DUKE POWER COMPANY

OCONEE NUCLEAR STATION

UNIT 2

REACTOR BUILDING

POST-TENSIONING SYSTEM

SIXTH SURVEILLANCE

February 14, 1995

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1.0 Introduction

The surveillance program for Oconee Nuclear Station, Unit 2, reactor building post-tensioning system was defined, and is executed, in order to assure continued quality of the system. Program consists of periodic inspections of nine pre-selected tendons - three hoop tendons, three vertical tendons, and three dome tendons - for symptoms of material deterioration or force reduction in excess of predicted values. Program assesses condition and functional capability of the system and, therefore, verifies adequacy of the system and provides an opportunity to take proper corrective action should adverse conditions be detected.

Requirements for the program are detailed in Oconee Technical Specifications, Section 4.4.2. Surveillance was conducted October 18 through November 8, 1994 in accordance with approved procedure MP/0/A/1400/022, Tendon - Reactor Building - Surveillance, and results of this sixth inspection are reported herein.

2.0 Summary and Conclusions

2.1 Summary

During this sixth inspection, three additional, randomly selected, vertical tendons were examined.

No significant discoloration and/or change in consistency of sheathing filler was observed.

End anchorage components were found to be in satisfactory condition with no sign of development of adverse conditions such as cracking or excessive corrosion, or missing or deformed buttonheads.

Lift-off forces for all inspected tendons exceeded required values.

Tendon wires were in excellent condition and no corrosion along the length of the wires was observed. It was determined that no wire breaks had occurred during the interval since the fifth inspection.

Mechanical tests of specimens showed no significant changes in ultimate strength of the wire as compared to results obtained during initial acceptance tests.

2.2 Conclusions

Based on the tests and inspections described herein, it is concluded that the post-tensioning system for Oconee Nuclear Station, Unit 2, is in satisfactory condition, that the functional capability of the system has not diminished, and that the system shows no detectable evidence of the occurrence of any adverse deterioration.

3.0 Results

3.1 Sheathing Filler

Sheathing filler at the ends of each inspected tendon was visually examined. Filler coating on end anchorage components, and color and consistency of filler, were found to be acceptable, with no evidence of water being present - see Table 1.

Samples of sheathing filler were obtained from each of three tendons from which a wire was removed. This filler was visually examined and no signs of water nor any discoloration of sheathing filler was evident.

3.2 End Anchorage Components

Results of end anchorage component inspections are shown in Tables 1 and 2. Buttonheads were inspected for acceptable shape, general appearance, cracks, and corrosion. No buttonhead defects or missing buttonheads were observed. Stress washers, shims, and bearing plates were visually inspected for cracking and corrosion. Some minor surface corrosion was present on edges and faces of shims and bearing plates; however, this condition existed at time of installation and no further deterioration has occurred in subsequent interval. Inside diameter of shims at one end of tendon 53H10 were found to be out of tolerance. These shims were removed and replaced with shims of equal thickness.

3.3 Lift-Off Forces

Lift-off forces were obtained for each inspected tendon - see Table 3. From these readings an average force per wire was determined. Long-term trends of these wire forces, considering effects of elastic shortening, steel relaxation, and concrete creep and shrinkage, are shown graphically in Figures 1, 2, and 3. Lift-off forces exceeded required values. Average lift-off force of three randomly selected vertical tendons - 61V14, 61V22, and 61V28 - coincided precisely with predicted value for current surveillance period.

3.4 Wire Surveillance and Testing

One surveillance tendon of each directional group was relaxed - 1D28, 53H10, and 45V16. One wire was removed from each of these tendons. Removed wires were visually checked for corrosion and pitting. General condition of the wires was determined to be equivalent to their condition at time of initial installation - see

Table 1.

Three specimens were cut from each of the extracted wires for tensile testing. Samples were taken from the ends and middle of each of the wires. Ultimate strength and elongation of each of the specimens were determined by tensile testing by the Applied Science Center, Duke Power Company. These tests are summarized in Appendix A and revealed no significant changes in ultimate strength or elongation of the wire as compared to results obtained during initial acceptance tests.

3.5 Retensioning and Filler Replacement

Following wire removal the relaxed tendons were retensioned, as closely as possible, to the same stress level indicated by the lift-off force data obtained during this surveillance. Sheathing filler which was removed during the surveillance process was replaced with new filler conforming to requirements of original specification.

