U.S. NUCLEAR REGULATORY COMMISSION

REGION III

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Report Nos:	50-282/97022(DRS); 50-306/97022(DRS)
Licensee:	Northern States Power Company
Facility:	Prairie Island Nuclear Generating Plant
Location:	1717 Wakonade Dr. East Welch, MN 55089
Dates:	October 28-31, 1997
Inspector:	R. Glinski, Radiation Specialist
Approved by:	G. Shear, Chief, Plant Support Branch 2 Division of Reactor Safety

EXECUTIVE SUMMARY

Prairie Island Nuclear Generating Plant
NRC Inspection Reports 50-282/97022; 50-306/97022

This announced inspection included a review of the licensee's plant support performance regarding the refueling outage, surveys to unconditionally release turbine components, shut down chemistry and crud burst, ALARA planning and implementation, and radiation worker practices. Overall, activities within the areas examined were well conducted and radiation protection support for the outage was effective. However, one instance of poor radiation worker practice was identified.

- The licensee's ALARA reviews and RWP/job planning identified and addressed radiological conditions for various outage tasks. The pre-job briefings were thorough and ALARA measures were effectively implemented. The continued development of dose reduction initiatives indicated a strong ALARA commitment (Section R1.1).

- The radiation protection staff exercised effective control of work practices and radiological conditions within the plant. Monitoring and control of contamination was successful as evidenced by the low number of personnel contaminations. Although there were some minor housekeeping issues identified during the inspection, the outage activities were conducted with a good ALARA focus (Section R1.2).

- The chemistry staff successfully conducted chemical additions during reactor shutdown which resulted in a reduction of the source term. Hideout return results were very low, confirming excellent water quality chemistry and indicating that fouling of the steam generators was not significant (Section R1.3).

- In general, radworker practices were appropriate. However, one Non-Cited Violation was identified due to an experienced radworker's display of a lack of respect for radiological boundaries and postings (Section R4.1).

- Surveys conducted for the free release of turbine components were extensive and the storage of conditionally released components was adequate to prevent the spread of potential contamination (Section R4.2).

Report Details

IV. Plant Support

R1 Status of Radiation Protection and Chemistry (RP&C) Controls

R1.1 ALARA Reviews and Implementation for the Unit 1 Refuel Outage

a. Inspection Scope (IP 83729)

The inspector reviewed procedures and several ALARA reviews, interviewed RP supervision regarding ALARA planning for the outage, attended a pre-job briefing, and observed the implementation of ALARA measures throughout containment.

b. Observations and Findings

The inspector noted that ALARA reviews for specific tasks were conducted by a Radiation Protection (RP) Supervisor prior to the development of the work packages and radiation work permits (RWPs). The ALARA reviews consisted of the following: (1) review of historical data for airborne radioactivity, contamination levels, dose rates, and lessons learned, (2) pre-job briefing material for radiological conditions and RP coverage, (3) dose reduction measures and engineering controls, (4) dosimetry requirements and hold points, and (5) low dose waiting areas. The inspector noted that the ALARA reviews were conducted in accordance with station procedure.

The inspector attended the pre-job briefing for the reactor head lift and ultrasonic testing jobs. Attendance at this briefing was mandatory for all personnel involved in these tasks. The pre-job briefing was well done and consisted of a detailed review of the head lift/removal and testing procedures, the requirement to close the air lock, radiological conditions, various ALARA measures, RP coverage, safety precautions, and RWP dosimetry requirements. The staff were allowed time for questions.

The inspector observed the reactor head lift and ultrasonic testing activities and verified that radiological controls such as high efficiency particulate air (HEPA) filters, multiple badging, remote dose monitoring, dust masks, and low dose areas were utilized by outage personnel. Plant personnel also utilized headsets to establish effective communication between the RP staff on the upper level with the staff in the reactor cavity. The dose rates near the stud holes and in the waiting areas were less than half of the expected values and the ultrasonic testing staff worked efficiently to accomplish their work quickly. As a result, this work expended just over 40% of the estimated dose for these activities.

The inspector observed the effective use of temporary shielding throughout the containment. In particular, lead blankets installed on safety injection piping and between the #11 steam generator (SG) and the #11 reactor coolant pump (RCP) reduced area dose rates by one-third. The dose expenditure for the RCP work was approximately 90% of the original estimate.

