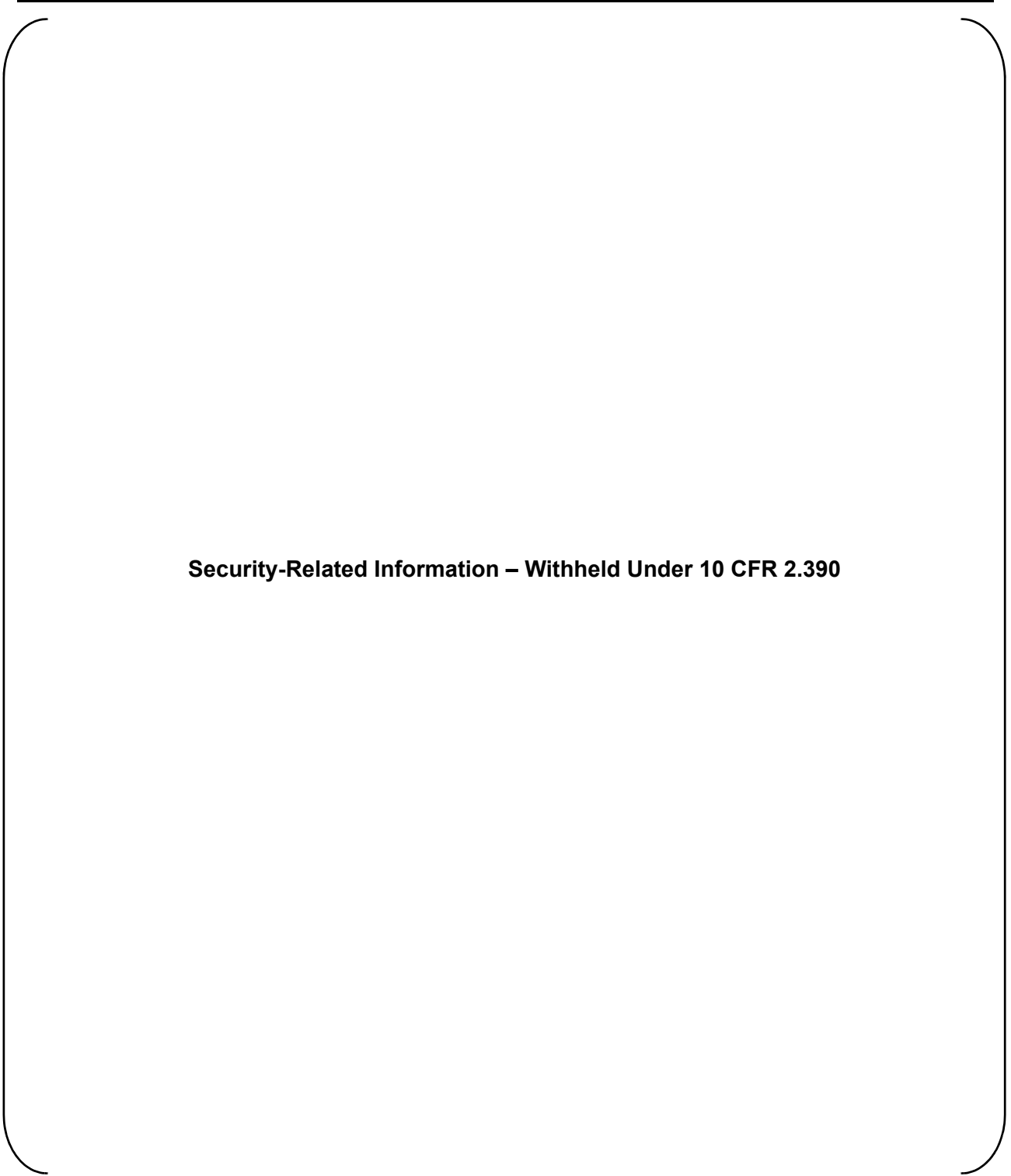
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Figure 2.2-3 US-APWR Building Architectural Layout R/B Plan View Elevation -26'-4"

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Figure 2.2-4 US-APWR Building Architectural Layout R/B Plan View Elevation 3'-7"



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Figure 2.2-5 US-APWR Building Architectural Layout R/B Plan View Elevation 25'-83"

