APPLICANT'S EXHIBIT 38

AmerGen

Oyster Creek Nuclear Generating Station

Updated Final Safety Analysis Report

Revision 13

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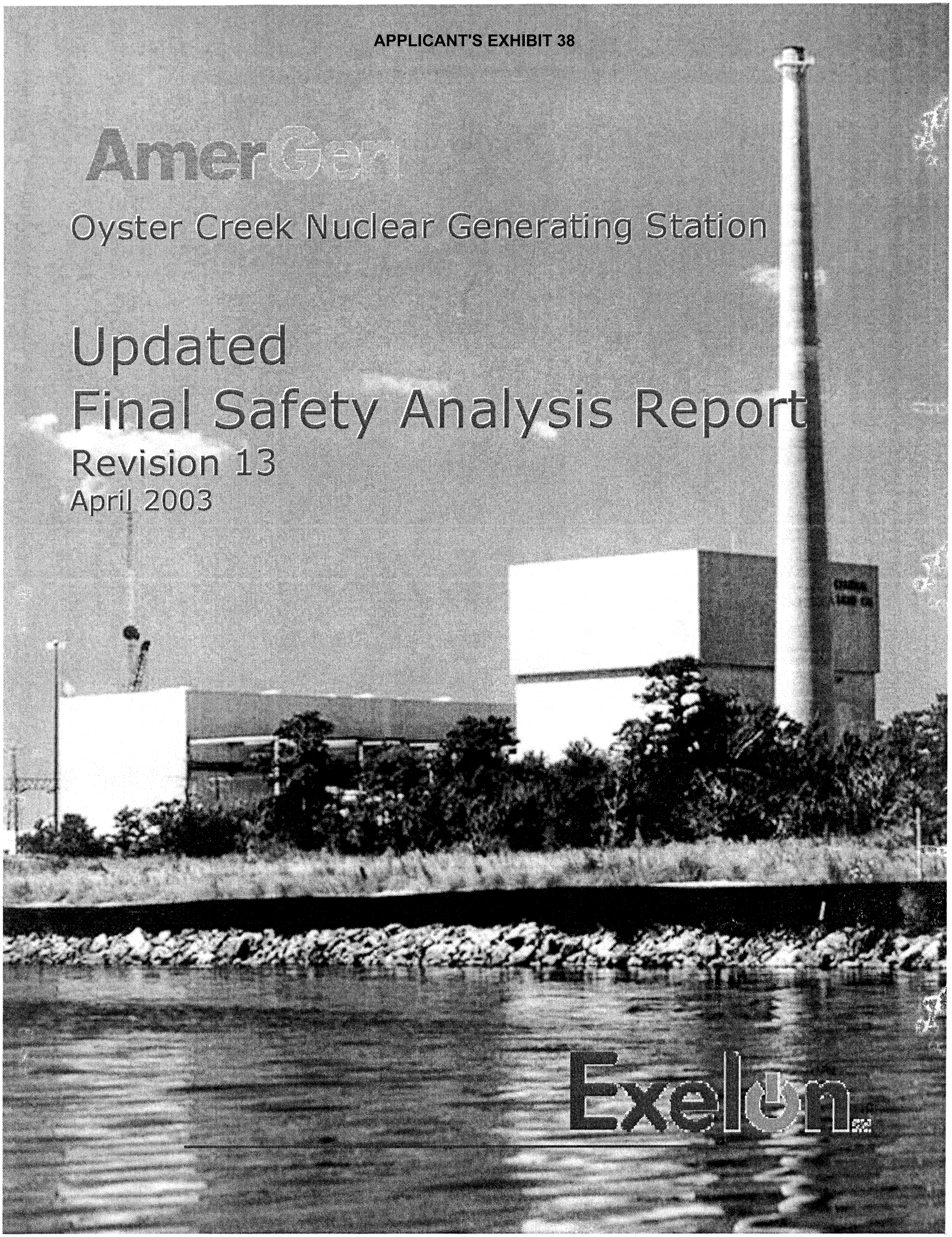

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3.8 DESIGN OF CATEGORY I STRUCTURES

The General Electric Company was the prime contractor for Jersey Central Power and Light Co. in the design and construction of the Oyster Creek Nuclear Generating Station (OCNGS). Thus, General Electric had the overall responsibility for the Containment System as a part of the total plant.

General Electric Company engaged the services of Burns & Roe, Inc. for engineering assistance and construction management. General Electric furnished the conceptual information drawings, design criteria, and design specifications. Burns & Roe was responsible for the detailed design, construction drawings, specifications, and management of the actual construction and installation. All Burns & Roe drawing information was supplied to General Electric who had the privilege of review and approval.

Burns & Roe, Inc., subcontracted the design, construction, and testing of the drywell and torus vessel, and vent system work to Chicago Bridge & Iron Company.

Subsequent to the initial design and the start of commercial operation, certain modifications were made to the torus under the Mark I Containment System Evaluation Program. This program is further discussed in Subsection 3.8.2.

Evaluations of the structural soundness of the Drywell were performed during 1986 and 1987. The results of these evaluations showed evidence of Drywell wall thinning at various locations. These evaluations, the results thereof, and mitigative measures, as applicable, are discussed in Section 3.8.2.8.

In addition, under the Systematic Evaluation Program (SEP), and independent review was conducted of the seismic design aspects of the OCNGS as they relate to overall design margins. The report "Seismic Review of the Oyster Creek Nuclear Power Plant as Part of the Systematic Evaluation Program", NUREG/CR-1981, UCRL-53018, RD, RM, was issued to summarize the evaluation program. The SEP is summarized in Section 1.10.

3.8.1 Concrete Containment

Not applicable

3.8.2 Steel Containment

The Function of the Primary Containment System is to accommodate, with minimum leakage, the pressures and temperatures resulting from the break of any enclosed process pipe, and thereby limit the release of radioactive fission products to values which will insure offsite dose rates well below 10CFR100 guideline limits. The design integrated leak rate for the system is no greater than 0.5 percent of its total volume per day at 35 psig.

The development, design, fabrication and construction of the OCNGS Primary Containment are discussed in detail in Reference 1. For the design and construction of the Primary Containment, Burns & Roe prepared a detailed design specification and bid package from design criteria information supplied by General Electric. Chicago Bridge & Iron assumed responsibility for providing the primary components of the Containment System. All design and construction drawings were submitted to Burns & Roe for approval and to General Electric for review prior to construction. Included in this package were openings and sleeves (nozzles) through the drywell wall to accommodate the penetration of process piping, instrumentation, and electrical lines. The actual penetration line fixtures and seals design, fabrication, and testing was subcontracted by Burns & Roe to piping or electrical fabricators as appropriate.

Subsequent to the design completion and start of commercial operation, additional loading conditions which arise in the functioning of the pressure suppression concept utilized in the Mark I Containment System design were identified. These additional loading conditions resulted in an industry wide reanalysis and modification program which is briefly described in the following paragraphs.

