U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 50-220/87-08

Docket No. 50-220

License No. DPR-63 Priority - Category C

Licensee: Niagara Mohawk Power Corporation
300 Erie Boulevard West
Syracuse, New York 13202

Facility Name: Nine Mile Point - Unit 1

Inspection At: Scribe, New York

Inspection Conducted: May 26-27, 1987

Inspectors: H. J. Bicehouse 6/15/87
H. J. Bicehouse, Radiation Specialist date

Approved by: H. Gilbertsen for 6-15-87
W. J. Pasciak, Chief date
Effluents Radiation Protection Section

Inspection Summary: Inspection on May 26-27, 1987 (Report No. 50-220/87-08)

Areas Inspected: A special, unannounced review of the circumstances surrounding high radiation levels on licensee's Shipment No. 1 WS-0697 noted at the Brunswick Steam Electric Plant on May 16, 1987 upon arrival of the shipment.

Results: Apparent violations of 10 CFR 71.5 including surface radiation levels exceeding 49 CFR 173.44(a) requirements (Detail 4), failure to meet packaging requirements under 49 CFR 173.412 and 173.465 (Detail 5) and failure to include Iron-55 activities in the shipping records under 49 CFR 172.203(d)(i) and (d)(iii) and 49 CFR 172.204(a)(1) (Detail 6).

DETAILS

1. Persons Contacted

1.1 Licensee Personnel

*J. Blasiak, Chemistry Supervisor - Unit 1
*W. J. Connolly, Quality Assurance Program Manager - Unit 1
*J. N. Duell, Chemistry Supervisor
*E. W. Leach, Radiation Protection Manager
*M. J. Masuicca, Assistant to Operations Superintendent
*T. J. Perkins, General Superintendent
*T. W. Roman, Station Superintendent
N. Spagnoletti, Manager, Corporate Health Physics
*C. L. Stuart, Superintendent, Chemistry & Radiation Management
*P. Volza, Supervisor, Radiation Protection

Other licensee personnel were also contacted or interviewed during the inspection.

1.2 NRC Personnel

*W. A. Cook, Senior Resident Inspector
*C. S. Marschall, Resident Inspector
W. L. Schmidt, Resident Inspector

*attended the exit interview on May 27, 1987

2. Scope

On May 16, 1987, a receipt inspection of two radioactive materials shipping packages sent by the licensee to the Brunswick Steam Electric Plant (Brunswick) showed external radiation levels of 1500 and 1800 millirem per hour (mrem/hr) on contact on the undersides of the two packages. This special reactive inspection reviewed the circumstances associated with those packages to determine the apparent causes of the radiation levels noted at Brunswick and compliance with NRC requirements in 10 CFR Parts 20 and 71, U.S. Department of Transportation (DOT) in 49 CFR Parts 170-189 and the licensee's Technical Specifications. Actions taken by the licensee in response to the violation noted during NRC Inspection No. 50-220/86-15 were also reviewed.

3. Summary of Events

On April 1, 1987, the licensee received a shipment from the Quad-Cities Nuclear Power Station (Cordova, Illinois) consisting of two packages containing a shearing machine, hydraulic equipment/hoses to operate the shearing machine and a support platform to be used in the operation of the equipment. This vendor-owned equipment was designed to shear highly radioactive stellite rollers and pins from Boiling Water Reactor (BWR) Control Rod Blades to allow subsequent disposal of the less radioactive portions of the Control Rod Blades as low-level radioactive waste. The licensee conducted a receipt inspection of the two packages under licensee's Procedure No. S-RP-4, "Picking Up, Receiving And Opening Packages Containing Radioactive Materials," Revision 2 (October 4, 1985). The receipt inspection showed that the packages were carried in a closed trailer as an "Exclusive Use" shipment. No external contamination was found on the packages and a radiation survey of the truck and the packages indicated the following:

Location	Radiation Level (mrem/hr)
Truck Cab	<0.5
2 meters external to Trailer Truck	≤5
Contact Trailer	≤30
Contact packages	≤110

The radioactive shipping record (RSR) accompanying the shipment indicated that the packages contained equipment contaminated with metal oxides of low-specific activity (LSA) with cobalt-60 as the only listed radionuclide. The licensee accepted the shipment and the packages were off-loaded and transported to the licensee's Unit-1 Refueling Floor.

