

U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-263/83-23(DE)

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 and Minneapolis, MN

Inspection Conducted: August 11-12, 17-19, 25-26, and November 8-9, 1983

Inspectors: *J.F. Streeter*
J. F. Streeter
(August 17-19, 25-26, November 8-9, 1983) 12/30/83
Date

N.J. Chrissotimos
for N. J. Chrissotimos
(August 11-12, 1983) 12-30-83
Date

Other Accompanying NRC Personnel: R. Westberg
(August 17-19, 1983)

A. S. Gautam
(August 11-12, 17-19, 25-26, 1983)

R. Farrell
(August 17-19, 1983)

Approved By: *J.F. Streeter for*
R. L. Spessard, Director
Division of Engineering 12/30/83
Date

Inspection Summary

Inspection on August 11-12, 17-19, 25-26, and November 8-9, 1983 (Report No. 50-263/83-23(DE))

Areas Inspected: Special, announced inspection by region-based inspectors of an August 1, 1983, event involving the actuation of the degraded voltage protection relays on 4160 V Essential Bus 16. The inspection involved a total

of 175 inspector-hours onsite by 5 NRC inspectors including 0 inspector-hours onsite during off-shifts.

Results: One item of noncompliance was identified (failure to conduct all appropriate tests following installation of the degraded voltage protection relays - Paragraph 3.a.).

DETAILS

1. Persons Contacted

D. E. Gilberts, Senior Vice President Power Supply
C. E. Larson, Director Nuclear Generation
*L. R. Eliason, General Manager Nuclear Plants
*D. M. Musolf, Manager Nuclear Support Services
*W. A. Shamla, Plant Manager
*W. J. Hill, Superintendent Technical Engineering
*M. F. Hammer, Lead I&C Engineer
*L. E. Pudlick, Engineer
D. D. Antony, Superintendent of Operations
*D. E. Nevinski, Plant Superintendent Engineering and Radiation Protection
*R. A. Goranson, Lead Production Engineer
S. J. Kollman, Superintendent Electric Plant
D. W. Krech, Lead QA Engineer
D. J. Heltemes, Superintendent Operations Coordination
G. R. Smith, Production Engineer
G. T. Goering, General Superintendent Nuclear Technical Services
F. J. Plourde, Assistant Manager Transmission Planning
*B. D. Day, Superintendent Operations Engineering

*Denotes those present at the exit interview on November 9, 1983.

2. Background

On August 1, 1983, at approximately 0400 an event occurred involving the actuation of the degraded voltage protection relays on 4160 V Essential Bus 16. The actuation resulted, as designed, in the automatic transfer of Essential Bus 16 to its emergency diesel generator. Operators returned the bus to its normal power source (i.e., the auxiliary transformer powered from the output of the station generator) within about 30 minutes. The plant was operated at 100% power throughout the event.

The licensee reported the event via telephone to the NRC at 0435 in accordance with 10 CFR 50.72, and subsequently provided special written reports to NRR in letters dated September 9 and October 14, 1983, in accordance with Item 8 of the August 31, 1983, Confirmatory Action Letter from Region III to the licensee.

A joint Region III/NRR site review of the event was conducted August 11-12, 1983. That review resulted in the issuance of the initial Confirmatory Action Letter on this matter on August 15, 1983. The results of that review were documented in a Safety Evaluation and associated Technical Evaluation Report which were transmitted to the licensee in an NRR letter dated September 8, 1983.

Following the initial site review, additional Region III site and corporate office visits were made to review the matter on August 17-19, 25-26, and November 8-9, 1983. On August 26 a joint Region III/NRR site meeting was conducted with the licensee. The result of that meeting was the issuance on August 31 of a clarification of and supplement to the August 15 Confirmatory Action Letter. On September 13 a meeting was conducted between the licensee, NRR and Region III to discuss the event, status and results of licensee actions, and future licensee actions.

3. Applicable Analyses

a. Degraded Grid

As a result of a July 1976 event at Millstone 2, NRR requested in an August 13, 1976, generic letter that Northern States Power Company conduct a thorough evaluation of the issue (i.e., degraded grid voltage condition) as it affected Monticello. In a subsequent letter dated June 3, 1977, NRR required the licensee to install second level undervoltage protection devices. The licensee provided an analysis of the issue, installed the undervoltage devices, and submitted a Technical Specification change request regarding the setpoint and operability requirements for the new devices. The approved setpoint which was issued by NRR in Technical Specification Table 3.2.6 was $3885 \text{ V} \pm 18 \text{ V}$ with a 10 ± 1 second time delay.