Mark I Containment System Evaluation Program

Background

The original design of the Mark I Containment System considered postulated accident loads previously associated with containment design. These included pressure and temperature loads associated with a Loss-of-Coolant Accident (LOCA), seismic loads, dead loads, jet impingement loads, and hydrostatic loads due to water in the suppression chamber. However, after establishment of the original design criteria, additional loading conditions which arise in the functioning of the pressure suppression concept utilized in the Mark I Containment System design were identified. These additional loads resulted from dynamic effects of drywell air and steam being rapidly forced into the suppression pool (torus) during a postulated LOCA and from suppression pool response to safety relief valve (SRV) operation generally associated with plant transient conditions.

Because these hydrodynamic loads had not been considered in the original design of the Mark I containment, the Nuclear Regulatory Commission (NRC) required that a detailed reevaluation of the Mark I containment system be made. In February and April 1975, the NRC transmitted letters to all utilities owning BWR facilities with the Mark I containment system design, requesting that the owners quantify the hydrodynamic loads and assess the effect of these loads on the containment structure. The February 1975 letters reflected NRC concerns about the dynamic loads from SRV discharges, while the April 1975 letters indicated the need to evaluate the containment response to the newly identified dynamic loads associated with a postulated design basis LOCA.

As a result of these letters from the NRC, and recognizing that the additional evaluation effort would be very similar for all Mark I BWR plants, the affected utilities formed an "ad hoc" Mark I Owners Group, and GE was designated as the Group's lead technical organization. The objectives of the Group were to determine the magnitude and significance of these dynamic loads as quickly as possible and to identify courses of action needed to resolve any outstanding safety concerns. The Mark I Owners Group divided this task into two programs: a Short Term Program (STP) and a Long Term Program (LTP).

Short Term Program

The objectives of the Short Term Program (STP) were to verify that each Mark I Containment System would maintain its integrity and functional capability when subjected to the most probable loads induced by a postulated design basis LOCA, and to verify that the licensed Mark I BWR facilities could continue to operate safely without endangering the health and safety of the public while a methodical, comprehensive Long Term Program (LTP) was being conducted.

The STP structural acceptance criteria used to evaluate the design of the torus and related structures were based on providing adequate margins of safety; i.e., a safety to failure factor of 2, to justify continued operation of the plant before the more detailed results of the LTP were available.

The results of the Short Term Program evaluation of the Oyster Creek torus were submitted to the NRC by Jersey Central Power and Light in 1976. As a part of that program, a drywell to wetwell differential pressure was imposed to reduce LOCA loads and a quencher was installed on the SRV discharge line to reduce SRV discharge transient induced loads. The conclusion of the Short Term Program evaluation was that the Oyster Creek torus met the criteria established for the Short Term Program.

The NRC concluded that a sufficient margin of safety had been demonstrated to assure the functional performance of the containment system and, therefore, any undue risk to the health and safety of the public was precluded. These conclusions were documented in the "Mark I Containment Short Term Program Safety Evaluation Report,"

NUREG-0408, dated December 1977. The NRC granted the operating Mark I facilities an exemption relating to the structural factor of safety requirements of 10CFR50.55(a) for an interim period while the more comprehensive LTP was being conducted.

Long Term Program

The objectives of the Long Term Program (LTP) were to establish conservative design basis loads that are appropriate for the anticipated life of each Mark I BWR facility (40 years), and to restore the originally intended design safety margins for each Mark I Containment System. The plans for the LTP and the progress and results of the program were reviewed with the NRC throughout the performance of the program.

The LTP consisted of:

a. The definition of loads for suppression pool hydrodynamic events

b. The definition of structural assessment techniques

c. The performance of a plant unique analysis (PUA) for each Mark I facility

The generic aspects of the Mark I Owners Group LTP were completed with the submittal of the "Mark I Containment Program Structural Acceptance Criteria, Plant Unique Analysis Application Guide" (PUAAG), NEDO-24583-1. The NRC concluded that load definitions and structural acceptance criteria documented in these two reports were acceptable for use in the plant-unique analysis of each plant. The NRC conclusions and comments were presented in the "Mark I Containment Long Term Program Safety Evaluation Report", NUREG-0661, dated July 1980.

Summary of Results

The analysis of the Oyster Creek torus and vent system has been performed in conformance with the requirements of the Mark I Containment Long Term Program. As a result, a number of structural modifications were designed for installation in the OCNGS Primary Containment as part of the Long Term Program.

The results of the analysis, which assumed that the modifications were completed, show that all components of the torus and vent system meet the criteria of the Mark I Long Term Program. Thus, the functional performance of the OCNGS Containment System will be assured for both Loss-of-Coolant Accidents (LOCA) and Safety Relief Valve (SRV) discharge suppression pool hydrodynamic loading conditions. Specific results of the analysis are given in the report "Plant-Unique Analysis Report, Suppression Chamber and Vent System", MPR-733 dated August 1982.

No evaluation of the Oyster Creek drywell was required in the Mark I Containment Long Term Program, since the maximum drywell pressure specified for Oyster Creek in the Long Term Program (NEDO-24572 Rev 2) is well within the design value specified in the original containment design.

The analysis of the piping systems attached to the Oyster Creek torus and vent system has been completed in conformance with the requirements of the Mark I Containment Long Term Program.

A number of piping and pipe support structural modifications were designed for installation as part of the Long Term Program. The analyses are based on the piping arrangement with all modifications installed. The loads used in the analyses of the piping are based upon the response of the Oyster Creek Containment modified as described in the report "Plant-Unique Analysis Report, Suppression Chamber and Vent System", MPR-733, dated August 1982.

The results of the analyses of piping systems attached to the Oyster Creek torus and vent system show that all piping, pipe hangers and supports, nozzles and related components meet the criteria of the Mark I Containment Long Term Program with the modifications completed. Specific results of the analyses are given in the report "Plant Unique Analysis Report, Torus Attached Piping", MPR-734, dated August 1982. These results were updated in MPR-999, Revision 3, "Addendum to MPR-734." (Reference 41)

An evaluation of the nozzles in the vent system for the Electromatic Relief Valves piping penetrations has been performed. The results, as presented in the report MPR-772, "Plant Unique Analysis Supplemental Report," indicate that all stresses are below ASME Code allowables and therefore, the penetrations meet the requirements of the Mark I Containment Long Term Program.

The Mark I Containment Long Term Program Confirmation Order dated January 19, 1982 required plant modifications needed to comply with the Acceptance Criteria in Appendix A of NUREG-0061, Mark I Containment Long Term Program, dated July 1980. This program is now complete for OCNGS.

Subsequent to the completion of this Mark I Containment Long Term Program, the high pressure actuation setpoints, specified by the Technical Specifications, were increased by 15 psig (Reference 45). To support this increase, an evaluation of the impact of the increased setpoints on Mark I results was completed (Reference 46). This evaluation utilized an estimation of, not a determination of, the resulting increases in stress levels. The results of this estimation were accepted as sufficient bases for assessing the impact of the setpoint increase on previously determined Mark I long term results.

3.8.2.1 Description of the Containment

The Primary Containment consists of a pressure suppression system with two large chambers as shown in Figure 3.8-1. The drywell houses the reactor vessel, the reactor coolant recirculating loops, and other components associated with the reactor system. It is a 70 ft diameter spherical steel shell with a 33 ft diameter by 23 ft high cylindrical steel shell extending from the top.