Table 1

Duke Power Company
Oconee Nuclear Station, Unit 2
Post-Tensioning System Sixth Surveillance

Post-Tensioning System Component Corrosion Documentation

	Shop End[3]					Field End[3]						Grease Filler		
Tendon	Bearing Plate	Shims	Button-heads	Stress Washer	Wires[2]	Bearing Plate	Shims	Button-heads	Stress Washer	Wires[2]	Free Water Removed (gal.)	Vol. (gal.) Removed	Vol. (gal.) Replaced	Color/ Consistency
1D28[4]	B	B	A	A	A	B	B	A	A	A	none present	1 1/2	1 1/2	good/good
2D29	B	B	A	A	N/A	B	B	A	A	N/A	none present	1	1	good/good
3D28	B	B	A	A	N/A	B	B	A	A	N/A	none present	1	1	good/good
13H9	B	B	A	A	N/A	B	B	A	A	N/A	none present	0	0	good/good
51H9	B	B	A	A	N/A	B	B	A	A	N/A	none present	0	0	good/good
53H10[4]	B	B	A	A	A	B	B	A	A	A	none present	0	0	good/good
23V14	B	B	A	A	N/A	B	B	A	A	N/A	none present	15	15	good/good
45V16[4]	B	B	A	A	A	B	B	A	A	A	none present	1	2	good/good
61V14[1]	B	B	A	A	N/A	B	B	A	A	N/A	none present	2	4	good/good
61V16	B	B	A	A	N/A	B	B	A	A	N/A	none present	1	3	good/good
61V22[1]	B	B	A	A	N/A	B	B	A	A	N/A	none present	4	6	good/good
61V28[1]	B	B	A	A	N/A	B	B	A	A	N/A	none present	2	5	good/good

Notes:

1. Randomly selected tendon.
2. Material condition can only be verified for detensioned tendons.
3. Corrosion Levels:
   - A. Metal is bright with no visible oxidation.
   - B. Metal is reddish-brown in color with no pitting.
   - C. Metal is pitted: 0.0" < pitting <= 0.003"
   - D. Metal is pitted: 0.003" < pitting <= 0.006"
   - E. Metal is pitted: 0.006" < pitting <= 0.010"
4. Tendon detensioned for wire removal during current surveillance period.

Table 2

Duke Power Company
Oconee Nuclear Station, Unit 2
Post-Tensioning System Sixth Surveillance

Post-Tensioning System Component Conditions

	Shop End			Field End		
Tendon	Shim Thickness[2]	Shim/Bearing Plate Damage	Buttonheads Unseated/Damaged	Shim Thickness[2]	Shim/Bearing Plate Damage	Buttonheads Unseated/damaged
1D28[4]	3 1/2"	N/A	N/A	3 1/2"	N/A	N/A
2D29	2 3/4"	N/A	N/A	2 3/8"	N/A	N/A
3D28	2 1/2"	N/A	N/A	3 1/4"	N/A	N/A
13H9	3"	N/A	N/A	3 1/8"	N/A	N/A
51H9	3"	N/A	N/A	3"	N/A	N/A
53H10[4]	2 1/4" / 2 1/4"	See Note 3.	N/A	2 1/4"	N/A	N/A
23V14	3"	N/A	N/A	4 7/8"	N/A	N/A
45V16[4]	2"	N/A	N/A	2 5/8"	N/A	N/A
61V14[1]	1 7/8"	N/A	N/A	2 1/4"	N/A	N/A
61V16	1 7/8"	N/A	N/A	2 1/2"	N/A	N/A
61V22[1]	2"	N/A	N/A	2 3/4"	N/A	N/A
61V28[1]	1 3/4"	N/A	N/A	2 1/4"	N/A	N/A

Notes:
1. Randomly selected tendon.
2. Double entries represent as-found and as-left conditions, respectively.
3. Inside diameter of shims out of tolerance. Shims removed and replaced.
4. Tendon detensioned for wire removal during current surveillance period.

