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4410-84-L-0085
Document ID 0005A

June 5, 1984

TMI Program Office
Attn: Dr. B. J. Snyder
Program Director
US Nuclear Regulatory Commission
Washington, DC 20555

Dear Dr. Snyder:

Three Mile Island Nuclear Station, Unit 2 (TMI-2)
Operating License No. DPR-73
Docket No. 50-320
Polar Crane Load Test Results

Attached for your information is the summary report for the load test of the Unit 2 polar crane. The report summarizes the refurbishment, pre-load test inspections, operational tests, load tests, and post-load test inspections of the polar crane. The crane was load tested to an actual weight of 214 tons; therefore, the crane is qualified to lift up to 170 tons. Post load test examinations show no identifiable signs of stress due to the load test. The main hook and tripod underwent nondestructive testing, as described in the attachment, with no indications of stress or load-related degradation in operational capability. The wire rope and electric motors also were examined with no degradation noted. The polar crane has been turned over to the Site Operations Department in accordance with appropriate administrative procedures.

It is concluded that the polar crane is capable of lifting the reactor vessel head and service structure asssembly, the plenum asssembly, and other lifts up to 170 tons without undue risk to the health and safety of the public.

If you have any questions concerning this information, please call Mr. J. J. Byrne of my staff.

Sincerely,

B. K. Kanga

B. K. Kanga
Director, TMI-2

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Attachment

cc: Deputy Program Director - TMI Program Office, Mr. L. H. Barrett

SUMMARY REPORT OF THE

THREE MILE ISLAND UNIT 2 REACTOR BUILDING

POLAR CRANE LOAD TEST

TABLE OF CONTENTS

1. INTRODUCTION:

The 500-ton Whiting Polar Crane installed in the Three Mile Island Unit 2 (TMI-2) Reactor Building was rendered inoperable as a result of the March 1979 accident.

Since the crane is important to the recovery effort, a major refurbishment program was developed. Following the refurbishment program the crane was operationally tested, and load tested to verify its integrity.

This report summarizes the load testing activities performed on the TMI-2 Polar Crane and presents the results of various post-testing examinations.

2. REFURBISHMENT, PRE-LOAD TEST INSPECTION AND OPERATIONAL TESTING

The Polar Crane Functional Description (Reference 1) described the minimum crane components and movements which are necessary to move the missile shields, remove the reactor vessel head and support the remainder of the recovery. This document included the program for crane QA/QC, maintenance, modifications, operability, and load testing. By letter to GPU dated November 18, 1983 (Reference 2) the NRC concurred with the functional description of the polar crane as it related to the polar crane load test.

An intensive inspection and maintenance program began on the crane in the late summer of 1982.

The main items inspected were the bridge drive system, the trolley drive system, bridge and trolley structure, trolley limit switches, main hoist drive system, main hoist wire rope, the main hoist hook and the runway rail system.

The most significant mechanical refurbishment was the replacement in-kind and adjustment of the main hoist brakes.

During the electrical inspections extensive damage was found on the conductor/collector system which supplies power to the bridge and trolley, the runway conductor/collector system and the cab and pendant controls that support bridge, trolley and main hoist functions. The conductor/collector system which supplied power and control for the main hoist and the trolley drive motor was replaced by a cabling system consisting of 33 conductors (sized to match the original design). The cabling was strung from the center of the crane bridge end girder to the center of the trolley. The replacement cable meets all necessary criteria for its intended use including ampacity, insulation level and flexibility.

The polar crane runway conductor/collector system which was originally located around the circumference of the containment dome was damaged extensively in the accident. Radiation exposure would have been significant for a replacement in kind, therefore, an alternate crane power supply (feeder) system was designed. This cabling was strung from the main disconnect switch in the cab to the center of the bridge girder down to the reactor coolant pump support beam and to the existing disconnect switch on elevation 347'6". The replacement cable meets all necessary criteria for its intended use including ampacity, insulation level and flexibility.

The control pendant was replaced with a new lightweight, watertight, control station which contains all of the original vital control functions.

The next phase of the refurbishment program was to conduct the no load operational test. This test demonstrated the operability of major crane components as well as the whole crane as a functional unit.

Also included in this phase of the refurbishment program was a "hands-on" inspection of the crane by the NRC Special Crane Consultant, Mr. T. H. Stickley.

3. LOAD TESTING OF THE REFURBISHED POLAR CRANE

The polar crane load test Safety Evaluation Report and procedure were approved by the NRC on November 18, 1983, (References 2 and 3).

The polar crane load test was designed to requalify the refurbished crane for the heaviest intended lift of the TMI-2 recovery effort, the reactor vessel head and service structure assembly. (Estimated weight is approximately 163 tons.) Consequently, it was intended to requalify the crane to 170 tons. The crane's lifting capability of 170 tons was to be demonstrated through a test load of an estimated 212 tons. As depicted in Figure 1, the test load consisted of a load test frame, the missile shields from over the reactor vessel and the pressurizer, the reactor vessel head lift rigging, and a load indicating device.

