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Director
Office of Nuclear Reactor Regulation
U S Nuclear Regulatory Commission
Washington, D C 20555

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
Docket Nos. 50-282 License Nos. DPR-42
50-306 DPR-60

Control of Heavy Loads (Special Lifting Devices)

Attached is the investigation concerning Special Lifting Devices mentioned in our six-month submittal dated August 31, 1981. This investigation is submitted in response to Mr Eisenhut's letter dated December 22, 1980, titled Control of Heavy Loads.

One item remains unresolved to date; ie, the turbine building crane response to Item 2.4.2(b) of the nine-month submittal dated December 9, 1981. The completion target date for this investigation is July 1, 1982. Should there be any changes in this target date we will notify you.

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Attachment

cc: Regional Admin-III, NRC
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CONTROL OF HEAVY LOADS
SPECIAL LIFTING DEVICES
NORTHERN STATES POWER COMPANY
PRAIRIE ISLAND

A. REACTOR VESSEL HEAD AND INTERNALS LIFTING RIGS

The reactor vessel head and internals lifting rigs were designed and built about 1970-1971. At that time, the general design criteria required the resulting stress in the load carrying members, when subjected to the total combined lifting weight, should not exceed one fifth (1/5) of the ultimate strength of the material. No formal stress report was prepared and no design specifications were written. Westinghouse defined the design, fabrication and quality assurance requirements on detailed manufacturing drawings and purchase order documents. Westinghouse issued the field assembly and operating instructions which included an initial load test. Westinghouse's objective was to provide a quality product and this product was designed, fabricated, assembled and inspected in accordance with internal Westinghouse requirements. In general, Westinghouse requirements meet the intent of ANSI N14.6 but not all the specific detailed requirements.

The review of the lifting devices has determined that these devices are not in strict compliance with all the ANSI N14.6 requirements. Listed below is a tabulation of these paragraphs and associated Westinghouse remarks.

1a. Requirement:

Para. 3.2.1.1 - requires the design, when using materials with yield strengths above 80% of their ultimate strengths, to be based on the material's fracture toughness and not the listed design factors.

1b. Remarks:

High strength materials are used in these devices and the fracture toughness was not determined. However, the stress design factors listed were used in the analysis and the resulting stresses are within the allowable stresses.

2a. Requirement:

Para. 5.1 lists owner responsibilities and 5.1.1 and 5.1.2 requires the owner to verify that the special lifting devices meet the performance criteria of the design specification by records and witness of testing.

2b. Remarks:

Since there wasn't any design specification for these rigs and 150% load testing was not originally required or performed, the utility obviously can't comply. However, the W Quality Release may be considered an acceptable alternate to verify that the criteria for certified material testing reports, non-destructive testing and documentation required by the Westinghouse drawings and purchasing document was satisfied. Although proof and functional testing was not required, the site assembly instructions require, after initial assembly in site, the following:

Raising the rig, assembled to its respective attachment, slightly above the supporting surface to be free hanging for one-half hour. During this time, visually inspect for signs of distress or distortion. Lowering the rig to its support and performing NDT-visual and mag. particle inspections of critical welds. It can be sa~e to assume that these 100% load tests were performed and acceptable since the rigs have been in operation for about 10 years.

3a. Requirement:

5.2 and 5.3 - Acceptance Testing and Testing to Verify Continuing Compliance - These paragraphs require the rigs to be initially tested at 150% maximum load followed by non-destructive testing of critical load bearing parts and welds and also annual 150% load tests or annual non-destructive tests and examinations.

3b. Remarks:

See Remark 2(b) also - The original rigs were load tested to only 100% of the load. A visual inspection including NDE testing of major load carrying welds and any other critical areas will be done prior to each use (typically at each refueling).

4. Discussion of the Design Criteria for a Stress Design Factor

NUREG 0612, paragraph 5.1.1(4) states that special lifting devices should satisfy the guidelines of ANSI N14.6. Further, NUREG 0612, 5.1.1(4) states: "In addition, the stress design factor stated in Section 3.2.1.1 of ANSI N14.6 should be based on the combined maximum static and dynamic loads that could be imparted on the handling device based on characteristics of the crane which will be used. This is in lieu of the guideline in Section

3.2.1.1 of ANSI N14.6 which bases the stress design factor on only the weight (static load) of the load and of the intervening components of the special handling device".

The dynamic characteristics of the crane would be based on the main hook and associated wire ropes holding the hook. Most main containment cranes use 16 or more wire ropes to handle the load. Should the crane hook suddenly stop during lifting or lowering a load, a shock load could be impacted by the connected device. The maximum design factor that is recommended by most design texts is a factor of 2 for loads that are suddenly applied. The stress design factors required in Section 3.2.1.1 of ANSI N14.6 are:

3 (weight) < Yield Strength
5 (weight) < Ultimate Strength

The factor of 3 specified, certainly, includes consideration of suddenly applied loads for cases where the dynamic impact factor may be as high as 2.0. For typical containment cranes, the dynamic factor is much closer to 1.0. Thus, we feel that the use of the design criteria in ANSI N14.6 satisfies the NUREG requirement.

To provide flexibility on stress design factor, the analysis of the devices (on each component that comprise these lifting devices) was performed with design factors of 1, 3, and 5. The results of the analysis indicate that all stresses are below the required acceptable limits. In all cases, using a stress design factor of 5 resulted in stress limits below the yield strength of the material.

B. TURBINE LIFTING RIG

The turbine component lifting rig was designed by Westinghouse prior to the existence of ANSI N14.6 and ANSI B30.9 - 1971. Additionally, this device was designed as not having any nuclear significance since it is to be used only in the turbine building. Documentation is not available to assure that all of the requirements of the two standards are met. Our review did include a review of Westinghouse provided drawings that were available. The information reviewed to date does indicate sound engineering practices were employed and there is reasonable assurance that the intent of the standards was in fact accomplished in the design and fabrication of the lifting rig. Furthermore, this device has been used to transport the loads for which it was designed to handle many times with no indications of design deficiencies.

Additionally, a visual inspection including NDE testing of major load carrying welds and any other critical areas will be done prior to each use (typically at each refueling).