3.8 Seismic Category I Structures

The information in this section of the reference ABWR DCD, including all subsections is incorporated by reference with the following standard departures and supplements.

STD DEP T1 2.15-1

STD DEP 1.8-1

STD DEP 12.3-3

STD DEP Admin

3.8.1.3.1 Normal Loads

STD DEP T1 2.15-1

STD DEP 1.8-1

(2)

The criteria for consideration of live loads for the designs of structural elements of the Reactor Building and *Control Building ~~and the Radwaste Building~~ are provided in Subsections 3H.1.4.3.1~~,~~* and *3H.2.4.3.1, ~~and 3H.3.4.3.1,~~ respectively.*

(b) Section 9.3 of ASCE Standards 7-88 and ~~Section 2334(a) of the 1991 Uniform Building Code~~ Section 12.7.2 of ASCE 7-05~~Section 1613 of the International Building Code (IBC)~~ *specify that a minimum of 25% of the floor live loads should be considered for the computation of design seismic forces for storage and warehouse type occupancies. The variation in live load intensity and occurrence in operating nuclear plants is expected to be no higher than that for storage ~~in~~* and *warehouse occupancies. A 25% of full live loads is, therefore, equally applicable to the nuclear plants.*

3.8.4 Other Seismic Category I Structures

STD DEP T1 2.15-1

STD DEP 12.3-3

Other Seismic Category I structures which constitute the ABWR Standard Plant are the Reactor Building and *Control Building. ~~and Radwaste Building substructure.~~ Figure 1.2-1 shows the spatial relationship of these buildings. The only other structures in close proximity to these structures ~~is~~*are the Radwaste Building and *the Turbine Building. ~~It is~~*These are *structurally separated from the other ABWR Standard Plant buildings.*

The R/B, steam tunnel, Residual Heat Removal (RHR) System, Reactor Water Cleanup (CUW) System, and Reactor Core Isolation Cooling (RCIC) System rooms are designed to handle the consequences of high-energy pipe breaks. The RHR, RCIC, and CUW rooms are designed for differential compartment pressures, with the associated temperature rise and jet force. ~~Steam generated in the RHR compartment from the postulated pipe break exits to the steam tunnel through blowout panels.~~The steam tunnel is vented to the Turbine Building (T/B) through the seismic interface restraint structure (SIRS). The steam tunnel, which contains several pipelines (e.g., main steam, feedwater, RHR), is also designed for a compartment differential pressure with the associated temperature changes and jet force.

3.8.4.1.3 ~~Radwaste Building Substructure~~ (Not Used)

STD DEP T1 2.15-1

~~The Radwaste Building (RWB) Substructure is shown in Section 1.2.~~

~~The Radwaste Building is a reinforced concrete structure 60.4 66.2m by 41.2 38.8m and a height of 29.5 27.4m from the top of the basemat. The building consists of a below grade substructure consisting of walls (1.2m thick) and slabs of reinforced concrete forming a rigid box structure which serves as a container to hold radioactive waste in case of an accident. This substructure is located below grade to increase shielding capability and to maximize safety. It is supported on a separate foundation mat whose top is 13.7m below grade. In addition, a reinforced concrete superstructure~~

~~15.7 13.4m high extends above grade floor level and houses the balance of the radwaste equipment.~~

~~The RWB Substructure houses the high and low conductivity tanks, clean up phase sperarators, spent resin storage tanks, a concentrated waste storage tank, distillate tank and associated filters, and pumps for the radioactive liquid and solid waste treatment systems.~~

~~Although the radwaste superstructure is not a Seismic Category I structure, its major structural concrete walls, slabs, columns and roof are designed to resist Seismic Category I loads.~~

~~The summary report for the readwaste building is in Section 3H.3. This report contains a description of radwaste building, the loads, load combinations, reinforcement stresses, and concrete stresses at locations of interest. In addition, the report contains reinforcement details for the basement, seismic walls, and floors.~~

3.8.4.2.3 ~~Radwaste Building Substructure~~ (Not Used)

STD DEP T1 2.15-1

~~[The RWB Substructure shall be designed using the same codes and standards as the reactor building. Refer to Subsection 3.8.4.2.1 for a complete list.]~~*

