GPU Nuclear

Technical Functions
Safety/Environmental Determination and 50.59 Review
(EP-016)

Unit OCNGS	Page 1 of 69
Document/ActivityTitle Drywell Steel Shell Plate Thickness Reduction	SE Rev. No. 11
Document No. *(if applicable)* Doc. Rev. No.	SE No. 000243-002

Type of Activity *(modification, procedure, test, experiment, or document)*: Document

1. Does this document involve any potential non-nuclear environmental concern? ☐ Yes ☒ No

   To answer this question, review the Environmental Determination (ED) form. Any **YES** answer on the ED form requires an Environmental Impact Assessment by Environmental Controls, per 1000-ADM-4500.03. If in doubt, consult Environmental Controls or Environmental Licensing for assistance. If all answers are **NO**, further environmental review is not required. In any event, continue with Question 2, below.

2. Is this activity/document listed Section I or II of the matrices in Corporate Procedure 1000-ADM-1291.01? ☒ Yes ☐ No

   If the answer to question 1 is **NO**, stop here. This procedure is not applicable and no documentation is required. (If this activity/document is listed in Section IV of 1000-ADM-1291 review on a case-by-case basis to determine applicability.) If the answer is **YES**, proceed to question 3.

3. Is this a new activity/document or a substantive revision to an activity/document? (See Exhibit 2, paragraph 3, this procedure for examples of non-substantive changes.) ☒ Yes ☐ No

   If the answer to question 3 is **NO**, stop here and complete the approval section below. This procedure is not applicable and no documentation is required. If the answer is **YES**, proceed to answer all remaining questions. These answers become the Safety/Environmental Determination and 50.59 Review.

4. Does this activity/document have the potential to adversely affect nuclear safety or safe plant operations? ☒ Yes ☐ No

5. Does this activity/document require revision of the system/component description in the FSAR or otherwise require revision of the Technical Sepcifications or any other part of the SAR? ☒ Yes ☐ No

6. Does the activity/document require revision of any procedural or operating description in the FSAR or otherwise require revision of the Technical Specifications or any other part of the SAR? ☐ Yes ☒ No

7. Are tests or experiments conducted which are not described in the FSAR, the Technical Specifications or any part of the SAR? ☐ Yes ☒ No

   IF ANY OF THE ANSWERS TO QUESTIONS 4, 5, 6, OR 7 ARE YES, PREPARE A WRITTEN SAFETY EVALUATION FORM.

   If the answers to 4, 5, 6, and 7 are **NO**, this precludes the occurrence of an Unreviewed Safety Question or Technical Specifications change. Provide a written statement in the space provided below (use back of sheet if necessary) to support the determination, and list the documents you checked.

   NO, because: ______________________

   Documents checked: ______________________

8. Are the design criteria as outlined in TMI-1 SDD-T1-000 Div. I or OC-SDD-000 Div. I Plant Level Criteria affected by, or do they affect the activity/document? ☐ Yes ☒ No

   If **YES**, indicate how resolved: ______________________

APPROVALS *(print name and sign)*

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N5047 (05-93)

1.0 PURPOSE

The purpose of this safety evaluation is to assess the structural integrity of the Oyster Creek drywell pressure vessel. This revision incorporates data on vessel thickness, sandbed coating inspections and resulting corrosion rates based on data obtained through September 1994 and assesses the period of time for which vessel structural integrity can be assured.

1.1 Introduction

The Oyster Creek drywell pressure vessel is of steel construction. Its original design incorporates a sandbed which is located around the outside circumference between elevations 8'11¾" and 12'3". The sand was removed during the 14R outage (December 1992) and the steel surfaces coated. Leakage was observed from the sandbed drains during the early to mid 1980's, indicating that water had intruded into the annular region between the drywell pressure vessel and the concrete shield wall. The presence of water in the sand was confirmed later when a water level (i.e., free water) was discovered during core boring operations to install anodes for cathodic protection (CP). Concerns about the potential for corrosion of the vessel resulted in thickness measurements being taken in the sandbed region in 1986. These measurements indicated that the vessel in the sandbed region was thinner than the 1.154 inch nominal thickness originally specified by Chicago Bridge & Iron Company (CBI) (Reference 2.3.1). Additional thickness measurements at elevations 50'2" and 87'5" were taken in 1987. These measurements also indicated areas where the pressure vessel was thinner than the originally specified. The specified nominal thickness at these elevations is 0.770 inches and 0.640 inches respectively.

