



UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
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SEP 11 1990

Report No.: 50-297/90-01

Licensee: North Carolina State University
Raleigh, NC 27695-7909

Docket No.: 50-297

License No.: R-120

Facility Name: North Carolina State University PULSTAR Reactor

Inspection Conducted: August 6-8, 1990

Inspector: C Bassett
C. H. Bassett, Sr. Radiation Specialist

8/28/90
Date Signed

Approved by: E. J. McAlpine
E. J. McAlpine, Chief
Radiation Safety Projects Section
Nuclear Materials Safety and Safeguards Branch
Division of Radiation Safety and Safeguards

9/11/90
Date Signed

SUMMARY

Scope:

This routine, unannounced inspection involved onsite review of the licensee's radiation protection program including: staff organization, training, radiation control activities, environmental monitoring, transportation activities, and followup on previous issues. Also, the NRC Region II Regional Administrator presented reactor operator qualification certificates to selected members of the licensee's staff and toured the facility.

Results:

Facility staffing and the current organizational structure appeared to be adequate although one position in the Nuclear Engineering Department remained open at the time of the inspection. Personnel exposures were well below established licensee administrative and regulatory limits. The licensee's environmental monitoring program appeared to be adequate, as did the program for shipping radioactive materials.

Within the areas inspected, two non-cited violations were identified:

- Failure to have an adequate procedure for surveying all areas in the reactor building, Paragraph 4.b.
- Failure to have an adequate procedure for preparing Continuous Air Monitor filters for analysis and specifying action limits, Paragraph 4.d.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

- *T. Bray, Manager, Reactor Operations
- *D. Dudziak, Head, Department of Nuclear Engineering
- *K. Mani, Reactor Health Physicist
- *G. Miller, Associate Director, Nuclear Reactor Program
- *W. Morgan, Radiation Protection Officer
- *H. Palmour, Chairman, Reactor Safeguards Advisory Group

Other licensee employees contacted included technicians, operators and office personnel.

*Attended exit interview.

2. Organization and Management Controls (83743)

a. Organization and Staffing

Technical Specification (TS) Section 6.1 details the organizational structure, management responsibility and lines of authority involved in the safe and efficient operation of the reactor facility.

The inspector reviewed the facility organization and verified that the current staffing and experience level of those in the organization met the requirements outlined in the TS. Since the last inspection the inspector noted that the position of Head, Department of Nuclear Engineering had been filled but the position of Director, Nuclear Reactor Program remained vacant. The licensee indicated that the new department head would help select the person to fill the nuclear reactor program director position.

The majority of the routine radiation protection activities and surveillances are performed by the facility operations/health physics staff. In the past, personnel from the campus Radiation Safety Office (RPO) participated in radiation protection activities by conducting routine contamination surveys and air sampling in the reactor facility. This practice has since been changed and the campus personnel only perform surveys outside the reactor building.

Campus Radiation Safety Office personnel continue to provide other services as in the past. These include performing the environmental monitoring for the reactor program, having the responsibility for final approval of radioactive material shipments, providing personnel monitoring service for the reactor facility staff, and calibrating

portable instruments used by the reactor facility staff. The campus personnel also assist with special or complex operations such as fuel transfer or during an emergency.

b. Radiation Protection Council

TS Section 6.2 details the composition of the Radiation Protection Council (RPC), qualifications of its members, required documentation of its responsibilities and authority, rules, and also meeting frequency. This section also requires that a Reactor Safeguards Advisory Group (RSAG) be formed to provide independent appraisals of reactor operations and outlines the RSAG composition, the members' qualifications and meeting frequency.

The inspector reviewed the minutes of the meetings held by the RPC and the RSAG since the last inspection. The inspector verified that the meetings were held as required and that issues reviewed and discussed were appropriate.

c. Audits and Appraisals

During the review of the RSAG meeting minutes it was not apparent that the RSAG was performing the appraisal function detailed in the TS. Through discussions with the Radiation Protection Officer and the Chairman of the RSAG, the inspector determined that the RSAG had been extensively involved with a recent problem concerning a hole in the reactor pool liner. The RSAG met much more frequently than required by the TS and performed numerous reviews and safety evaluations of methods proposed to repair the fuel pool liner. This was considered by the licensee to satisfy the appraisal function.