On February 29, 1984 the main hoist of the polar crane was successfully full load tested. This test was completed after no-load operational testing and a series of progressive steps to demonstrate the functional capability of the crane. First, the 6-ton internals indexing fixture was lifted and held with the main hoist brakes. No settlement occurred and no abnormal conditions existed. Next, the four 40-ton missile shields from atop the reactor vessel and the 32-ton missile shield from over the pressurizer were assembled on the load test frame. The test load assembly was then lifted to an elevation 6 in. above the operating deck and held with the main hoist brakes for 30 minutes. Again, no settlement or other abnormalities occurred.

The test load was then raised to a height of 10 feet above the operating deck for the loss of power test. The loss of power test was conducted to show that the crane brakes can withstand the maximum stress induced by a sudden stop at maximum load in high hoist speed in the downward direction.

At the 10 foot mark the load was held with the main hoist brakes for 5 minutes and no settlement or abnormal conditions occurred. The loss of power test continued by lowering the load in high hoist speed to an elevation approximately 4 feet above the operating deck when the lowering was terminated by pushing the "STOP" button on the control pendant. The test load was held for 5 minutes and no settlement or abnormalities occurred. The main hoist test was concluded when the test load was lowered to an elevation 6 in. above the operating deck, held for 5 minutes and observed for settlement and abnormal conditions. No settlement occurred and no abnormal conditions existed. The actual load cell reading was 388,000 lbs. which, based on calibration data, translates to an actual load weight of 428,000 lbs.

The crane bridge and trolley travel were next tested with load, followed by the hook rotation test. The hook rotation test provided assurance of free hook rotation under load conditions.

Supplemental work, being conducted concurrently with the polar crane load test, measured electric motor current and observed any unusual operating characteristics of the crane. (References 4 and 5). Electrical measurements were taken outside the reactor building to minimize occupational radiation exposure. Measurements were taken in each direction of rotation for each speed while handling several different loads. These measurements were then compared with published and calculated burdens of the motors, clutches, brakes, and associated control components. This item was also of special interest to determine if high mechanical loads and thus increased electrical current draw would occur when the bridge wheels crossed over the rail gaps.

Also, during the load test, personnel were stationed on the polar crane to make specific observations of crane operating characteristics. As a result of these observations, it was reported that the overall manner in which the crane operated with loads exceeding 200 tons was excellent. Control response was immediate. Sequencing of multi-speed motors to high speed was smooth and virtually noiseless. At no time did the crane give evidence of stress under load. It was also noted that braking was effective in all cases and that when the main hoist brake drum and brake shoe were match marked, no drifting was noted.

4. POST-LOAD TEST INSPECTIONS

Following the load test an inspection program was implemented to examine major crane components. Additionally, the rigging components that were part of the load test and that will be used during reactor vessel head removal were also inspected. Specifically, this rigging consists of the tripod, the turnbuckle pendant assemblies, extension bar, handling extension, load cell rigging, and associated pins and bore plates.

4.1 Main Hoist Hook

The main hook was nondestructively tested (Reference 6). The results of this visual inspection proved no cracks, severe gouges, or nicks. The magnetic particle examination showed no linear indications. These results are documented by Reference 7.

4.2 Main Hoist Wire Rope

The wire rope was visually inspected. (Reference 8). The inspectors examined the wire rope for rust, adequate lubrication, kinks, abrasion, corrosion, scrubbing, flattening, peening, heat damage, broken wires, wire diameter, groove forming, and wire rope lay. The results were documented as satisfactory per Reference 7.

4.3 Head Removal Rigging

The three most highly stressed welds of the tripod were nondestructively tested (Reference 9). After surface preparation to ensure all protective coating was removed the three welds were visually inspected and no evidence of service related discontinues were found. The welds were then magnetic particle examined and no linear indications were found. As documented in Reference 10, these welds were determined acceptable, proving no degradation of capacity, as a result of the polar crane load test.

4.4 Electric Motor Current Readings

Magnetic tape and strip chart records were made of selected activities. Individual motor current may be determined from these charts. The measured currents were found to be somewhat less than expected for a 214 ton lift. The actual electrical current values were considerably below the capability of the motors and the selected values of their circuit protection devices. No evidence of electrical current spikes was detected even when the magnetic tape records were rerun at one-half the original speed. These records were carefully examined for any anomalous indication as might be seen if the bridge drives encountered any abnormal resistance, such as passage over joints in the runway rail.

5. SUMMARY AND CONCLUSIONS

Based on the results of the polar crane load test and subsequent inspections, the polar crane is now rated at 170 tons. In accordance with the appropriate administrative procedures for modifications and maintenance activities the polar crane has been turned over to the Site Operations department. A complete history of the polar crane recovery task is documented in the turnover package (Reference 11).

Therefore, it is concluded that the polar crane is capable to lift the reactor vessel head and service structure assembly, the plenum assembly, and to perform future activities to support the recovery effort.

