U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No.: 50-263/89030(DRS)

Docket No.: 50-263 License No.: DPR-22

Licensee: Northern States Power Company
414 Nicollet Mall
Minneapolis, MN 55401

Facility Name: Monticello Nuclear Generating Station

Inspection At: Monticello, MN

Inspection Conducted: November 13 through 16, 1989

Inspector: D. S. Butler
D. S. Butler
12/7/89
Date

Approved By: R. N. Gardner
R. N. Gardner, Chief
Plant Systems Section
12/7/89
Date

Inspection Summary

Inspection on November 13 through 16, 1989 (Report No. 50-263/89030(DRS))
Areas Inspected: Special, announced inspection to followup on modifications to correct original design deficiencies in the LPCI swing bus transfer logic (62705).
Results: Of the areas inspected, no violations or deviations were identified.

A strength observed during the review of the LPCI modifications concerned the preoperational/operational tests. The tests were well written and completely tested all logic combinations of the installed components.

8912130144 891207
PDR ADOCK 05000263
Q PDC

DETAILS

1. Persons Contacted

   Northern States Power Company (NSP)

   D. D. Antony, Plant Manager
   *B. D. Day, General Superintendent, Engineering and Radiation Protection
   *S. A. Engelke, Superintendent, Nuclear Technical Services
   *D. K. Olson, Electrical Engineer
   *H. E. Girzi, Electrical Engineer

   Nuclear Regulatory Commission (NRC)

   J. E. Hard, Senior Resident Inspector
   *W. O. Long, NRR Project Manager

   The inspector also contacted other licensee personnel during the course of the inspection.

   *Denotes persons attending the exit interview on November 16, 1989.

2. Licensee Action on Previous Inspection Findings

   (Closed) Unresolved Item (263/88017-04): Low Pressure Coolant Injection (LPCI) swing bus design concerns.

   The licensee informed the NRC that a failure of a 125 Vdc bus could leave only one core spray pump capable of injecting into the reactor vessel. This was not accounted for in the current Monticello Safety Analysis.

   In response to this item, the NRC issued a Confirmatory Action Letter (CAL) RIII-88028 which confirmed the following licensee corrective action items:

   (1) Provide adequate procedures and training to the operators to make them aware of this situation and actions necessary to manually restore power to the deenergized LPCI valves in the event of a loss of 125 Vdc power.

   (2) During the next scheduled refueling outage (August 1989), make modifications to assure that a failure of one division of 125 Vdc power will not disable all of the LPCI functions.

   (3) Submit by October 7, 1988, to the Office of Nuclear Reactor Regulation and to the NRC Region III Office, a report describing the current swing bus configuration including a justification for continued operation of the Monticello facility.

Regarding these actions, the resident inspector verified that the necessary training and procedures were adequate and implemented. Thus, Item (1) above was closed.

Item (2) was completed during the 1989 (Cycle 13) refueling outage and is the subject of this inspection report. The details of the inspector's review of this item are described in Section 3 of this report. The change made to the LPCI swing bus d-c control power effectively removed the potential for a failure of one division of 125 Vdc power from disabling all of the LPCI functions. Thus, Item (2) above is considered closed.

The report required by Item (3) was accepted by NRC letter (TAC No. 71092), dated September 8, 1989. Thus, Item (3) above is considered closed.

3. Low Pressure Coolant Injection (LPCI) Subsystem

a. Swing Bus Design Bases

The LPCI mode of operation of the residual heat removal (RHR) system pumps water into the reactor vessel on a loss of coolant accident (LOCA) signal to flood the core and prevent fuel clad melting. LPCI operation uses two identical pump loops with two pumps in parallel. The two loops are arranged to discharge water into two different reactor recirculation loops. A cross connection exists between the pump discharge lines of each loop. The LPCI recirculation line break detection logic, when LPCI is initiated, will open the LPCI injection valve to the unbroken recirculation loop and close the recirculation pump discharge valve in the unbroken loop.

The power for the RHR pumps is supplied from redundant a-c power. Each pump pair receives its power from a different bus. Motive power for the LPCI injection valves comes from a common bus (swing bus) which can be automatically connected to an alternate standby power source. Control power for the LPCI components comes from the d-c buses.

