3.8.1.2.1 Design Codes, Standards, Specifications, and Regulations

The design codes, standards, specifications, and regulations are listed in Table 3.8-1. The primary design code for concrete containment is ASME Section III, Division 2, Subsection CC (Reference 3).

3.8.1.2.2 NRC Regulatory Guides

Conformance to each NRC Regulatory Guide (RG) is described in Section 1.9. The NRC RGs applicable to the design of the concrete containment are ~~NRC RG 1.35 (Reference 4),~~ NRC RG 1.35.1 (Reference 5), NRC RG 1.136 (Reference 6), and NRC RG 1.7 (Reference 7).

3.8.1.2.3 Industry Standards

Internationally recognized industry standards published by ASTM are used whenever possible to define material properties, testing procedures, and fabrication and construction methods.

3.8.1.3 Loads and Load Combinations

The containment is designed to resist the loads given in Article CC-3000 of the ASME Code and NRC RG 1.136 with the exceptions listed below.

a. The post-LOCA flooding combined with the safe shutdown earthquake (SSE) is more severe than the post-LOCA flooding combined with the operating basis earthquake (OBE) set at one third or less of the SSE for the plant. Therefore, only the post-LOCA flooding SSE combination is considered in the design.

b. Subarticle CC-3720 of the ASME Code is satisfied when the containment structure is exposed to the load combination listed below. As a minimum design condition, the pressure ($P_{g1} + P_{g2}$) is not less than 310 kPa (45 psig).

$$D + F + T + P_{g1} + P_{g2}$$

and welding procedures are in accordance with Subarticle CC-4530 of ASME Section III, Division 2.

All nondestructive examination procedures are in accordance with Section V of the ASME Code.

3.8.1.7 Testing and Inservice Inspection Requirements

3.8.1.7.1 Structural Integrity Test

The structural integrity test (SIT) is performed in accordance with ASME Section III, Division 2, CC-6000 to verify the structural integrity of the containment. The test is performed after the containment is complete, including the liner, concrete structures, all electrical and piping penetrations, equipment hatch, personnel airlocks, and post-tensioning.

The pressure will be brought up to 115 percent of the containment design pressure in approximately five or more equal increments. At each pressure level, the pressure will be held constant for 1 hour prior to measuring the deflections.

~~Under the test pressure level, the crack pattern for all cracks larger than 0.254 mm (0.01 in) and longer than 150 mm (6 in) will be mapped at the locations required by the ASME Code.~~

3.8.1.7.1.1 General Requirements

Prior to operating the plant, the SIT is performed to demonstrate the structural acceptability of the primary containment.

At each pressure level, the pressure will be held constant for 1 hour to allow for the pressure and containment response to stabilize and to survey the exterior surface of the primary containment. Internal and external temperature measurements will be taken.

Pre- and post-test inspections will be performed to confirm that the concrete, liner plate, and interior structures were not damaged during the SIT.

Under each test pressure level, the crack patterns are measured in accordance with Subarticle CC-6225 of ASME Section III, Division 2. All cracks larger than 0.254 mm (0.01 in) and longer than 150 mm (6 in) will be mapped at the locations required in Subarticle CC-6350 of ASME Section III, Division 2.
Displacement of the containment is measured and evaluated in conformance with Subarticle CC-6223 and CC-6360 of ASME Section III, Division 2.

elevation. This criterion may be waived if the residual displacements within 24 hours are not greater than 10 percent.

Test results and conclusions will be documented in a separate report.

3.8.1.7.2 Inservice Surveillance

(Reference 4), NRC RG 1.35.1, and 10 CFR 50.55a

3.8.1.7.2.1 General Requirements

During the plant life, the in-service inspection of the containment is performed in accordance with the requirements of the ASME Section XI, Subsection IWL. The inservice inspection includes a visual examination of the concrete exterior surface for cracking, spalling, or grease leakage; a visual inspection of the tendon anchorage assembly of sampled tendons; a tendon lift-off test to discover damaged or broken tendon wires and to provide reasonable assurance of an acceptable prestress level during the plant life.