The licensee opened the shipping packages, assembled the work platform, lowered it into the fuel pool and secured it to the fuel pool wall. The shearing machine and hydraulic equipment were assembled, tested for operation and lowered into the fuel pool to rest on the platform supported by the overhead crane.

On April 9, 1987, the licensee began cutting BWR Control Rod Blades which had been stored in the fuel pool since approximately March 1986 following their removal from the Unit-1 reactor core. The licensee removed the roller balls and pins from fourteen BWR Control Rod Blades placing the sheared portions of the blades in a storage bucket and returning the Control Rod Blades to a separate in-pool storage location. The operations were conducted underwater in the fuel pool due to the high radiation levels associated with the operation. The licensee conducted these operations under licensee's Procedure No. N1-FHP-31, "Control Blade Corner Removal," Revision 2 (March 31, 1987). A total of fifty-six "corners" were sheared and stored in the fuel pool during the operation from the fourteen Control Rod Blades. On April 15, 1987, the licensee completed the shearing operation.

On April 16, 1987, the licensee began "hydrolasing," (ie. high pressure water), decontamination of the shearing machine. A survey of the shearing machine taken prior to initial decontamination efforts showed radiation fields in excess of 50 rads per hour on portions of the machine. A survey taken on the machine following initial decontamination showed reductions in radiation levels to 12 and 25 rads per hour at the previously noted greater than 50 rads per hour locations. From April 16, 1987 to April 28, 1987, efforts to decontaminate the shearing machine continued with periodic radiation surveys to measure the reduction in radiation fields. On April 28, 1987, a survey prior to packaging the shearing machine showed two spots reading 5 rads per hour and 50 rads per hour on the shearing machine. Other radiation levels were noted ranging from 15 to 500 millirads per hour. Contamination surveys ("wipes") indicated smearable contamination from 18,000 disintegrations per minute (dpm) to 350 millirads per hour were still present on the shearing machine. No additional decontamination of the shearing machine was done.

The shearing machine was wrapped with two lead blankets and placed into Shipping Box No. 1 along with the hydraulic equipment and hoses. Shipping Box No. 1 was stored on the Unit-1 Refuel Floor. On May 1, 1987, the box was surveyed and no radiation levels exceeding 140 millirem per hour were noted. No external contamination on the box exterior was noted.

The platform was also "hydrolased" and, on April 29, 1987, it was removed from the fuel pool, disassembled and packed into Shipping Box No. 2. Shipping Box No. 2 was essentially a pallet with a rectangular cover to enclose the remaining five sides to make a "box". The thirty-foot high platform was dissembled into three ten-foot sections with connectors (flange-bolt arrangements) and packed. During this operation, a contract technician (wearing a single set of cotton coveralls) was found to be contaminated with two "hot particles." A "hot particle" was noted on the individual's forearm and a second "hot particle" was noted on the thigh. Skin dose calculations made by the licensee assigned dose equivalents of 2,513 millirems to the right thigh and 2,010 millirem to the left forearm for 1 square centimeter areas each at a depth of 70 microns.

A survey of the Control Rod Blade Work Platform taken after decontamination and immediately prior to packing on April 29, 1987 showed radiation levels from 5 millirads per hour to 2.2 rads per hour and smearable contamination from 22,000 dpm to 1,300,000 dpm per 100 square centimeters. The work platform components were packed and Shipping Box No. 2 was closed and stored on Unit-1 Refuel Floor.

On May 15, 1987, the licensee loaded the two packages on an open bed trailer and dispatched them as licensee's shipment No. 1 WS-0697 to Brunswick. The vehicle was routed as "Exclusive Use" by the licensee.

