

THREE MILE ISLAND NUCLEAR STATION
UNIT 1

REACTOR CONTAINMENT BUILDING
SECOND TENDON SURVEILLANCE TEST
THREE YEARS AFTER S.I.T.

EVALUATION OF TENDON H51-13

JANUARY 30, 1978

Prepared By:

J C Herr

J. C. Herr, P.E.
Project Structural Engineer
Power Engineering Division

Reviewed by:

F L Moreadith

F. L. Moreadith, PhD, P.E.
Supervisor, Technical Services
Structural Engineering
Power Engineering Division

Gilbert Associates, Inc.
P. O. Box 1498
Reading, Pennsylvania 19603

7910100

518
1415 259

ATTACHMENT #1

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
1.0	<u>SYNOPSIS</u>	1
2.0	<u>FIELD INSPECTION</u>	2
2.1	LIFT-OFF TEST	2
2.2	BROKEN WIRE	2
2.3	SPLIT BUTTONHEADS	2
2.4	ACCEPTANCE CRITERIA	3
3.0	<u>EVALUATION</u>	4
3.1	LIFT-OFF TEST	4
3.2	BROKEN WIRE	5
3.3	SPLIT BUTTONHEADS	5
4.0	<u>CONCLUSION</u>	7

1.0

SYNOPSIS

During the Three Mile Island Nuclear Station Unit 1 (TMI-1) Tendon Surveillance Test, Three Years after S.I.T., Gilbert Associates, Inc. (GAI) was requested to evaluate hoop tendon H51-13. The evaluation was necessary since inspection results indicated that tendon H51-13 may have one broken wire and four buttonheads with splits exceeding the acceptance criteria.

The prestress force confirmation test (lift-off force) demonstrated that the force in tendon H51-13 continues to be at an acceptable level for design load combinations. The buttonheads of tendon H51-13 will be inspected again during the next scheduled tendon surveillance to ensure that acceptable circumstances continue.

1415 261

2.0 FIELD INSPECTION

Lift-off tests and buttonhead inspections for tendon H51-13 were conducted by VSL Corp. and verified by TMI-QA. GAI inspected the tendon buttonheads when the tendon was detensioned.

2.1 LIFT-OFF TEST

The lift-off test results for tendon H51-13 were:

<u>End</u>	<u>Lift-Off Force</u>
Shop (Buttress #1)	1259 kips
Field (Buttress #5)	1171 kips

An evaluation of these results is presented in Section 3.1.

2.2 BROKEN WIRE

One wire protruded approximately 5" from the shop end stressing washer after detensioning. This condition was defined as a "broken wire."

A discussion of this "broken wire" is presented in Section 3.2.

2.3 SPLIT BUTTONHEADS

Splits in four (4) buttonheads exceeded the acceptance criteria of "The sum total of all splits on the opening of one split less than 2^o to vertical axis shall not exceed 0.060". The splits are approximately parallel to the wire axis with the larger splits being diamond shaped and appearing to be the result of the buttonheading.

The recorded split widths in the buttonheads are:

Shop End	One split of 0.080" > 0.060"
Shop End	One split of 0.100" > 0.060"

1415 262

Field End	One split of 0.150" > 0.060"
Field End	Splits of 0.010" and 0.055" for sum total of 0.065" > 0.060"

A discussion of the split buttonheads is presented in Section 3.3.

2.4 ACCEPTANCE CRITERIA

The acceptance criteria for wires/buttonheads is "Any tendon with one missing, broken, and/or damaged wires is subject to rejection, if at the same time four additional buttonheads do not meet acceptance criteria for buttonheads." Tendons which do not satisfy the acceptance criteria shall be further evaluated.

The inspection results for broken wires and split buttonheads place tendon H51-13 within the acceptance criteria limits requiring further evaluation. However, the "broken wire" appears to be a result of an error in judgement of what constitutes a broken wire. As concluded in Section 3.2, there may be no broken wires in tendon H51-13 and hence the tendon may not be subject to rejection.

3.0 EVALUATION

An evaluation of the inspection results of tendon H51-13 is presented to demonstrate the acceptability of the tendon.

3.1 LIFT-OFF TEST

The expected prestress loss at the time of measuring lift-off for tendon H51-13 was calculated to be 180.3 kips considering the actual elastic shortening experienced by the tendon due to the tendon stressing sequence. The expected lift-off force was calculated to be:

<u>End</u>	<u>Original Force</u>	<u>Expected Lift-Off</u>
Shop	1463 kips	1282.7 kips
Field	1395 kips	1214.7 kips

The lift-off test results given in Section 2.1 are less than those expected by the following percentages and are acceptable.

<u>End</u>	<u>Percentage</u>
Shop	1.8%
Field	3.6%

The average lift-off force of 1215 kips is 135 kips greater than the lower bound tendon force of 1080 kips, i.e. the average minimum design tendon force.

The lift-off test results demonstrate that tendon H51-13 is maintaining an acceptable level of prestress force, the main characteristic checked by the tendon surveillance inservice inspection program.

3.2 BROKEN WIRE

During the tendon surveillance inspection, tendon H51-13 was detensioned to inspect for broken or damaged wires. One wire which protruded approximately 5" from the stressing washer was defined as a "broken wire". Apparently steps were not taken to verify that the wire was broken.

Undocumented discussions disclosed that the wire was drawn into the washer and its buttonhead reseated when the tendon was retensioned.

Experience has demonstrated that wires of a detensioned tendon will protrude from the stressing washer varying amounts and not be broken.

It is concluded that the wire may not be broken. The tendon surveillance procedure will be revised to include definitive means of determining if protruding wires are in fact "broken wires".

3.3 SPLIT BUTTONHEADS

The intent of the buttonhead inspection is to detect gross changes in the condition of the buttonheads. The "Tendon Buttonheading Card" for tendon H51-13 was reviewed and found to indicate that, at installation, all splits were within tolerance and that there were no unacceptable buttonheads. If that is the case, then the splits in four buttonheads defined in Section 2.3 have occurred since installation.

Splits of the type found on the buttonheads of tendon H51-13 should allow the wire to develop the minimum guaranteed ultimate tensile strength of the wire (1, 2).

1415 265

¹ "Buttonheads for Tendon Wires of a Prestressed Concrete Reactor Vessel", J. F. Hildebrand, PCI Journal, September-October, 1971.

² "Investigation of Buttonhead Efficiency", Western Concrete Structures Co., Inc., Technical Report Number 6, July, 1968.

During the next scheduled tendon surveillance test, the buttonheads of tendon H51-13 will be inspected to determine if changes are occurring in the split buttonheads.

1415 266

4.0

CONCLUSION

As described in Section 3.0, tendon H51-13 is acceptable as inspected. Its continued acceptance will be confirmed during the next scheduled inspection.

1415 267