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Figure 2.2-6 US-APWR Building Architectural Layout R/B Plan View Elevation 50'-2"

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Figure 2.2-7 US-APWR Building Architectural Layout R/B Plan View Elevation 76'-5"

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Figure 2.2-8 US- APWR Building Architectural Layout R/B Plan View Elevation 101'-0"

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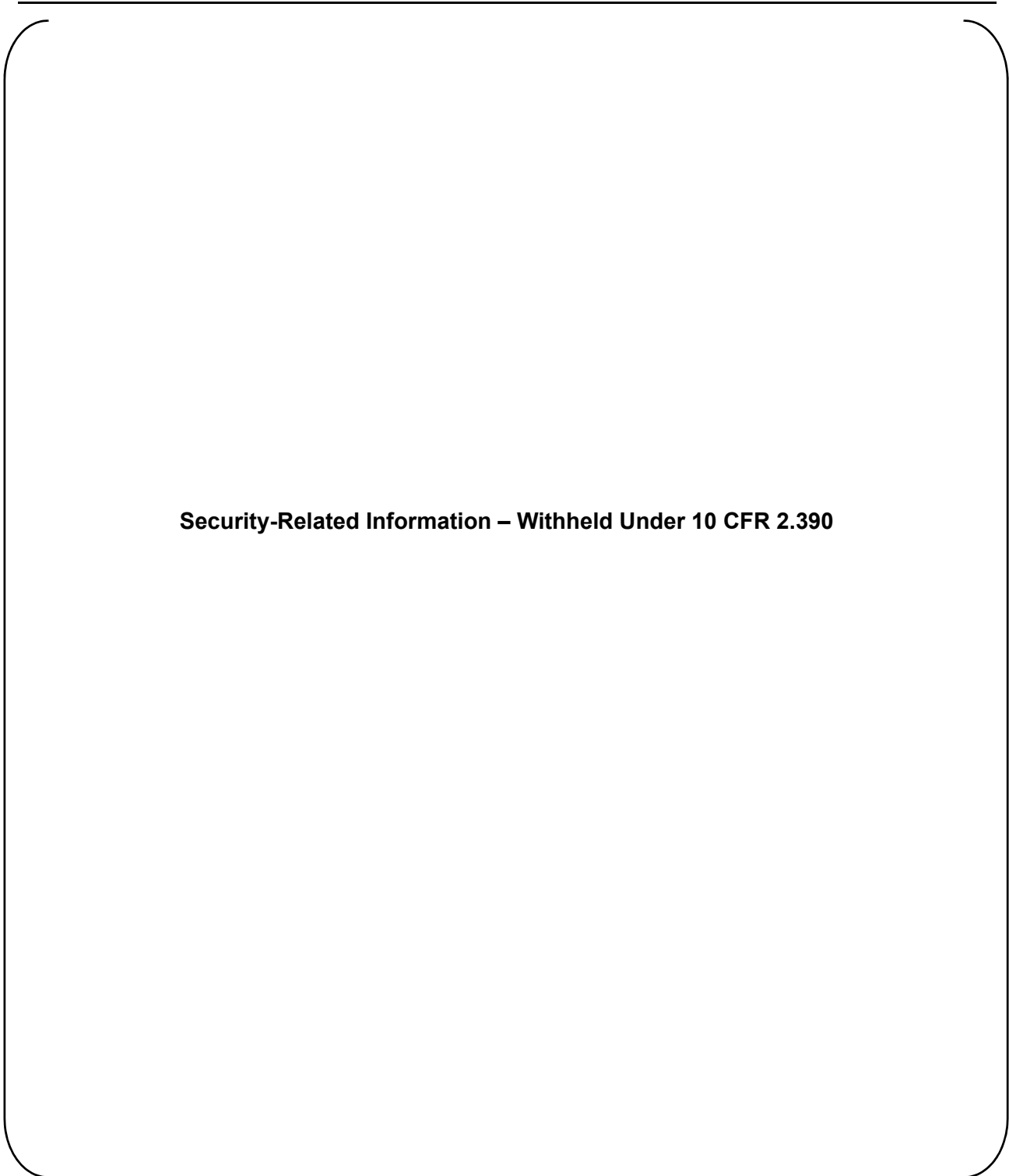
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Figure 2.2-9 US- APWR Building Architectural Layout R/B Plan View Elevation 115'-6"