6. REFERENCES

1. Polar Crane Functional Description, 15737-2-M72-MH02 Rev. 3

2. Letter, Snyder to Kanga, "Reactor Building Polar Crane Load Test" November 18, 1983.

3. Unit Work Instruction 4370-3891-83-PC0001, "Polar Crane Load Test"

4. Unit Work Instruction 4374-3891-83-PC0032, "Polar Crane Load Test Check List"

5. Unit Work Instruction 4374-3891-83-PC0027, "Polar Crane Load Test - Monitor Power Supply Current"

6. Unit Work Instruction 4370-3100-83-C201, "NDE Main Hook"

7. Interoffice Memorandum DERO-0258, dated 04/05/84, Subject: Polar Crane Load Test and Post Load Test Inspections.

8. Unit Work Instruction 4370-3100-83-C195, "Wire Rope Inspection After Load Test"

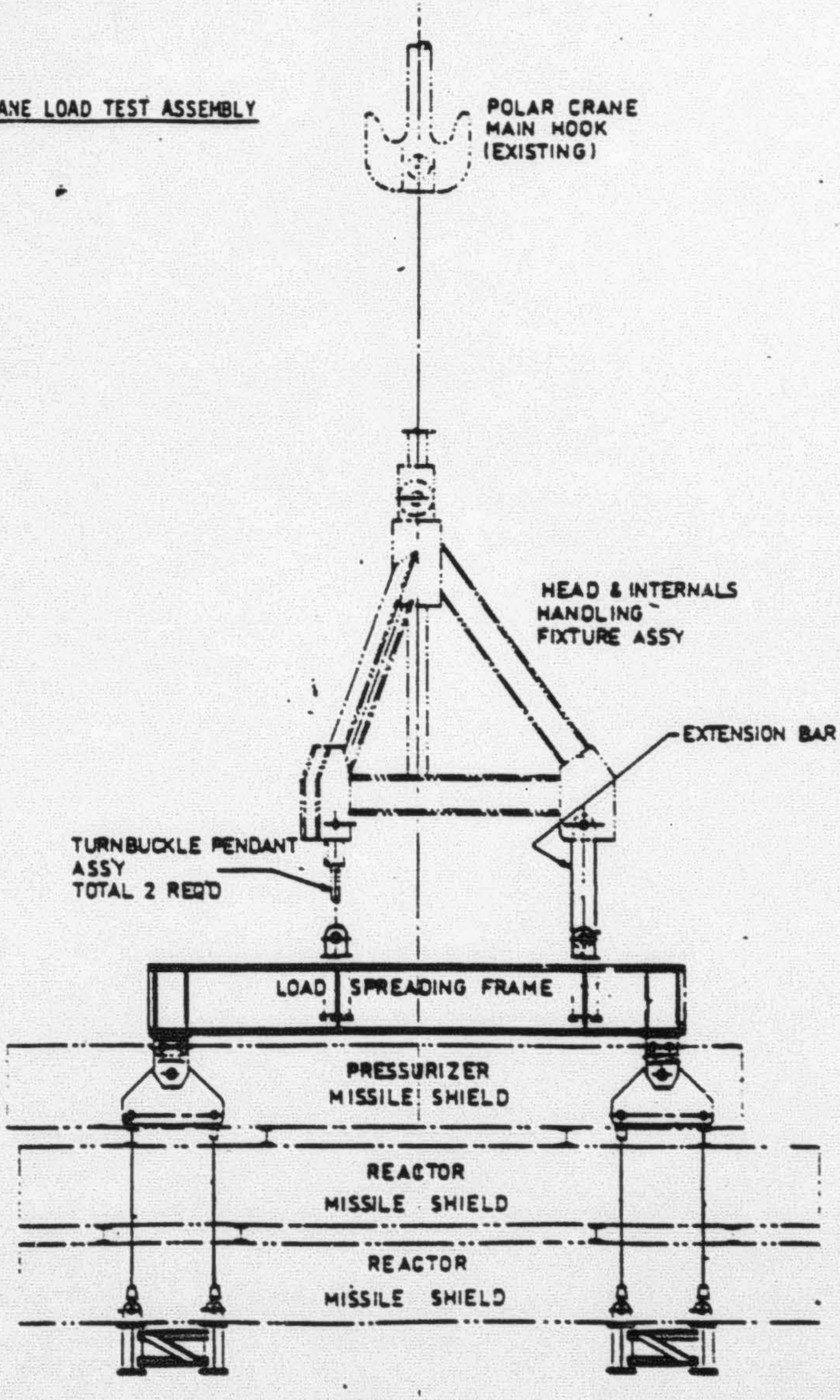
9. Unit Work Instruction 4370-3100-83-C164, "NDE Tripod Welds"

10. Interoffice Memorandum DERO-0263, dated 04/13/84, Subject: Post Load Test Inspection of TMI-2 Tripod

11. Interoffice Memorandum 4370-84-1024, dated 04/04/84, Subject: Unit 2 Polar Crane Turnover Package

FIGURE 1

POLAR CRANE LOAD TEST ASSEMBLY



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