RO:I Form 12
(Oct 74) (Rev)

U.S. ATOMIC ENERGY COMMISSION

DIRECTORATE OF REGULATORY OPERATIONS

REGION I

RO Inspection Report No: 50-320/74-08 Docket No: 50-320

Licensee: Metropolitan Edison Company License No: CPPR-66

Box 542 Priority:

Reading, Pennsylvania 19603 Category: A

Location: Middletown, Dauphin County, Pa. (Three Mile Island 2) Safeguards Group:

Type of Licensee: PWR, 871 MWe (B&W)

Type of Inspection: Special, Announced

Dates of Inspection: December 5, 9, 19 and 30, 1974

Dates of Previous Inspection: October 23, 1974

Reporting Inspector: A. A. Varela 1/8/75
Anthony A. Varela, Reactor Inspector Date

Accompanying Inspectors: Date

Date

Date

Date

Other Accompanying Personnel: None Date

Reviewed By: R. C. Haynes 1/14/75
R. C. Haynes, Senior Reactor Inspector Date

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SUMMARY OF FINDINGS

Enforcement Action

Not applicable

Licensee Action on Previously Identified Enforcement Items

Not applicable

Design Changes

The licensee is considering changes in tendon wire and wedge design, and has conducted tests during the month of December, 1974 to demonstrate their acceptability in accordance with PSAR commitments and, as agreed at meeting with the Directorate of Licensing October 21, 1974. (Details, Paragraphs 1, 2 and 3)

Unusual Occurrences

Not applicable

Other Significant Findings

Not applicable

Management Interview

No formal management meeting was held by the RO inspector. The inspector's findings presented in the details of this report are the results of his observations of the testing. The details also include preliminary results of the available raw data he collected during and after some of the tests.

Representatives of the licensee, the AE, the constructor and the vendor of the prestressing system were present during tests, conducted at Wilkes-Barre, Pennsylvania, and Lehigh University at Bethlehem, Pennsylvania on December 5, 9, 19 and 30, 1974, to test for acceptability the revised geometry tendon anchor wedges and the low relaxation strands manufactured by Florida Wire and Cable Company (FWC). The RO inspector was informed by the licensee that all test data will be analyzed by the vendor and the AE for presentation to the Directorate of Licensing in mid-January 1975.

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General Public Utilities Service Company

Mr. J. H. Wright, Resident Civil Engineer, Site
Mr. L. Garibian, Structural Engineer, Parsippany Office

Burns and Roe

Mr. L. Lenkow, Project Civil Engineer
Mr. O. Mallon, Supervising Civil Engineer

Stressteel Corporation

Mr. M. G. Suarez, Vice President
Mr. R. Bonomo, Manager, Field Operations
Mr. F. Selenski, Plant Superintendent

Lehigh University

Dr. R. Slutter, Professor of Civil Engineering

United Engineers and Constructors

Mr. D. Perry, Quality Assurance Engineer

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DETAILS

1. Static Tests Conducted at Stressteel Plant, Wilkes-Barre, Pennsylvania 12-5-74

a. The inspector observed eleven static tests conducted at the Stressteel Plant, Wilkes-Barre, Pa. on 12/5/74 to study the effects of the redesigned 7° buttress wedge anchor on the percentage elongation at ultimate load. Three - 7 wire ½" diam. strands measuring 14.849 ft. were pulled in a test block in each test by a 150 ton jack. The wire is identified as ½" low relaxation strand from Pack No. 4287-23 obtained from the Florida Wire and Cable Company and is identified in certified test Report No. 5224 as follows:

Test Report 5224 9/11/74 ½" Dia. Stabilized Strand (270kip) Taken at random from a lot consisting of Coil/Reel Numbers 4287-23; Manufactured under Specifications ASTM Designation A-416-68.

Ultimate B/S	42,500 lb.
Load at 1% exten.	39,950 lb.
Yield Str. 0.2% offset	41,550 lb.
Prop. Limit 0.02% offset	38,000 lb.
Elong. at 28,910 lb.	0.00685 in/in
or in 10 ft.	0.8220 in
Ultimate Elong. in 24 in	5.08 %
Area	0.1532 sq. in.
Mod. of Elasticity	27,548,550 Psi

The procedure used in the static tests included the following significant items:

a. Pretension strands to 1500 psi on pretensioning gauge.

b. Seat test wedge with wedge seating ram (apply pressure until pretensioning gauge dial indicator moves).

c. Visually inspect tautness of strands for length equalization.