The pressure absorption chamber* is a steel shell in the shape of a torus located below and around the base of the drywell. It has a major diameter of 101 ft, a chamber diameter of 30 ft, and is filled to approximately 12 ft depth with demineralized water. The structure is made up of 20 mitered wedge shaped sections or bays with internal stiffening rings or ring girders at each miter.

The two chambers are interconnected through 10 vent pipes 6 ft 6 in in diameter equally spaced around the circumference of the pressure absorption chamber which feed into a common header inside the pressure absorption chamber. This header also takes the shape of a torus of 101 ft major diameter by 4 ft 7 in minor diameter. There are 120 downcomer pipes, 2 ft in diameter, uniformly spaced which have their open ends extending 3 ft below the minimum water level in the pressure absorption chamber. Gas phase return lines with vacuum breaker valves feed back gas to the drywell in case its pressure is less than the absorption chamber.

The base of the drywell is supported on a concrete pedestal conforming to the curvature of the vessel. For erection purposes a structural steel skirt was first provided supporting the vessel. A portion of the steel skirt was left in place to serve as one of the shear rings intended to prevent rotation of the drywell during an earthquake.

After erection, concrete was poured up to the level of the vessel floor providing uniformity in the support by following the contour of the drywell vessel.

A three inch clearance has been provided between the steel vessel of the drywell and the concrete drywell shield wall to provide for a regulated expansion of the drywell steel shell. This clearance was achieved by applying a compressible material to the outside of the drywell vessel prior to placement of the shield wall concrete. For further detail refer to Subsection 3.8.2.4.

The vent header is supported by pinned columns inside the absorption chamber. The downcomers are connected in pairs by pinned braces.

* The pressure absorption chamber is identified often in various reference documents, drawings, and figures as suppression chamber, wetwell, or torus.

Projecting downward from the vent pipe header are downcomer pipes, terminating below the water surface of the pool. During a Loss-of-Coolant Accident (LOCA), the upward reaction from the downcomers is resisted by columns to the bottom of the absorption chamber. Due to the vent clearing jet forces the columns are pinned top and bottom to accommodate the differential horizontal movement between the header and the pressure absorption chamber. The horizontal reaction from the downcomers is resisted by the pinned braces.

Jet deflectors are provided in the drywell at the entrance of each vent pipe to prevent possible damage to them from jet forces which might accompany a pipe break in the drywell.

Access to the pressure absorption chamber from the Reactor Building is provided through two manholes with double gasketed bolted covers which can be tested for leakage.

Access to the drywell is provided through the equipment hatch and personnel air lock and through the double gasketed drywell head cover, all of which have provisions for being individually leak tested.

The pressure absorption chamber is supported on columns located on the outer and inner radii of the torus at the miters. At the center of each bay, a sliding saddle is provided to support the torus, resist upward forces caused by a LOCA, and allow for thermal expansion of the chamber.

The outer columns were pinned at the bottom and the inner columns are pinned at the top and bottom to allow radial growth of the absorption chamber due to temperature and pressure changes. Support for horizontal forces and lateral stability is provided by cross bracing between the outer support columns.

Additional details on the Containment System penetrations and on the equipment hatch and personnel air lock are presented in Subsection 3.8.2.4. The Appendices to Reference 1 provide details and dimensions of these penetrations and the personnel air lock. General arrangement drawings showing the relationship of the Containment System to the surrounding structures are presented as Drawings 3E-153-02-001 through 009. Overall dimensions and volumes of the Containment System are given in Table 3.8-1.

3.8.2.2 Applicable Codes, Standards and Specifications

The design, materials, fabrication, construction and inspection of the Containment System conform to, but are not necessarily limited to, the applicable sections of the following codes and specifications which are used to establish or implement design bases and methods, analytical techniques, material properties, construction techniques and quality control provisions.

Other tests and standards identified by the lead documents listed and in effect or promulgated at the time the design or construction was performed, shall also be considered as viable controlling documents.

The design and construction of the Containment System involved two basic stages:

- Original Construction (Basic Design)
- Subsequent Design Modification

Codes, standards and specifications are presented in the following paragraphs relative to these two stages.

Original Construction (Basic Design)

a. American Society of Mechanical Engineers
Boiler and Pressure Vessel Code, Sections VIII and IX, latest edition at the time of design, with all applicable addenda; nuclear case interpretation 1270 N-5, 1271 N, 1272 N-5 and other applicable case interpretations.

Boiler and Pressure Vessel Code, Section II, latest edition at the time of design with all applicable addenda, for the following material specifications:

SA-201	Carbon-Silicon Steel Plates of Intermediate Tensile Ranges for Fusion-Welded Boilers and Other Pressure Vessels
SA-212	High Tensile Strength Carbon-Silicon Steel Plates for Boilers and Other Pressure Vessels
SA-300	Steel Plates for Pressure Vessels for Service at Low Temperature
SA-333	Seamless and Welded Steel Pipe for Low Temperature Service
SA-350	Forged or Rolled Carbon and Alloy Steel Flanges, Forged Fittings, and Valves and Parts for Low Temperature Service

b. American Society for Testing and Materials Standards

A36	Structural Steel
A193	Specification for Alloy Steel and Stainless Steel Bolting Material for High Temperature Service
A307	Specification for Low Carbon Steel Externally and Internally Threaded Standard Fasteners

c. American Institute of Steel Construction

Specification for the design, fabrication and erection of structural steel for buildings.

d. Federal Specifications

TT-P-86c	Paint; Red-Lead Base, Ready Mixed

e. Steel Structures Painting Council Specifications

SSPC-SP-3	Power Tool Cleaning
SSPC-SP-6	Commercial Blast Cleaning

f. State of New Jersey Laws, Rules and Regulations

g. Burns & Roe Specifications

S-2299-4	Design, Furnishing, Erection and Testing of the Reactor Drywell and Suppression Chamber Containment Vessels

Design Modification

Modifications subsequent to the basic Containment System design and construction have transpired over a number of years after being initiated in 1975. As such, numerous codes and code revisions have been utilized in carrying out the design and construction efforts.

The following codes, standards and specifications have been supplied to indicate the basic nature of the documents being employed. Specific information relative to actual governing documents used, must be obtained from the individual modification's "System Design Description" for the Oyster Creek plant.

a. American Society of Mechanical Engineers

ASME Boiler and Pressure Vessel Code, Section III, Subsection NE," Class MC Components," (1977 Edition through Summer 1977 Addenda).

ASME Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," Division 1, (1977 Edition through Summer 1978 Addenda).

ASME Boiler and Pressure Vessel Code, Section II, "Material Specifications," (1977 Edition through Summer 1978 Addenda).

ASME Boiler and Pressure Vessel Code, Section III, Subsection NF, "Component Supports," (1977 Edition through Summer 1977 Addenda).

b. American Concrete Institute

ACI 349-76, "Code Requirements for Nuclear Safety-Related Concrete Structures," (through 1979 Supplement).

