5.2.2.4.4 QUALITY CONTROL AND NONDESTRUCTIVE TESTING

Butt-welded joints in the main liner shell and in the dome were examined by the following methods:

a. 100% visual inspection
b. 20% liquid penetrant examination
c. 100% vacuum box testing or leak testing
d. 2% spot radiograph examination

5.2.5.2.1.1 General Design Criteria for Post-Tensioning System

f. Prestressing Arrangement

The configuration of the tendons in the dome (see Figure 5-2) is based on a three-way tendon system consisting of three groups of tendons oriented at 120° with respect to each other. A large concrete ring girder is provided at the intersection of the dome and wall. The cylindrical wall is prestressed with a system of vertical and horizontal tendons. The horizontal system consists of a series of rings. Each ring is made up of three tendons, each subtending an angle of 120°. Six buttresses are used as anchorages with the tendons staggered so that adjacent rings do not have tendons anchored at the same buttress. Each hoop and dome tendon is stressed from both ends so as to reduce the friction losses. The vertical system consists of vertical tendons anchored in the foundation mat and ring girder. For typical tendon arrangement, see Figure 5-2 and Figure 5-4.

5.2.5.2.3.1 Personnel and Equipment Access Penetrations

During Modes 5 and 6, refueling outages, and/or extended Mode 5 outages, an Outage Equipment Hatch (OEH) may be used in place of the permanent Equipment Hatch. (License Amendment 208 [3N0703-03] allows a Temporary Equipment Hatch Closure to be available, instead of the Permanent Equipment Hatch or the OEH, when moving non-recently irradiated fuel assemblies. The Temporary Equipment Hatch Closure does not need to completely block the Equipment Hatch opening, nor be capable of resisting pressure.) The OEH, with an inside diameter of 22 feet 4 inches, will be maintained in an installed position using existing permanent Equipment Hatch swing bolts. The OEH will be designed and bolted sufficiently to form a gap-free seal around the circumference of the frame. The OEH contains a single access door for moving equipment that is also designed with a gap-free seal. The OEH is equipped with various mechanical and electrical service penetration to allow the access door to remain closed and sealed when not moving equipment.

5.4.5.1 SEISMIC ANALYSIS OF STRUCTURES

The natural frequencies and response loads obtained from the seismic system analyses are summarized as follows:

a. Reactor building shell (8 lumped masses)

Natural Frequencies (Hz)

4.4

16.0

B-21

30.6
42.3
50.8
60.0
83.3
98.4

5.4.6.3 STRUCTURAL DESIGN CRITERIA

5.4.6.3.1 CODES

AISC, "Specification for the Design Fabrication and Erection of Structural Steel for Buildings," November, 1983.
ACI, "Code Requirements for Nuclear Safety Related Concrete Structures," (ACI-349-85).
Regulatory Guide 1.142, "Safety-Related Concrete Structures for Nuclear Power Plants (Other than Reactor Vessels and Containments)," Revision 1, October, 1981.
Standard Review Plan, Section 3.8.4, "Other Seismic Category 1 Structures," Revision 1, July, 1981.
Regulatory Guide 1.61, "Damping Values for Seismic Design of Nuclear Power Plants," October, 1973.

5.6 TESTING

5.6.1 STRUCTURAL PROOF TEST AND INSTRUMENTATION

Because of the importance of the reactor building to public safety, its integrity was verified by a pressure test. This pressure test permitted verification that the structural response of the principal strength elements was consistent with the design. The test pressure level was 63.3 psig (115% of the design). This test pressure level was selected so as to impose, insofar as practical with a static pressure test, maximum stresses on principal strength elements which are reasonably consistent with those stresses imposed by a Loss-of Coolant Accident (LOCA) and the Design Basis Earthquake (DBE). A complete description of the test and acceptance criteria are included in the report "Reactor Containment Building Structural Integrity Test," GAI-1930, December 7, 1976.

5.6.2 COMPONENT LEAK TESTING DURING CONSTRUCTION

Component leak testing was employed to detect any leaks which may have affected the integrity of the containment vessel and the results of the initial integrated leak rate test. The tests were performed at a pressure not less than 49.6 psig.

The following areas were locally tested for leakage:

a. Welds in reactor building liner plate.
b. Containment penetrations (mechanical & electrical).
c. Equipment and personnel access hatches.
d. Fuel transfer tubes.
e. Isolation valves in lines penetrating the containment boundary as required by Appendix J to 10 CFR 50.

Repairs were made of any leaks detected. A comprehensive program of testing equipment in the manufacturer's plant plus Quality Control and Assurance during installation kept the leaks detected during preoperational leak monitoring at a minimum. Examples of the pretesting are: The steel liner welds are radiographed, liquid penetrant inspected, and leak tested during the normal installation; all penetrations including the equipment and personnel access locks were examined in accordance with the requirements of the ASME Nuclear Vessel Code for Class B Vessels, and all mechanical and electrical penetrations have been pressure tested. Prior to the initial integrated leak rate test, isolation valves in lines penetrating the containment boundary were pressure tested for leak tightness as required by 10 CFR 50, Appendix J.

Maximum use was made of local pneumatic pressurization during the preoperational leak monitoring tests to develop methods and procedures for maximum utilization of this system in detecting leakage and locating the leaks. The methods and procedures so developed will thereafter be utilized in detecting and locating leaks throughout the life of the plant.

5.6.4 OPERATIONAL LEAKAGE RATE TESTS

Operational leakage rate tests are conducted periodically in accordance with the Containment Leakage Rate Testing Program to ensure that the integrity of containment is maintained and to determine if any leakage problems have developed since the previous integrated leakage rate test.

The operational leakage rate tests consist of integrated leakage rate tests of the containment system and individual leakage rate test of components which penetrate or seal the boundary of the containment system. These tests are performed at regular intervals, in accordance with the Containment Leakage Rate Testing Program and after major repairs or whenever there is any indication of gross leakage.