U. S. ATOMIC ENERGY COMMISSION
REGION III
DIVISION OF COMPLIANCE

Report of Inspection

CO Report No. 263/70-17

Licensee:	Northern States Power Company (Monticello) License No. DPR-22 Category B	
Dates of Inspection:	October 19-21, 1970	
Dates of Previous Inspection:	September 23, October 1 and 2, 1970	
Inspected By: C. D. Feierabend	Principal Reactor Inspector	11-4-70
J. W. Sutton	Reactor Inspector (Construction)	11-4-70
Reviewed By: H. D. Thornburg	Senior Reactor Inspector	11-4-70
Proprietary Information:	None	

SCOPE

Type:	Boiling Water Reactor
Power Level:	1670 Mwt (Low Power License: 5 Mwt)
Location:	Monticello, Minnesota
Type of Inspection:	Announced

Mr. Feierabend reviewed plant status, including status of the standby gas treatment and feedwater system testing. Mr. Sutton reviewed preparations for system expansion testing, and observed initial pipe hanger adjustment.

SUMMARY

Safety Items - None.

Noncompliance Items - None.

Unusual Occurrences - None.

Status of Previously Reported Problems - The licensee has prepared a response to the Form AEC-592 that was issued as a result of the previous inspection.

Other Significant Items - Initial local leak rate testing of the main steam isolation valves indicated that one valve is leaking in excess of allowable limits. (Section E.1.)

Failure of feedwater pump impellers has been determined to be rapid fatigue failure, the specific cause not yet identified. Thorough investigation is in progress including vibration analyses and investigation of possible system harmonics. Pump rotors have been modified to reduce stresses on the inlet vanes. (Section H.1.)

The standby gas treatment system design review has not been completed. (Section K.)

Management Interview - The inspectors conducted an exit interview with licensee and contractor personnel at the conclusion of the inspection. The following personnel attended:

AEC - CO:III

C. Feierabend
J. Sutton

Northern States Power Company

C. Larson
M. Clarity
G. Jacobson
J. Sullivan

General Electric Company

J. Miller
G. Mattey

Mr. Sutton discussed his observations of the preparations for system expansion testing and spring hanger adjustment. He stated that the preparations inside primary containment were satisfactory, but that a small sample of spring hangers observed in the turbine building indicated that initial spring hanger adjustments had not yet been satisfactorily completed. Mr. Jacobson stated that a Northern States Power engineer would participate in verification of spring hanger settings prior to system heatup.

Mr. Sutton stated that he had observed some loose materials, such as pipe ends and plate cutoffs, on ledges and ventilation ducts while inspecting inside primary containment. Mr. Larson stated that a final cleaning is scheduled and that special attention will be given to those areas that are not visible from normal access areas.

In response to questions concerning the main steam isolation valves, Mr. Mattey stated that a leak rate test performed after replacement of the air pilot valves indicated that two of the lines were leaking. The valves were opened and flushed with water to remove any foreign matter and retested. Leakage for one line was 40 scfm which still exceeded the allowable limit of 11.5 scfm per valve. He stated that plans are to install inflatable seals in the steam line inside the reactor vessel and to test each valve individually.

Mr. Feierabend stated that Compliance is very interested in obtaining all available information concerning resolution of the problems associated with the reactor feedwater and standby gas treatment systems. Mr. Larson stated that he will inform the inspector concerning status of the systems, and that Northern States Power does not intend to proceed with any testing that requires secondary containment integrity until the standby gas treatment system is reliable. Mr. Miller stated that GE has placed top priority on resolving the problems with the two systems.

Mr. Larson stated that progress in all other areas was approximately on schedule and that, except for the reactor feedwater and standby gas treatment systems, the facility could be ready to proceed with power testing within ten days.

The inspector (Feierabend) conducted a separate informal interview with Mr. Simandl during the inspection and by telephone on October 22. The inspector voiced his concern that lack of resolution of the problems with the standby gas treatment system and the feedwater system could delay further licensing action. Mr. Simandl assured the inspector that Northern States Power is concerned regarding the two systems, and that they will require satisfactory resolution of the problems before considering power operation.

