U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 50-353/89-18

Docket No. 50-353

License No. CPPR-107

Licensee: Philadelphia Electric Company
2301 Market Street
Philadelphia, PA 19101

Facility Name: Limerick Nuclear Generating Station, Unit 2

Inspection At: Limerick, Pennsylvania

Inspection Conducted: April 29 - May 6, 1989

Inspectors: J Carrasco 5-17-89
Joseph E. Carrasco, Reactor Engineer Date

Approved by: S Chaudhary 5/17/89
Suresh Chaudhary, Chief, MPS Date
Engineering Branch, DRS, RI

Inspection Summary: Routine unannounced inspection on April 29 - May 6, 1989 (Inspection Report No. 50-353/89-18)

Areas Inspected: Structural Integrity Test (SIT) procedures and implementation; involvement of QA/QC with the SIT.

Results: Based on the review of the SIT results the inspector determined that the preliminary results appear acceptable.

DETAILS

1.0 Persons Contacted

1.1 Philadelphia Electric Company

* H. W. Vollmer, Section Manager Civil/Mechanical Plant
* D. M. O'Rourke, Structural Engineering Branch Head
* R. Reifsnyder, Nuclear QA Engineer

1.2 Bechtel Incorporated

B. Patel, SIT Test Director
P. J. Galanti, SIT Test Director Alternate
T. Lieb, Quality Control
B. Simmons, Test Supervisor
N. Gonzales, Test Engineer
* V. K. Aggarwal, Civil Group Supervisor
* S. Mitkal, QA Engineer
* S. H. Loo, Project Engineer Civil

1.3 Kemper Insurance Company

G. Voishnis, Authorized Nuclear Inspector

1.4 U.S. Nuclear Regulatory Commission

J. M. Trapp, Reactor Engineer
R. Fuhrmeister, Resident Inspector
T. Kenney, Senior Resident Inspector

* Denotes those present during the exit meeting held on May 8, 1989.

2.0 Introduction and Overview

2.1 Background

Current licensing regulations require that containment structures protecting water cooled nuclear power reactors be pressure tested before a nuclear power plant may be placed into service. The purpose of the test is dual in nature. First, the structural response of the containment to the test pressure is intended to provide the design engineer the information to evaluate and validate design assumptions; second, the test will reveal serious construction deficiencies, if they exist.

The structural integrity test, therefore, is to demonstrate that the primary containment responds to internal pressure as analyzed and documented in final safety analysis report.

3.0 Procedure and Organization

The inspector reviewed the Bechtel procedure for the structural integrity test (titled, "Specification for Primary Containment Structural Integrity Test for the Limerick Generating Station Units 1&2 Philadelphia Electric Company" No. 8031-C-112) against the USNRC Regulatory Guide 1.18 Revision 1, Structural Acceptance Test for Concrete Primary Reactor Containments; ASME B & PV Code, Section III, Division 2, Article CC-6000, July 1980 Edition; and the Limerick Generating Station Unit 2 FSAR Section 3.8.1.7.1.1, structural acceptance test. Based on this review, the inspector determined that the Bechtel procedure was adequate for the implementation of the Structural Integrity Test (SIT).

Bechtel had established two test teams for covering the test on a twenty four hour basis. Each team consisted of pretest, control room monitoring, crack mappers and calibration crews. The inspector determined that each group had sufficient personnel to perform the task effectively.

4.0 Acceptance Criteria

The licensee had established the following acceptance criteria for the structural integrity of the containment.

4.1 Displacement Measurements

The maximum allowable displacements for the containment structure were:

(a) The average containment wall radial displacement at any elevation to be less than 0.537 inches.

(b) The measured containment wall vertical displacement to be less than 0.574 inches.

4.2 Visual and Concrete Crack Inspection

(a) Total width of any one crack to be less than 0.060 inches.

(b) No visibly detectable signs of damage to either the concrete structure or the steel line..

4.3 The Deflection Recovery

(a) If the measured deflections at joints of maximum predicted deflection did not exceed the maximum allowable value shown in (1) above: the deflection recovery at the points of maximum expected deflection within 24 hours after complete depressurization must be 70% or more. The points of maximum predicted deflection were contained in supplement I of specification 8031-C-112.

(b) If the measured maximum deflection at points of maximum predicted deflection exceeded 130% of predicted values, the deflection recovery at points of maximum expected deflection within 24 hours after complete depressurization must be 80% or more.

5.0 Implementation of the Structural Integrity Test

The inspector observed that all the precautionary measures were implemented in accordance with Supplement II to the specification 8031-C-112 Section 4.1.

According to test plan, the primary containment was pneumatically pressurized to 115% of the design pressure (which is 1.15 times 55 psig or 63.25 psig) to determine the structural response of the containment.

The second test was to determine the behavior of the diaphragm (slab that divides the wet well and the dry well) by pneumatically pressurizing the dry well to 63.25 psig and the suppression pool to 28.50 psig to obtain a differential pressure (ΔP) of at least 30 times 1.15 or 34.5 psig.

The displacements were measured by using 66 displacement transducers and associated hardware located on preselected locations. Transducers were utilized to measure shell displacements radially and vertically, and displacements at hatches (major containment penetrations). The locations where measurements were made are listed in Attachment I.

The actual pressurization of the containment began on April 29 at 1505 with a gradual build up of pressure (3 psig/hr. nominal) as specified in specification 8031-C-112. The peak pressure of 63.25 psig was reached on April 30 at 1404 followed by 1 hr. hold for crack mapping and gathering of data from all the transducers.