Since 1987 GPUN has developed and implemented a drywell vessel corrosion monitoring program (Reference 3.1.4.21) in which inspections are conducted at identified corroded locations. Inspections have been periodically performed during refueling outages and outages of opportunity in the former sandbed region, in the spherical region (elevation 50'2" and 51'10"), and in the cylindrical region (elevation 87'5").

1.2 Background Discussion

Discovering that the drywell pressure vessel thickness was less than originally specified necessitated a number of activities. The purpose of these activities was to establish that the vessel was structurally acceptable to support continued safe operation of Oyster Creek. A summary of the activities undertaken and the resulting conclusions are provided herein.

1.2.1 Vessel Thickness Measurements

References 3.1.4.1, 3.1.4.5, 3.1.4.6, 3.1.4.22 and 3.1.4.23 document the non destructive ultrasonic testing examination methods utilized to measure vessel thickness, the locations chosen for thickness measurements, the locations for metallurgical plug samples taken from the drywell vessel and the extensive amount of data taken (in excess of 1,000 individual UT readings). Obtaining the thickness measurements over a large portion of the vessel's circumference at four elevations enabled GPUN to establish an ongoing corrosion rate monitoring program and assess the structural integrity of the vessel.

As documented in Reference 3.1.4.29 in April of 1991 a supplemental augmented series of inspections were performed on the drywell vessel. Results were that all inspected locations meet code requirements.

1.2.2 Corrosion Assessment

References 3.1.4.2 and 3.1.4.3 document the metallurgical evaluations of the two inch plug samples which were removed from the vessel in the sandbed region in December, 1986 and the upper elevation (EL. 50'2") in November, 1987. Reference 3.1.4.24 documents metallurgical evaluation of an additional two inch plug removed in April, 1990. The type of corrosion noted, coupled with an assessment of the vessel construction and operating history, allowed GPUN to establish the probable cause of the corrosion and to conservatively project corrosion rates. GPUN conducts ongoing periodic vessel thickness measurements which statistically monitor and establish corrosion rates.

The ongoing measurements are not taken in all the locations where measurements were taken initially in 1986, 1987 and 1990. The initial locations where corrosion/material loss was most severe were selected for the ongoing program. This reduction of inspection scope was done primarily to reduce the man-rem exposure received when taking drywell measurements. Note that a spot check of locations measured initially was performed during the 12R (October, 1988) outage which confirmed proper selection for ongoing measurements.

In March, 1990 an additional check was performed at elevation 50'2". This check consisted of a continuous UT "A" scan in all accessible areas in a one inch band at elevation 50'2". Results confirmed that the existing grid in Bay 5 was among the thinnest at this elevation. As a result of this check, three additional grids at elevation 50'2" were added to the program.

Elevation 50'2" is representative of vessel plates originally delivered with a mean nominal thickness of .770 inch and installed between elevation 23'6" to 51'.

In April, 1990 an additional elevation was investigated for corrosion. This elevation at 51'10" is representative of drywell vessel plate originally delivered with mean nominal thicknesses of .722 inch and installed between elevation 51' to 65'. This investigation was performed by continuous UT "A" scan in a one inch band, at elevation 51'10". Results showed only one area which was less than nominal. An inspection grid of this area (Bay 13) was added to the inspection program.

Corrosion assessments have been periodically accomplished as summarized herein. The previous bounding corrosion rate projections (discussed in previous versions of this Safety Evaluation and in Ref. 3.1.4.2 and 3.1.4.3) are no longer accurate and are not discussed in this revision of this safety evaluation.