DETAILS

A. Persons Contacted

J. Simandl - Manager, Construction
J. Sullivan - Principal Quality Assurance Representative
C. Larson - Plant Superintendent (Operations)
M. Clarity - Assistant Plant Superintendent (Operations)
G. Jacobson - Plant Results Engineer
D. Antony - Test Engineer
M. Dinville - Test Engineer
D. Nevinsky - Test Engineer

General Electric Company (GE)

R. Goettge - Site Manager
J. Miller - Operations Manager
G. Mattey - Operations Superintendent
J. Staley - Test Engineer
J. Sheehan - Test Engineer
G. Chew - Test Engineer

Bechtel Corporation (Bechtel)

W. Balodis - Chief Startup Engineer

B. Administration and Organization

There have been no recent personnel or organizational changes in the operating staff.

C. Operations

As previously reported,[1/] the licensee had postponed criticality pending resolution of difficulties with the standby gas treatment system. This decision remains in effect and the operational neutron sources will remain with GE in California until the licensee determines that it is prudent to commence low power reactor testing.

1/ CO Report No. 263/70-16.

E. Primary System

1. Main Steam Isolation Valves (MSIV)

Air pilot valves for all of the MSIV have been replaced with valves with increased clearances to prevent the sticking problems that had occurred at Dresden 2.[2/] On October 7-9, after completion of the modifications, leak rate tests were performed at 25 psig on the MSIV by pressurizing between the valves and measuring pressure decay. The test that included MSIV 2-80-D and 2-86-D indicated a leakage of ~ 40 scfh vs. 11.5 scfh per valve maximum allowable leakage. The licensee plans to perform additional MSIV tests to determine individual valve leakage rates and to perform any maintenance needed to assure minimum valve leakage. Surveillance testing of the MSIV will be completed prior to operation above 5 Mwt.

2. Primary System Expansion

a. System Expansion, STP 10.

The inspector reviewed GE Specification No. 22A2192AR, "System Expansion," dated January 15, 1970, with revisions SR1-5/20/70, SR2-8/23/70 and SR3-8/28/70. The procedure was found to be properly signed off by NSP representatives.

The specifications outlined the procedures to be followed to verify that the reactor drywell piping system is free and unrestrained with regard to thermal expansion and that suspension components are functioning in the specified manner.

A GE engineer was assigned the responsibility for the accuracy and proper adjustment of all spring hangers installed within the drywell. GE Record Forms 10-1, System Expansion - Hanger Test Data, Load or Deflection, and Form 10-2, System Expansion - Special Devices, were reviewed by the inspector. The forms contained the following headings:

2/ CO Report No. 237/70-6.

Hanger number, system temperatur F° - system pressure, reactor pressure, visual remarks, hanger deflection, calculation, Measurement and % Differential. GE personnel had recorded the initial measurement data for 98 spring hangers located in the drywell. All readings recorded were taken at ambient temperature and so noted. Designated hangers which have been classed as inaccessible during testing, have been provided with instrumentated recording devices. During warmup, GE and NSP personnel will be monitoring all accessible hangers for the purpose of recording any movement.

The records reviewed were found to be comprehensive and contained the proper steps and procedures to be used to assure that all designated hangers are functioning properly.

The procedures were found to be in accordance with Section XI of the ASME Boiler and Pressure Vessel Code.

b. Inspections of Installation

A random sampling was made of 30 of the 98 spring hangers located in the following systems: Recirculation, steam, feedwater, core spray, control rod drive hydraulic system return, high pressure coolant injection and torus water. Those selected were visually inspected to verify the cold readings that had been recorded. All readings, with the exception of one, located on a torus water line were found to be correct.

It appears that GE has exercised control over the installation of the hangers located within the drywell and has followed procedures and specifications.