Through discussions with licensee representatives, the inspector also determined that the RSAG had used a checklist-type format to perform their appraisals in the past but was not currently doing so. The possibility of using this format or something similar to more easily demonstrate compliance with TS requirements was discussed. The licensee indicated that they would likely use the checklist format again to ensure that all areas of the reactor program were reviewed.

No violations or deviations were identified.

3. Training (83743)

10 CFR 19.12 requires the licensee to instruct all individuals working in or frequenting any portion of the restricted area in the health protection problems associated with exposure to radioactive material or radiation, in precautions or procedures to minimize exposure, and in the purpose and functions of protective devices employed, applicable provisions of Commission Regulations, individuals' responsibilities and the availability

of radiation exposure reports which workers may request pursuant to 10 CFR 19.13.

The inspector reviewed records of the training given to the reactor operators, the health physics staff, and others who occasionally visit and assist at the facility such as the campus RPO health physics technicians. The inspector verified that the appropriate training was being given to the various groups as required.

No violations or deviations were identified.

4. Radiation Control (83743)

a. Posting

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 of the documents specified in (1), (2), or (3) is not practicable, the licensee may post a notice which describes the documents and states where they may be examined.

During tours of the facility, the inspector noted the presence of the required postings at the entrance to the restricted access area of the research reactor control room.

No violations or deviations were identified.

b. Surveys

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.

TS 6.3.a(8) requires that operating procedures pertaining to radiation control be written, updated periodically, and followed.

HP Procedure 20-14, Radiation and Contamination Surveys of PULSTAR Bay, Rev. 2, dated March 1, 1989, requires that contamination surveys be performed at intervals not to exceed 10 working days and that direct radiation surveys be performed monthly in the reactor bay.

The inspector reviewed the results of the contamination surveys from June 1989 through July 1990. In all cases removable contamination was reported as less than the Lower Limit of Detection (LLD) of the proportional counter used for counting smears. The inspector also reviewed the results of the monthly direct radiation surveys. Surveys for both gamma and neutron radiation were reported on the

survey maps. The surveys from June 1989 through July 1990 indicated general area dose rates from 0.1 to 1.5 millirem per hour (mr/hr) for beta-gamma and from 0.1 to 0.5 mr/hr for neutron exposure. The highest specific area readings were generally noted in the area of the neutron radiography unit and varied from 5 to 10 mr/hr for beta-gamma and from 25 to 30 mr/hr for neutron exposure. Contact radiation level readings with such items as shield plugs in front of beam tubes varied from 10 to 20 mr/hr for beta-gamma and 1 to 2 mr/hr for neutron exposure. Radiation readings in the reactor bay were performed after the reactor had been brought to 95 percent (95 %) power for at least 30 minutes.

During this review, the inspector inquired about radiation and contamination surveys conducted in the reactor building inside the Mechanical Equipment Room (MER). A review of the procedure and the map provided therein indicated that surveys were to be conducted in the reactor bay but none were directed to be performed inside the MER area. The licensee indicated that radiation and contamination surveys are conducted but only following maintenance or other operations in the MER. Through discussions with the licensee, the inspector determined that operators routinely enter the area to perform inspections and check outs of the equipment. The licensee also indicated that the MER area had been surveyed routinely by the RPO health physics (HP) technicians. However, when that function was assumed by the reactor HP staff, the area had been overlooked as an area that needed to be routinely surveyed.

The licensee agreed that the MER area needed to be surveyed routinely and initiated changes to the procedure to ensure that the area is surveyed during surveys of the reactor bay.

The licensee was informed that failure to have an adequate procedure for ensuring that all routinely entered areas of the reactor building are surveyed was an apparent violation of TS 6.3.a(8). However, Section V.A of the NRC Enforcement Policy states that, for isolated Severity Level V violations (those of minor safety significance), a notice of violation normally will not be issued regardless of who identifies the violation provided that the licensee has initiated appropriate corrective action before the inspection ends. In such situations, a formal response from the licensee is not required and the inspection report serves to document the violations and the corrective actions. After conferring with NRC management, the inspector determined that this NRC identified violation met those criteria and was not being cited (50-297/90-01-01).