1.2.3 Corrosion Rate Assessment

Reference 3.1.4.7, 3.1.4.10, 3.1.4.11 through 3.1.4.14, 3.1.4.25 through 3.1.4.28, 3.1.4.31 through 3.1.4.34, 3.1.4.36, 3.1.4.37, and 3.1.4.40 document the ongoing statistical analysis of vessel ultrasonic thickness (UT) measurements as they are taken at specific locations over time. The corrosion rate monitoring program involves the establishment of six inch by six inch grid locations on the vessel interior, the use of a template with 49 holes on one inch centers for locating the UT probe, a specified ± 1/8 inch tolerance on the location of subsequent measurements and taking thickness measurements periodically. This program has enabled GPUN to statistically determine corrosion rates at these grid locations.

Since the grid locations are in the known areas where corrosion/material loss is most severe, the corrosion rates and projected wall thicknesses are determined over a small fraction of the drywell but conservatively applied uniformly.

1.2.4 Structural Assessment

References 3.1.4.17 through 3.1.4.19 provide an overall analysis of the Oyster Creek drywell pressure vessel structural requirements. The UT readings obtained through September, 1994 and resulting statistical analysis coupled with the GE Nuclear structural analyses and a recently NRC approved license amendment establishing a 44 psig design pressure in place of 62 psig (Reference 3.1.2) provide the structural basis for assuring safe operation of Oyster Creek until end of plant license (April 9, 2009).

The corrosion rates, where available, have been used to project material loss. The structural evaluations have been performed assuming minimum uniform thicknesses in the areas of concern. Since corrosion is confined to specific areas, the existing evaluations and resulting vessel thickness requirements are very conservative in that they do not take credit for actual wall thicknesses in excess of the minimum used in the evaluations. In addition, the coating inspection of the former sandbed region insures the corrosion rate at this area remains at zero.

1.3 Purpose Summary

This safety evaluation will demonstrate that (based on data collected through September, 1994) plant operations can continue until end of license life based on the structural evaluation of the drywell. Action has been taken to eliminate leakage from the reactor cavity region, and for periodic surveillance (Ref. 3.1.4.21) of vessel thickness at intervals that ensure that the wall thickness will not decrease below acceptable levels between inspections.

The former sandbed area of the drywell has been cleaned and coated (during 14R Outage) to stop corrosion. The coating is visually inspected to ensure it remains effective. Additionally, the analysis of the UT data collected during the most recent inspection (September 1994) indicates that for the upper elevations of the drywell, there is no evidence of ongoing corrosion.

2.0 SYSTEMS AFFECTED

2.1 System No. 243, Drywell and Suppression System, particularly the drywell vessel structure.

2.2 Drawing showing original thickness - Chicago Bridge and Iron Co., Contract Drawings 9-0971, Drawing Nos. 1 through 11.

2.3 Documents which describe the Oyster Creek drywell pressure vessel design.

2.3.1 "Structural Design of the Pressure Suppression Containment Vessel" for JCP&L/Burns and Roe, Inc., Contract No. 9-0971, by CB&I Co., 1965.

3.0 EFFECTS ON SAFETY

3.1 Documents that Describe Safety Function & Evaluations

3.1.1 OCNGS Unit 1 Facility Description and Safety Analysis Report

3.1.1.1 Licensing Application, Amendment 3, Section V

3.1.1.2 Licensing Application, Amendment 11, Question III-18

3.1.1.3 Licensing Application, Amendment 15

3.1.1.4 Licensing Application, Amendment 68

3.1.2 Technical Specification Documents

3.1.2.1 Technical Specification and Bases - OCNGS Unit, Appendix A to Facility License DRP-16, JCP&L Docket No. 50-219, Sections 3.5, 4.5, 5.2.

3.1.2.2 Technical Specification Amendment 165.

3.1.3 Regulatory Documents

3.1.3.1 10CRF50, Appendix A. General Design Criteria for Nuclear Power plants

- Criterion 2 - Design basis for Protection against natural phenomena
- Criterion 4 - Environmental and Missile Design Bases
- Criterion 16 - Containment Design
- Criterion 50 - Containment Design Basis

3.1.4 GPUN Technical Data Reports (TDR), Calculations and Drawings

3.1.4.1 TDR 851 Assessment of Oyster Creek Drywell Shell.

3.1.4.2 TDR 854 Drywell Sandbed Region Corrosion Assessment.

3.1.4.3 TDR 922 Drywell Upper Elevation, Wall Thinning Evaluation.

3.1.4.4 (This reference has been superseded by References 3.1.4.17 through 3.1.4.19).

