



UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30323

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Report No. 50-297/87-03

Licensee: North Carolina State University
Raleigh, NC 27607

Docket No.: 50-297

License No.: R-120

Facility Name: North Carolina State University Pulstar Reactor

Inspection Conducted: September 29-30, 1987

Inspector:

B. K. Revsin
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10/7/87
Date Signed

Approved by:

C. M. Hosey
C. M. Hosey, Section Chief
Division of Radiation Safety and Safeguards

10/7/87
Date Signed

SUMMARY

Scope: This routine, unannounced, onsite inspection was conducted in the area of radiation protection and included: internal and external exposure control and assessment; control of radioactive materials and contamination, surveys, and monitoring; transportation of radioactive material and followup on previous enforcement items, Bulletins and Circulars.

Results: One violation - failure to maintain and adhere to radiation control procedures.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

P. J. Turinsky, Head, Department of Nuclear Engineering
G. D. Miller, Associate Director, Nuclear Reactor Program
K. V. Mani, Reactor health Physicist
T. C. Bray, Reactor Operations manager
D. W. Morgan, Radiation Protection Officer
T. L. Brackin, Radiation Safety Specialist

2. Exit Interview

The inspection scope and findings were summarized on September 30, 1987, with those persons indicated in Paragraph 1 above. One violation containing three examples of failure to maintain and/or adhere to written radiation control procedures (Paragraphs 4.e and 4.f) were discussed in detail. One unresolved item* (URI) concerning calibration records for Eberline RM-14 personnel friskers (Paragraph 4.f), was also discussed. Licensee management acknowledged the findings and took no exceptions. The licensee did not identify as proprietary any of the material provided to or reviewed by the inspector during this inspection.

3. Licensee Action on Previous Enforcement Matters (92702)

(Closed) Violation (50-297/87-01-01) Failure to post documents required by 10 CFR 19.11. The inspector reviewed the licensee's response dated April 21, 1987, and verified that the corrective action stated in the response had been implemented.

(Closed) Violation (50-297/87-01-02) Improper shipping papers and failure to meet limited quantity shipment requirements. The inspector reviewed the licensee's response dated April 21, 1987, and verified that the corrective action specified in the response had been implemented.

(Closed) Violation (50-297/87-01-03) Failure to verify authorization of transferee to receive byproduct material. The inspector reviewed the licensee's response dated April 21, 1987, and verified that the corrective action specified in the response had been implemented.

*An unresolved item is a matter about which more information is required to determine whether they are acceptable or may involve a violation or deviation.

4. Radiation Control (83743)

- a. 10 CFR 20.201(b) requires the licensee to perform such surveys as may be necessary and are reasonable under the circumstances to evaluate the extent of the radiation hazards that may be present.

Procedure HP-20-14, Radiation and Contamination Survey Pulstar Bay, Revision 1, January 1, 1986, required that direct radiation surveys be performed monthly. The inspector reviewed the results of the monthly direct radiation surveys between January 1 and September 1, 1987. The licensee stated that surveys were performed after the reactor had been brought to 100 percent power for at least 30 minutes. Routinely, both gamma and neutron surveys were performed and in general, dose rates were low, i.e., less than one and five millirem per hour respectively.

No violations or deviations were identified.

- b. 10 CFR 20.202 required that appropriate personnel monitoring devices be worn by personnel likely to receive an exposure in excess of 25 percent of the limits specified in 10 CFR 20.101 or who enter high radiation areas.

10 CFR 20.101 stated the quarterly radiation exposure limits to the whole body, skin of the whole body and extremities.

During tours of the facility, the inspector observed personnel monitoring devices being worn. The licensee used film badges supplied by a National Voluntary Laboratory Accreditation program approved vendor for measuring official dose. From July 1, 1986, to June 30, 1987, the academic year, the inspector verified that exposures were well below regulatory limits in that the highest individual exposure was 60 millirem (mrem) followed by two individuals with exposures totaling 50 mrem each.