H. Power Conversion System

1. Feedwater System

Failure of feedwater (FW) pump impellers was identified during the previous inspection.[3/] The inspector reviewed the available records concerning the feedwater pumps, observed

3/ CO Report No. 263/70-16.

that the pumps had been reassembled and observed operation of one of the pumps during initial testing. The inspector discussed FW pump performance with the Bechtel engineer who had participated in installation and testing.

a. Operating History

The pumps were released to startup on March 23, 1970. Pump 2-B was again operated on April 29, 1970, for a short run (~ 20 minutes) to check the recirculation line piping. The recirculation valves were moved close to the condenser to reduce hydraulic shock caused by valve operation.

On May 1, 1970, pump 2-A was operated and failed. Failure was a sheared key that holds the balance to the shaft. Inspection of pump 2-B revealed that a similar failure had apparently occurred while the pump was windmilling. Cause appeared to be a clearance problem at lower speeds. During the operation on May 1, 1970, a failure in one of the recirculation valves also occurred.

Both rotors were returned to De Laval for balance repair. Repairs included replacement of the 3/8" shaft keys with 1/2" keys and adding a spring loaded thrust, providing additional clearance to prevent recurrence of balance failures.

The rotors were returned to the site in June 1970. Testing after reassembly showed excessive vibration at pumps and piping. Investigation and conferences between De Laval and Bechtel resulted in some changes in piping supports, some new hangers added and spring loadings changed to provide the recommended loading for the pumps. Additional breakdown orifices were installed in the cleaning lines to reduce the noise level and restraints were added to the recirculation pipe at the recirculation valve.

Both pumps were operated periodically in July and August to obtain vibration measurements and other data. Vibration measurements were still high but systems were operable. Alignment checks indicated that good

alignment was maintained. A 100-hour test run was performed on one pump during August 20-24. Problems with the coupling on pump 2-A and with one of the recirculation valves prevented operation of portions of the system during preoperational testing. A new coupling was received. It was installed and the pump was operated on September 15 under supervision of two De Laval representatives. Both pump and piping vibrations were high. Balancing the coupling by changing keys on the motor of pump 2-B reduced vibration at the motor end.

On September 29 it was decided to disassemble pump 2-A to look at the bearings because of continued high vibration. At the same time inspection of the recirculation valve disclosed a piece of the pump impeller lodged in the valve. The pump was disassembled showing that two of the five vanes of the first stage impeller were broken. Inspection of pump 2-B showed that one vane of the first stage impeller was missing.

A search of the system was made to recover the pieces. This included examination of both recirculation lines, the condenser sparger, recirculation valves, control valves and high pressure FW heaters. All pieces were recovered except for three pieces. One piece of the impeller from pump 2-B, ($\sim$ 3" long x 1 1/2" wide), one bolt end (5/8" bolt $\sim$ 1/2" long) and a small "sliver" from the pump 2-B impeller ($\sim$ 1/4" x 1/8"). The rotors were shipped to De Laval for investigation and repair.

The licensee believes that the three missing pieces are located in a vertical section of the FW piping where flow forces are not sufficient to transport the pieces further in the system. The FW system has been isolated from the reactor vessel during all operations to date. In addition, the tubes of the FW heaters provide a barrier for all pieces over 3/8" in diameter effectively preventing such material from entering the reactor vessel.

b. Investigation and Repairs

Bechtel and De Laval are investigating the failures and are reanalyzing the entire FW system to determine all contributing causes and take any necessary corrective measures.

[illegible]al initiated a testing program on the failed [illegible]ents and on a spare rotor to determine mode of failure and to ascertain the cause(s) if possible. Photomicrographs showed that failure was transgranular. The failure was analyzed as rapid fatigue failure. A spare rotor was analyzed for natural vibration frequencies and the inlet vane vibration was checked for dynamic resonance. Resonant frequencies of 2100 and 2400 cycles per second were identified. An analysis of all possible system excitation frequencies failed to identify any excitation due to system geometry. No excitation frequencies were found which would correspond to the natural frequency of the impeller inlet vanes.