3.1.4.5 Sketch 3E-SK-S-89, Ultrasonic Testing - Drywell Level 50'2" - 87'5" Plan.

3.1.4.6 Sketch 3E-SK-S85, Drywell Data UT Location Plan.

3.1.4.7 TDR 948, Statistical Analysis of Drywell Thickness Data.

3.1.4.8 NRC Letter Docket 50-219, dated October 26, 1988, subject "Oyster Creek Drywell Containment".

3.1.4.9 Primary Containment Design Report, dated 9/11/67, Ralph M. Parson Company.

3.1.4.10 Calc. C-1302-187-5360-006 "Projection of Drywell Mean Thickness thru October, 1992".

3.1.4.11 Calc. C-1302-187-5300-008 "Statistical Analysis of Drywell Thickness Data thru 2/8/90".

3.1.4.12 Calc. C-1302-187-5300-009 Rev. 0 "OC Drywell Projected Thickness".

3.1.4.13 Calc C-1302-187-5300-001 Rev. 0, "Statistical Analysis of Drywell Thickness Data thru 4/14/90".

3.1.4.14 Calc C-1302-187-5300-012 Rev. 0, "OCDW Projected Thickness Using Data thru 4/24/90".

3.1.4.15 This reference no longer applicable, therefore, is deleted.

3.1.4.16 This reference no longer applicable, therefore, is deleted.

3.1.4.17 "Justification For Use of Section III, Subsection NE, Guidance in Evaluating The Oyster Creek Drywell", Technical Report TR-7377-1, dated November 1990, Teledyne Engineering Services.

3.1.4.18 "An ASME Section VIII Evaluation of Oyster Creek Drywell for without Sand Case, Part I, Stress Analysis", dated February 1991, GE Nuclear Energy, San Jose, CA.

3.1.4.19 "An ASME Section VIII Evaluation of the Oyster Creek Drywell for without Sand Case, Part 2, Stability Analysis", Rev. 2, dated November 1992, GE Nuclear Energy, San Jose, CA.

3.1.4.20 This reference no longer applicable, therefore is deleted.

3.1.4.21 GPUN Specification IS-328227-004, Revision 10, "Functional Requirements For Drywell Containment Vessel Thickness Examination".

3.1.4.22 Sketch 3E-Sk-M-275, Rev. 0, "UT Drywell Level 50'2", March 1990 Readings".

3.1.4.23 Sketch 3E-Sk-M-358, Rev. 0, "UT Drywell Level 51'-10", April 1990 Readings".

3.1.4.24 "Oyster Creek Drywell Corrosion Evaluation", dated June 1990, GE Nuclear Energy, San Jose, CA.