The new devices were installed on 4160V Essential Buses 15 and 16 in 1978. The licensee measured the dropout value during the modification to assure it was $3885 \text{ V} \pm 18 \text{ V}$; however, the pickup value was not measured. Following the August 1 event, the licensee measured the pickup value and determined it to be about 100 volts greater than the dropout value. The licensee's failure to measure the pickup value during the modification was contrary to Criterion III of Appendix B, 10 CFR Part 50, as implemented by Section 13.2 of the licensee's Operational Quality Assurance Plan in effect at that time (Revision 3 dated June 20, 1978). This is considered to be an item of noncompliance (263/83-23-01).

The significance of the licensee's failure to measure the pickup value was demonstrated during the August 1 event. The 4160 V Essential Bus 16 voltage was initially between 3960 V and 3990 V and then dipped below 3885 V momentarily when #14 RHRSW pump was started. The degraded grid undervoltage relays dropped out but were not picked up after the voltage dip because the initial voltage was below the pickup value. Therefore, after a time delay of 10 seconds the Essential Bus 16 supply was transferred to its emergency diesel generator. The bus was initially on its normal source (i.e., the auxiliary transformer powered from the output of the station generator) and the emergency diesel generator was challenged without the preferred power source first being checked by the transfer logic. This is in accordance with design intent but appears to be a deficiency in the transfer logic since it increases the susceptibility of the plant to spurious separations from the offsite (preferred) power

sources. The transfer logic design was based on the assumption that all offsite sources are degraded upon actuation of the degraded voltage protection relays. NRR will review this design during its review of the licensee's reanalysis of the adequacy of the station electric distribution system which will be submitted by the licensee to NRR by December 31 in accordance with Item 9 of the August 31 Confirmatory Action Letter.

b. Distribution System

As a result of a September 1978 event at Arkansas Nuclear One, NRR requested in a August 8, 1979, generic letter that Northern States Power Company conduct a thorough analysis of the adequacy of the onsite distribution of power from the offsite power circuits. The licensee conducted an analysis which was reviewed by a contractor for the NRC. The results of the NRC contractor review were the subject of a Technical Evaluation Report (TER) which was endorsed by NRR in a Safety Evaluation (SE). The TER and SE found the licensee's analysis and corrective actions acceptable, and the TER and SE were transmitted to the licensee by an NRR letter dated May 28, 1982.

The licensee's analysis assumed a set of what the licensee thought to be the most pessimistic conditions that would be encountered with a heavily loaded grid. Those assumptions yielded pre-trip values of 119.7 KV and 350.8 KV on the 115 KV and 345 KV Substations respectively. The analysis indicated that the Substation voltages would dip to 119 KV and 350 KV following a Monticello trip. These values in turn yielded a minimum 4160 V bus voltage of about 4025 V under the most demanding loading conditions.

At the time of the August 1 event, the grid was in a lightly loaded condition with the station generator operating at a reduced terminal voltage to aid in keeping the grid voltage down. The result was a 345 Substation voltage of about 345 KV and a 4160 V Essential Bus 16 voltage of between 3960 V and 3990 V. Since the 115 KV bus voltage is controlled by an autotransformer, the 115 KV Substation voltage remained close to 120 KV. Most, if not all of the conditions assumed in the licensee's heavily loaded grid analysis did not exist on August 1.

The August 1 event revealed that the licensee's reanalysis of the adequacy of the station electric distribution system should consider (1) lightly as well as heavily loaded grid conditions, (2) operation on the No. 11 Unit Auxiliary Transformer, and (3) the transfer sequence from No. 11 Unit Auxiliary Transformer to the offsite power sources following a loss of coolant accident. These matters will be considered by NRR during its review of the licensee's reanalysis due December 31. In the interim, licensee analyses indicate that the present bus voltage controls (refer to Paragraph 5) assure acceptable voltage levels (refer to Paragraph 3.c.), under worst case conditions

and station auxiliary loads are being powered from the preferred power source rather than No. 11 Transformer. These actions are in accordance with Items 3 and 5 of the Confirmatory Action Letters.

c. Minimum Acceptable 4160V Bus Voltage

In accordance with Item 1 of the August 15 Confirmatory Action Letter, the licensee conducted an analysis to determine the minimum acceptable operating voltages on the 4160V essential buses. The licensee concluded in a August 24 letter responding to Item 1 that 4080 V was the minimum acceptable value. The licensee concluded that Substation voltages above 117.4 KV and 340.5 KV are acceptable and that procedural action levels of 118.5 KV and 345 KV on the 115 KV and 345 KV Substations assure the capability to yield at least 4080 V on the 4160 V buses.

d. Reanalysis of Distribution System

As mentioned above in Paragraph 3.a, the licensee has agreed to submit to NRR by December 31 a complete reanalysis of the adequacy of the station electric distribution system. In the interim, the analysis described in Paragraph 3.c above is the governing analysis for proper bus voltages.