One non-cited violation (NCV) was identified.

c. External Exposure Review

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

10 CFR 20.102 requires that appropriate personnel monitoring devices be worn by personnel likely to receive exposure in excess of 25 percent of the limits specified in 10 CFR 20.101 or who enter high radiation areas.

During tours of the facility, the inspector observed personnel monitoring devices being worn as required. The licensee uses film badges supplied by a National Voluntary Laboratory Accreditation Program (NVLAP) approved vendor for measuring official dose.

The inspector reviewed and discussed the licensee's exposure records for persons working at or visiting the research reactor facility from July 1, 1989 through May 31, 1990. The highest accumulated whole body exposure for the year 1989 was approximately 90 millirem (mrem). The licensee indicated that this exposure, received by a faculty member, was due to performing various experiments. The highest accumulated year-to-date exposure through May 31, 1990, was 30 mrem. This exposure had been received by a reactor operator and was due to loading and unloading experiments. The inspector noted that the majority of the recorded exposures were less than the detection limit, approximately 10 mrem, of the vendor provided film badge.

No violations or deviations were identified.

d. Air sampling

10 CFR 20.103(a)(1) states that no licensee shall possess, use, or transfer licensed material in such a manner as to permit any individual in a restricted area to inhale a quantity of radioactive material in any period of one calendar quarter greater than the quantity which would result from inhalation for 40 hours per week for 13 weeks at uniform concentrations of radioactive material in air as specified in 10 CFR 20, Appendix B, Table 1, Column 1.

TS 6.3.a(8) requires that operating procedures pertaining to radiation control be written, updated periodically, and followed.

HP Procedure 20-12, Changing Continuous Air Monitor (CAM) Filters, Rev. 2, dated March 1, 1990, requires in Step 5.(25) that used filters be returned to the Health Physics laboratory for analysis per HP-20-11.

The inspector observed the licensee's air sampling of the reactor bay. This is performed by a continuous air monitor (CAM) located on top of the reactor adjacent to the pool. Filters are to be changed

and counted for radioactivity on a weekly basis. The inspector noted that the practice of taking daily air samples by RPO personnel had been discontinued.

During a review of the procedure used to prepare air samples for laboratory analysis, the inspector noted that the procedure, HP Procedure 20-11, Preparation of Air Sample Filters for Laboratory Proportional Counting, Rev. 2, dated March 1, 1990, outlined the preparation of filter samples from the 847-1 Continuous Filter Air Sampler (CFAS) and gave actions to be initiated based upon the results of the filter analyses. No such information was included in the procedure for CAM filters although these filters were mentioned in the discussion section of the procedure.

The inspector discussed the lack of guidance on how to prepare the CAM filters for analysis and the lack of action limits in HP Procedure 20-11 with licensee representatives. They agreed that such guidance belonged in the procedure and initiated a change to the procedure to include the needed information and action limits.

The inspector informed the licensee that failure to have an adequate procedure for analyzing CAM filters which included action limits was an apparent violation of TS 6.3.a(8). However, after conferring with NRC management, the inspector determined that this NRC identified violation met the criteria discussed in Paragraph 4.b above and the violation would not be cited (50-297/90-01-02).

One NCV was identified.

e. Facility Tours

During tours of the research reactor bay, adjacent areas, and associated laboratory facilities, the inspector noted a high degree of cleanliness and organization of materials and equipment. Selected review of instrumentation in use at various locations throughout the facility verified that portable and fixed radiation survey instruments were calibrated and source checked in accordance with approved procedures.

No violations or deviations were identified.

5. Environmental Protection Program (80745)

a. Annual Report

10 CFR 20.106(a) requires that the licensee not possess, use, or transfer licensed material so as to release to an unrestricted area radioactive material in concentrations which exceed the limits specified in 10 CFR 20, Appendix B, Table . . . except as authorized pursuant to 20.302 or 20.106(b).

TS 6.7.4 requires an annual operating report covering the previous year to be submitted to the NRC Region II Regional Administrator no later than August 31st of each year. TS 6.7.4.f requires that a summary of the nature and amount of radioactive effluents released or discharged to the environs be included in the report.