3.1.4.25 Calc C-1302-187-5300-015, "Statistical Analysis of Drywell Thickness Data Thru 3/3/91".

3.1.4.26 Calc C-1302-187-5300-016, "OCDW Projected Thickness Using Data Thru 3/3/91".

3.1.4.27 Calc C-1302-187-5300-017 "Statistical Analysis of Drywell Thickness Data thru May, 1991".

3.1.4.28 Calc C-1302-187-5300-018, "OCDW Projected Thickness using Data thru May, 1991".

3.1.4.29 GE Report "Final Report - Oyster Creek Drywell Containment Vessel Random UT Project" dated May 8, 1991.

3.1.4.30 IS-402950-001, Rev. 0 Functional Requirements for Augmented Drywell Inspections.

3.1.4.31 Calc C-1302-187-5300-19 "Statistical Analysis of Drywell Thickness Data thru November, 1991".

3.1.4.32 Calc C-1302-187-5300-20 "OCDW Projected Thickness Using Data thru November 1991".

3.1.4.33 Calc C-1302-187-5300-021 "Statistical Analysis of Drywell Thickness Data thru May, 1992".

3.1.4.34 Calc C-1302-187-5300-022 "OCDW Projected Thickness Using Data thru May, 1992".

3.1.4.35 Safety Evaluation SE-402950-005 "Removal of Sand from Drywell Sandbed".

3.1.4.36 Calc C-1302-187-5300-025 "Statistical Analysis of Drywell Thickness Data thru December 1992".

3.1.4.37 Calc C-1302-187-5300-024 "OC DW Projected Thickness Using Data thru December, 1992".

3.1.4.38 TDR 1108 Summary Report of Corrective Action Taken form Operating Cycle 12 through 14R Outage.

3.1.4.39 Calc C-1302-187-5300-024 "O.C. Drywell External UT Evaluations" in the Sandbed.

3.1.4.40 Calc C-1302-187-5300-028 - Statistical Analysis of Drywell Thickness Data thru September, 1994.

3.1.4.41 Memo #5514-94-319 - Dated September 30, 1994 - Subject: Inspection D.W. Sandbed Coating in Bay 11 - O.C.

3.1.4.42 Calc C-1302-243-5320-071 - Rev. 1, "Drywell Thickness Margins."

3.1.4.43 Memo #5340-94-120 - Dated November 9, 1994 - Subject: Video Inspection of DW Sandbed Bay #3.

3.1.4.44 Memo #5340-95-062 - Dated July 12, 1995 - Subject: Life Expectancy of Drywell Shell Coating in Former Sandbed O.C.

3.1.5 <u>Industry Codes and Standards Applicable Codes</u>

3.1.5.1 The ASME Boiler and Pressure Vessel Code and applicable nuclear code cases utilized for the design of the drywell pressure vessel are as listed in References 3.1.4.17 through 3.1.4.19.

3.1.5.2 Applicable Drywell Shell Plate Material Standards/Specification

SA-212 High Tensile Strength Carbon - Silicon Steel Plates for Boilers and other Pressure Vessels.

3.2 Drywell Pressure Vessel Safety Function Drywell Geometry Description

3.2.1 The drywell, sometimes referred to as the containment vessel or containment structure, houses the reactor vessel, reactor coolant recirculating loops, and other components associated with the reactor system. The structure is a combination of a sphere, cylinder, and 2:1 ellipsoidal dome that resembles an inverted light bulb. The spherical section has an inside diameter of 70'.

The cylindrical portion connecting the sphere to the dome has a diameter of 33'. The structure is approximately 99' high. The plate thicknesses vary from a maximum of 2.56" at the transition between the sphere and the cylinder down to a minimum of 0.640" in the cylinder. The dome wall thickness is 1.18".

Figure 1 illustrates the drywell structure along with the pertinent dimensions. The top closure, which is 33' in diameter, is made with a double tongue and groove seal which permits periodic checks for leak tightness. Ten vent pipes, six feet six inches in diameter, are equally spaced around the circumference to connect the drywell and vent header to the pressure suppression chamber.

The drywell interior is filled with concrete to elevation 10'3" to provide a level floor. Concrete curbs follow the contour of the vessel up to elevation 12'3" with cutouts around the vent lines.

On the exterior, the drywell is encapsulated in concrete of varying thickness from the base elevation up to the elevation of the top head. From there, the concrete continues vertically to the level of the top of the spent fuel pool.

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 which serves as one of the shear rings that prevent rotation of the drywell during an earthquake.

The proximity of the biological shield concrete surface to the steel shell varies with elevation. The concrete is in full contact with the shell over the bottom of the sphere at its invert elevation 2'3" up to elevation 8'11¼". At that point, the concrete is stepped back 15 inches radially to form a pocket which continues up to elevation 12'3". The pocket was originally filled with sand which formed a cushion to smooth the transition of the shell plate from a condition of fully clamped between two concrete masses to a free standing condition. The sand pocket was connected to drains which allowed drainage of any water which might enter the sand. The sand was removed during the 14R outage (December 1992).

The sand "springs" helped to ease this transition. GE analysis (Ref. 3.1.4.18 and 3.1.4.19) has shown that the sand is not required so long as vessel thickness in that region is greater than or equal to .736 inches (with margin as stated in 3.3.2.1). Justification for removing sand from the sandbed is covered under a separate Safety Evaluation (Ref. 3.1.4.35). As stated above, the sand was completely removed and the drywell vessel was coated in the sandbed region during the 14R refueling outage (Figure 2). The sand was removed via ten (10) 20" diameter access holes drilled equally spaced through the containment concrete shield wall.