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d. Make and record initial readings.

9.1 Set elongation gauge to zero.
9.2 Measure initial wedge set (relative to wedge plate).
9.3 Measure length out to out of bearing plates.
9.4 Read load cell.

e. Start application of load.

10.1 Stopping at each load increase, read elongation and hydraulic gauge pressure at load cell readings of 100, 150, 200, 250 and 300.

10.2 Measure wedge set at load cell reading of 300 only.

10.3 Increase load continuously until failure, reading load cell and hydraulic gauge pressure at elongations of 2, 2-¼, 2-½, 3, 3-½, 4, 4-½, 5.....

f. Record all readings (elongation, load cell, pressure gauge, wedge set) at failure.

g. Dismantle test assembly for inspection. Record details of failure mode.

h. Determine actual failure load, compute net % elongation and record.

b. Ten of the eleven tests used 7 degree buttress wedges (18 serrations/inch), 2¼" long at the anchor end and 2½" long on the pull end. The eleventh test used 2¼" long 7° buttress wedges at both ends.

The results are summarized below:

Test No.	% Elongation	Load at Failure (Kips)*	Identification of Wire Break(s)
1	2.6	41.7	one strand: one wire shear at front of test wedge
2	4.0	42.3	one strand: two wires cup cone at front of jack end
3	4.4	42.4	one strand: five wires including center c.c. at front of test wedge

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Test No.	% Elongation	Load at Failure (Kips*)	Identification of Wire Break(s)
4	4.6	42.4+	one strand: two wire c.c. at front test wedge & one wire c.c. 8' away from test wedge one strand: one wire shear in front of jack end wedge one strand: six outside wires c.c. in front of jack end wedge
5	3.6	42.2	one strand: seven wires, 6 outside c.c. center shear, ± 6' from jack end
6	4.6	42.4+	one strand: 1 wire c.c. front of test wedge & 3 wires 1 shear 2 c.c. ± 16" away from test wedge
7	4.0	42.3	one strand: 1 wire c.c. ± 3' away from test wedge
8	4.8	42.4+	one strand: 6 outside wires c.c. at front jack end wedge
9	4.6	42.4+	one strand: 1 wire shear/c.c. at front of jack end wedge one strand: 2 wires c.c. at front of jack end wedge
10	4.6	42.4+	one strand: 4 wires c.c.) one strand: 1 wire shear, 2 wires c.c.) at front of jack end wedge one strand: 2 wires c.c.)
11	4.1	42.3	one strand: 1 wire shear/c.c.) at front jack end wedge one strand: 3 wires c.c.)

Note: Test Nos. 4, 9, 10 & 11 identify breaks in different strands.
* Scaled value from plot of FW&C Co. Test Report # 5224:
1) Ultimate B/S = 42,500 lb/strand at Elong. in 24 in. = 5.08%
2) GUTS = 41,300 lb at 2.0% Elong.

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c. All of the static tests at Wilkes-Barre on 12/5/74 used a loadcell that was calibrated by Lehigh University on 11/26/74. However, the erratic behavior of the instrument made load readings unreliable. The instrument is identified, "Loadmeter MDX-8 Serial # 168, Transducers Inc, Santa Fe Springs, California". Hydraulic line pressures were also recorded, using a calibrated instrument but, the inspector was informed, the jacking ram efficiency was unknown. However, the inspector observed that elongation measurements were accurately determined and was informed that use of the average Load Versus Elongation curve for the FWC stand was an acceptable and accurate means of determining the applied load.

2. Dynamic Tests Conducted at Lehigh University 12/16/74

The inspector observed the preparation, set-up, calibration and start of one of two dynamic tests started at Lehigh University Fritz Engineering Laboratory on 12/16/74.