As a further ALARA measure to reduce outage dose, plant personnel conducted increased pipe flushing of the regenerative heat exchanger subsequent to the crud burst to reduce dose rates in the regenerative heat exchanger room. In addition, over 325 pounds of temporary lead shielding was installed in this room. These ALARA actions reduced the regenerative heat exchanger general area dose rates from 150-200 millirem per hour (mrem/h) to approximately 80-90 mrem/h. As additional ALARA measures, the letdown orifice isolation valve was repacked outside the room and the valve bonnet was machined to increase the run life to 10 years. The collective dose expended for this work was less than 40% of the dose for similar work in 1994.

Another area with significantly reduced dose rates was the steam generators. Surveys indicated that dose rates for the channelheads, tubesheets, and secondary handholes were 40-60% lower than for previous outages. Although the reason for the lower dose rates was not fully understood, these lower dose rates coupled with efficient work practices enabled the licensee to accomplish the SG activities with a significant dose savings.

Although the RP staff effectively estimated and controlled the radiation dose for various outage activities, there were outage jobs which exceeded the RP estimates. The reactor head view port installation expended more than three times the dose estimate primarily due to a significant time underestimate for the unbolting of the three lower sections. However, the installation of the view port will preclude the need to remove the shroud for inspections during future outages. The incore thimble tube cleaning and the upper internals lifting rig sandblasting jobs exceeded the dose estimates due to the increased number of workers used to accomplish these tasks. There were no indications of significant dose from rework, miscommunication, or job mismanagement.

The licensee has historically conducted its outages with effective ALARA controls, and the RP staff has developed ALARA initiatives for future outages. The ALARA initiatives for the future include: (1) cleaning the reactor head studs outside containment and (2) the installation of a ring around the reactor head to facilitate hanging lead blankets which would cover the control rod drive columns, thereby reducing general area dose rates.

c. Conclusions

The inspector determined that the licensee's ALARA reviews and RWP/job planning identified and effectively addressed radiological conditions for various outage tasks. The inspector noted that ALARA pre-job briefings were thorough and that ALARA measures were effectively implemented by station staff. Continued focus on further dose reduction initiatives indicated a strong ALARA commitment.

R1.2 Observation of Contamination and Airborne Radioactivity Controls, Radiological Postings, and Housekeeping in the Containment and Auxiliary Buildings

a. Inspection Scope (IP 83750)

The inspector conducted walkdowns and observed various outage activities in the containment and auxiliary buildings. In addition, the inspector interviewed RP staff regarding control of radiological conditions and also reviewed radiological survey, personnel contamination, and whole body count data.

b. Observations and Findings

Postings and survey maps appropriately reflected current plant conditions, and the inspector noted that the RP staff conducted timely surveys in response to changing plant conditions. In general, housekeeping was very good and no radiological impediments to work activities were observed. However, several contaminated areas in the auxiliary building contained tools and protective clothing which should have been properly stored in containers. The inspector noted that personnel dosimetry was worn as prescribed, survey meters and air samplers were within calibration, and temporary plastic tents were erected to control the spread of contamination from work on the highly contaminated SG areas and components.

Contamination controls were effective, as potentially contaminated items were either within the designated areas or were bagged and labeled appropriately. However, the inspector noted that some of the plastic bags which contained the SG lead doors were torn. Plant staff promptly double bagged these components. Personnel contamination data indicated that the licensee was well below the outage goal and that the contaminations generally involved low levels of radioactivity. Skin dose assessments were conducted for several workers and only one incident exceeded the 100 millirem dose threshold for a skin dose assignment.

Monitoring for airborne radioactivity was extensive, as air samplers were located throughout containment in close proximity to work areas. The data for a variety of jobs demonstrated that airborne radioactivity was detected only for the internals lifting rig sandlasting and steam generator work with levels that were less than eight derived air concentrations (DACs) and less than two DACs, respectively. The lifting rig sandblasting was conducted within a temporary tent and the workers wore full-face respirators. There were positive nasal smears and minor intakes from other work, but none of the dose assessments exceeded the 25 mrem threshold for dose assignment. The inspector reviewed this data and determined that the dose assessments used appropriate methodology.