A modification to the inlet vanes was made to provide more rigid leading edges. This consisted of machining a "square" leading edge. Vibration analysis of the modified impeller showed that the [illegible]ural frequencies did not change, but the amplitude was reduced by 1/3 from 0.045" to 0.015". Their mechanical analysis indicated that, with a drop in amplitude of 3 to 1, the stress level dropped to 1/5 of the previous design.

A metallurgical analysis of the bolt failure indicated that the bolts had failed from flexural fatigue. Calling of the bolted interface indicated that the diffuser had been permitted to rotate and work within the case causing the bolts to be flexed. A small portion of each broken bolt remained in the threads. The original bolts were made from 416 stainless steel bar stock. This is a free-machining 12% chrome stainless steel hardened to Rc 15 to 18.

A new material has been selected for these bolts, in addition to increasing the bolt diameter from 5/8" to 3/4". Four hundred ten (410) stainless steel will be employed to improve fatigue strength. Rolled threads will also be placed on these bolts and the hardness controlled to Rc 24 - 26 to inhibit stress corrosion. The corrective measures taken on the bolt circle were learned during the correction of a similar problem on a 20,000 hp turbine pump. The repair was successful on the larger unit.

The modifications were completed on the spare rotor and on the rotor for pump 2-B (with a slightly different contour to the inlet vane) and the rotors were returned to the site. Two De Laval representatives and a consultant supervised reassembly and startup of the pumps on October 20. Pump vibrations were still high (higher on pump 2-A than on pump 2-B) and piping vibrations had not noticeably improved.

Current plans are to obtain additional vibration analyses while the pumps are in operation, via a consultant service, and to coordinate analysis of the pump and system problems. A meeting is scheduled in Bechtel's San Francisco office during the week of October 25.

2. Pipe Hangers

Inspection of pipe hanger adjustments within the primary containment vessel verified that proper adjustments had been made. (Section E.2.b., above.) Observation of several pipe hangers external to primary containment indicated that additional adjustments and verification of hanger settings is needed. Approximately [illegible] the hangers checked did not have a support indication although accompanying personnel believed that the hangers observed had received initial adjustments. Responsibility for initial adjustment and recording data for piping outside primary containment was assigned to a Bechtel engineer. The cognizant engineer was not readily available, so discussion of the hanger settings was deferred. The cognizant GE and NSP engineers stated that all of the spring hanger settings would be physically reverified prior to system heatup. This item was discussed in the exit interview and is considered to be an open item to be resolved prior to system heatup.

K. Containment

Standby Gas Treatment System (SGTS)

Operational problems associated with the SGTS have been discussed in previous inspection reports.4/ The licensee has reported the system malfunctions to DRL in accordance with technical specification requirements.

4/ CO Report Nos. 263/70-15 and 263/70-16.

GE and Bechtel design review efforts are not yet complete. The review efforts included temporary assignment of a GE engineer to the site for several days to observe system operation and testing. The licensee is expecting a report from GE concerning resolution of system problems, however it had not yet been received at the site.

Secondary containment integrity will not be required until low power testing is resumed. The licensee is operating the SGTS daily to verify maintenance performed, gain additional experience in system operation and to identify and resolve all system deficiencies. Problems encountered during this testing do not require reports to DRL as long as system operability is not a license requirement. However, the licensee plans to inform Compliance of the results of the testing and resolution of system deficiencies.

During system operation for design review on October 9, the inlet valve for the B train failed to open. This was similar to the malfunction of A train on September 28, however the cause appeared to be binding of the butterfly on the neoprene valve liner. Resolution of valve operating problems will be included in the design review and system upgrading.

The licensee indicated that CO:III would be informed when the results of the GE-Bechtel design review have been received. CO:III will review the results, including any projected system upgrading for assurance that a reliable system is provided and license requirements are met.