~~In addition, the non-Seismic Category 1 I reinforced concrete portion of the superstructure is designed according to the seismic provisions of the uniform building code.~~

3.8.4.3.2 Control Building ~~and Radwaste Building Substructure~~

STD DEP T1 2.15-1

3.8.4.4.1 Reactor Building~~,~~ and Control Building~~, and Radwaste Building Substructure~~

STD DEP T1 2.15-1

[The Reactor Building~~,~~and *Control Building ~~and Radwaste Building Substructure~~ will be designed in accordance with ACI-349 for concrete structures and ANSI/AISC-N690 specification for steel structures.]**

*The Reactor Building*and *Control Building. ~~and Radwaste Building Substructure~~ are analyzed using the computer codes listed in Appendix 3C.*

The foundation for Category I structures is contained in the summary reports for their respective buildings. The reactor building foundations is contained in Section 3H.1~~,~~ and *the control building foundation is in Section 3H.2.~~, and the radwaste building foundation is in Section 3H.3~~. This summary report contains a section detailing safety factors against sliding, over turning, and floatation.*

3.8.4.5.3 ~~Radwaste Building Substructure~~ (Not Used)

STD DEP T1 2.15-1

~~[Structural acceptance criteria are defined in ANSI/AISC-N690 and ACI 349 Codes.] In no case does the allowable stress exceed 0.9Fy where Fy is the minimum specified yield stress. The design criteria preclude excessive deformation of the Reactor Building. The clearances between adjacent buildings are sufficient to prevent impact during a seismic event.~~*

3.8.5.1 Description of the Foundations

STD DEP T1 2.15-1

~~The Radwaste Building foundation is a rectangular reinforced concrete mat 60.4m by 41.2 and 2.5m thick. The top of the Radwaste Building mat is 13.5m below grade. The foundation mat is constructed of cast-in-place conventionally reinforced concrete. It supports the Radwaste Building structure~~.

The foundation for Category 1 structures is contained in the summary reports for their respective buildings. The Reactor Building foundation is contained in Section 3H.1 and *the Control Building foundation is in Section 3H.2.~~, and the Radwaste Building foundation is in Section 3H.3.~~ This summary report contains a section detailing safety factors against sliding, over turning, and floatation.*

3.8.6 COL License Information

3.8.6.1 Foundation Waterproofing

The following standard supplement addresses COL License Information Item 3.23.

Foundation waterproofing is done by placing a waterproofing membrane near the top elevation of the concrete fill.~~chemical agent on the exposed concrete surface of the mudmat.~~ The remainder of the concrete fill is then poured on top of the waterproofing material.~~concrete foundation is poured directly onto the concrete mudmat.~~ A waterproof membrane that could degrade the ability of the foundation to transfer loads is not used.

The coefficient of friction of the waterproofing material will be determined with a qualification program prior to procurement of the membrane material. The qualification program will be developed to demonstrate that the selected material will meet the waterproofing and friction requirements. The qualification program will include testing to demonstrate that the waterproofing requirements and the coefficient of friction required to transfer seismic loads for STP 3 & 4 have been met. Testing methods will simulate field conditions to demonstrate that the minimum required coefficient of friction is achieved by the structural concrete fill - waterproof membrane structural interface. The material will meet the required friction factor.

The test program will be based on the test methods contained in ASTM D1894. The tests will be performed with the expected range of normal compressive stresses. The coefficient of friction, as defined in ASTM D1894, is the ratio of the force required to move one surface over another to the total force applied normal to those surfaces. The test fixture assembly will be designed to obtain a series of shear / lateral forces and the corresponding applied normal compressive loads. The test data will be generally represented by a best fit straight line whose slope is the coefficient of friction.

3.8.6.2 Site Specific Physical Properties and Foundation Settlement

The following site-specific supplement addresses COL License Information Item 3.24.

Physical properties of the site-specific subgrade medium and the settlement of foundations are assessed in Sections 3H.6.4.2 and 2.5S.4.

3.8.6.3 Structural Integrity Test Result

The following standard supplement addresses COL License Information Item 3.25.