At 1700 on May 16, 1987, radiation protection personnel at Brunswick conducted radiation/contamination surveys during that licensee's receipt inspection of Shipment No. 1 WS-0697 and noted 1,500 millirems per hour on contact with the bottom of Shipping Box No. 1 (i.e. shearing machine and components) and 1,800 millirems per hour on contact with the bottom of Shipping Box No. 2, (i.e. Control Rod Blade Work Platform).

Initially, Brunswick personnel were unable to reach the licensee's contact and, as a result, notification to the licensee was delayed until May 18, 1987. The licensee's initial notification was received from the equipment vendor and subsequently confirmed in a telephone conversation with Brunswick personnel. The licensee informed the NRC resident inspectors on May 19, 1987 and they contacted NRC Region I. Based on information received in contacts with the Nine Mile Point and Brunswick NRC resident inspectors and the licensee, NRC Region I issued PNO-I-87-44 on May 20, 1987.

On May 21, 1987, the licensee's Manager, Corporate Health Physics observed the opening of both shipping containers on the Brunswick Refueling Floor. "Chips" were removed from the inside bottom of Shipping Box No. 2 which read 24 rads per hour (combined beta-gamma) and 3 rads per hour (gamma only). Visual examination of a "chip" showed it to be approximately 1/8 to 1/4 inch in size.

On May 27, 1987, during the inspection, a radiation control foreman of Brunswick reported to the licensee that a wipe of the inside surface of Shipping Box No. 1 showed gamma readings of approximately 2 rads per hour. "Chips", (i.e. object, visible to the eye) were not noted on the wipe. Gamma spectroscopic examination showed the radionuclides to be predominantly cobalt-60.

4. Package Radiation Levels

10 CFR 71.5 prohibits delivery of licensed material to a carrier for transport unless the licensee complies with applicable regulations in 49 CFR Parts 170-189. 49 CFR 173.441(a) requires that each package of radioactive materials offered for transport be prepared for shipment so that under conditions normally incident to transportation, the radiation level does not exceed 200 millirem per hour at any point on the external surface of the package.

Contrary to these requirements, on May 15, 1987, the licensee delivered two packages (as licensee shipment No. 1 WS-0697) to a carrier for "exclusive use" transport to the Brunswick plant. During receipt inspection and radiation/contamination surveys made by radiation protection personnel at Brunswick, Shipping Box No. 1 was shown to have an external surface radiation level of 1,500 millirem per hour. Shipping Box No. 2 was shown to have an external surface radiation level of 1,800 millirem per hour. Since the packages were transported on an open bed trailer, the applicable package limit was 200 millirem per hour.

Examinations by Brunswick personnel, (for Shipping Box No. 2 this examination was observed by a licensee representative) noted "hot particle" and "chip" contamination in the packages with radiation levels consistent with those observed on the outside of the packages.

For the purposes of this report, "hot particles" are defined as radioactive particulate contamination not readily observable by unaided eyes. "Chips" are defined as radioactive particulate contamination sufficiently large to be discernable by unaided eyes.

The licensee apparently failed to prepare the two packages for shipment so that conditions normally incident to movement by truck would not cause the radiation levels to exceed 200 millirem per hour at any point on the external surface of the packages. "Hot particles" and "chips" were apparently left on the contaminated equipment contained in the packages which could be and were dislodged during shipment. Supporting this conclusion are the following observations:

(1) Surveys made by the licensee prior to the shipment did not note any radiation levels on the surfaces of the packages exceeding 200 millirem per hour;

(2) Surveys made by Brunswick radiation protection personnel noted localized radiation levels on the package surfaces of 1500 and 1800 millirem per hour;

(3) "Hot particles" comparable in radiation level to the radiation levels on contact with the Shipping Box No. 1 were noted during examination at Brunswick;

(4) A "chip" comparable in radiation level to the radiation levels on contact with Shipping Box No. 2 was noted during examination at Brunswick;

(5) "Hot particles" dislodged during handling operations on April 29, 1987 contaminated the contract technician on the forearm and thigh; and

(6) The "hot particles" and "chip" were found inside the boxes at locations consistent with the contact surface readings exceeding regulatory limits.