Table 3

Duke Power Company
Oconee Nuclear Station, Unit 2
Post-Tensioning System Sixth Surveillance

Tendon Lift-Off Forces

Tendon	Shop End Lift-off Force (kips)[3]		Field End Lift-off Force (kips)[3]		Average Lift-off Force (kips)[3]		Total Number of Wires Missing/Removed[4]	Initial Number of Wires[2]	Effective Number of Wires	Average Force Per Wire[3]	
1D28[6]	749.2	712.5	706.5	718.6	727.85	715.55	3	93	90	8.09	7.95
2D29[5]		724.6		700.2		712.4	1	90	89		8.00
3D28		688		706.5		697.25	2	93	91		7.66
13H9		639		729.4		684.2	2	93	91		7.52
51H9[5]		717.3		651.2		684.25	2	93	91		7.52
53H10[6]	705.2	717.3	675.7	688	690.45	702.65	4	93	89	7.76	7.89
23V14		712.5		717.3		714.9	2	93	91		7.86
45V16[6]	694.4	621.8	668.8	674.9	681.6	648.35	2	93	91	7.49	7.12
61V14[1]		670.2		656.6		663.4		90	90		7.37
61V16		670.2		656.6		663.4	2	93	91		7.29
61V22[1]		694.4		656.6		675.5		90	90		7.51
61V28[1]		664.1		644.5		654.3		90	90		7.27

Notes:

1. Randomly selected tendon.
2. Reference: Prestressing Report, Reactor Building, Duke Power Company, Oconee Nuclear Station, Unit 2, dated March 1972 by Bechtel Corporation.
3. Double entries represent as-found and as-left conditions, respectively.
4. A blank represents a value of zero.
5. Testing suspended at documented force, 'Shop End' only. Safety concerns prohibited increased ram pressures necessary to achieve lift-off. (Reference Proposed Resolution to OEP IN 91-80)
6. Tendon detensioned for wire removal during current surveillance period.