The containment is designed to allow access to the post-tensioning systems during in-service inspections.

The visual examination is performed for accessible areas in accordance with Subarticle IWL-2510 of ASME, Section XI. When conditions exist in accessible areas that could indicate the presence of, or result in, degradation to inaccessible areas, the acceptability of inaccessible areas will be evaluated to meet the requirements of 10 CFR 50.55a.

The examination of the post-tensioning system, including sample selection, tendon force and elongation measurements, and examination of anchorage areas meets the requirements of Subarticle IWL-2520 of ASME, Section XI.

3.8.1.7.2.2 Predict

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The prediction of te

losses at the time of test. As a minimum, the following sources of prestress loss are considered:

a. Elastic shortening taking into consideration the sequence of stressing of the tendon

b. Creep and shrinkage of concrete

c. Stress relaxation in tendon

d. Reduction of wire cross section due to corrosion, if any

The containment leakage tests comply with 10 CFR 50, Appendix J and are performed in accordance with NEI 94-01 and ANSI/ANS 56.8. Type A, B, and C tests are described in Section 6.2.6.

e. Ineffective wires (e.g., broken, unseated) documented during initial stressing

The procedures and formulations presented in NRC RG 1.35.1 are used to establish the upper bound and lower bound of prestress losses at the time of test.

3.8.1.7.2.3 Acceptance Criteria

The acceptance criteria for the in-service inspections are as specified in ASME Section XI, Subsection IWL-3000. ~~The acceptance criteria also meet any additional requirements of NRC RG 1.35.~~

Items with examination results that do not meet the acceptance standards are evaluated to determine:

a. Causes of the condition

b. Acceptability of the containment without repair

c. Whether or not repair is required, and if required, the extent, method, and completion date for the repair

3.8.2 Steel Containment

The APR1400 does not use a steel containment.

This subsection pertains to ASME Class MC components that are part of the containment described in Subsection 3.8.1. ASME Class MC components include the equipment hatch, personnel airlocks, and piping and electrical penetration sleeves.

3.8.2.1 Description of Containment

3.8.2.1.1 Equipment Hatch

The equipment hatch consists of a dished head door, matching barrel frame with anchorage, and the lifting equipment that operate the hatch door as shown in Figure 3.8-13. The clear

b. Initial leak rate test: hatches are tested at a peak pressure. Leakage does not exceed the design limit of the volume of the airlock in 24 hours.

3.8.2.7.2 Inservice Inspection

MC components are tested in accordance with ASME Section III, Division 1, Subsection NE 6000.

Inservice inspections of the MC components follow the requirements of ASME Section XI, Subsection IWE, with the additional requirements of 10 CFR 50.55a. Subsection 6.2.6 describes leak-rate testing of the containment system and associated acceptance criteria.

3.8.3 Concrete and Steel Internal Structures of Steel or Concrete Containment

3.8.3.1 Description of the Internal Structures

The internal structure is a group of reinforced concrete structures that enclose the reactor vessel and primary system. The internal structure provides biological shielding for the containment interior. A description of various structures that constitute the internal structure is given in the following paragraphs. The details of the internal structure are shown in Figures 1.2-2 through 1.2-8.

The internal structures are seismic Category I structures with the exception of platforms that do not support seismic Category I equipment and miscellaneous steel.

Platforms that do not support seismic Category I equipment and miscellaneous steel are seismic Category II structures. Seismic Category II structures are designed for the SSE using seismic Category I criteria to prevent adverse interaction with other seismic Category I structures, systems, and components.

The containment internal structures are connected with the containment basemat by

The visual examination is performed for accessible areas in accordance with Subarticle IWE-2310 of ASME, Section XI. When conditions exist in accessible areas that could indicate the presence of or the result in degradation to inaccessible areas, the acceptability of inaccessible areas will be evaluated to meet the requirements of 10 CFR 50.55a. The inservice inspection summary report as required by IWA-6000 is to include the evaluation results for inaccessible areas identified for evaluation. The containment leakage tests comply with 10 CFR 50, Appendix J and are performed in accordance with NEI 94-01 and ANSI/ANS 56.8.