4. Assumption in Analyses Submitted to the NRC

The inspectors discussed with licensee representatives at the corporate office and plant the general area of how the licensee views assumptions in analyses submitted to the NRC. The licensee representatives stated that they do not view assumptions in such analyses to be operational constraints unless the assumptions are clearly identified as operating limits in technical specifications or other correspondence with the NRC.

This licensee philosophy was applied to the pre-trip 115 KV and 345 KV Substation voltages (119.7 KV and 350.8 KV respectively) assumed in the licensee's January 30, 1981, analysis of the adequacy of the station electrical distribution system. The 119.7 KV and 350.8 KV values were not incorporated into the technical specifications or other license condition or explicitly identified by the licensee or NRC as operating limits. The values were not specifically addressed in the text of the Updated Safety Analysis Report (USAR) although the licensee's analysis was incorporated in the USAR as Reference 9 on Pages 8.11-1.

Since the licensee did not consider those assumptions as limits, the licensee did not develop operational controls to assure grid conditions satisfied those assumptions. Consequently, there were occasions when the 345 KV system was operated at levels less than 350.8 KV. This occurred in most cases when the station generator was operated at reduced voltages when low system load conditions caused high 345 KV voltage conditions. During such periods, the reduced station generator voltages caused the 345 KV Substation voltage to drop to as low as 342 KV. The level that

existed at the time of the August 1 event was 345 KV while the generator voltage was at 20.94 KV. Since the licensee did not consider the assumptions as limits, the licensee did not invoke the provisions of 50.59 and prepare a safety evaluation prior to operating at levels below the assumed values.

The licensee's practice of not treating analytical assumptions as operational constraints and not applying the requirements of 50.59 to operations outside those assumptions is under NRC review. This matter is considered an Unresolved Item (263/83-23-02) pending completion of the NRC review.

5. Bus Voltage Controls

The inspector reviewed bus voltage controls that existed prior and subsequent to August 1. Prior to August 1 there were no limits imposed on bus voltages for the reasons explained in Paragraph 4 above. There was a 3900 V minimum value added to the log sheet in 1982 in response to a general INPO comment regarding the practice of having minimum and maximum expected values on log sheets. The licensee stated that the plant staff had been made aware of the 3885 V setpoint of the degraded voltage protection relays through training sessions following the 1978 relay installation. There was a limit imposed on generator output voltage of 22 KV \pm 5% which translated into a minimum 4160 V essential bus voltage of approximately 3900 V. There were alarms as follows:

<u>Parameter</u>	<u>Low Alarm</u>	<u>High Alarm</u>	<u>Alarm Location</u>
Generator Output Voltage	20.9 KV	23.1 KV	Control Room
4160 V Busses 1 through 16	3800 V	4550 V	Control Room
345 KV Substation	345 KV	351 KV	Control Room
345 KV System	345 KV	354 KV	Dispatcher Center
115 KV System	115 KV	124 KV	Dispatcher Center

Prior to August 1 the System Dispatcher had a written procedure for reducing the 345 KV system voltage. There was no written procedure for raising the system voltage. Presumably, the System Dispatcher used his knowledge of the grid and determined corrective actions on a case-by-case basis.

Subsequent to the August 1 event, the following actions were taken related to bus voltage controls:

- . Volume F Temporary Memo No. 619 was issued and was subsequently superseded by No. 620 on September 9 which placed operating limits on the station auxiliary system.
- . Control Room computer alarms were revised as follows:

<u>Parameter</u>	<u>Low Alarms</u>	<u>High Alarms</u>
Generator Output Voltage	21.6 KV	23.0 KV
4160 V Busses 15 and 16	4090 V	4400 V
345 KV Substation	345 KV	354 KV
115 KV Substation	118.5 KV	122 KV
1 AR Transformer Secondary	4110 V	4400 V

- . Control Room log sheet was revised to indicate a minimum expected voltage on 4160 V Busses 15 and 16 of 4090 V and a maximum expected value of 4400.
- . System Dispatcher 115 KV system low and high alarms were revised to 118.5 KV and 122 KV.
- . System Dispatcher procedure was implemented for raising low 345 KV system voltage.

The inspector toured the Control Room and observed bus voltage instrumentation, confirmed the computer alarm settings, and verified that the operator on shift was cognizant of bus voltage controls. The inspector concluded that the licensee had developed and implemented appropriate administrative controls to assure that the 345 KV and 115 KV switchyard voltages remain above the minimum values necessary to assure their associated minimum operating voltages on the 4160 V essential busses.