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Figure 2.2-10 US-APWR Building Architectural Layout R/B Section View Section “A-A”



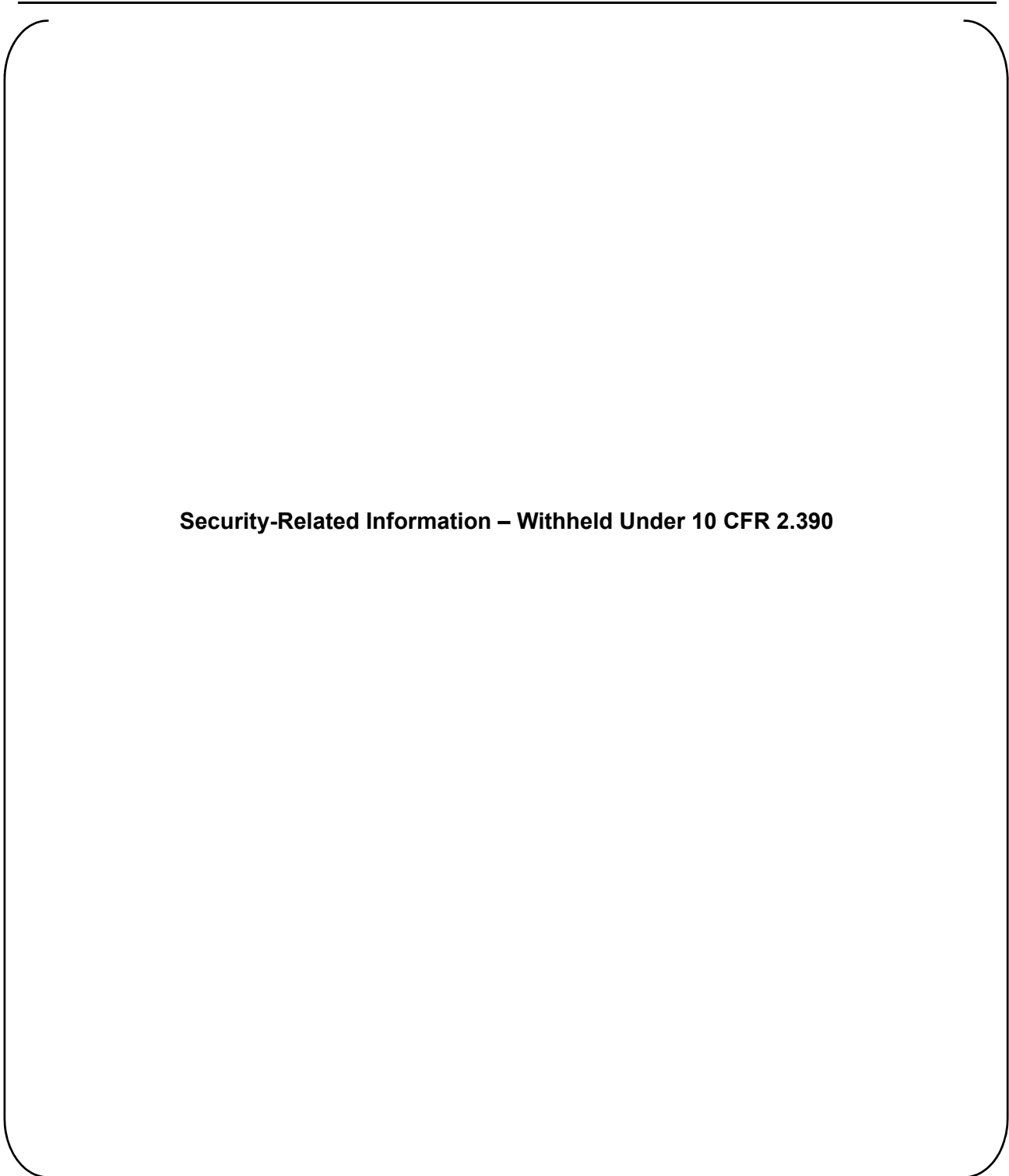
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Figure 2.2-11 US-APWR Building Architectural Layout R/B Section View Section “B-B”

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Figure 2.2-12 US-APWR Building Architectural Layout PS/Bs Plan View
Elevation -26'-4", 3'-7", 39'-6"



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Figure 2.2-13 US-APWR Building Architectural Layout PS/B Section View Section “A-A”

2.7.3 Cooling Water Systems

2.7.3.1 Essential Service Water System (ESWS)

2.7.3.1.1 Design Description

The essential service water system (ESWS) is a safety-related system that provides cooling water to the component cooling water (CCW) heat exchangers and the essential chiller units. The ESWS transfers the heat from these components to the ultimate heat sink (UHS).