These tests were undertaken to determine if the minimum specified ultimate strength of the ½" diameter stabilized wire could be developed, under prescribed dynamic loading, using the 7 degree buttress wedges. This test used strand taken from the same reel identified for the static tests. Dr. R. Slutter of Lehigh University conducted the testing to fulfill requirements of Guide Specifications of the Prestressed Concrete Institute, Post Tensioning Manual of 1973 as identified in Section 3.1.8(2). The test machine used, identified Alfred J. Amsler of Schaffhausen, Switzerland, was set to cycle at about 250 to 260 cycles per minute for the first of two tests. The guide specifications state: "A dynamic test shall be performed on a representative specimen and the tendon shall withstand without failure, 500,000 cycles from 60 percent to 66% of its minimum specified ultimate strength, and also 50 cycles from 40% to 80% of its minimum specified ultimate strength -----." The completion of these test on 12/17/74 was not observed by the inspector. The licensee informed the inspector that the same three strands were used on both dynamic tests and they withstood the tests without evidence of wire failure. The results of these tests will be presented to D.L. in mid-January, 1975. The inspector calipered a specimen of the strand used before testing and observed that the individual and aggregate diameters of the 7 wires conformed to the requirements of ASTM A 416-68, Grade 270, for nominal diameter and nominal steel area of the strand. The center wire measured 0.170" and the outside wires 0.165" in diameter.

3. Full Scale Tendon Tests at Lehigh University 12/19 and 12/30/74

a. Test No. 1, 12/19/74

A full scale test with a 21' long tendon was conducted at Lehigh University, Firtz Laboratory, Bethlehem, Pennsylvania on 12/19/74,

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using strand from the same reel identified in previous tests. A 5,000,000 lb. Baldwin universal test machine was used. The load scale instrumentation is identified as a Tate-Emery Test Machine and bore calibration stamps dated 10/31/74. Dr. R. Slutter of Lehigh University conducted the testing. The inspector was informed that the anchor block used in this test duplicated field conditions while that at the pull end was modified to present a "softer" splay condition. Load cell readings at intervals of 250,000 lbs with corresponding elongation measurement readings were observed for loads up to 1,500,000 lbs. and thereafter, load cell readings for each ½" elongation were recorded. The inspector observed the maximum load reading to be about 2,150,000 lb., however, it appeared to the inspector the first wire break occurred at about 2,115,000 lb. The final results of this test were not available at the completion of this test. The inspector was informed after this test that, pending dismantling of the test equipment and the inspection of wire breaks as to condition and location, the final analysis of test results would be made at a later date. However, it appeared from preliminary results that the AE's specification requirement, that the guaranteed minimum yield stress be 0.90 f's, was obtained. It appeared to the inspector that no wire break occurred at 85% of GUTS and the ultimate load exceeded 95% of GUTS at about 3% elongation. On 12/26/74 the licensee informed the inspector that a second full scale test would be conducted at Lehigh University on 12/30/74. Inspection of Test No. 1 wire breaks had disclosed nine wires broke at the reducing collar. The licensee added that examination of the anchor end where the wires broke, disclosed that the trumpet splay angle did not represent the intended field condition. On 12/30/74 the inspector examined the wire breaks and observed that all breaks occurred at the reducing collar and they appeared to be ductile failures. The inspector examined the reducing collar and verified by measurements that the 3 degree entrance angle (PSAR Appendix 3c, Figure 3c-6) had not been provided.

b. Test No. 2 December 30, 1974

A second full scale test was conducted at Lehigh University on 12/30/74 employing a 21 ft. tendon made from strand taken from the same reel identified in previous tests. The significant difference between test No. 1 and No. 2 was the addition of the 3 degree entrance angle at the reducing collar. In addition the inspector was informed before Test No. 2 that loading beyond the yield point would be faster to avoid relaxation of the wire between load increments. The inspector recorded time intervals between load increments during test No. 2 and compared them with those he had taken during test No. 1. It appears to the inspector that test No. 1 took about ten minutes between the yield point and the ultimate of 2,150 Kips whereas test No. 2 took about five minutes between yield and ultimate of 2,195 Kips. The percent elongation at the latter appears to be over 4%. No visual

observation of broken wires was possible during the test, but the sound of wires snapping was noted by the inspector to number about five between about 2,000 Kips and up to the ultimate.

The inspector was informed by the Stressteel Company after all testing was completed, that pending inspection of the wire breaks expected after 1/1/75, an analysis of all test data would be made. The licensee and AE representatives added that all information recorded on the various tests and Stressteel's analysis would be presented to the AE for review. The final report was expected to be submitted to DL in mid-January 1975.

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