Certain difficulties were encountered for the second part of the SIT (the establishment of a ΔP for the diaphragm) due to inadequate sealing of the down-comer caps. Leakage through the downcomers between the drywell and wetwell were detected by air bubbles in the suppression pool. Several leaks from the SRV lines into the suppression pool were also detected.

After all the repairs were performed to ensure a good seal of the diaphragm openings to the suppression pool (e.g. down-comers and SRV lines), the following sequence of events took place.

1) Pressurized dry well to approximately 34 psig to determine if the pressure could be maintained.
2) Pressurized suppression pool to 28.5 psig.
3) Increased dry well pressure to 63.25 psig.
4) Completed SIT procedural steps that remained incomplete.
5) Completed the high pressure by-pass test.
6) Depressurized containment.
7) Completed and closed out SIT test procedure.

The pressurization of the dry well (step 3 above) was done at the rate of 8 psi/hr. reaching desired peak pressure at 1728 on May 4. Step 6 above was accomplished at 2114 on May 4.

6.0 Results

The NRC inspector reviewed data summaries for the different phases of the test as follows:

- A summary of data taken at the start of the peak pressure hold. The data were taken at 1404 on April 30 at 63.35 psig and 72.10 F.

- A summary of data taken at the end of the peak pressure hold. The data were taken at 1504 on April 30 at 63.30 psig and 74.0 F.

By review of test results, the inspector determined that in the suppression pool, the maximum displacement of 0.171 inches occurred at transducer H7 located at elevation 219'-3" azimuth 56 degrees. In radial direction, this was within the expected displacement predicted by the analysis and constituted only 32% of the allowable maximum displacement.

- Recovery displacement data taken at 0800 on May 1, at 0.00 psig and 71.50 F. The inspector determined the recovery at all transducer locations was greater than 70%, with exception of two locations, H25 located at elevation 315', azimuth 0 degrees outside the dry well; and H27 at elevation 315', azimuth 120 degrees outside the dry well where their recovery was 4% and 66%, respectively.

The inspector found these two recovery values acceptable, since the acceptance criteria for % of recovery states 70% recovery applies at joints of maximum predicted values. Joints H25 and H27 are not joints of predicted values for having 70% recovery.

- Bypass Test data taken at the start of the peak pressure hold at 1728 on May 4 at 62.80 psig and 70.50 F.

- Bypass Test data taken at the end of the peak pressure hold at 1828 on May 4 at 62.80 psig and 69.70 F.

By review of both test results, the inspector determined that in dry well, the maximum displacement of 0.093 inches occurred at transducer E20 located at elevation 258'+(12' 5") and azimuth 315 degrees inside the dry well over an equipment hatch. However, this represents only 17% of allowable displacement at this location.

- Bypass Test recovery displacement data taken at 0804 on May 5 at 0.05 psig and 63.10 F. All transducer locations registered over 70% recovery.

7.0 <u>Conclusion</u>

Based on the observation of the SIT and the review of data, the inspector determined that the SIT was a successful test. However, a more detailed review and analysis of the data will be performed by the NRC after the licensee submits his final report to the NRC.

8.0 Management Meetings

Licensee management was informed of the scope and purpose of the inspection at the beginning and during the inspection. The findings of the inspection were discussed with licensee representatives during the course of the inspection and presented to the licensee management on May 8, 1989 at the exit meeting (see paragraph 1 for attendees).

At no time during the inspection was written material provided to the licensee by the inspector. The licensee did not indicate that proprietary information was involved within the scope of this inspection.

ATTACHMENT I

Transducer Identification	Elevation	Azimuth
H1	196'	30 degrees
H2	196'	83 degrees
H3	196'	135 degrees
H4	196'	240 degrees
H5	196'	274 degrees
H6	196'	330 degrees
H7	219'-3"	56 degrees
H8	219'-3"	110 degrees
H9	219'-3"	176 degrees
H10	219'-3"	230 degrees
H11	219'-3"	290 degrees
H12	219'-3"	350 degrees
H13	238'	0 degree
H14	235'-3 1/2"	61 degrees
H15	238'	126 degrees-30'
H16	238'	182 degrees
H17	238'	240 degrees
H18	238'	300 degrees
H19	282'	30 degrees
H20	282'	90 degrees
H21	282'	150 degrees
H22	282'	208 degrees
H23	282'	270 degrees
H24	282'	330 degrees
H25	315'	0 degree
H26	315'	60 degrees
H27	315'	120 degrees
H28	315'	180 degrees
H29	315'	240 degrees
H30	315'	300 degrees
D1	Vertical	45 degrees
D2	Vertical	105 degrees
D3	Vertical	165 degrees
D4	Vertical	225 degrees
D5	Vertical	285 degrees
D6	Vertical	345 degrees
V1	Vertical	60 degrees
V2	Vertical	120 degrees
V3	Vertical	180 degrees
V4	Vertical	240 degrees
V5	Vertical	300 degrees
V6	Vertical	0 degree
E1	258'	Per Drawing
E2	258'	C-898 Bechtel
E3	258'	
E4	258'	
E5	258'	
E6	258'	

E7	258'+(18' 4")	135 degrees
E8	258'+(10' 3")	135 degrees
E9	258'+(7')	135 degrees
E10	258'-(6' 11")	135 degrees
E11	258'-(11' 4")	135 degrees
E12	258'-(18')	135 degrees
E13	258'	Per Drawing
E14	258'	C-898 Bechtel
E15	258'	
E16	258'	
E17	258'	
E18	258'	
E19	258'+(18' 4")	315 degrees
E20	258'+(12' 5")	315 degrees
E21	258'+(7' 1")	315 degrees
E22	258'-(7' 7")	315 degrees
E23	258'-(12' 3")	315 degrees
E24	258'-(17' 4")	315 degrees