3.8.2.3 Load and Loading Combinations

The Primary Containment is designed to withstand all credible conditions of loading, including preoperational test loads, normal loads, severe environmental loads, extreme environmental loads, and abnormal loads. These loads are considered in the applicable load combinations to assure that the response of the structure will remain within the design limits prescribed in Subsection 3.8.2.5.

The loads and load combinations provided below are extracted from Reference 1. Loads and load combinations relative to the modifications implemented after start of commercial operation are contained in References 2 through 11.

a. Design Loadings

The loadings considered in the design of the drywell, absorption chamber and interconnecting elements include:

- loads caused by temperature and internal or external pressure conditions.
- Gravity loads from the vessels, appurtenances and equipment supports.
- Horizontal and vertical seismic loads acting on the structures.
- Live loads.
- Vent thrusts.
- Jet forces on downcomer pipes.
- Water loadings under normal and flooding conditions.
- The weight of contained gas in the vessels.
- The effect of unrelieved deflection under temporary concrete loads during construction.
- Restraint due to compressible material.
- Wind loads on the structures during erection.

b. Description of Loads

1. Pressures and Temperatures Under Normal Operating Conditions

During reactor operation the vessels will be subjected to temperatures up to 150°F at close to atmospheric pressure. The absorption chamber will also be subject to the loads associated with the storage of up to 91,000 cubic feet of water distributed uniformly within the vessel.

2. Pressures and Temperatures Under Accident Conditions

The drywell and the vent system are designed for an internal pressure of 44 psig coincident with a temperature of 292°F and for an internal pressure of 35 psig coincident with a temperature of 281°F. The 35 psig and 281°F have been considered to prevail for a period of 4 to 5 days as a design condition. The absorption chamber is designed for an internal pressure of 35 psig coincident with the loads associated with the storage of absorption pool water increased in volume up to 91,000 cubic feet and a temperature of 150°F.

3. Jet Forces

The drywell shell and closure head are designed to withstand jet forces of the following magnitudes in the locations indicated from any direction within the drywell:

Location	Jet Force (Max.)	Interior Area Subjected to Jet Force
Spherical Partof Drywell	566,000 pounds	3.14 square feet
Cylinder and Sphere to Cylinder Transition	466,000 pounds	2.54 square feet
Closure Head	16,000 pounds	0.09 square feet

These jet forces consist of steam and/or water at 300°F maximum in the impingement area. The jet forces do not occur simultaneously. However, a jet force is considered to occur coincident with internal design pressure and a temperature of 150°F.

The spherical and cylindrical parts of the drywell are backed up by reinforced concrete with a layer of compressible material and an air gap between the outside of the drywell and the concrete to allow for thermal expansion. It is assumed that local yielding will take place, but it has been established that a rupture will not occur. This assumption is discussed more fully in Section III-2.4 of Reference 1.

Where the shell is not backed up by concrete (closure head), the primary stresses resulting from the combination of loads previously defined does not exceed 0.9 times the yield point of the material at temperature.

However, the primary plus the secondary stresses are limited to three times the allowable stress values given in Table UCS-23, Section VIII, ASME Boiler and Pressure Vessel Code. Supporting data is available in the report, "Loads on Spherical Shells", prepared by CB&I following a series of load tests on spherical plates. This report is included as an Appendix in Reference 1.

The absorption chamber and vent system are designed to withstand jet force reactions associated with the design basis LOCA. The design reaction on each 24 inch diameter downcomer pipe is 21,000 pounds. Stresses resulting from these reactions are limited to ASME Code allowables.

4. <u>Gravity Loads to be Applied to the Drywell Vessel</u>

- The weight of the steel shell, jet deflectors, vents and other appurtenances.
- Loads from structural members used to support equipment.
- An allowance for the weight of the compressible material applied to the exterior of the vessel and as described in the B&R, Inc. report "Expansion of the Drywell Containment Vessel", which is included as an Appendix in Reference 1.
- The live load on the access opening: 11 tons or 150 pounds per square foot, whichever is more severe.
- The live load for the depth of water on the water seal at the top flange of the drywell with the drywell hemispherical head removed.
- The weight of contained gas during the tests.

- Dead and live loads on the welding pads provided on the inside of the containment sphere shoulders, spaced at 8 foot centers in each direction. Permanent loads are 200 pounds on each pad, with 800 pounds of live load on any two adjacent pads.

- A temporary load due to the pressure of fluid concrete which was placed directly against the compressible material attached to the exterior of the drywell and vents. The fluid concrete pressure was controlled by limiting the rate of placement per hour in order to have a pressure limit of 3 psi on the compressible material.

5. Gravity Loads to be Applied to the Absorption Chamber

- The weight of the steel shell including catwalk, vent header, downcomer pipes and other shell appurtenances.

- The absorption pool water stored in the vessel as specified above.

- The weight of contained air during the tests.

6. Lateral Load

The drywell vessel which was exposed above grade, prior to construction of the Reactor Building, was designed to withstand wind loads on the projected area of the circular shape in accordance with the height zones listed below. These loads were analyzed in combination with other loads applicable during this stage, with stresses limited to 133 percent of the ASME allowable stresses.

Height Above Grade in Feet	Wind Load in Pounds per Sq. Foot
0 - 30	15
30 - 50	18
over 50	24

The effects of the lateral loads at the blanked off vessel penetrations were investigated.

7. Seismic Loads

A lateral static coefficient equal to 22 percent, and a vertical static coefficient equal to 10 percent, of the permanent gravity load was assumed as acting simultaneously with each other.

This load was taken concurrently with permanent gravity loads, accident pressure conditions and other lateral loads as shown in Figures 3.8-4 and 3.8-5. These values were based on studies and criteria described in Section 2.5.

The static coefficients listed were used by CB&I to develop the design of the drywell and absorption chamber. After completion of this design and fabrication of the vessels, John A. Blume & Associates were engaged by G.E.to perform a dynamic analysis of the structure under seismic conditions. The complete analysis performed by Blume has been included in Appendix III-2.4 (Item 3) in Reference 1. The results of these calculations list coefficients equal to those utilized by CB&I in their calculations, corroborating the adequacy of the seismic design performed by CB&I.

c. Loading Combinations Used in the Basic Design of the Drywell and Vent System

1. Case I - Initial Test Condition at Ambient Temperature at Time of Test

- Gravity load of vessel and appurtenances
- Design pressure
- The weight of contained air
- Lateral load due to wind or seismic forces whichever is more severe
- Vent thrusts
- Vertical seismic load

2. <u>Case II - Final Test Condition at Ambient Temperature at Time of Test</u>

- Gravity load of vessel and appurtenances
- Gravity load from equipment supports
- Gravity load of compressible material
- Gravity load of welding pads
- Design pressure
- Seismic loads
- Effect of unrelieved deflection under temporary concrete load
- Restraint due to compressible material
- Vent Thrusts

3. <u>Case III - Normal Operating Condition at Operating Temperature Range of 50°F to 150°F</u>

- Gravity load of vessel and appurtenances
- Gravity load from equipment supports
- Gravity load of compressible material
- Seismic loads
- Vent thrusts
- Restraint due to compressible material
- Gravity load on welding pads
- Effect of unrelieved deflection under temporary concrete load
- External pressure of 2 psig
- Live load on personnel air lock