The ESWS consists of four independent divisions with each division providing fifty percent (50%) of the cooling capacity required for design basis accidents and for safe shutdown. Each essential service water pump (ESWP) discharge line is provided with two (2) 100% capacity strainers.

- 1.a The functional arrangement of the ESWS is as described in the Design Description of Subsection 2.7.3.1.1 and in Table 2.7.3.1-1 and as shown in Figure 2.7.3.1-1.
- 1.b Each mechanical division of the ESWS (~~Division A, B, C & D~~) except for piping located within the standard design structures except for the ESWPC as shown in Figure 2.7.3.1-1 is physically separated from the other divisions so as not to preclude accomplishment of the safety function.
- 2.a.i The ASME Code Section III components of the ESWS, identified in Table 2.7.3.1-2, are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
- 2.a.ii The ASME Code Section III components of the ESWS identified in Table 2.7.3.1-2 are reconciled with the design requirements.
- 2.b.i The ASME Code Section III piping of the ESWS, including supports, identified in Table 2.7.3.1-3, is fabricated, installed, and inspected in accordance with ASME Code Section III requirements.
- 2.b.ii The ASME Code Section III piping of the ESWS, including supports, identified in Table 2.7.3.1-3 is reconciled with the design requirements.
- 3.a Pressure boundary welds in ASME Code Section III components, identified in Table 2.7.3.1-2, meet ASME Code Section III requirements for non-destructive examination of welds.
- 3.b Pressure boundary welds in ASME Code Section III piping, identified in Table 2.7.3.1-3, meet ASME Code Section III requirements for non-destructive examination of welds.
- 4.a The ASME Code Section III components, identified in Table 2.7.3.1-2, retain their pressure boundary integrity at their design pressure.
- 4.b The ASME Code Section III piping, identified in Table 2.7.3.1-3, retains its pressure boundary integrity at its design pressure.

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Table 2.7.3.1-5 Essential Service Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 1 of 10)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
<p>1.a The functional arrangement of the ESWS is as described in the Design Description of Subsection 2.7.3.1.1 and in Table 2.7.3.1-1 and as shown in Figure 2.7.3.1-1.</p>	<p>1.a Inspection of the as-built ESWS will be performed.</p>	<p>1.a The as-built ESWS conforms to the functional arrangement as described in the Design Description of Subsection 2.7.3.1.1 and in Table 2.7.3.1-1 and as shown in Figure 2.7.3.1-1.</p>
<p>1.b Each mechanical division of the ESWS <u>located within the standard design structures except for the ESWPC as shown in Figure 2.7.3.1-1</u>(Division A, B, C & D) except for piping is physically separated from the other divisions so as not to preclude accomplishment of the safety function.</p>	<p>1.b Inspection and analysis of the as-built ESWS will be performed.</p>	<p>1.b Each mechanical division of the as-built ESWS <u>located within the standard design structures except for the ESWPC as shown in Figure 2.7.3.1-1</u>(Division A, B, C & D) except for piping is physically separated from the other <u>mechanical</u> divisions of the system by spatial separation, barriers or enclosures so as to assure that the functions of the safety related system is<u>are</u> maintained <u>considering postulated dynamic effects (i.e., missile and pipe break hazard), internal flooding and fire</u>.</p>
<p>2.a.i The ASME Code Section III components of the ESWS, identified in Table 2.7.3.1-2, are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.</p>	<p>2.a.i Inspection of the as-built ASME Code Section III components of the ESWS identified in Table 2.7.3.1-2 will be performed.</p>	<p>2.a.i The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III components of the ESWS identified in Table 2.7.3.1-2 are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.</p>

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3.0 INTERFACE REQUIREMENTS

3.1 DESIGN DESCRIPTION

This section identifies the safety significant interface requirements between the US-APWR standard plant design and the site-specific design.