The low pressure core cooling system design bases state, in part, that ". . . the use of a common bus for some of the LPCI components is desirable from a reliability point of view and is acceptable because the core spray subsystem and LPCI operation are arranged independently to accomplish the same objective". In addition, the design criteria state, in part, that ". . . the low pressure core cooling system consists of these subsystems: core spray "A" subsystem, core spray "B" subsystem, and the LPCI subsystem". Finally, the design criteria concluded that the LPCI subsystem by itself is not required to meet all the requirements of IEEE-279 (Criteria for Protection Systems for Nuclear Power Generating Stations), in particular, single-failure criterion, since it is backed up by the two core spray subsystems. However, to assure the availability of the LPCI subsystem, the transfer of LPCI to its alternate power source should be single failure proof.

b. Swing Bus Design Criteria

The LPCI swing bus design is in use in both BWR 3 and 4 plants. The design was approved for use prior to the development of Regulatory Guide (RG) 1.6, "Independence Between Redundant Standby (ONSITE) Power Sources and Between Their Distribution Systems". The main concern in using a swing bus design has been the potential for a single failure to cause redundant emergency diesel generators (EDGs) to be paralleled resulting in the loss of redundant emergency power sources (common mode failure). Thus, the LPCI swing bus design was permitted on BWR 3/4 plants under the assumption that there be no single failure problem associated with the transfer scheme and that motive power for the LPCI motor operated valves be available from redundant sources.

c. Swing Bus Design Flaws

Recently, a swing bus design flaw was discovered in the original design swing bus transfer scheme at several plants. The design flaw could prevent the swing bus from seeking its alternate a-c power source as the result of a single failure of the Division I d-c control power concurrent with a loss of offsite power (LOOP).

To mitigate a large LOCA, the Monticello plant design relies on two core spray pumps being available or one core spray pump and LPCI (two RHR pumps). Loss of LPCI d-c control power could be caused by the failure of the Division I 125 Vdc battery. As a result, concurrent with a LOCA and LOOP, the following equipment would not be available:

- Division I EDG
- Division I Core Spray
- LPCI

The low pressure cooling system would be reduced to a Division II core spray loop.

During discussions between the licensee and the NRC regarding the proposed modification to correct the d-c control power failure with NRR, it was identified that if the EDG was supplying the swing bus and its output degraded to a certain voltage range or frequency range, the LPCI valves may not operate if required and the swing bus would not transfer to its alternate source. This resulted in the licensee proposing a second modification to initiate a swing bus transfer on a degraded EDG output, such as undervoltage, overvoltage, underfrequency and overfrequency.

d. Swing Bus Modification No. 89Z021

This modification was implemented to assure that the swing bus would transfer on a loss of the Division I 125 Vdc battery concurrent with a LOOP. The modification implemented the following changes (see Enclosure 2):

1) Removed normally closed breakers ACB 52-3320 and ACB 52-4320 that connected Division I Motor Control Center (MCC) 133B (LPCI injection valves loop "A") to Division II MCC 143 B (LPCI injection valves loop "B").

2) Hard wired MCC 133B to 143B.

3) Provided coordinated series breakers ACB 52-307 and ACB 52-3300 (both normally closed) between Division I Load Center (LC) 103 and MCC 133B.

4) Provided coordinated series breakers ACB 52-407 (normally closed) and ACB 52-4300 (normally open) between Division II LC 104 and MCC 143B.

5) Provided Division I 250/125 Vdc control power (different d-c power source than the Division I 125 Vdc source) to breaker ACB 52-3300.

6) On a loss of normal swing bus supply voltage, delayed swing bus transfer (maximum of 15 seconds) to allow for EDG start and loading (maximum 10 seconds) and prevented transfer if power is restored.

The new design ensures the following during a LOCA:

1) On a LOOP concurrent with a loss of Division I 125 Vdc battery, the automatic transfer will occur and LPCI (two (2) RHR pumps), LPCI injection valves and Division II core spray would be available.

2) On a LOOP concurrent with a loss of Division I 250/125 Vdc control power, two core spray loops would be available.

3) On a LOOP concurrent with a loss of Division II 125 Vdc battery, LPCI (two (2) RHR pumps), LPCI injection valves and Division I core spray would be available.

Therefore, the new design ensures that adequate low pressure core cooling will be available to mitigate a LOCA as analyzed in the Monticello Safety Analysis.