4. Case IV - Refueling Condition with Drywell Hemispherical Head Removed, at Operating Temperature Range of 50°F to 150°F
   - Gravity load of vessel and appurtenances
   - Gravity load from equipment supports
   - Gravity load of compressible material
   - Gravity and live load on welding pads
   - Water load on water seal at top flange of drywell
   - Seismic loads
   - Effect of unrelieved deflection under temporary concrete load
   - Restraint due to compressible material
   - Vent thrusts
   - External pressure of 2 psig
   - Live load on access opening

5. Case V-Accident Condition at Temperature Listed Below
   - Gravity load of vessel and appurtenances
   - Gravity load from equipment supports
   - Gravity load of compressible material
   - Gravity load on welding pads
   - Seismic loads
   - Design Pressure: Maximum positive pressure of 44 psig at 292°F decaying to 35 psig at maximum temperature at 281°F, to maximum negative pressure of 2 psig at 205°F.
   - Effect of unrelieved defl8ection under temporary concrete load
   - Restraint due to compressible material
   - Vent thrusts
   - Jet forces

d. Load Combinations Used in the Basic Design of the Absorption Chamber

1. Case I - Initial and Final Test Condition at Ambient Temperature at Time of Test

- Gravity load of vessel and appurtenances
- Absorption pool at the operating maximum of 91,000 cubic feet of water
- Seismic loads
- Design pressure
- Vent thrusts

2. Case II - Temporary Condition at Ambient Temperature During Construction

- Gravity load of vessel and appurtenances
- Seismic loads

3. Case III - Normal Operating Condition at Operating Temperature Range of 50°F to 150°F

- Gravity load of vessel and appurtenances
- Absorption pool at the operating minimum of 82,000 cubic feet of water
- Seismic loads
- Vent thrusts

4. Case IV - Accident Condition at 150°F Maximum

- Gravity load of vessel and appurtenances
- Absorption pool at the operating maximum of 91,000 cubic feet of water

- Seismic loads
- Design pressure of 35 psig
- Vent thrusts
- Jet forces on downcomer pipes

3.8.2.4 Design and Analysis Procedures

The design and analysis procedures described herein are those presented in Reference 1. Subsequent to the initial design, certain modifications were made to Primary Containment penetrations. The original design, modifications and analyses related to them are discussed in Subsection 3.8.2.4.3.

3.8.2.4.1 Drywell

Primary Membrane Stresses

The membrane stresses are based on the assumption that the thin shell resists the imposed loads by direct stress only. In addition, for earthquake design, it has been assumed that the shell as a free standing circular cantilever beam of variable cross section. Stresses have been computed at various points along the vertical axis of the drywell as shown on Figures 3.8-6 and 3.8-7. The notations adopted in these calculations are defined as follows:

T_1 = Latitudinal force in pounds per inch of meridional arc length

T_2 = Meridional force in pounds per inch of arc length

S_1,S_2 = Unit stresses corresponding to T_1 and T_2 and are equal to T_1 or T_2 divided by t

W = Total gravity load above the plane, in pounds

P = Internal or external pressure in lbs/in^2.

R = Radius of the cylinder or sphere as applicable, in inches

t = Plate thickness in inches

q = Vertical angle between vertical axis and point in the shell being computed

The internal force per unit width is computed from the following relationships:

Cylindrical Portion of Drywell:

$T_1 = PR$ and $T_2 = PR/2$ for internal or external pressure

$T_2 = W/2\ \ p\ R$ for gravity loads

$T_2 = -T_1 = Meq/S$ for earthquake loads

$T_2 = Mw/S$ for wind loads

where Meq and Mw are the moments due to earthquake and wind, respectively, and S is the Section Modulus of the Section.

Spherical Portion of the Drywell:

$T_1 = T_2 = PR/2$ for internal or external pressure

$T_2 = -W/2\ \ p\ R\ \sin^2 q\ \ ;\ T_1 = -PR\cos\ q\ \ -T_2$ for gravity loads

$T_2 = -T_1 = Meq/\ p\ R^2(\sin^3 q)$ for earthquake load

$T_2 = T_1 = Mw/\ p\ R^2(\sin^3 q)$ for wind load

Load Deflection Tests

Design pressure for the drywell requires a relatively thin walled steel vessel. However, the vessel has relatively little capability to resist concentrated jet forces. Such loads are, however, readily accepted by the massive concrete shield which surrounds the vessel. Accordingly, the space between the steel drywell vessel and the concrete shield outside has to be sufficiently small so that, although local yielding of the steel vessel can occur under concentrated forces, yielding to the extent causing rupture will be prevented. Space has been provided to allow the drywell to expand when in its stressed condition in order for it to function as a pressure vessel. In addition, the vessel is subject to thermal expansion due to exposure to operating and possible accident temperatures which are significantly higher than ambient.

In order to investigate whether or not a steel shell could deflect up to three inches locally without failure as a result of a concentrated load, CB & I conducted a series of tests on a steel plate formed to simulate a portion of the drywell vessel. The tests also provided data on loading required to produce a given deflection, and the strain at various points of the shell. In performing these tests, it was assumed that permanent deformation is not considered as failure.

The basic test section was designed and fabricated to simulate a 70 foot diameter sphere. The material and plate thickness used were typical of the type used in pressure suppression containment system applications. By modifying the basic section through the addition of an 18 inch diameter fitting with insert type reinforcing, a typical penetration was simulated. Again by the removal of the insert type fitting and the insertion of an 18 inch diameter fitting with pad type reinforcing, another typical penetration was simulated.

Step by step procedures, description of the tests, as well as load deflection and load strain curves are included in the CB & I report "Loads on Spherical Shells" in Appendix III-2.4 (Item 2) of Reference 1. The results of these tests indicate that spherical steel shells of this diameter and thickness, as well as fittings with insert type reinforcing located in a spherical steel shell are capable, under concentrated loading, of withstanding a substantial localized deflection without failure. Graphs of the theoretical radial strain in the shell, calculated assuming the shell to be a membrane, are included in this report. They indicate that the experimental data conforms rather well to the theoretical values. This confirms that the shell was acting in close conformity to the approximate theoretical mode.

<u>Expansion of the Drywell Containment Vessel</u>

The load deflection tests performed by CB&I on steel plates provided the basis for selecting three inches as the maximum acceptable space between the cold drywell shell and the biological concrete shield which surrounds it.

The three inch space precludes the use of a conventional forming system for the inner face of the concrete shield.

The approach taken was to fill the space permanently with a material having sufficient compressibility to permit the expected vessel movement and yet be rigid enough so as not to deform under the fluid pressure of concrete. This pressure can be controlled by limiting the rate of placement of the concrete.

To eliminate the need for a continuous internal pressure in order to prevent compressive forces on the vessel, an inelastic compressible material was selected; such a material can be permanently compressed once by simulating the conditions causing the greatest vessel expansion. The residual air gap created by the inelastic compression of the material will then offer no resistance to subsequent repetitions of vessel expansion.