Figure 1

Dome Tendon Group Force-Time Plot

Mean Force per Wire vs. Time

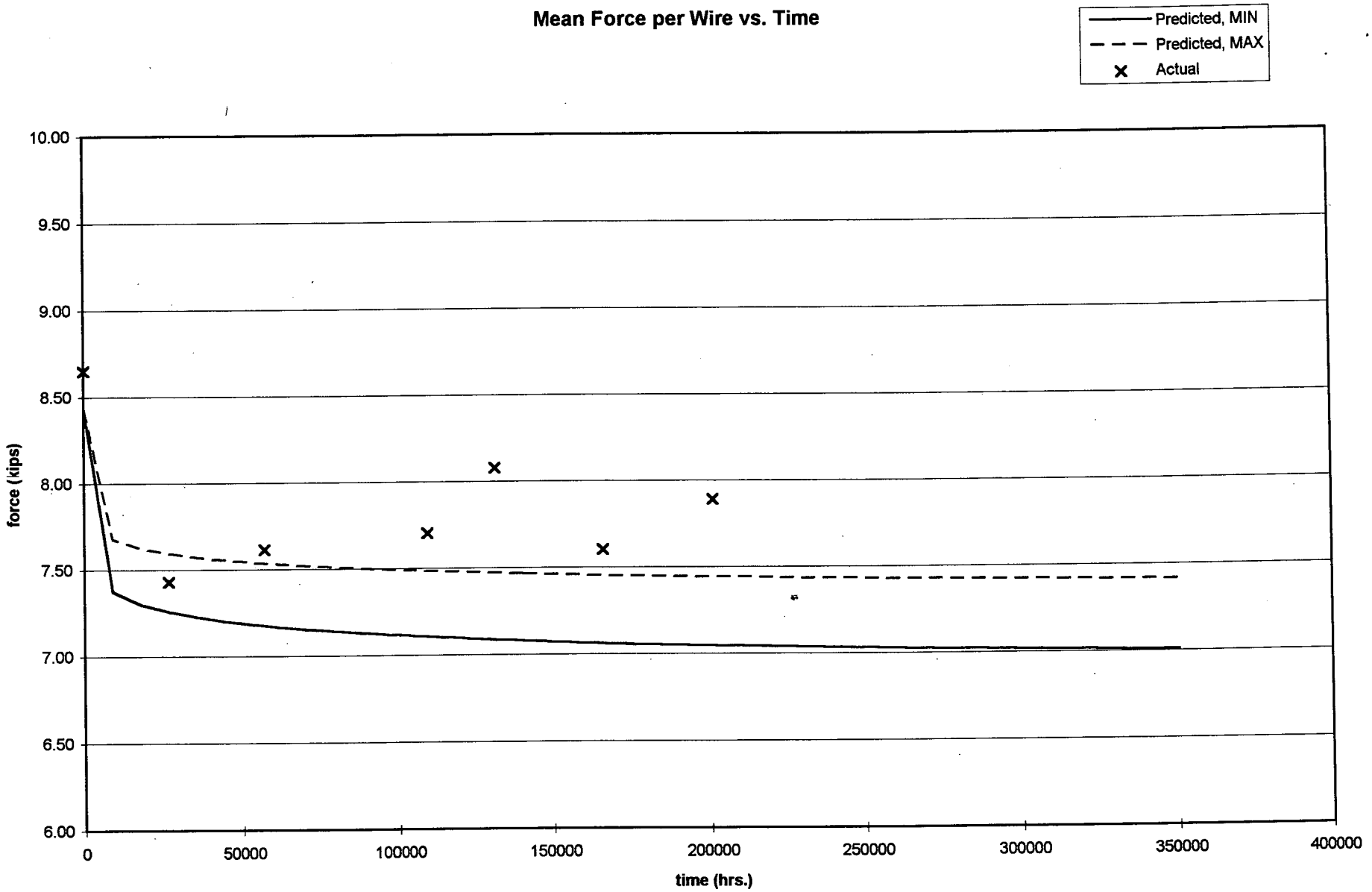


Figure 2