The US-APWR standard plant design consists of several buildings (reactor building including the prestressed concrete containment vessel and containment internal structure, power source buildings, auxiliary building, turbine building and access building); and the systems and equipment located in those buildings. For some systems included in the standard plant design, the associated structure (e.g., the power source fuel storage vaults and essential service water pipe tunnel) is a site-specific structure. The essential service water pipe chase (ESWPC), is structurally part of the R/B complex. However, the systems and equipment in the ESWPC are site-specific. As allowed by the regulations, conceptual designs for systems that are not part of the US-APWR standard plant design are included in the DCD for the purpose of allowing the NRC to evaluate the overall acceptability of the standard plant design. However, the final details of these conceptual designs are subject to change due to site-specific conditions.

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Although descriptions of the power source fuel storage vaults (PSFSVs) and the essential service water pipe tunnel (ESWPT) are provided in this DCD, the structural design of the PSFSVs and ESWPT, including seismic and dynamic qualification, as applicable, are finalized based on the site-specific arrangement.

An interface requirement as specified in this section applies to a system, a portion of a system, or a structure that must be added or connected to the standard plant design to complete the design of the US-APWR at a specific site.

A COL applicant referencing the US-APWR certified design is responsible for site-specific designs that meet the interface requirements and for verifying that the as-built structures, systems, and components conform to the site-specific designs using an ITAAC process that is similar to that provided for the certified design.

3.2 INTERFACE REQUIREMENTS

3.2.1 Ultimate Heat Sink

Ultimate heat sink (UHS) is a safety-related system and is site-specific. The following are site-specific interface requirements:

- a. The UHS system design meets the divisional separation requirements of the essential service water system (ESWS) and the UHS is capable of performing its safety functions under design basis event conditions and coincident single failure with or without offsite power available.
- b. The safety related, pressure retaining components, and their supports, are designed, constructed and inspected in accordance with ASME Code Section III, if applicable to the site-specific design.
- c. The maximum supply water temperature is 95 °F under the peak heat loads condition to provide sufficient cooling capacity to the ESWS.

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- d. The UHS water level is maintained such that available net positive suction head (NPSH) is greater than the ESW pump's required NPSH during all plant operating conditions including normal plant operations, abnormal and accident conditions. The ESW pump operation does not cause vortex formation at minimum allowed UHS water level.
 - e. The UHS system has main control room (MCR) and remote shutdown console (RSC) alarms and displays for UHS water level and water temperature.
 - f. The UHS system has MCR and RSC controls for UHS components' active safety functions if applicable to the site-specific design.
 - g. UHS components that have protection and safety monitoring system (PSMS) control (if applicable to the site-specific design) perform an active safety function after receiving a signal from PSMS.
 - h. The UHS can provide the required cooling for a minimum of 30 days without make-up during accident conditions.
 - i. The UHS system is designed to prevent water hammer.

3.2.2 Fire Protection System

Portions of the fire protection system are site specific. The following are the site-specific interface requirements:

- a. The seismic standpipe system can be supplied from a seismic Category I water source with a capacity of at least 18,000 gallons.
- b. The fire protection system water supply is from two separate, reliable freshwater sources; or from one freshwater lake or pond of sufficient size with two separate and independent suctions in one or more intake structure(s).

3.2.3 Essential Service Water System

Portions of the ESWS are site specific due to its dependence on the site-specific UHS system. The following are the site-specific interface requirements:

- a. The ESWS piping in the ESWPC and the ESWPT that connects to the UHS system is designed, constructed and inspected in accordance with ASME Code Section III. MIC-03-T1-0008
- b. System layout of the ESWS and UHS system is verified to assure that the pressures in the ESWS and UHS system are above saturation conditions during all plant operating conditions including normal plant operations, abnormal and accident conditions.
- c. The sum of the ESW pump shutoff head and static head is such that the ESW system design pressure is not exceeded.
- d. The ESWS is designed to prevent water hammer.
- e. The ESWS can provide cooling water required for the component cooling water (CCW) heat exchangers and the essential chiller units of the essential chilled water system