RP coverage for specific jobs and routine rounds was evident. The inspector observed that RP Specialists (RPS) at the Radiologically Controlled Area (RCA) access, the containment access, and steam generator control point adequately briefed workers and exercised appropriate control of various tasks.

c. Conclusions

Overall, the RP staff exercised effective control of work practices and radiological conditions within the plant. Monitoring and control of contamination was successful as evidenced by the low number of personnel contaminations and the low levels of contamination detected. Although there were some minor housekeeping issues, the inspector noted that outage activities were conducted with a good ALARA focus.

R1.3 Reactor Coolant System (RCS) Shutdown Chemistry Controls and Steam Generator Hideout Return Results

a. Inspection Scope (IP 83750)

The inspector reviewed the RCS shutdown chemistry controls and hideout return data, and interviewed chemistry supervision regarding the results.

b. Observations and Findings

During the shutdown for this refueling outage, plant personnel performed an early boration with 800 parts per million (ppm) boron at 400 degrees, followed by a hydrogen peroxide (H_2O_2) addition to the RCS. The early boration, conducted in the presence of about 5 ppm hydrogen, created an acid-reducing condition which aided in removing iron from the primary system. Then, through the addition of H_2O_2, an acid-oxidizing condition was established which facilitated a large release of nickel and other corrosion products (crud burst) from the fuel bundles that was subsequently removed from the RCS by the purification system.

During this Unit 1 outage, the time period for the acid reduction phase was slightly extended over the previous outage. For the acid-oxidizing phase, plant staff conducted three separate additions of H_2O_2 to maintain the oxygen levels between 2000-4000 parts per billion. An RCS pump was operated for 4 hours after the initial peroxide addition, rather than only one half hour as in previous outages, to facilitate a thorough mixing of the RCS. The RP&C staff monitored the radiochemistry data, which indicated that these shutdown controls achieved a crud burst of greater than 150 curies, which was comparable to the previous outage. The primary constituent of the crud burst was cobalt-58, but significant amounts of cobalt-60, copper-64, and antimony-122 were also removed from the RCS by this activity.

Hideout return data was 10-20 times lower than the previous Unit 1 outage, which was consistent with the extremely low levels of ionic contamination levels detected in the primary coolant during operation. All cation and anion returns were well below the previous cycle, but the silica return was slightly elevated. Plant personnel indicated that the low level of hideout return was indicative of insignificant fouling of the SGs. The inspector determined that the chemistry staff used appropriate methodology for these activities.

c. Conclusions

The inspector determined that the licensee had effectively implemented chemical additions during reactor shutdown which resulted in an overall reduction of the source term. In addition, hideout return data confirmed excellent water quality and indicated the SG fouling was not significant.

R4 Staff Knowledge and Performance in RP&C

R4.1 Failure of a Radworker to Read and Comply with Radiological Postings

a. Inspection Scope (IP 83750)

The inspector interviewed RP supervision, an Instrument and Control technician (I&C tech), and an RPS. In addition, the inspector reviewed applicable procedures, the RWP, and the RP&C management response to this example of poor radworker performance.

b. Observations and Findings

In general, the inspector observed that radworker practice was good, that dosimetry was properly worn, boundaries were appropriately maintained, and workers conducted adequate contamination frisks after exiting containment. However, an RPS on rounds identified that an I&C tech who was checking differential pressure (DP) switches on the gap cooling system crossed a high radiation boundary in the "C" sump area of the containment basement without a dose rate meter or knowledge of the radiological conditions. The I&C tech stated that he did not read the posting because he assumed that it was the same, as he had seen in this area previously, which was "No Loitering" on a magenta and yellow rope. However, after the incore thimbles were pulled, the area was re-surveyed and the posting was changed to read, "Caution High Radiation Area - Dose Rate Meter Required". The RPS conducted a radiation survey of this area for the I&C tech, which demonstrated that the dose rates were 100 millirem per hour (mrem/h) at the DP switch and 50 mrem/h at arms length.