After careful consideration, testing, and investigations as to the type of material to be utilized, an asbestos fiber magnesite cement product was selected. To determine the required minimum thickness of the material, it was necessary to establish the extent to which it was compressed. This was determined by the expansion of the vessel associated with its highest postulated temperature for any future operating or accident condition, and by the procedure planned for expanding the vessel to create an air gap larger than required to accommodate any future conditions.

Information and discussions pertaining to the performance, design and analysis aspects of the inelastic compressible material is given in Subsection 3.8.2.4.3.

An internal pressure of 35 psig (saturated steam pressure at a temperature of 281°F) resulted in an expansion which exceeded postulated accident or operating expansion, and hence, was a criterion for determining spacing dimensions.

At the most critical location, the point on the sphere most distant from the bottom embedment, thermal expansion was expected to be about 1.06 inches. Tests on the spacing material to measure the pressure required to reduce its thickness by this amount, and also taking into account the compression resulting from the fluid concrete pressure before setting, indicated an initial thickness requirement of about 2 1/2 inches. The design pressure transmitted to the concrete shield wall by the spacing material during initial expansion of the vessel would be 20 psi, which is tolerable from the standpoint of the concrete strength. Some tolerance on thickness of the compressible material had to be allowed. A workable limit of ±1/4 inch was chosen. Since the design pressure on the wall assumed 2 1/2 inches minimum, thickness of 2 3/4 inches ±1/4 inch was specified.

In considering the acceptability of the three inch gap as a maximum between the steel vessel and the concrete shield, it should be noted that this distance would be reduced by: the compression of the material under the fluid concrete pressure; the thermal expansion of the vessel in going from ambient temperature during construction to an operating temperature at which the design accident might occur; and the fully compressed thickness of the material. These conditions were expected to reduce the three inches to well below the 3.125 inch minimum failure deflection of the CB&I jet load simulation tests, particularly in view of the conservative approach used in those tests. It was thus concluded that a gap of three inches between the drywell vessel and the biological concrete shield would be satisfactory.

The construction schedule required that the compressible material be applied to the exterior of the vessel prior to the construction of the concrete shield wall.

The mixing and foam injection, as well as the application procedure for the compressible material to the vessel was performed in accordance with that developed by the manufacturer, All Purpose Fireproofing Corp. The material was built up in three coats to make a total thickness of 2 3/4 inches ±1/4 inch for the upper hemisphere. Since the lower hemisphere of the cylindrical section will have less total expansion, 2 1/2 inches ±1/4 inch of the compressible material was applied over their surfaces. A polyethylene sheet reinforced with glass fibers was used to prevent bonding of the spacing material and the concrete. The actual application was completed in about two weeks.

After completion of the material application, any damages noted were repaired. Testing and inspection services were provided to assure that the quality and workmanship were as required.

After the biological concrete shield wall was poured against the compressible material and cured, the vessel was prepared for the expansion operation. Expansion of the vessel was accomplished by pressurizing with heated air by means of portable compressors, electric duct heaters and fans placed at various locations within the vessel.

A temperature recorder was used to monitor temperature. Several of the existing vessel penetrations, consisting of pipes welded into the vessel and extending out through the concrete shield wall through sleeves, were used to monitor vessel expansion.

The expansion operation was conducted as planned, and pressure, temperature and expansion recorded throughout the procedure. The concrete shield wall exterior was examined periodically and particularly at maximum temperature and pressure; no evidence of distress was observed. An inspection of the interior of the drywell immediately after the expansion operation and again some 12 hours later gave no evidence of distress. The maximum displacement recorded during expansion was 0.61 inches which was less than the time temperature performance value calculated by computer program method. This measurement together with the favorable results of the examination of the shield wall and drywell vessel interior corroborated the assumptions made in the drywell design. Complete step by step procedures, initial criteria and conclusions drawn from this expansion procedure are included in the B&R, Inc. report "Expansion of the Drywell Containment Vessel" in Appendix III-2.4 (Item 1) of Reference 1. See also Subsection 3.8.2.4.3.

Maximum Primary Membrane Stresses in the Shell

The maximum primary membrane stresses in the shell result from the following combination of loads.

Internal pressure of **44 psig**, dead load of the shell and appurtenances lateral and vertical seismic loads, gravity load on welding pads and gravity load of the compressible material. The internal pressure load causes by far the greatest stress.

The maximum stress is 19,200 psi which is less than that allowed by the code. It occurs in the cylindrical portion of the drywell. Other stresses computed at other points along the drywell are lower in magnitude.

In addition to maximum stresses computed for the cylindrical and spherical portions of the drywell, stresses have been computed on the elliptical head of the vessel taking into account the effect of jet forces since this portion of the vessel is not backed up by concrete. The maximum stress on the head and been found to be 29,340 psi and it results from jet forces combined with an internal pressure of 44 psig. The design specification allowance for this loading combination is 31,500 psi.

Since the personnel and equipment hatch had no concrete backing to take the effect of jet forces, this portion of the drywell as well as its components was investigated and designed for jet forces in conjunction with the other load combinations as set forth in Figures 3.8-4 and 3.8-5. The effect of eccentricities on possible jet forces was also analyzed and the design provided reinforcements and stiffeners as required to maintain stresses within specified limits.

In conclusion, the design of the personnel and equipment hatch is adequate, and provides a safe and well engineered structure.

Flooded Condition

The drywell vessel has been analyzed for its ability to withstand loading resulting from partial flooding and for maximum flooding to El. 74'-6" (see Figure 3.8-8).

In each case, the maximum stress computed for various locations on the shell are below the ASME Code allowables. In addition, critical buckling of the vessel under flooded conditions has been analyzed. The results of this analysis show that there is ample margin of safety under either flooding condition.

Buckling Considerations

The drywell shell must be capable of resisting the compressive stresses resulting from the external pressure, the dead load of the shell and appurtenances, the dead load of the compressible material, the live load on the access and beam loads, the gravity loads on the weld pads, plus the wind or seismic loads. These loads produce uniaxial compressive stresses of varying magnitude at different points along the drywell shell.

Section VIII of the ASME B&PV Code (1950), permits an allowable compressive stress of 1,800,000 (t^2/R) for uniaxial compression. Later editions of the code do not include this equation as such, but include tables for allowable external pressures which are based on this allowable.

The state of stress at any point in the spherical shell may be expressed as a biaxial compressive stress plus a uniaxial compression. By combining the T_1 and T_2 stresses acting at the point algebraically, the allowable compressive stress is then given by the relationship:

$$(T_2 - T_1)/1.8 \text{ X } 10^6(t^2/R) + T_1/9 \text{ x } 10^5(t^2/R)\pounds 1,$$

where T_1 and T_2 are compressive stresses. This relationship applies to buckling of the spherical shell under biaxial compression. Also:

$$T_2/1.8 \text{ x } 10^6(t^2/R)\pounds 1,$$

which is the axial buckling of the cylindrical shell.

The stress values at the different points along the shell are summarized in Table 3.8-2 and are below the ASME allowables.

