

U. S. NUCLEAR REGULATORY COMMISSION

Docket No: 50-297  
License No: R-120  
Report No: 50-297/99-201  
Licensee: North Carolina State University  
Facility: PULSTAR Reactor  
Location: North Carolina State University  
Raleigh, North Carolina  
Dates: February 9-12, 1999  
Inspector: Craig Bassett, Senior Non-Power Reactor Inspector  
Approved by: Seymour H. Weiss, Director  
Non-Power Reactors and Decommissioning  
Project Directorate  
Division of Regulatory Improvement Programs  
Office of Nuclear Reactor Regulation

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## EXECUTIVE SUMMARY

This routine, announced inspection included onsite review of various aspects of the licensee's programs concerning the conduct of operations and emergency preparedness as they relate to the licensee's Class 2 one megawatt (1MW) research reactor. The licensee's programs were directed toward the protection of public health and safety and were in compliance with NRC requirements. No safety concerns or violations of regulatory requirements were identified.

### Conduct of Operations

- Staffing, reporting, and record keeping met requirements specified in Technical Specifications (TS) Section 6.1.
- Review and oversight functions required by TS Section 6.2 were acceptably completed by the Radiation Protection Committee (RPC) and the Reactor Safety and Audit Committee. Design changes had been reviewed with respect to 10 CFR 50.59 and approved by the RPC as required.
- The requalification/training program was up-to-date and acceptably maintained. Medical examinations were being completed as required.
- Facility procedures and document reviews satisfied TS Section 6.3 requirements. Procedural compliance was acceptable.
- Reactor fuel movements were made and documented in accordance with procedure and the fuel was being inspected biennially as required by TS Section 4.1.
- The program for surveillance and Limiting Conditions for Operation confirmations was being carried out in accordance with TS requirements.
- The program for the control of experiments satisfied regulatory requirements and license commitments.
- No problems had been identified concerning reactor operations with respect to Y2K concerns but the recorder that indicated the results of the radiation monitors was not Y2K compliant. The licensee had ordered new software to correct the problem.

### Emergency Preparedness

- The PULSTAR Emergency Plan was found to be acceptable after the last major revision in 1998.
- The Emergency Procedures were being updated as required and were adequate to carry out the provisions of the Emergency Plan.
- With one minor exception where bullhorns were not in two Emergency Lockers, the emergency response facilities and equipment were being maintained as required. This

discrepancy was corrected immediately. First responders were knowledgeable of proper actions to take in case of an emergency.

- The licensee maintained current Letters of Agreement with offsite agencies that showed that support would be available in case of an emergency.
- Annual drills were held as required, critiques were used to identify strengths and weaknesses, and corrective actions were taken to resolved problems identified.
- Documentation of emergency preparedness training for staff and off-site personnel indicated that training was being conducted as required.

## Report Details

### Summary of Plant Status

The licensee's one megawatt (1MW) PULSTAR research reactor continues to be operated in support of undergraduate instruction and laboratory experiments, reactor operator training, and various types of research. During the inspection, the reactor was being started-up, operated, and shutdown as required to support training for commercial power reactor engineers.

#### 1. Organization, Operations, and Maintenance Activities (Inspection Procedure [IP] 69001)

##### a. Inspection Scope

To verify staffing, reporting, and record keeping requirements specified in Technical Specifications (TS) Section 6.1 were being met, the inspector reviewed:

- organization and staffing for the facility,
- administrative controls,
- the reactor console logs, and
- the annual reports.

##### b. Observations and Findings

The licensee's current operational organization consisted of the Director, Associate Director, Reactor Operations Manager, Chief Reactor Operator, Chief of Reactor Maintenance, Manager of Nuclear Services, Reactor Health Physicist, Program Assistant, and Instrument Maker. Three of the individuals mentioned above are qualified Senior Reactor Operators (SROs). This organization was consistent with that specified in the TS.

