FROM:
Northern States Power Company
Minneapolis, Minn. 55401
R.O. Bonnanson, Jr.

DATE OF DOCUMENT: Oct. 18, 1971
DATE RECEIVED: Oct. 21, 1971
NO.: 4612

LTR. X MEMO: REPORT: OTHER:

TO:
Dr. Peter A. Morris

ORIG.: 3 signed CC: OTHER:

ACTION NECESSARY ☐ NO ACTION NECESSARY ☐
CONCURRENCE ☐ COMMENT ☐
DATE ANSWERED: BY:

CLASSIF: U POST OFFICE REG. NO:

FILE CODE: 50-263

DESCRIPTION: (Must Be Unclassified)
Ltr trans the following:

ENCLOSURES:
REPORT-Summary of HPCI Problems Experienced During Starup Testing at Monticello Plant.....

(3 cys encl rec'd)

REMARKS:

REFERRED TO	DATE	RECEIVED BY	DATE
Knuth w/9 cys for ACTION	10-22-71		
DISTRIBUTION:			
Reg File Cy			
AEC PDR			
OGC-Rm-P-506-A			
Compliance (2)			
H. Price & Staff			
D. Thompson			
Morris/Schroeder		DO NOT REMOVE	
Skovholt			
Boyd		ACKNOWLEDGED	
E.G. Case			
DTIE(Laughlin)			
NSIC(Buchanan)		4612	DL

U.S. ATOMIC ENERGY COMMISSION
MAIL CONTROL FORM FORM AEC-326S (8-60)

☆ U.S. GOVERNMENT PRINTING OFFICE: 1970—406—979

Regulatory File Cy.

NSP

NORTHERN STATES POWER COMPANY
Minneapolis, Minnesota 55401

October 18, 1971

Dr. Peter A. Morris, Director
Division of Reactor Licensing
United States Atomic Energy Commission
Washington, D.C. 20545

Dear Dr. Morris:

MONTICELLO NUCLEAR GENERATING PLANT
Docket No. 50-263 License No. DPR-22

Summary of HPCI Problems Experienced
During Startup Testing

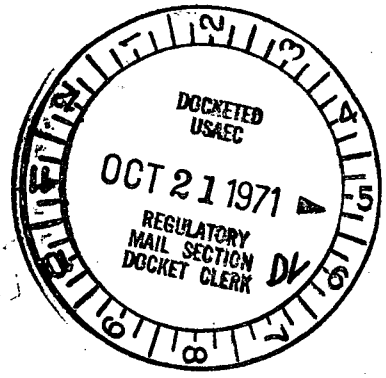
As requested by the Region III Division of Compliance Office, we are forwarding the attached report, "Summary of HPCI Problems Experienced During Startup Testing" for your information.

Yours very truly,

R.O. Duncanson, Jr., P.E.
Gen. Supt. of Power Plants - Mechanical
Chairman - Monticello Safety Audit Committee

ROD/caf

Attachment



4612

October 16, 1971

MONTICELLO NUCLEAR GENERATING PLANT

Summary of HPCI Problems Experienced During Startup Testing

This report summarizes the problems encountered while testing the HPCI system during the Monticello Nuclear Generating Plant Startup Test Program.

The pre-operational testing of the HPCI system was performed during January, 1970. During this time all valves were tested, instrumentation was calibrated and functionally tested, all control logic was tested and the turbine was operated using 80 psi heating boiler steam. The heating boiler steam supply was insufficient to operate the machine under load, consequently, the turbine governor could not be tested. A complete test that demonstrated machine performance at design conditions was not possible until high pressure steam was available from the reactor.

As a result of HPCI testing performed at other G E plants, the Monticello HPCI flow controller was modified in January of 1971 prior to initial plant heatup. "Tracking" capability was added, wherein the flow controller output could be held at a preset value during periods when the turbine was shutdown. Previously, the controller output would integrate to a 50 Ma "saturated" condition during shutdown periods, thereby causing unacceptable overspeed conditions during the automatic fast startup transient. The tracking signal is released when the turbine stop valve leaves the closed position, and the controller output integrates to the value required to satisfy input demand.

A design error was found and corrected involving an air operated pressure control valve which had been installed on the system cooling water loop. The valve was replaced with a self-actuated pressure control valve.

Initial startup testing of the HPCI system was started on February 20, 1971. The following problems were corrected during this initial test period:

1. The flow controller "tracking" station was found inoperable due to a ground loop between the controller and the electronic governor.

   The ground loop was corrected, the controller tracking capability was demonstrated.

2. The "tracking" modification affected the ability of the controller to provide a "bumpless" manual to auto transfer. This was eventually corrected by further modifications to the controller.