Up from elevation 12'3" there is a 3" gap between the drywell and the concrete biological shield wall which is filled with foam material that provides no structural support. An upper lateral seismic restraint, attached to the cylindrical portion of the drywell at elevation 82.17 ft., allows for thermal, deadweight, and pressure deflection, but not for lateral movement due to seismic excitation. All penetrations for piping, instrumentation lines, vent ducts, electrical lines, equipment accesses, and personnel entrance have expansion joints and double seals where applicable.

The spherical area is described by 10 segments, one at each downcomer, referred to as bays. The bays are odd numbered 1 thru 19 (Figure 3).

3.2.2 Drywell Pressure Vessel Safety Function

3.2.2.1 Functional Design

The drywell pressure vessel is one of the major structural components of the Primary Containment System (PCS) discussed in Section 6.2 of the Oyster Creek Nuclear Generating System Update FSAR. The safety function of the Primary Containment System is to accommodate, with a minimum of leakage, the pressures and temperatures resulting from the break of any enclosed process pipe; and, thereby, to limit the release of radioactive fission products to values which will insure offsite does rates well below 10CFR100 guideline limits.

3.2.2.2 Design Criteria

The design criteria for the Containment are as follows:

a. To withstand the peak transient pressures (coincident with an earthquake) which could occur due to the postulated break of any pipe inside the drywell.

b. To channel the flows from postulated pipe breaks to the torus.

c. To withstand the force caused by the impingement of the fluid from a break in the largest local pipe or connection, without containment failure.

d. To limit primary containment leakage rate during and following a postulated break in the primary system to substantially less than that which would result in offsite doses approaching the limiting values in 10CFR100.

e. To include provisions for leak rate tests.

f. To be capable of being flooded following a Design Basis Accident to a height which permits unloading of the core.

3.2.2.3 Drywell Vessel Design Pressure and Temperature Parameters

- The drywell and connecting vent system tubes are designed for 44 psig, internal pressure at 292°F, and an external pressure of 2 psig at 205°F.

- The design lowest temperature to which the primary containment vessel is subjected is 30°F.

3.3 Effects of Drywell Pressure Vessel Thickness Reduction

In order to demonstrate that the vessel thickness reduction will not adversely affect the ability of the drywell to perform its safety function, GPUN establishes a conservative corrosion rate, projects vessel thickness, and shows by analysis that allowable stresses are not exceeded for the design basis load conditions.

3.3.1 Results of Corrosion Monitoring Program

3.3.1.1 Monitoring Program Summary

Reference 3.1.4.21 defines the drywell corrosion inspection program. This program identifies nine (9) locations for UT inspection. These nine locations were selected for inspection based on extensive drywell thickness investigation performed during the initial corrosion investigation phase (1986 through 1991). These nine (9) locations (exclusive of the former sandbed region) exhibited that worst metal loss and therefore were selected for monitoring wall thickness.

Originally, the knowledge of the extent of corrosion was based on a UT inspection plan involving going completely around the inside of the drywell at several locations. Nine six-by-six grids on either side of each vent penetration were used to characterize the situation at the elevation of the sandbed. At each of the upper elevations a belt-line sweep was used with readings taken on as little as one inch centers wherever thickness changed between successive nominal 6" centers. Grids were established in the upper elevations in this way.

As experience increased with each data collection campaign, only grids showing evidence of change were retained in the inspection program. Additional assurance regarding the adequacy of this inspection plan was obtained by a completely randomized inspection, involving 59 grids,that showed that all inspection locations satisfied code requirements.

As a minimum, the nine locations above the former sandbed region specified in the program, will be inspected during the 16R refueling outage and every third refueling outage thereafter. This frequency of inspection is considered adequate because most recent data obtained indicates that there is no evident of ongoing corrosion at the upper elevations of the drywell vessel.

Reference 3.1.4.21 also covers coating inspection of the drywell shell exterior at the former sandbed region. The corrosion in this area of the drywell vessel was arrested during the 14R refueling outage (December 1992), as the steel surface was coated for corrosion protection.