Summary

Since all possible loads, as well as their combinations, have been taken into consideration, and the maximum stresses computed are all within the design specifications and ASME Boiler and Pressure Vessel Code allowables, the drywell design is adequate.

3.8.2.4.2 Torus

Following the original design of the facility, additional design, analysis and modification work was performed for the torus under the Mark I Containment Systems Evaluation Program. These efforts are described in detail in References 2 through 11. The general analytical procedures and computer techniques utilized in the design modifications of the suppression chamber are provided in Reference 10. The discussion that follows was extracted from Reference 1, the Primary Containment Design Report.

Primary Membrane Stresses

The absorption chamber is supported on twenty pairs of columns located on the inner and outer peripheries and equally spaced. An internal ring girder of variable cross section has been provided at each of the supporting points to reduce local stresses and to add stiffness to the section. Although the principal stresses computed on the absorption chamber were circumferential, detailed analyses have been performed to determine the magnitude of localized stresses at the points of column and downcomer supports, vents, etc., to determine the need for and provide additional stiffeners and reinforcing as required.

Tests specifically for this application of the material conducted by the United States Testing Company, were to determine increments of pressure required to cause increments of deflection up to 50 percent of sample thickness. The samples were made using the production equipment and procedure to spray onto metal surfaces; the tests were made with samples in vertical and horizontal positions, at ambient temperature and at 300°F. Material loss after compaction was measured on test panels compressed in the vertical position; loss was about 1 percent of compressed sample weight; it was observed that loss was occurring at the break in the samples at the perimeter of the compression shoe, a discontinuity which would not occur in service. The reduction in thickness of the samples results principally from the collapse of the cellular structure impacted by the foam and maintained by the magnesite cement, however, some elastic compression of the asbestos fibers would be expected. The test samples were retained by the testing agency for periodic observation of rebound; rebound stabilized at 20 percent of total deflection.

The tests and evaluations indicated that the foamed asbestos fiber magnesite cement product has the required compression characteristics and stability, and would be unaffected by long term exposure to radiation and heat.

Further evaluation of the design of Primary Containment penetration is presented in References 13 and 14.

3.8.2.5 Structural Acceptance Criteria

The Structural Acceptance Criteria relating the design and analysis results for the loads and load combinations given in Subsection 3.8.2.3 to the allowables, is presented in Subsection 3.8.2.4 and other referenced documents. The Basic Design phase of the Containment System is given in Subsection 3.8.2.4 and the references listed in Subsection 3.8.6. These reference documents must be addressed to obtain complete information.

A summary of allowable stresses considered in the original design of the facility used in conjunction with certain seismic loading combinations is given in Table 3.8-3.

3.8.2.8 Drywell Corrosion

The potential for corrosion of the drywell vessel was first recognized when water was noticed coming from the sand bed drains in 1980. Corrosion was later confirmed by ultrasonic thickness (UT) measurements taken in 1986 during 11R. During 12R (1988) the first extensive corrective action, installation of a cathodic protection system, was taken. This proved to be ineffective. The system was removed during 14R (1992).

The upper regions of the vessel, above the sand bed, were handled separately from the sand bed region because of the significant difference in corrosion rate and physical difference in design. Corrective action for the upper vessel involved providing a corrosion allowance by demonstrating, through analysis, that the original drywell design pressure was conservative. **Amendment 165 to the Oyster Creek Technical Specification (Ref. 48) reduced the drywell design** pressure from 62 psig to 44 psig. The new design pressure coupled with measures to prevent water intrusion into the gap between the vessel and the concrete will allow the upper portion of the vessel to meet ASME code for the remainder life of the plant.

In the sand bed region laboratory testing determined the corrosion mechanism to be galvanic. The high rate of corrosion in this region required prompt corrective action of a physical nature. Corrective action was defined as; (1) removal of sand to break up the galvanic cell, (2) removal of the corrosion product from the vessel and (3) application of a protective coating. Keeping the vessel dry was also identified as a requirement even though it would be less of a concern in this region once the coating was applied. The work was initiated during 12R by removing sheet metal from around the vent headers to provide access to the sand bed from the Torus room. During operating cycle 13 some sand was removed and access holes were cut into the sand bed region through the shield wall. The work was finished during 14R.

After sand removal, the concrete floor was found to be unfinished with improper provisions for water drainage. Corrective actions taken in this region during 14R included; (1) cleaning of loose rust from the drywell shell, followed by application of epoxy coating and (2) removing the loose debris from the concrete floor followed by rebuilding and reshaping the floor with epoxy to allow drainage of any water that may leak into the region.

During 14R, UT measurements were taken from the outside surface of the drywell vessel in the sand bed region. Measurements were taken in each of the ten sand bed bays. The results of this inspection and the structural evaluation of the "as found" condition of the vessel is contained in Reference 44. As documented in the TDR, the vessel was evaluated to conform to ASME code requirements given the deteriorated thickness condition. In general these measurements verified projections that had been made based on measurements taken from inside the drywell. Several areas were thinner than projected. In all cases these areas were found to meet ASME code requirements after structural analysis.

The cleaning, floor refurbishing and coating effort completed in 14R will mitigate corrosion in the sand bed area. Since this was accomplished while the vessel thickness was sufficient to satisfy ASME code requirements, drywell vessel corrosion in the sand bed region is no longer a limiting factor in plant operation. Inspections will be conducted in future refueling outages to ensure that the coating remains effective. In addition, UT measurements will also be taken from inside the drywell. The frequency and extent of the coating inspections and UT thickness measurements will be **per Reference 47, as follows:**

1. **For the upper elevations, UT measurements will be made during the 16th. refueling outage (September, 1996) and during every second refueling outage, thereafter. After each inspection, a determination will be made if additional inspection is to be performed.**

2. **For the sandbed region, visual inspection of the coating as well as UT measurements of the shell will be made during the 16th. refueling outage. The coating will be inspected again during the 18th. refueling outage (Year 2000). Based on the results of the inspection of the coating, determinations will be made for additional inspections.**

3. **For water leakage not associated with refueling activities, an investigation will be made as to the source of the leakage. GPU Nuclear will take corrective actions, evaluate the impact of the leakage and, if necessary, perform an additional drywell inspection about three months after the discovery of the water leakage.**

Reference 42 provides the evaluation of the latest drywell UT inspections through the next scheduled inspection.

GPUN will notify NRC prior to implementing any changes to the drywell thickness measurement inspection program (Reference 43).

3.8.5.6 Materials, Quality Control and Special Construction Techniques

The primary materials of construction are concrete and reinforcing steel. Their descriptions and basic quality control procedures are discussed in Subsection 3.8.4.6.

There were no special construction techniques.

3.8.5.7 Testing and Inservice Surveillance Requirements

The ability of the drywell and torus to transmit pressure associated loads to the soil media via the foundations has been demonstrated by the structural integrity test described in Subsection 3.8.2.7.

No preoperational or inservice surveillance tests are required for the other Category I structure foundations.

3.8.6 References

(1) Oyster Creek Nuclear Power Plant Unit No. 1, Facility Description and Safety Analysis Report, Docket No. 50-219, Amendment No. 15, Primary Containment Design Report, September 11, 1967.