The inspector's review of the modification package included the following:

1) <u>Fuse/Breaker Coordination</u>

   The inspector reviewed the coordination plot and breaker trip setting cards to ensure that proper coordination had been established to protect LC 103 and LC 104. The LCs also supply power to MCC 133A and MCC 143A, respectively, which in turn, provide power to the core spray injection valves (see

Enclosure 2). A bolted fault on the swing bus, if coordination did not exist, would have the potential to open the source breaker to LC 103 causing a loss of Division I core spray as well as LPCI. The design also provided protection if breaker 52-3300 opened on an overcurrent condition such that the transfer scheme would not transfer a faulted swing bus to LC 104. The maximum fault current that would be seen on the swing bus was 7720A. The fault current was within the instantaneous trip capability of MCC breakers 52-3300 and 52-4300. The instantaneous trip time-over-current characteristics adequately coordinated with the short time tripping characteristics of upstream MCC breakers 52-307 and 52-407, and LC breakers 52-301 and 52-401, respectively. Therefore, the LCs were adequately protected and the potential to parallel redundant power sources was reduced by adequate coordination between two series breakers (single failure protection).

The LPCI swing bus provides power to the following valves:

MCC	LOAD	DESCRIPTION
133B	MO 2014	LPCI Injection Valve Motor
	MO 2012	LPCI Injection Valve Motor
	MO 2-53A	Recirculation Pump Discharge Valve Motor
	MO 2-43A	Recirculation Pump Suction Valve Motor
	MO 4085A	LPCI Crosstie Line Isolation Valve Motor
143B	MO 2015	LPCI Injection Valve Motor
	MO 2013	LPCI Injection Valve Motor
	MO 2-53B	Recirculation Pump Discharge Valve Motor
	MO 2-43B	Recirculation Pump Suction Valve Motor
	MO 4085B	LPCI Crosstie Line Isolation Valve Motor

The largest loads on the swing bus are LPCI injection valves MO 2012 and MO 2013. Overload protection was provided by a heater overload and fault protection was provided by 125A fuses. These devices are coordinated with the MCC feeder breakers. Two valves on the MCCs are considered to be nonsafety-related. Recirculation pump suction valves MO 2-43A and MO 2-43B were at one time considered to be safety-related, but no longer receive a close signal when LPCI is initiated. The motor starter becomes the 1E isolation device. The licensee informed the inspector that the motor starter was procured safety-related and that all the fuses used at Monticello were purchased commercial grade. The inspector reviewed Preventive Maintenance (PM) Procedure No. 4841-1, "Recirculation System MO Valves

Electrical Maintenance". The same PM procedure was used for both safety-related and nonsafety-related recirculation valve motor starters. The suction valve motor starters were being adequately maintained and were of the correct size to ensure Class 1E isolation.

The following motor operated valve fuse sizes were verified in the plant to correspond to the NSP Circuit Breaker and Fuse Coordination Study:

MCC	LOAD	DESCRIPTION	FUSE SIZE
133B	MO 2014	LPCI Injection Valve Motor	45A
	MO 2012	LPCI Injection Valve Motor	125A
	MO 2-53A	Recirculation Pump Discharge Valve Motor	60A
	MO 2-43A	Recirculation Pump Suction Valve Motor	60A
	MO 4085A	LPCI Crosstie Line Isolation Valve Motor	15A
143B	MO 2015	LPCI Injection Valve Motor	45A
	MO 2013	LPCI Injection Valve Motor	125A
	MO 2-53B	Recirculation Pump Discharge Valve Motor	60A
	MO 2-43B	Recirculation Pump Suction Valve Motor	60A
	MO 4085B	LPCI Crosstie Line Isolation Valve Motor	15A
133A	MO 1753	Core Spray Valve Motor	45A
	MO 1751	Core Spray Valve Motor	45A
143A	MO 1754	Core Spray Valve Motor	45A
	MO 1752	Core Spray Valve Motor	45A

The fuses installed agreed with the study in all of the above cases.

The licensee is procuring fuses as commercial grade. They are currently obtaining the fuses from two manufacturers and from specific production sites. During the receipt inspection, the licensee was performing nondestructive and destructive tests of each batch of fuses received. The licensee was adequately controlling the replacement of blown fuses with Administrative Control Document No. 4 AWI-04.07.03, "Replacement of Failed Fuses". The preferred method of fuse replacement at Monticello utilizes an identifical fuse as a replacement. The alternate method, if an identical fuse replacement could not be located, was to replace the fuse with an equivalent fuse as determined from the Monticello Fuse Cross Reference Guide. In addition, the fuse procedure required that fuse equivalency be documented by a written determination and that the fuse/breaker coordination study be updated. The licensee informed the inspector that they had expanded their fuse verification program to include control fuses and that this program was currently in progress. The inspector concluded that the licensee was adequately controlling the replacement of fuses in the plant to maintain coordination.