The I&C tech completed this DP switch check and told the RPS that he needed to check another DP switch which was located in the #11 SG vault. The RPS informed the I&C tech of the radiological conditions in the SG vault and assumed the individual would enter the SG vault from above the refuel floor. However, the I&C tech entered the #11 SG vault from the access ladder in the basement. This entry to the SG vault required that the individual pass through a barrier which was posted "High Contamination Area - Contact HP Prior to Entry". Again, the I&C tech did not read the posting, but he had spoken to the RPS and assumed that he had the proper approval. The individual donned extra booties and gloves. The I&C tech then walked through a highly contaminated area (HCA), exited the HCA through a slit in a plastic barrier erected to mitigate the spread of contamination, checked the DP switch, and then re-entered and returned through the HCA all the way to the basement before removing the extra protective clothing. The RP staff was concerned that this inappropriate practice may have spread contamination. However, radiological surveys showed that this action did not spread contamination. The RPSs monitoring the SG eddy current testing observed this individual on the SG cameras and called containment access to inquire as to who had been given authorization to enter the SG vault. The containment access RPSs indicated that they were unaware that anyone other than the eddy current testing staff would be in the SG vaults. This I&C tech was later questioned about his activities in the SG high contamination area and he confirmed that he had been in the SG vault.

The RP&C staff initiated an Employee Observation Report to document the fact that this individual crossed two separate RP boundaries without reading the postings and/or complying with the posted instructions. The entry into the high radiation area (HRA)

was a violation of General RWP Requirements #6 and #7 which require that staff be knowledgeable of dose rates, and that staff observe special requirements for high radiation area entry and use dose rate meters, respectively. In addition, Section F-2 of the Operations Manual requires that plant personnel observe and understand radiological postings, and RP procedure #1120 states, in part, that entries into HRAs with an alarming dosimeter, "**SHALL BE MADE AFTER** the dose rate levels have been established and personnel are aware of them". Therefore, this occurrence was a procedural violation.

In response to this procedural violation, the licensee took the following corrective actions;

- the I&C tech was counseled about following RP procedures,
- the plant manager counselled plant supervisors on the expectations for both accountability and adherence to work standards,
- RP&C changed the policy for posting no loitering areas to use only stanchions, wall signs or mobiles, and yellow/magenta rope will no longer be used,
- the plant manager wrote a letter which reminded plant personnel of the expectations that all staff comply with RP rules - this letter was posted throughout the plant,
- a camera was installed at the personnel airlock to aid communication with staff who enter through this path,
- an alternate entryway to the #11 SG platform was installed from the platform which is below the RCP - this entryway does not require staff to cross an RP boundary,
- RP&C staff will consider better shielding around the "C" sump to eliminate this and other HRAs, and
- this occurrence will be routed to all supervisors and be incorporated into the General Employee Training to stress adherence to RP rules.

This non-repetitive, licensee-identified and corrected violation is being treated as a Non-Cited Violation, consistent with Section VII.B.1 of the NRC Enforcement Policy (NCV 50-282/97022-01; 50-306/97022-01). However, the NRC is concerned that an experienced radworker who was involved in containment activities did not read radiological postings for high radiation and high contamination areas, which indicated a lack of respect for radiological boundaries and postings which were established in accordance with 10 CFR Part 20 and standard RP practice to mitigate undue radiation exposure to radworkers.

c. Conclusions

Overall, the inspector observed that radworker practices were appropriate. However, a Non-Cited Violation was identified due to an individual who crossed two RP boundaries without reading or complying with the postings. This action displayed a lack of respect

for radiological controls established in accordance with 10 CFR Part 20 and standard RP practice to protect workers from undue radiation exposure.

R4.2 Radiological Surveys for the Free Release of Turbine Components

a. Inspection Scope (IP 83750)

The inspector reviewed the free release survey procedure and interviewed RP&C staff involved in the surveys performed to release the turbine components. The inspector also walked down the storage areas outside the RCA which contained the released and conditionally released turbine components.

b. Observations and Findings

Interviews with contract RPSs responsible for this work indicated that these individuals had ample experience with free release surveys at other facilities. The RP staff had written a specific procedure to govern this process, RPIP 1321 "Unconditional Release of Turbine Components", which was based on discussions with other nuclear facilities which had detected turbine contamination. This procedure required a 100% survey of the areas most likely to be contaminated, such as the last row of turbine blades, the gland seal area, and the stationary cylinder thermal shield; and a 10% survey of the remaining areas. The RPSs indicated that the available time allowed them to conduct 100% surveys of most turbine components. These surveys consisted of smears, mass checks, and frisks; and also utilized a microrem meter designed to detect low levels of radiation. Survey data demonstrated that no contamination was detected on any of the turbine components.