Structural Integrity Test (SIT) of the containments will be performed in accordance with Subsection 3.8.1.7.1 and ITAAC Table 2.14.1 Item #3. The first containment will be considered a prototype and its SIT performed accordingly. The details of the test and the instrumentation, as required for such a test, will be provided in the ASME Construction Specification. The test and instrument plan for the Unit 3 SIT will conform to the requirements for prototype containments as delineated in Article CC-6000 of ASME Section III, Division 2. The test and instrument plan for the Unit 4 SIT will conform to the requirements for nonprototype containments as delineated in Article CC-6000 of ASME Section III, Division 2.~~to NRC for approval.~~

The details of the SIT and the instrumentation required for the test will be provided in the ASME Construction Specification. The ASME Construction Specification will be provided to NRC for approval a minimum of six months before performance of the SIT.

3.8.6.3.1 Details of the Test:

The containment is subjected to integrity tests that include both an overall internal pressure test and a differential pressure test. The overall SIT will be performed at a test pressure of at least 1.15 times the containment design pressure in both the drywell and suppression chamber simultaneously. The differential pressure test will be performed at a test pressure of at least 1.0 times the maximum design differential pressure. The test pressure will be held for at least 1 hour.

Predictions of displacements and strains will be made prior to the start of the Unit 3 test. During the SIT tests, the suppression chamber and spent fuel pool will be filled with water to the normal operational water level. Atmospheric air will be used as the testing medium for both the overall and the differential pressure test. The Designer or his designee will perform a pretest visual examination of the accessible portions of the primary containment vessel prior to the structural integrity (SI) test in accordance with CC-6210 of ASME Section III, Division 2. The Designer or his designee will witness the SI test and will monitor displacement measurements.

3.8.6.3.2 Instrumentation:

Instrumentation for the measurement of pressure, displacement, strain, crack width and length, and temperature will be provided in accordance with CC-6220 of ASME Section III, Division 2. Output of all instruments will be recorded prior to start of testing and any erratic readings corrected, if possible, or noted. All malfunctioning instrumentation will be reported to and evaluated by the Designer before proceeding with testing. Instruments that become erratic or inoperative during testing will be reported to the Designer before proceeding with testing.

Displacement, strain (for Unit 3), and temperature measurements will be made in accordance with CC-6300 of ASME Section III, Division 2. Displacement, strain, and temperature will be recorded at the locations specified in the test and instrument plan as defined in the Construction Specification. The test plan will be available prior to start of construction of the concrete containment so that sufficient time is available for placement of instrumentation to be embedded in concrete or otherwise installed during construction.

The primary containment will be pressurized and depressurized at rates not to exceed 20% of the test pressure per hour in accordance with CC-6321 of ASME Section III, Division 2.

Test data will be collected in accordance with CC-6340 of ASME Section III, Division 2. For the prototype Unit 3 Containment, strains and associated temperatures will be measured for a minimum period of 24 hours prior to the SI test to evaluate the strain variations resulting from temperature change. Concrete crack patterns will be mapped at locations specified by the Designer before the tests, at maximum pressure, and after the tests in accordance with CC-6350 of ASME Section III, Division 2. Mapped areas will include areas where high surface tensile strain is predicted.

A post-test examination will be made within one (1) week of depressurization. Details of the posttest examination will be the same as those of the pretest examination required by CC-6210 of ASME Section III, Division 2.

3.8.6.3.3 Test Acceptance Criteria:

Crack and strain (for Unit 3) measurements will be reviewed by the Designer for evaluation of the overall test results. The primary containment will be considered to have satisfied the structural integrity test if the minimum requirements specified in CC-6410 of ASME Section III, Division 2 are met. If measurements and studies by the Designer indicate that the requirements of CC-6410 are not met, remedial measures will be undertaken or a retest will be conducted in accordance with CC-6430 of ASME Section III, Division 2.

3.8.6.3.4 Structural Integrity Test Report:

The results of structural integrity tests will be submitted to the Designer. The report will meet the minimum requirements of CC-6530.

3.8.6.4 Identification of Seismic Category I Structures

The following site-specific supplement addresses COL License Information Item 3.26.

A complete list of Seismic Category I Structures, Systems, and Components can be found in Table 3.2-1, which includes the following site-specific Seismic Category I Structures:

- Ultimate Heat Sink
- Reactor Service Water Piping Tunnel

A description of these structures can be found in section 3H.6.