Hoop Tendon Group Force-Time Plot

Mean Force per Wire vs. Time

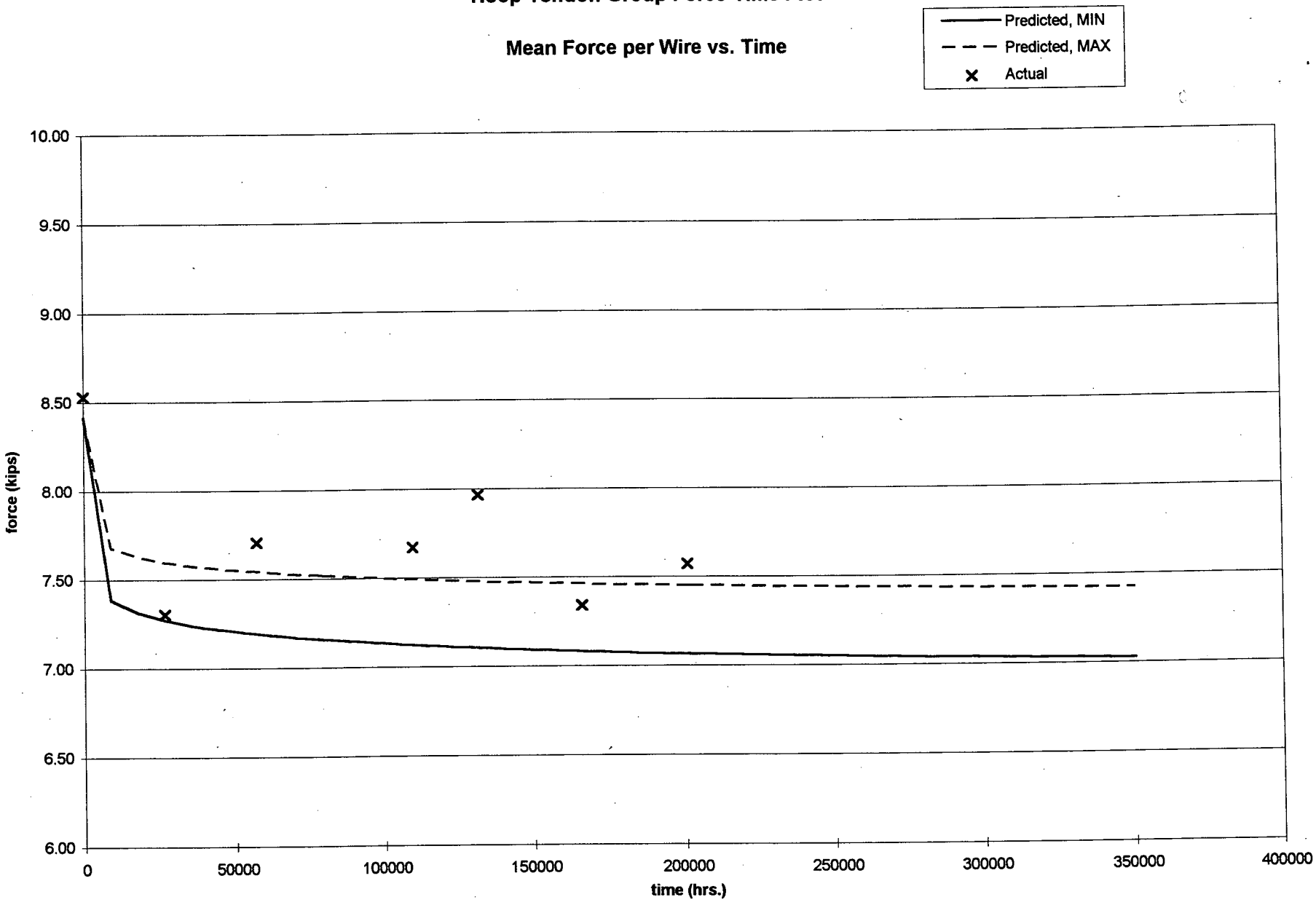
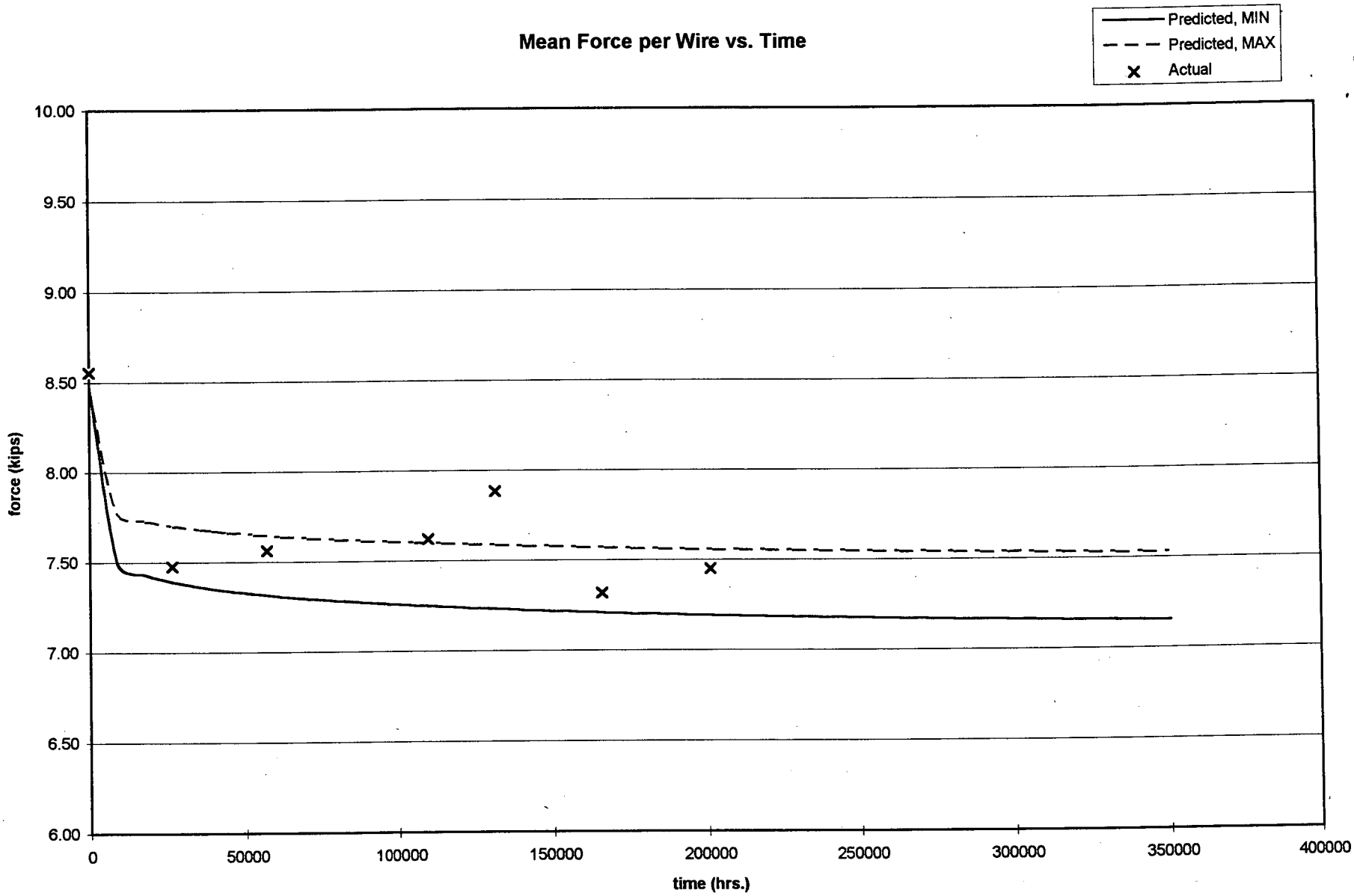