The inspector has no concerns regarding this item.

2) <u>LPCI Swing Bus Switchover Delay</u>

The licensee contracted General Electric (GE) Nuclear Energy to determine the impact on the current Monticello ECCS performance analysis of changing the LPCI swing bus switchover delay time from 10 to 15 seconds after receipt of an EDG initiation signal. GE concluded that the additional 5 second delay in LPCI swing bus switchover would have no impact on the Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) limits for the upcoming operating cycle. The inspector was concerned that the 5 second delay would not be factored into future ECCS performance analyses. GE provided a letter (DAH 89-075, dated November 17, 1989) that indicates that GE maintains a computerized data bank for use in performing reload transient and ECCS performance analyses for Monticello. The data bank contains performance assumptions of individual components and systems. GE confirmed that the longer LPCI swing bus switchover time delay had been incorporated into the Monticello plant-specific data base.

The inspector has no concerns regarding this item.

3) <u>Training</u>

The licensee's Production Training Department provided adequate training on the LPCI swing bus modification to both licensed operators and equipment operators. The training was provided in Lesson No. M 9115 L 021, "1989 Outage Mod Training".

The craft personnel performing the installations were provided adequate training on applicable section work instructions prior to commencing installation.

The inspector has no concerns regarding this item.

4) <u>DC Loading</u>

The engineering evaluation, Contract No. PA4764CQ, determined that the additional loads (control power) added to panels D33 and D211 by this modification were acceptable and did not impact the 4-hour capability of the Division I 250/125 Vdc and Division II 125 Vdc batteries under any station blackout scenarios.

The inspector has no concerns regarding this item.

5) Safety Evaluation

The safety evaluation documentation addressed the design, installation, and testing of the modification. The inspector reviewed this documentation and determined that the safety evaluation was adequate and that the modification did not involve an unreviewed safety question.

The inspector has no concerns regarding this item.

6) Modification Testing

The inspector reviewed Pre-Op/Op Test Procedure No. MP-88EP01-3 and Drawing No. E-105, Sheet 6. The test procedure received appropriate reviews and approvals. The acceptance criteria were adequately identified and all sign-offs were completed. The test verified all contact combinations and provided adequate test overlap into unmodified portions of the swing bus control logic. Test discrepancies were well documented and resolved prior to continuing the test. Quality Control (QC) inspectors were involved with all phases of the testing. The QC inspectors independently verified and signed off on each acceptance criteria step. The swing bus hardware and control logic performed as designed.

The inspector has no concerns regarding this item.

7) Surveillance Testing

The inspector reviewed Surveillance Test Procedure No. 0036, "ECCS Automatic Initiation Test, Including Loss of Auxiliary Power". The surveillance test had been updated to reflect the hardware and control logic changes. The test verified all contact logic combinations, relay timing, breaker actuations, and provided adequate test overlap into other portions of tested circuitry.

The inspector has no concerns regarding this item.

e. Swing Bus Modification No. 89Z100

This modification was implemented to assure that the swing bus would transfer on degraded bus conditions when receiving power from the EDG. The modification installed the following relays:

1) Loss of Voltage (1 second)
2) Degraded Voltage (9 seconds)
3) Overfrequency
4) Underfrequency
5) Overvoltage

Also, the existing loss of voltage relay (used to detect loss of normal supply voltage) was relocated with the above relays in Cabinet C327.

The inspector reviewed and determined that the safety evaluation, training, d-c loading, and modification testing had been adequately addressed by the licensee and had received the same level of review as discussed in the appropriate subsections of Section 3.d. of this report.

The inspector's review of the modification package included the following:

1) <u>Seismic Installation</u>

   The licensee procured seismically qualified relays. The peaks of the Monticello spectra were lower than the zero period acceleration (ZPA) of the relays' test response spectra. The relays were installed in a Hoffman Box (C327) which was determined to be structurally adequate for the earthquake and gravity loads imposed on it. All of the control cables run between C327 and MCC 133B were located in seismically installed conduits.

   The inspector has no concerns regarding this item.