The inspector noted that there were large turbine components which had been conditionally released after cursory surveys and these were stored on railcars or flat beds outside the RCA until further surveys could be completed. The inspector walked down these stored components and determined that the material used to wrap these components was of sufficient strength to remain intact and prohibit the spread of any potential contamination. The RP&C staff planned to survey these components after the outage.

c. Conclusions

Surveys conducted for the free release of turbine components were extensive and were accomplished by experienced staff. Storage of conditionally released components was adequate to prevent the spread of contamination.

X1 Exit Meeting Summary

The inspector presented the inspection results to members of licensee management on October 31, 1997. The licensee did not indicate that any materials examined during the inspection should be considered proprietary.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

A. Johnson, Radiation Protection Supervisor
S. Lappegaard, Radiochemistry Supervisor
D. Larimer, Radiochemistry Supervisor
G. Malinowski, Radiation Protection Supervisor
D. Shulke, General Superintendent of Radiation Protection and Chemistry
J. Sorensen, Plant Manager
P. Wildenborg, Health Physicist

NRC

P. Krohn, Resident Inspector, Prairie Island
S. Ray, Senior Resident Inspector, Prairie Island
S. Thomas, Resident Inspector, Prairie Island

INSPECTION PROCEDURES USED

IP 83750, "Occupational Exposure"
IP 83729, "Occupational Exposure During Extended Outages"

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

50-282/97022-01	NCV	Failure of an experienced radworker to read and comply with radiological postings
50-306/97022-01		

Closed

50-282/97022-01	NCV	Failure of an experienced radworker to read and comply with radiological postings
50-306/97022-01		

LISTING OF DOCUMENTS REVIEWED

Inspect SI-7-2 ALARA Review, Radiation Work Permit (RWP) #131

Replace Charging Pump Discharge Check Valves ALARA Review, RWP #116

Steam Generator Primary Manways/Diaphragms/Nozzle Dams/ECT/Plug Pulling/Tube Sleeving, ALARA Review, RWPs #1020, 1022, 1024, 1025

Repack Letdown Orifice Isolation Valves ALARA Review, RWP #111

Internals Lifting Rig Paint, ALARA Review, RWPs #1102

Reactor Coolant Pump Motor Preventative Maintenance ALARA Review, RWP #1101

Re-Torque RCP Main Flange Bolts ALARA Review, RWP #1100

Remove Irradiated Incore Detectors ALARA Review, RWP #1091

SI-9-4 Repair ALARA Review, RWP #1058

Sump C Entries with Stuck Incore Detector ALARA Review, RWP #1046

Repack MV-32078 ALARA Review, RWP #133

Steam Generator Secondary Side Inspection ALARA Review, RWP #1079

Reactor Vessel Weld #1 UT and Ligament UT Inspection ALARA Review, RWP #1099

Prairie Island Radiation Protection Implementing Procedure (RPIP) 1134, Revision 3, "RWP Compliance Check"

Prairie Island RPIP 1120, Revision 12, "Posting of Restricted Areas"

Prairie Island RPIP 1160, Revision 3, "ALARA Reviews"

Prairie Island RPIP 1170, Revision 7, "Incore Detector and Seal Table Work"

Prairie Island RPIP 1321, Revision 0, "Unconditional Release of Turbine Components"

Administrative Work Instruction 5AWI 3.15.2, Rev. 6, "Employee Observation Reporting"

Radiation Work Permit No. 1006, Rev. 1, "I+C Calibration/SP's and Routine Maintenance"

LIST OF ACRONYMS USED

ALARA	As Low As is Reasonably Achievable
DAC	Derived Air Concentration
DP	Differential Pressure
HCA	High Contamination Area
HEPA	High Efficiency Particulate Air
HRA	High Radiation Area
I+C tech	Instrument and Controls Technician
NCV	Non-Cited Violation
ppm	parts per million
RCA	Radiologically Controlled Area
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RP	Radiation Protection
RP&C	Radiation Protection and Chemistry
RPS	Radiation Protection Specialist
RWP	Radiation Work Permit
SG	Steam Generator