The inspector discussed the use of extremity dosimetry with the licensee with particular reference to loading and down-loading stringer baskets. These aluminum baskets hold the plastic bottles containing target material while they undergo irradiation in the reactor pool. The licensee stated that to the best of their knowledge this question had been addressed a number of years ago but the results of this study were no longer available for review nor could the licensee recall the results of the study. The licensee stated that it was not uncommon for dose rates from the baskets to reach 5-10 Roentgens per hour (R/hour), but that general practice was not to actually remove the baskets from the pool but to release the plastic bottles from the basket which would then float to the top where they could be retrieved. Additionally two radiation monitors were located overhead (6 to 8 feet) and would alarm should any

unusual radiation field develop. The set point for the Geiger-Mueller (GM) detector was 2.5 mR/hour while the ionization chamber detector had two set points, an alert at 10 mR/hour and an alarm at 100 mR/hour. Receiving an alarm at 100 mR/hour required building evacuation. Due to the location of these monitors over the reactor bridge and at the loading/down-loading area for the stringers, the licensee felt confident that should any abnormal radiation field exist, personnel would be sufficiently alerted. Additionally, film badges worn by personnel had not indicated any exposure problems. The inspector stated that depending on the position personal dosimetry was worn by individuals, the whole body dosimeter could be two to three feet from the activated aluminum basket while the fingers could potentially reside next to this radiation source. In conclusion to these discussions, the licensee agreed to re-evaluate the extremity dose received by personnel at the facility. The licensee stated that extremity rings would be worn for approximately six months to reassess the magnitude and significance of personnel extremity dose. The inspector stated that this would be reviewed during future inspections (Inspector Followup Item 50-297/87-03-01).

No violations or deviations were identified.

- c. 10 CFR 20.203 specifies the requirements for posting radiation areas, high radiation areas and radioactive material areas.

During tours of the facility the inspector observed the above posting and verified through observation of survey records that postings and survey measurements were congruent.

No violations or deviations were identified.

- d. 10 CFR 19.11 requires each licensee to conspicuously post current copies of (1) 10 CFR Parts 19 and 20; (2) the license; (3) operating procedures; and (4) Form NRC-3, in sufficient places to permit individuals engaged in licensed activity to observe them on the way to and from any licensed activity location. If posting the documents specified in (1), (2) and (3) is not practicable, the licensee may post a notice which describes the document and states where they may be examined.

During tours of the facility the inspector noted the presence of the required postings at both entrances and exits from the Pulstar reactor bay.

No violations or deviations were identified.

- e. Technical Specificatio 6.3.a.8 states that operating procedures shall be written, updated periodically and followed for radiation control and shall be maintained and available to all operating personnel.

Procedure HP-40-1, Utilization of Reactor Irradiation Facilities, Revision 1, January 7, 1986, Paragraph 8 states that the stringer is placed on the Bridge for dose rate measurement which shall be provided to the Reactor Operator for entry on Form NRP-3 (Run Sheet).

Procedure HP-40-1, Paragraph 6 further states that Reactor Operations will be notified before removing anything from the pool.

Further discussions with licensee personnel concerning reactor irradiations elicited the fact that the control of each irradiation was maintained by a Run Sheet which were kept on the operating console of the reactor. The inspector reviewed the numerous Run Sheets that had been completed during the month of July 1987, and noticed that in the majority of cases, the column denoting radiation level after experiment irradiation had not been completed as required by procedure. The licensee stated that the reason for this was twofold: (1) irradiations were often left under water for several days after irradiation to permit decay of short lived radioactivity, and consequently dose rate measurements were not available, and (2) actual practice had evolved at the facility such that personnel removed experiments from the pool as needed without regard for the presence or absence of Operations personnel in the Control Room to record dose rate measurements. The inspector pointed out that procedure HP-40-01 required that Operations be notified prior to removal of anything from the reactor pool. The licensee stated that this was not usually done since irradiated material was often removed early in the morning before Operations personnel were available and that the success of the program required flexibility in this regard. Licensee representatives further stated that while dose rate measurements had not recorded in many instances, such surveys had been performed on both the aluminum baskets and on the target material after removal from the plastic bottle by individuals trained in proper survey technique. The licensee explained that since most irradiations were for neutron activation analysis, a survey to ensure low activity of the sample was mandatory to prevent destruction of sensitive counting equipment. The inspector stated that for radiation protection purposes, surveys of the baskets were of more interest than the target material since dose rates may be several orders of magnitude greater than those of the target which are usually less than 5 mR. The licensee stated that surveys were always performed even though the data on the Run Sheet did not reflect this practice.

Failure to follow radiation control procedure HP-40-1 requirements to record dose rate measurements on Run Sheets after irradiations and to notify reactor operations before removal of material from the reactor pool were identified as two examples of an apparent violation of Technical Specification 6.3.a.8 (50-297/87-03-02).

f. Instrument Calibration

10 CFR 20.201(b) requires each licensee to make or cause to be made such surveys as may be necessary for the licensee to comply with the regulations, and are reasonable under the circumstances to evaluate the radiation hazards that may be present. 10 CFR 20.201(a) defines survey to mean an evaluation of the radiation hazards incident to the production, use, release, disposal, or presence of radioactive materials which may include a physical survey of the location of materials and equipment, and measurements of levels of radiation or concentrations of radioactive material present.