3. The pump discharge flow orifice sensing lines were found reversed and were corrected.

4. The local "Turbine Trip" capability using the overspeed trip valve would not operate. The hydraulic oil dump pipe from the turbine stop valve was replaced with tubing, increasing the flow area. The oil pump suction piping was carefully sealed to prevent air inleakage that would cause oil pump cavitation.

5. The torus level switches that cause HPCI suction transfer from the Condensate Storage Tanks to the torus on high torus water level had to be remounted to eliminate vibration induced trips. A transfer would result on machine startup as turbine exhaust flow caused the exhaust piping and torus to vibrate.

   The switches were also found installed about four feet above the proper trip point. The switches were moved to the correct elevation and supported from the building wall.

6. A broken resistor was found in the auxiliary oil pump starting circuit which delayed the start of the auxiliary oil pump and therefore the starting time of the turbine about 3-4 seconds. This was repaired.

7. HPCI steam line isolation due to initiation of the high steam flow sensors would occur after the 45 second time delay. The switches were calibrated and a new trip point was set based on the observed differential pressure at design conditions.

8. The "test-return" piping vibrated excessively during operation. Additional piping supports were installed.

9. At the 1000 psi steam pressure condition, the stop valve opening time was excessive. An adjustment was made to the pilot valve to reduce the steam pressure on the stop valve balance piston which improved the opening time.

10. Initial testing uncovered problems regarding compatability between the flow control signal, the electronic governor system, and the turbine hydraulic control system. The following changes were made:

    a. A new amplifier printed circuit board was installed to improve slow turbine speed measurement.

    b. New "frequency-range" capacitors were installed to cover the required turbine speed range.

    c. Isolation transformers were installed to isolate the input and output signals within the electronic governor.

After correcting the above problems, test activity resumed on the HPCI system, and "operational" status was finally achieved. However, gain and stability adjustments on the electronic governor were at their limits, the adjustments on the electronic governor were near their limits, and system control was still on the edge of instability, primarily the result of a "noisy" flow control signal.

Further testing on the HPCI system to optimize flow controller proportional band and reset settings was performed from March 21 to March 24 at reactor pressures ranging from 170 psi to 350 psi. As of March 24, the system was operating satisfactorily at reactor pressures up to 350 psig. During the plant outage following this testing, modifications in the flow controller to allow "bumpless" manual to auto transfer were permanently wired.

When the HPCI system was tested at 650 psig on April 17, the flow did not come up to 3000 gpm within the desired 25 seconds and a 400 gpm peak to peak instability was noted in pump flow. A few adjustments were made to the flow controller and governor without success. The decision was made to declare the system inoperable.

In order to correct the instability problems, the flow controller was converted to a pure "integral" controller by removing the proportional band feature. A new electronic governor was installed which incorporated the following permanent modifications:

1. New amplifier printed circuit board was installed to obtain wide speed range control and to improve gain and stability adjustments.

2. New "frequency-range" capacitators were installed to cover the required turbine speed range.

3. Isolation transformers were installed to provide isolation between the speed input signal, the convertor circuit board, and the tachometer printed circuit board.

4. The signal convertor was modified to reduce load on the output loop of the flow controller. It was also noted that the present signal convertors used ceramic resistors which were dipped in epoxy, an unacceptable condition which resulted in overheated components.

The hydraulic system was modified as follows:

a) The 1/8" choke orifice in the 100# hydraulic system was removed.

b) The hydraulic bypass on the stop valve was removed.

c) The 30# pilot valve supply orifice was changed from 5/32" to 3/16" diameter.

HPCI testing following the above modifications revealed the following two problems which had to be corrected.

a. A steam leak from the turbine valve chest cover required removal of the cover for inspection. The steam chest flange faces were stoned to remove imperfections from the "jacking" bolts. The steam leak was apparently the result of relaxed torque on the steam chest bolting.

b. The governor hydraulic actuator was removed and inspected because of faulty operation and found to be fouled. Oil samples were taken revealing high particle count. The turbine oil system was drained, cleaned and flushed and a new hydraulic actuator was installed. Turbine oil samples are presently analyzed every six months.

Following some initial difficulty in calibrating the new electronic governor, the HPCI system was successfully tested throughout its required pressure range on May 2 and 3, 1971. Test results are tabulated below.

Tests Conducted 5/2/71 Thru 5/3/71

Test No.	1	2	3	4	5
Reactor Pressure, psig	170	339	650	1000	1000
Pump Discharge Pressure, psig	340	410	748	1060	1175
Pump Flow Rate GPM	3100	3050	3100	3070	3100
Flow Start, seconds	5.5	6.0	6.0	6.0	5.5
Controller Ramp Start, seconds	5.5	6.0	6.0	6.0	6.5
Controller @ Req'd Output, seconds	16.5	16.5	18.0	21.0	20.0
Time to 3000 GPM, seconds	17.0	17 0	19.0	22.0	20.0

NOTE: Times indicated are from the time the steam supply valve starts to open and are recorded to the nearest 0.5 second.