COL 3.8(7) The COL applicant is to confirm that uneven settlement due to construction sequence of the NI basemat falls within the values specified in Table 2.0-1.

COL 3.8(8) The COL applicant is to provide the necessary measures for foundation settlement monitoring considering site-specific conditions.

COL 3.8(9) The COL applicant is to provide testing and inservice inspection program to examine inaccessible areas of the concrete structure for degradation and to monitor groundwater chemistry.

COL 3.8.(10) The COL applicant is to provide the following soil information for the APR1400 site: 1) elastic shear modulus and Poisson's ratio of the subsurface soil layers, 2) consolidation properties including data from one-dimensional consolidation tests (initial void ratio, Cc, Ccr, OCR, and complete e-log p curves) and time-versus-consolidation plots, 3) moisture content, Atterberg limits, grain size analyses, and soil classification, 4) construction sequence and loading history, and 5) excavation and dewatering programs.

3.8.7 References

1. 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities,” U.S. Nuclear Regulatory Commission.

2. ASME Section III, Subsection NE, “Class MC Components,” The American Society of Mechanical Engineers, the 2007 Edition with the 2008 Addenda.

3. ASME Section III, Division 2, “Code for Concrete Containments,” Subsection CC, American Society of Mechanical Engineers, 2001 Edition with 2003 Addenda.

4. ~~Regulatory Guide 1.35, “Inservice Inspection of Ungrouted Tendons in Prestressed Concrete Containment,” Rev. 3, U.S. Nuclear Regulatory Commission, July 1990.~~

ASME Section XI, “Rules for Inservice Inspection of Nuclear Power Plant Components,” American Society of Mechanical Engineers, 2007 Edition with 2008 Addenda.

5. Regulatory Guide 1.35.1, “Determining Prestressing Forces for Inspection of Prestressed Concrete Containments,” U.S. Nuclear Regulatory Commission, July 1990.

Table 1.9-1 (5 of 38)

NRC Regulatory Guide		Revision / Issue Date	Conformance or Summary Description of Deviation	DCD Tier 2 Section
1.34	Control of Electroslag Weld Properties	Rev. 1 03/2011	The APR1400 conforms with this NRC RG except that the electroslag process is not used during fabrication of any reactor coolant pressure boundary components.	5.2.3.3, 5.2.3.4.4, 5.3.1.4, 5.4.2.1.4
~~1.35~~	~~Inservice Inspection of Ungrouted Tendons in Prestressed Concrete Containment~~	~~Rev. 3 07/1990~~	~~The APR1400 conforms with this NRC RG.~~	~~3.8.1.2.2, 3.8.1.7.2.3~~
1.35.1	Determining Prestressing Forces for Inspection of Prestressed Concrete Containments	07/1990	The APR1400 conforms with this NRC RG.	3.8.1.2.2, 3.8.1.5.1.2, 3.8.1.5.2.2, 3.8.1.7.2.2, 3.8A.1.4.1.3.3, 3.8.1.2.2, 3.8.1.5.1.2, 3.8.1.5.2.2
1.36	Nonmetallic Thermal Insulation for Austenitic Stainless Steel	02/1973	The APR1400 conforms with this NRC RG.	5.2.3.2.3, 5.4.2.1.4, 6.1.1.1, 6.1.1.2.2, 6.1.1.2.3
1.40	Qualification of Continuous-Duty Safety-Related Motors for Nuclear Power Plants	Rev. 1 02/2010	The APR1400 conforms with this NRC RG.	N/A
1.41	Preoperational Testing of Redundant On-site Electric Power Systems to Verify Proper Load Group Assignments	03/1973	The APR1400 conforms with this NRC RG.	14.2.12, 8.1.3.3
1.43	Control of Stainless Steel Weld Cladding of Low-Alloy Steel Components	Rev. 1 03/2011	The APR1400 conforms with this NRC RG.	5.2.3.3, 5.3.1.4, 5.4.2.1.3