2) <u>Housekeeping</u>

   The C327 cabinet is installed outside of the vital area housing MCC 133B. The inspector observed that the area around C327 was clean and that all the equipment in the immediate area was rigidly installed. There were many large conduits run along the floor separating the area near Cabinet C327 from normal plant traffic routes. The inspector was concerned that the storage of unsecured materials near the cabinet could become potential missiles during a seismic event and damage the cabinet. The licensee informed the inspector that housekeeping rounds were frequently performed and that this particular area was not known as a storage area due to the difficulty of climbing over the conduits.

   Based on the above, the inspector has no concerns regarding this item.

3) <u>Engineering Analysis EA-89R070-01</u>

This analysis determined the relay trip settings. The analysis based the setpoints on actual EDG loading characteristics that were determined from actual operating conditions. The licensee factored in actual voltage and frequency swings from the starting and tripping of large ECCS motors. As a result, the setpoints were set at a point that provided maximum sensitivity to bus conditions as well as reliable operation.

The inspector has no concerns regarding this item.

4) <u>Surveillance Testing</u>

The relays are calibrated by electrical control technicians (ECT). In the modification test, MP-89R070-4, the ECT was required to verify that the relays had been calibrated. The modification test then provided the test overlap into existing swing bus control circuitry and Surveillance Test No. 0036.

The surveillance procedure to test this logic has not been written. The completion of this procedure is being controlled within the modification package by Form 1-3045, "Procedures". This form will have to be dispositioned prior to closing the modification package. The inspector discussed what portions of the logic circuit will require surveillance testing with the licensee. The surveillance test will not only have to verify the proper operation of each bus degraded condition relay, but also include the EDG breaker closed permissive logic. The following devices will require future testing:

DEVICE	CONTACT
Breaker 152-502 control switch	6/6C
Breaker 152-502 auxiliary "a"	6/6T
Relay CA/152X-33	M2/T2
	M3/T3
Relay CD/152X-33	M3/T3
	M3/R3
Relay 62-33	M2/T2
Relay DA/94P-33	11/12
Relay CE/27-33 (Loss of Voltage)	1/5
Relay BB/59-33 (Overvoltage)	15/14
Relay BA/81-33 (Overfrequency)	12/11
(Underfrequency)	15/14
Relay AB/27-33A (1 second)	10/11
Relay AA/27-33B (9 seconds)	10/11

The licensee acknowledged what testing would have to be included in the new surveillance test.

Based on the above, the inspector has no concerns regarding this item.

6) Computer Alarm Response Procedures

The licensee has increased the capacity, capability, and availability (demonstrated to be greater than 99%) of the VAX (plant) computer. One of the computer's functions is to monitor alarm contacts. Alarm outputs are provided to a monitor screen located adjacent to the control room center desk and to an alarm printer. A single chime announces an incoming computer alarm.

The licensee has begun a program to develop computer alarm response procedures. This area is relatively new and is in its infancy. The following computer alarms have been added as a result of the LPCI modifications:

COMPUTER ID	DESCRIPTION
V4K321	Loss of 52-4300 close control power alarm.
V4K322	52-3300 position status.
V4K323	Loss of 52-3300 trip control power alarm.

The computer alarm response procedures for the above alarms have not been written. The completion of these procedures is being controlled within the modification package by Form 1-3045.

The inspector discussed with the licensee the alarming of one of the LPCI swing bus computer alarms and the affect on LPCI operability. The licensee indicated that a 7-day limiting condition for operation (LCO) would be entered. This places some importance on the timely acknowledgement of LCO type computer alarms. The licensee indicated that they would review the computer alarm process, and within the capability of the computer, a means to prioritize computer alarms.

Based on the above, the inspector has no concerns regarding this item.

f. Summary

The inspector determined the licensee had adequately designed, installed, tested and trained personnel on the two LPCI swing bus modifications. The safety evaluations were well written and provided the necessary information to determine that the modification did not create an unreviewed safety question. One outstanding feature of the modification process was the preoperational/operational tests. The tests were well written and completely tested all logic combinations of the installed components. In both tests, the hardware functioned as designed.

The completion of these modifications fully satisfies the licensee's commitment made in CAL-RIII-88028, Item (2), and this item is considered closed.

4. Exit Interview

The inspector met with licensee representatives (denoted in Paragraph 1) at the conclusion of the inspection on November 16, 1989, and summarized the scope and findings of the inspection. The inspector also discussed the likely informational content of the inspection report with regard to documents reviewed by the inspector during the inspection. The licensee did not identify any of the documents as proprietary.

INSPECTION REPORT NO.
263/89030
ENCLOSURE NO. 2

LPCI SWING BUS CONTROL POWER