(2) NUREG-0661. Safety Evaluation Report, Mark I Containment Long Term Program Resolution of Generic Technical Activity A-7. July 1980.

(3) NUREG/CR-1083, LBL-6754. Aslam, M; Godden, W.G.; and Scalise, T. Sloshing of Water in Annular Pressure Suppression Pool of Boiling Water Reactors under Earthquake Ground Motions. Lawrence Berkeley Laboratory for U.S.N.R.C. October 1979.

(4) NUREG/1082, LBL-7984. Aslam, M; Godden, W.G.; and Scalise, T. Sloshing of Water in Torus Pressure-Suppression Pool of Boiling Water Reactors under Earthquake Ground Motions. Lawrence Berkeley Laboratory for U.S.N.R.C. October 1979.

(5) NUREG-0408. Mark I Containment Short Term Program: Safety Evaluation Report. December 1977.

(6) NEDO-21888 (Revision 2). Mark I Containment Program: Load Definition Report. November 1981.

(7) NEDO-24572 (Revision 2). Mark I Containment Program: Plant Unique Load Definition Oyster Creek Nuclear Generating Station. July 1982.

(8) NEDO-24583-1. Mark I Containment Program Structural Acceptance Criteria: Plant-Unique Analysis Application Guide. October 1979.

(9) NEDC-23702-P. Arain, S.M. Mark I Containment Program: Seismic Slosh Evaluation. March 1978.

(10) MPR-733. Oyster Creek Nuclear Generating Station Mark I Containment Long-Term Program: Plant-Unique Analysis Report Suppression Chamber and Vent System. August 1982.

(11) MPR-734. Oyster Creek Nuclear Generating Station, Mark I Containment Long Term Program: Plant-Unique Analysis Report Torus Attached Piping. August 1982.

(11a) MPR-722. Oyster Creek Nuclear Generating Station, Mark I Containment Long Term Program: Plant-Unique Analysis Supplemental Report. July 1983.

(12) Von Karman, "The Buckling of Spherical Shells by External Pressure," Pressure Vessel and Piping Design, Collected Papers, ASME, 1960, pp. 633 to 640.

(13) Oyster Creek Nuclear Power Plant Unit No. 1, Facility Description and Safety Analysis Report, Docket No. 50-219, Amendment No. 50, Primary Containment Penetration Design, March 1969.2

(14) Oyster Creek Nuclear Power Plant Unit No. 1, Facility Description and Safety Analysis Report, Docket No. 50-219, Amendment No. 51, Supplemental Information Regarding Primary Containment Penetrations, March 21, 1969.

(15) Letter from I. R. Finfrock, Jr. (JCP&L) to George Lear (NRC), dated November 1, 1977, on Torus Pool Swell-Relief Valve Actuation.

(16) Letter from George Lear (NRC) to I.R. Finfrock, Jr. (JCP&L), dated March 24, 1977, Summary of March 4, 1977 Meeting Results, Related to Torus Inspection for Corrosion and Staggered Relief Valve Set Points.

(17) Letter EATJM-190, March 22, 1977, Report on Steam Vent Cleaning Phenomenon.

(18) Letter EATJM-29, January 10, 1977, Report on Steam Vent Clearing Phenomenon.

(19) Letter EA-76-686, July 16, 1976, Oyster Creek Torus Shell Thickness Evaluation.

(20) Drwg 4104-1 Biological Shield Wall

(21) Drwg 4205-1 Biological Shield Wall, Sections & Details

(22) Drwg 4069-4 Radial Beam Framing (Inside Drywell)

(23) Drwg 2063-4 General Arrangement-Reactor Building Sections (from Print Book; shows drywell internals).

(24) Drwg 4049-7 Reactor Building Floor Plan & Sections (Outside Drywell Shell).

(25) Drwg CBI 34-3 Floor Framing Bracket

(26) Drwg CBI 35-3 Floor Framing Hanger

(27) Calculations 19-62 Drywell Steel Framing at El. 46'-08" to 19-102

(28) Calculations 29-19

(29) Calculations 9-126 to 9-304

(30) Calculations 21-32 to 21-56

(31) Calculations 6-1 to 90

(32) Letter from D.A. Ross (JCP&L) to B.H. Grier (NRC:I&E), dated December 7, 1979, Re: IE Bulletin 79-02

(33) Letter from D.A. Ross (JCP&L) to B.H. Grier (NRC:I&E), dated August 3, 1979, Re: IE Bulletin 79-02.

(34) Letter from D.A. Ross (JCP&L) to B.H. Grier (NRC:I&E), dated July 6, 1979, Re: IE Bulletin 79-02.

(35) Letter from P.B. Fiedler (GPUN) to D.M. Crutchfield (NRC: DRL), dated November 2, 1983, Re: IE Bulletin 80-11.

(36) Letter from P.B. Fiedler (GPUN) to D.M. Crutchfield (NRC: DRL), dated August 11, 1983, Re: IE Bulletin 80-11.

(37) Letter from I.R. Finfrock, Jr. (JCP&L) to B.H. Grier (NRC: I&E), dated September 19, 1980, Re: IE Bulletin 80-11.

(38) Calculations, Sheets 9-1 to 9-25, Frame 37.

(39) Drawings 4075-7, 4049-7, 4103-4.

(40) Calculation Sheets: 1-1 to 1-128, Frame 2;
to 28-130, Frame 36;
to 27-94, Frame 31;
to 3-59, Frame 18;
to 9-125, Frame 37.

(41) MPR-999, Rev. 3, Oyster Creek Nuclear Generating Station, Mark I Containment Long Term Program: Addendum to MPR-734 Plant-Unique Analysis Report Torus Attached Piping, 12/88

(42) GPUN Safety Evaluation SE-000243-002, (Current Revision), "Drywell Steel Shell Plate Thickness Reduction".

(43) Letter, GPUN to NRC, dated March 25, 1993, NRC SER for License Amendment No. 163, dated April 6, 1993.

(44) GPUN Technical Data Report TDR-1108, "Summary Report of Corrective Action Taken from Operating Cycle 12 through 14R", April 28, 1993.

(45) Letter, NRC to GPUN, dated February 21, 1995, NRC SER for License Amendment No. 177, dated February 21, 1995.

(46) MPR-1434, Evaluation of Proposed Increase in Technical Specification Limits for EMRV Setpoint Pressure on Mark I Containment Long-Term Program Analyses. March 1994.

(47) Letter , NRC to GPUN, dated November 1, 1995, Subject: "Changes in the Oyster Creek Drywell Monitoring Program," as clarified by Letter, NRC to GPUN, dated February 15, 1996, same subject.

(48) NRC SER for License Amendment No. 165, dated September 13, 1993.

(49) Letter, A. Dromerick, NRC, to J. J. Barton, GPUN, "Evaluation of Upper Reactor Building and Non-Safety Architectural Components Subjected to Tornado-Wind Loading – Items 1 and 11 of SEP Topic III-2 (M79165)," Docket No. 50-219, December 7, 1992.

(50) BC-TOP-9-A, Revision 2, "Design of Structures for Missile Impact:, Bechtel Corporation