Failure to prepare the packages in Shipment No. 1 WS-0697 to ensure that the radiation levels did not exceed 200 millirem per hour under the conditions of truck transport constitutes an apparent violation of 10 CFR 71.5. 50-220/87-08-01

5. Packaging

The licensee repackaged the shearing and hydraulic machines, hydraulic hoses and connections, and the work platform components in the two shipping containers in which that equipment was received. Neither container had been evaluated to ensure that it met Type A quantity packaging requirements in 49 CFR 173.412 by test requirements for Type A packages in 49 CFR 173.465. The licensee determined that the radioactive materials were "Low Specific Activity" (LSA) under 49 CFR 173.403(n)(5). The definition in 49 CFR 173.403(n)(5) includes the provision that the radioactive material not be readily dispersible. The term, "readily dispersible", implies that the radioactive materials cannot be dislodged in a manner that increases the radiological hazards associated with the package in the conditions normally incident to its transport. Implicit in the concept of radiological hazards are exposures by ingestion, inhalation or other contamination by the radioactive materials of an individual and exposures caused by radiation fields resulting from radioactive decay of the materials.

Three observations support a conclusion that the radioactive materials in the two packages of licensee Shipment No. 1 WS-0697 were readily dispersible and, thus, failed to meet the definition of LSA under 49 CFR 173.403(n)(5):

(1) Routine handling of components of the work platform by the contract technician on April 29, 1987 dislodged "hot particles" subsequently discovered on that technician's skin;
(2) "Hot particles" were found inside Shipping Box No. 1; and
(3) A "chip" was found inside Shipping box No. 2.

As noted earlier, observations (2) and (3) are apparent causes of the increased radiation levels on those two packages noted at Brunswick.

Observation (1) provided an indication approximately two weeks prior to shipment that radioactive materials were dislodged by handling and movement. On April 29, 1987, three contract technicians were disassembling and packing the components of the Control Rod Blade Work Platform. The technician closely involved in the operation was found to be contaminated on the left arm and right thigh areas by "hot particles" at 1115. The individuals were working under licensee's Radiation Work Permit (RWP) No. 87-3890-1 which covered the entire operation from April 1, 1987 through removal from the Refuel Floor for shipment. Protective clothing requirements on the RWP failed to specify "wet suits", (i.e. plastic or similar relatively impervious clothing). Licensee's Procedure No. S-RP-5, "Radiation and Radioactive Contamination Control," Revision 3 (September 30, 1986) in Table 2 recommends a "wet suit" for work conditions involving contamination as shown on the licensee's survey of the Control Rod Blade Work Platform (i.e. licensee's Survey No. 1 RB-10993).

The technicians were wearing single sets of cotton coveralls (with gloves, shoe and head coverings, etc.) during the work. Radioactive particulate contamination was dislodged from the work platform components, came into contact with technician's skin in at least two locations and caused unnecessary beta exposure to the skin estimated at 2,513 millirems to the right thigh and 2,010 millirem to the left forearm.

Under the licensee's Radiological Incident Report (RIR) program, the licensee reviewed the event, estimated the resulting beta skin exposure and issued a memorandum to the radiation protection staff to require "wet suits" for future similar work activities and conditions. However, the licensee failed to recognize that the material was apparently dispersible and, thus, could be dislodged during movement in transport. The inspector noted that had the dispersible nature of the radioactive material been recognized, the licensee could have taken additional precautions in packaging it for shipment, such as additional decontamination efforts to remove "hot particles" and "chips".