The inspector reviewed the licensee's Annual Report covering the period of July 1, 1988, through June 30, 1989, to ascertain whether releases of liquid and gaseous radioactive material to the environment were within regulatory requirements. The quantities of radioactive material released via the liquid effluent pathway are summarized below in microcuries (uCi) and liters (l):

<u>Qtr.</u>	<u>Total uCi Released Per Qtr.</u>	<u>Total Vol. Released Per Qtr.</u>	<u>Diluent Liters Per Qtr.</u>	<u>uCi Tritium Released Per Qtr.</u>
1st	44.06	4.77E4	6.25E4	37.80
2nd	70.98	2.05E4	1.57E5	66.35
3rd	82.59	2.04E4	1.86E5	77.60
4th	162.25	2.05E4	3.85E5	104.44

For the reporting period, a total of 359.88 uCi of all nuclides was released and a total of 286.19 uCi of Tritium was released. All liquid released, when diluted by campus water resulted in activity considerably less than 4E-7 microcuries per milliliter (uCi/ml). There were no liquid effluents that were not releasable to the sanitary sewer system.

The total quantity of radioactive gaseous effluents released during the reporting period was 4,343 Curies. The yearly average concentration of Argon-41 (Ar-41) released from the reactor facility exhaust stack during the reporting period was 1.4E-8 uCi/ml. Through analysis of the stack filters, the licensee found that there was no particulate activity indicated on any filter during the reporting period.

The inspector determined that all radioactive effluent releases were within the federal regulatory limits.

b. Environmental Gamma Exposures

TS 6.7.4.i requires the licensee to provide data in the annual report concerning the results of environmental surveys performed outside of the facility.

The environmental parameter monitored for the PULSTAR reactor facility was that of direct radiation from the facility and from gaseous effluents via a system of 5 thermoluminescent dosimeter (TLDs) located on the rooftops of campus buildings with the air monitoring equipment used for environmental air sampling. Exposures were integrated over a 3 month period at each of the air monitoring

stations with a control station located in the David Clark Laboratories. The data illustrated that the observed exposures are those expected to be produced by background radiations in that specific area of North Carolina. The data indicated an average exposure rate of from 18 to 20 mrem per quarter.

No violations or deviations were identified.

6. Transportation (86740)

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

The inspector discussed the transportation of radioactive material with licensee representatives. Several shipments had been made since the last inspection which involved shipping potassium chloride to the Bowman Gray medical school. Each shipment contained approximately one millicurie of Potassium-42 (K-42). Licensee records indicated that the shipments had been made in accordance with Procedure HP 10-5, Transfer and Shipment of Radioactive Material, Rev. 2, dated March 1, 1989. The inspector reviewed the associated shipping records and verified that licensee activities in this area were conducted in compliance with approved procedures and with the applicable regulations.

No violations or deviations were identified.

7. Regional Administrator's Visit and Tour

Prior to the inspection, the NRC Region II Regional Administrator presented reactor operator (RO) qualification certificates to members of the facility staff who had previously passed the RO qualification examinations. Following this presentation, the Regional Administrator and the resident inspectors from the Shearon Harris Nuclear Power Plant toured the licensee's facility. Licensee representatives outlined the facility's operations, security system, and emergency response plan. The NRC representatives also toured the licensee's Scaled Pressurized Water Reactor (SPWR) facility which is used extensively in training courses given to power reactor operators.

8. Exit Interview

The inspection scope and results were summarized on August 8, 1990, with those persons indicated in Paragraph 1. The adequacy of the licensee's organization and staffing was discussed as were the proceedings of the RPC and the RSAG. The inspector noted that the external exposures received by facility personnel were well within the established administrative and federal limits. The high degree of cleanliness and organization of

facility equipment and materials was noted. Licensee management was informed that failure to have an adequate procedure for performing surveys in the reactor building and failure to have an adequate procedure for analyzing CAM air filters were apparent violations of TS requirements. However, since the provisions of Section V.A of the NRC Enforcement Policy were met, these apparent violations were not being cited. The licensee did not identify as proprietary any of the material provided to or reviewed by the inspector during this inspection.

Item Number	Description and Reference
50-297/90-01-01	NCV - Failure to have an adequate procedure for ensuring that all routinely entered areas of the reactor building are surveyed (Paragraph 4.b).
50-297-89-01-02	NCV - Failure to have an adequate procedure for analyzing CAM filters which includes action limits (Paragraph 4.d).