As stated in 3.3.1.7 of this safety evaluation, the coating was inspected during the 15R refueling outage on a sample basis. Results of the inspection were satisfactory with no indications of coating failures.

As a minimum, additional inspections of the coating will be conducted during the 16R refueling outage and again during refueling outage 18R. This frequency of inspections is adequate based on results of prior coating inspection and estimated coating life (8-10 years) per reference 3.1.4.44. After the inspection in refueling outage 18R, an assessment will be made, appropriate actions will be taken, and the need for future inspections will be determined to ensure that the drywell integrity is maintained until at least April 2009. The scope of the inspection as set forth in reference 3.1.4.21 of inspecting two bays, is adequate because the environmental conditions and coating application methods were similar for all ten bays when the coating was applied. Also, the two bays selected for inspection are known to be worst leakage areas with most corrosion attack prior to the coating application.

In summary, the inspection program (Reference 3.1.4.21) is adequate to assure drywell vessel integrity until at least April 9, 2009 (end of plant license).

3.3.1.2 Corrosion Rates

Reference 3.1.4.40 discusses the statistical analysis of the UT data taken over the time period February, 1987 through September, 1994 for the sandbed region grids and November, 1987 through September, 1994 for the upper elevation grids. A new monitored location (#50-22) above the sandbed was added to the program in December of 1992. The corrosion rate was determined by calculating the rate of change of the mean thickness at each measured grid using linear regression analysis. The corrosion rate has previously been expressed as the slope of the regression line ± the standard error of the slope. Below are the current corrosion status assessments in the most limiting areas for each of the major elevations. The corrosion at the sandbed region was arrested in December, 1992 when the subject surfaces were cleaned and coated. Inspection of the coated surfaces performed in September of 1994 revealed that the coating is performing satisfactory as documented in reference 3.1.4.41.

Sandbed Region	- Corrosion arrested.
Elevation 50'2"	- F-Ratio <1.0
Elevation 51'10"	- F-Ratio <1.0
Elevation 87'5"	- F-Ratio <1.0
Elevation 60'-11"	- Insufficient Data

Evaluation of the September, 1994 inspection data indicates that for Elevations 50'-2", 51'-10", 60'11", and 87'5", there is no evidence of ongoing corrosion. This assessment (Ref. 3.1.4.40) is based on the fact that the statistical regression estimate can not be used to define a corrosion rate because the F-ratio is far too low for reliable use, or that there are fewer than four measurements. (See paragraph 3.3.1.3--Sphere elevation 60'-11")

Because the statistical F-test for significance of the regression rate estimate is very low, there is no evidence of ongoing corrosion, only random variation associated with measuring techniques.

3.3.1.3 Projections

Projections are determined by performing regression analysis, when appropriate.

Sandbed

The entire sandbed region of the drywell shell O.D. was coated during the 14R refueling outage (December 1992). This coating was inspected in September 1994. This inspection showed no coating failure or signs of deterioration. Therefore, the corrosion in this region has been arrested and no further corrosion is expected to occur. To ensure that the coating applied will remain effective, visual inspections by direct and/or remote methods will be conducted per reference 3.1.4.21. The coating will again be inspected during refueling outage 16R and again during refueling outage 18R. Should an inspection reveal coating failure, an assessment will be made, appropriate actions will be taken, and the need for additional inspections will be determined to ensure that the drywell integrity is maintained until at least April 2009 (end of License). The coating has an estimated life prediction of 8-10 years, before signs of local deterioration are expected (Reference 3.1.4.44). Currently, a margin of 70 mils exists between the required metal thickness and the actual mean metal thickness at the thinnest location as measured during the 15R outage in September 1994. This margin provides additional assurance for drywell integrity in the unlikely case of coating failure between inspection intervals.

Based upon the arrested corrosion, and future monitoring of the coating, it is reasonable to conclude that this region will not become limiting prior to April 2009.

Cylinder, Elevation 87'-5"

As a result of low F-ratio at this elevation, it can be concluded that there is no evidence of ongoing corrosion at this location. The September, 1994 data indicates that the thinnest location at this elevation has a mean thickness of 613 mils. Therefore, a margin of 161 mils exists between actual and minimum mean acceptable thickness. With the 161 mils margin which currently exists, minimum mean acceptable thickness could not be reached by April 2009, unless there was an ongoing corrosion rate of approximately 11 MYP. A corrosion rate of this magnitude would be observable. A corrosion rate of 11 MPY has not been observed in any location above the sandbed.