6. SALP Concerns

At the time the SALP 4 report was generated, preliminary findings from this inspection indicated some potential problems in the areas of design changes, implementing procedures to assure operations within the bounding assumptions of safety analyses, and communications with the NRC. Following are summaries of these matters:

- a. Design Changes - As described in Paragraph 3.a above the licensee failed to measure the pickup value of the degraded voltage protection relays installed in a 1978 design change. The licensee's response to this violation will address the adequacy of the design change process.
- b. Implementing procedures to assure operations within the bounding assumptions of safety analyses - As described in Paragraph 4 above, the lack of implementing procedures for bus voltage controls stemmed from the licensee's practice of not treating analytical assumptions as operational constraints. This practice is under NRC review.
- c. Communications with the NRC - The inspection did not reveal communications problems between the NRC and the licensee. Additionally, the inspection results did not indicate that the potential problems with the reset span for the Monticello degraded voltage protection relays should have been identified by better communications between the staffs of Monticello and Prairie Island.

7. NRR Safety Evaluation

The NRR Safety Evaluation concerning the August 1 event concluded that the cause of the event was plant operation at a voltage below that analyzed in the licensee's January 30, 1981, analysis submitted to and approved by the NRC. NRR also concluded that this operation, in turn, was caused by inadequate communication between the licensee's corporate-level licensing staff and the plant operating staff. The inspection confirmed that the plant was being operated at the time of the event with a 345 KV grid voltage of about 345 KV which is less than the 350.8 KV pre-trip value assumed in the licensee's analysis. The inspector concluded that if the station generator had been operated at the output voltage needed to keep the 345 KV Substation at or above 350.8 KV the event would not have occurred even with station auxiliaries on the No. 11 Transformer. However, the inspector determined the root cause to be corporate and plant personnel having the view that the 350.8 KV value was not an operational constraint rather than inadequate communications between the corporate and plant staff.

NRR concluded that plant operation at voltages below those assumed in the licensee's January 30, 1981, may have rendered the offsite power system incapable of performing its safety function. A licensee analysis submitted to NRR for review on August 24, 1983, indicates that the offsite power system was capable of performing its safety function at the voltage levels that existed on August 1. This and other questions raised in the Safety Evaluation will be resolved during the NRR review of the submittals required by the August 15 and 31 Confirmatory Action Letters.

Licensee responses to certain conclusions reached in the Safety Evaluation are contained in a November 15, 1983, licensee letter to NRR.

8. Summary of Conclusions

- a. The licensee's practice of not treating assumptions made in analyses submitted to the NRC as operational constraints and of not applying the requirements of 50.59 to operations outside those assumptions may be contrary to NRC requirements. This matter is under NRC review. (Reference Paragraph 4)
- b. The licensee failed to measure the pickup value of the degraded grid voltage protection relays installed in a 1978 design change which is contrary to Appendix B, Criterion III. (Reference Paragraph 3.a)
- c. The cause of the event was operation of the station generator at reduced output voltages for system voltage control such that the 345 KV Substation voltage was less than the 350.8 KV value assumed in the licensee's January 30, 1982, analysis. (Reference Paragraph 7)
- d. There was no evidence of inadequate communication between the corporate and plant staffs. (Reference Paragraph 7)

- e. There was no evidence that the potential problems with the reset span of the Monticello degraded grid voltage protection relays should have been identified by better communications between the staffs of Monticello and Prairie Island. (Reference 6.c)
- f. The licensee has developed and implemented appropriate administrative controls to assure that the 345 KV and 115 KV switchyard voltages remain above the minimum values necessary to assure their associated minimum operating voltages on the 4160 V essential busses. (Reference Paragraph 5)
- g. The licensee's reanalysis of the adequacy of the station electric distribution system should consider: (1) lightly as well as heavily loaded grid conditions, (2) operation on the No. 11 Unit Auxiliary Transformer, and (3) the transfer sequence from No. 11 Unit Auxiliary Transformer to the offsite power sources following a loss of coolant accident. (Reference Paragraph 3.b)
- h. The transfer logic design that was based on the assumption that all offsite sources are degraded upon actuation of the degraded voltage protection relays increases the susceptibility of the plant to spurious separations from the offsite power sources. (Reference Paragraph 3.a)

9. Unresolved Items

Unresolved items are items about which more information is required in order to ascertain whether they are acceptable items, items of noncompliance, or deviations. An unresolved item disclosed during this inspection is discussed in Paragraph 4.

10. Exit Interview

The inspector met with licensee representatives (denoted in Paragraph 1) at the conclusion of the inspection. The inspector summarized the scope and findings of the inspection.