Figure 3

Vertical Tendon Group Force-Time Plot

Mean Force per Wire vs. Time



Appendix A

Metallurgical Analysis Report

APPLIED SCIENCE CENTER

Metallurgical Analysis Report

Sample No.: 1755 **Station:** Oconee **Unit:** 2
Requestor/Dept.: Lawrence Llibre - ONS MCE
Principal Investigator: Sue Anderson
Submitted To: Lawrence Llibre **Date:** 12/6/94
cc: Donna R. Keck - Nuclear Services

Equipment Description:
Reactor Building Surveillance tendons 1D28, 45V16, 53H10

Background Information:
Periodic tensile testing is performed on selected tendons to assure their conformance to ASTM A421 requirements.

Three 36" sections of each 1/4"-diameter tendon were supplied as described in the table below. Each original sample was sectioned in half for testing purposes.

ID/Location	Diameter (in)	Percent Elongation	Maximum Load (lb)	Tensile Strength (ksi)
1D28 - Field end	0.248	4.6	11,900	246.3
- Field end	0.248	5.0	11,890	246.2
- Middle	0.249	**	11,870	243.8
- Middle	0.248	4.6	11,860	245.6
- Shop end	0.248	5.4	11,940	247.2
- Shop end	0.249	5.2	11,940	245.2
45V16 - Field end	0.249	4.6	12,300	252.6
- Field end	0.248	**	12,300	254.7
- Middle	0.248	**	12,270	253.9
- Middle	0.249	**	12,240	251.3
- Shop end	0.249	4.2	12,240	251.3
- Shop end	0.248	4.3	12,270	253.9
53H10 - Field end	0.249	5.0	12,090	248.3
- Field end	0.249	5.2	12,060	247.8
- Middle	0.248	4.0	12,070	249.8
- Middle	0.249	**	12,070	247.9
- Shop end	0.249	4.7	12,070	247.8
- Shop end	0.248	4.9	12,080	250.1

NOTE: ** indicates specimen broke outside of gage marks

ASTM A421 requires a minimum tensile strength of 240 ksi and 4.0% elongation. A 10.0" gage length was used for calculation of elongation. Elongation was not calculated per paragraph 6.3 of ASTM A421 but was measured after fracture.

A 220,000 lb load cell was used for the test. Applicable calibration sheets for the testing machine are attached.

Conclusions:
The tendon samples met the strength and elongation requirements for ASTM A421 material.

If the Metallurgy Lab can be of further assistance, please call me at (704) 875-5326.

Approved by: S Anderson **Date:** 12/6/94

Reviewed by: CR Sharpe 12/6/94

PAGE 3, SAMPLE # 1[redacted]5

INSTRON

Instruments and Systems for Advanced Materials Testing

Certificate of Verification

This is to certify that the following described testing machine has been calibrated by us and the loading range(s) have been found to be within a tolerance of ±.5%[*] ±1.0%[ ]

Machine Model	8505	Load Cell Type	2518-620
S/N	H0170	Capacity	220,000 lb.
Location	DUKE POWER	Serial No.	UK007
Date of Verification	12-6-93		

CALIBRATION APPARATUS - Load Cells with High Resolution Indicators, Precision Weights. Verifications traceable to the NIST (National Institute of Standards & Technology), in accordance with A.S.T.M. E74 and E4 specifications.

Authorized Instron Corp. Representative: Daryl C. Brown

Instron Corporation - 100 Royall Street - Canton, Massachusetts 02021 - Tel. (617) 828-2500

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