During tours of the facility, the inspector observed instruments in use. At the exit from the reactor bay to the Control Room, two Eberline RM-14s with HP-210 probes were available for personnel to monitor themselves for contamination before entry into the Control Room, a clean area. Both of these instruments had calibration stickers on them that indicated that calibration was approximately six months overdue. The licensee stated that the instruments had been calibrated on schedule (quarterly) and that the old sticker had not been removed. To verify calibration of the instruments, a review of licensee records was undertaken. During 1986, RM-14s were calibrated on the required frequency; however, for the first two quarters of 1987, no calibration records could be found. The licensee stated that instrument records had recently been reorganized and that the ones in question must have been misplaced since they believed the instruments had been calibrated on the appropriate frequency. At the time of the Exit Interview the records had not been located. The use of calibrated instruments in performing personal and other types of surveys was discussed. The inspector stated that failure to be able to demonstrate that calibrated instruments had been used to perform surveys would be considered a violation of 10 CFR 20.201(b). Presently, however, this area will be considered an unresolved item pending completion of the licensee's search for the records and will be evaluated during future inspections (50-297/87-03-03).

Discussions concerning instrument calibration, source checks and response checks were held with licensee representatives. The licensee stated that response checks were generally performed on a weekly basis and consisted of exposing the instrument and attached probe to a button source of Pu-239 with an activity of greater than 150,000 disintegrations per minute (dpm). At times, other sources were used or were available for use. A positive deflection of the instrument needle was considered ample verification of instrument performance although this methodology was not delineated in a radiation control procedure. The licensee also stated that source checks of these RM-14 instruments were not performed, i.e., exposing an instrument to a known activity source in a fixed geometry in relation to the detector and verifying that the instrument read accurately, plus or minus a permissible error.

Calibration of the RM-14 was discussed. The licensee stated that an electronic calibration was performed following the manufacturer's recommendations; however, these recommendations had never been formalized into a procedure. The inspector stated that Technical Specification 6.3.a.8 required that radiation control procedures be written. Failure to maintain written procedures for instrument calibration was identified as an additional example of an apparent violation of Technical Specification 6.3.a.8 (50-297/87-03-02).

The use of source checks versus response checks for instrumentation was considered during which it was pointed out by the inspector, that use of a response check, a needle deflection in response to a small radioactive source, failed to verify that an instrument was performing accurately in that no acceptance criteria for instrument performance under these conditions had been established. The inspector stated that conducting source checks rather than response checks for instruments between calibrations was standard industry practice for verifying that the instrument was working appropriately. The licensee stated that this practice would be re-evaluated.

5. Transportation (86740)

10 CFR 71.5(a) requires each licensee who transports licensed material outside the confines of its plant or other place of use to comply with the applicable requirements of the Department of Transportation in 49 CFR Parts 170 through 189.

The inspector reviewed the records of shipments of radioactive material from the facility made between April 1987 through August 1987.

No violations or deviations were identified.

6. Followup on Bulletins and Circulars (92703)

- a. (Closed) Bulletin 78-01, Neutron Monitoring Practices. The inspector reviewed current practices for neutron monitoring at the facility. Routinely, the reactor bay was surveyed for neutron radiation using an Eberline PNR-4, the results of which indicate a minimal neutron hazard (less than 5 mR/hour). These readings are taken after the reactor has been at 100 percent power for at least 30 minutes. Other administrative controls include prohibitions against beam port removal with the reactor at power and use of the Radiation Work Permit program. A Radiation Work Permit is required when neutron hazard is anticipated. Neutron dosimetry is not normally worn by personnel, but is readily available should the need arise.
- b. (Closed) Bulletin 78-08, Radiation Levels from Fuel Element Transfer Tubes. This Bulletin is not applicable to the licensee's facility.

- c. (Closed) Circular 78-03, Packaging Greater than Type A Quantities of Low Specific Activity Radioactive Material for Transport. The inspector reviewed the licensee's Quality Assurance Program for transportation of greater than Type A quantities of radioactive material and found its provisions adequate to meet regulatory requirements.
- d. (Closed) Bulletin 79-19, Packaging of Low-Level Radioactive Waste for Transport and Burial. Procedure HP-10-5, Transfer and Shipment of Radioactive Material, and its attendant checklists, which implement the elements of the program for transportation of radioactive materials, was reviewed and found to be congruent with the requirements of 49 CFR Parts 170 through 189.