Since the radioactive materials contained in licensee Shipment No. 1 WS-0697 were "readily dispersible," the shipment failed to meet the definition of LSA material in 49 CFR 173.403(n)(5). The radioactive material did not meet the requirement for LSA material and, thus, it was inappropriate to ship the material in packages which had not been shown to meet Type A quantity packaging requirements. The estimated 316.1 millicuries of cobalt-60 in the two packages as shipped by the licensee were type A quantities under 49 CFR 435 and normal form under 49 CFR 173.403(5). Failure to ensure that the packages in Shipment No. 1 WS-0697 met Type A quantity packaging requirements in 49 CFR 173.412 by tests under 49 CFR 173.465 constitutes an apparent violation of 10 CFR 71.5(a)(1)(i). 50-220/87-08-02

6. Iron-55

During NRC Inspection No. 50-220/86-15, the licensee was cited for failure to identify the radionuclide Iron-55, its activity, and by that omission, the total radioactivity associated with several radioactive waste shipments. Although Licensee's Shipment No. 1 WS-0697 did not involve radioactive waste, the licensee was processing BWR Control Rod Blades and the radioactive contamination resulting from that operation contributed to the contamination of the Control Rod Blade Work Platform and shearing equipment. A vendor report of the radioactivity associated with three Control Rod Blades from the licensee's fuel pool in 1985 showed the presence of Iron-55 at ratios of Iron-55 activity to Cobalt-60 activity of 0.64, 0.62 and 0.14. Iron-55 decays by electron capture with a physical half-life of approximately 2.7 years. Iron-55 is produced by neutron irradiation in the reactor core of alloys in Control Rod Blades. Iron-55 cannot be detected by conventional gamma spectroscopy as conducted by the licensee. Contamination smears of the shearing equipment and work platform made by the licensee showed 100% of the gamma activity resulted from Cobalt-60. Since the chemical behavior of Iron and Cobalt are similar, (i.e. transition metals), the presence of cobalt-60 in the

contamination smears indicate the possible presence of Iron-55 also. Moreover, radiochemical measurements made by the vendor confirmed Iron-55's presence in similar BWR Control Blades at the licensee's facility. Review of the licensee's evaluation of the radionuclides associated with Shipment No. 1 WS-0697 showed that the licensee failed to consider Iron-55's possible presence and to evaluate the activity contribution which that presence would entail. Such an evaluation was reasonable in view of the above.

The inspector reasoned that the arthimetric average of the ratios of Iron-55 to Cobalt-60 activities noted in the vendor's report on similar contamination would provide a rough estimate of the potential Iron-55 activity. An arthimetric average ratio of 0.46 resulted. Based on the licensee's calculation of the cobalt-60 activity associated with Shipment No. 1 WS-0697 of 316.1 millicuries, use of the average ratio results in a calculated Iron-55 activity of an additional 145 millicuries. In addition, it is reasonable to presume the presence of Iron-55 since the BWR Control Rod Blades were removed from the licensee's reactor core approximately 14 months before shipment which is less than one physical half-life for Iron-55. Based on guidance issued by the U.S. Department of Transportation, radionuclides constituting more than 1% of the total activity of the radioactive shipments total activity must be identified on the shipping papers, 49 CFR 172.203(d)(i), and have their total radioactivity included in the radioactivity of the shipment, 49 CFR 172.203 (d)(iii).

In addition, the licensee certified that the radioactive material in shipment 1 WS-0697 was properly described in the radioactive shipping record when Iron-55 wasn't named nor included in the total radioactivity of the shipment contrary to requirements in 49 CFR 172.204(a)(1). Failure to include Iron-55 and its associated radioactivity constitutes an apparent violation of 10 CFR 71.5(a)(1)(vi). 50-220/87-08-03

7. Exit Interview

The inspector met with the licensee's representatives (denoted in Detail 1) at the conclusion of the inspection on May 27, 1987. The inspector summarized the scope of the inspection and findings as described in this report. The licensee's representative indicated that appropriate corrective actions would be taken following completion of the licensee's investigation of the shipment.

At no time during this inspection was written material provided to the licensee by the inspector. No information exempt from disclosure under 10 CFR 2.790 is discussed in this report.