Additional assurance will be provided by volumetric inspection during the next refueling outage (16R) and at least every third refueling outage thereafter.

Sphere, Elevation 50'-2"

As a result of low F-ratio at this elevation, it can be concluded that there is no evidence of ongoing corrosion at this location.

The September, 1994 data indicates that the thinnest location at this elevation has a mean thickness of 733 mils. Therefore a margin of 192 mils exists between actual and minimum mean acceptable thickness.

Although the data on hand does not permit a statistically rigorous calculation of corrosion rate, it is adequate to support a conclusion that this region will not become limiting prior to April 2009, unless there was an ongoing corrosion rate of approximately 13 MPY. A corrosion rate of this magnitude would be observable. A corrosion rate of 13 MPY has not been observed in any location above the sandbed.

Additional assurance will be provided by volumetric inspection during the next refueling outage (16R) and at least every third refueling outage thereafter.

Sphere, Elevation 51'-10"

As a result of low F-ratio at this elevation, it can be concluded that there is no evidence of ongoing corrosion at this location.

The September, 1994 data indicates that the thinnest location at this elevation has a mean thickness of 695 mils. Therefore a margin of 177 mils exists between actual and minimum mean acceptable thickness.

Although the data on hand does not permit a statistically rigorous calculation of corrosion rate, it is adequate to support a conclusion that this region will not become limiting prior to April 2009. With the 177 mils margin which currently exists, minimum mean acceptable thickness could not be reached by April 2009, unless there was an ongoing corrosion rate approximately 12 MPY. A corrosion rate of this magnitude would be observable. A corrosion rate of 12 MPY has not been observed in any locations above the sandbed.

Additional assurance will be provided by volumetric inspection during the next refueling outage (16R) and at least every third refueling outage thereafter.

Sphere, Elevation 60'-11"

This location was added to the Drywell Corrosion monitoring program with the first UT data set taken in December 10 1992 and a second UT data set taken in September 1994. As a result of the limited data at this elevation, a statistical analysis of the corrosion rate, could not be performed. Therefore, a projection based on regression analysis will not be meaningful. The

September, 1994 data indicates that the thinnest location at this elevation has a mean thickness of 709 mils. Therefore, a margin of 191 mils exists between actual and minimum mean accepted thickness.

Although the data on hand does not permit a statistically rigorous calculation of corrosion rate, it is adequate to support a conclusion that this region will not become limiting prior to April 2009. With the 191 mils margin which currently exists, minimum mean acceptable thickness could not be reached by April 2009, unless there was an ongoing rate of approximately 13 MPY. A corrosion rate of this magnitude would be observable. A corrosion rate of this magnitude has not been observed in any locations above the sandbed.

Additional assurance will be provided by volumetric inspection during the next refueling outage (16R) and at least every third refueling outage thereafter.

3.3.1.4 <u>Projected Local Vessel Thicknesses</u>

Because mean uniform thickness can consist of local values less than the mean, consideration has been given to the significance of such readings. The number of such readings is extremely limited and have been evaluated as not structurally significant as follows (Ref. 4.1.4.40)

<u>Sandbed</u>

The lowest local reading is .770 inches (Ref. 3.1.4.40). The local acceptable thickness for the sandbed region is .49 inches (Section 3.3.2). As mentioned in 3.3.1.3, the sandbed region was coated and no further corrosion is expected in this area, and the .280" margin is more than adequate for the balance of plant life (April 2009).

<u>Cylinder, Elevation 87'5"</u>

The lowest local reading is .551 inches (Ref. 3.1.4.40). The local acceptable thickness for this elevation is .300 inches (Section 3.3.2). Therefore, a margin of approximately 251 mils exists between actual and local acceptable thickness. If this local area is actually corroding, it would have to corrode at a rate of approximately 17 mils/year to reach the minimum local acceptable thickness by April 2009. A corrosion rate of approximately 17 mils/year has not been observed to date (above the sandbed) and is not considered credible.