Through discussions with licensee representatives the inspector determined that management responsibilities and the organization at the facility had not changed since the previous NRC inspection in January 1998 (Inspection Report No. 50-297/98-201). The inspector determined that the Associate Director, Nuclear Reactor Program (NRP), retained direct control and overall responsibility for management of the facility as specified in the TS. The Associate Director reported to the Chancellor of the university through the Director, NRP; the Head of the Department of Nuclear Engineering; and the Dean of the College of Engineering.

The Reactor Operations Manager maintained a schedule for reactor operations and tracked the completion of maintenance and surveillance activities. With input from the Chief Reactor Operator and the Chief of Reactor Maintenance, this practice kept everyone aware of upcoming activities and helped ensure good administrative control over operational and maintenance aspects of the facility.

A review of the reactor console logs showed that they were being maintained as required and problems, if any, were being documented. The annual reports

summarized the required information and were issued at the frequency specified in the Technical Specifications.

c. Conclusions

Staffing, reporting, and record keeping met the requirements specified in TS Section 6.1.

2. Review, Audit, and Design Change Functions (IP 69001)

a. Inspection Scope

In order to verify that the licensee had established and conducted reviews and audits as required and to determine whether modifications to the facility were consistent with 10 CFR 50.59 and TS Section 6.2 the inspector reviewed:

- Radiation Protection Committee (RPC) meeting minutes,
- Reactor Safety and Audit Committee (RSAC) meeting minutes,
- NRP Procedures,
- audits and reviews, and
- design changes reviewed under 10 CFR 50.59.

b. Observations and Findings

Section 6.2 of the TS required that the RPC consist of at least seven voting members and meet at least six times per year to review safety aspects of facility operation. The RSAC was required to be composed of at least five persons and meet at least four times per year with intervals between the meetings not to exceed six months.

The inspector reviewed the RPC's and RSAC's meeting minutes from February 1997 to the present. These meeting minutes showed that each committee was composed of more than the minimum number of members required and met as required by the TS with a quorum being present. The inspector noted that the RPC and the RSAC had reviewed/considered the types of topics outlined by the TS.

It was noted that both committees completed audits of reactor program but the RSAC had the responsibility of conducting a biennial audit of the requalification program and the Emergency Plan and Emergency Procedures. An annual audit was required of the other aspects of the reactor facility operations to verify compliance with TS and license requirements. The inspector noted that, since the last NRC inspection, audits had been completed in those areas outlined in the TS. The inspector noted that the audits and the resulting findings were detailed and that the licensee's responses and corrective actions were acceptable.

Through review of applicable records and interviews with licensee personnel, the inspector determined that all design changes that had been initiated and/or completed at the facility since the last NRC operations inspection had undergone the prescribed review and approval process. Initially licensee staff completed the established forms outlining the changes. The proposed changes were subsequently reviewed by a person

not having direct responsibility for the equipment or projects affected. Then the changes were presented to the RSAC and the RPC for review and approval in accordance with procedure. The inspector noted that the proper functioning of the equipment or item that had been changed was verified to be operational by tests or verifications as needed. The appropriate changes were also documented in procedures. Affected portions of the Safety Analysis Report (SAR), TS, and drawings were pending to be updated.

It was also noted that one of the changes was determined to constitute an unreviewed safety question. This change, involving the use of beryllium reflectors in the core periphery, was submitted to the NRC as a TS change as required and was awaiting review and approval.

c. Conclusions

Audits were being conducted by the RPC and the RSAC according to the requirements specified in the TS. Design changes had been reviewed with respect to 10 CFR 50.59 and approved by the RPC as required. One change involving the use of beryllium reflectors in the core was determined to constitute an unreviewed safety question and the results of the evaluation had been submitted to the NRC for review.

3. Operator Licenses, Requalification, and Medical Requirements (IP 69001)

a. Inspection Scope

To determine that operator requalification activities and training were conducted as required and that medical requirements were met, the inspector reviewed:

- active license status,
- logs and records of reactivity manipulations,
- written examinations,
- training records, and
- medical examination records.

b. Observations and Findings

As noted earlier, the licensee currently has three qualified SROs at the facility. All licenses were current and the earliest that any was scheduled to expire is in May of the year 2000. Previously there had been four qualified SROs at the facility but one individual had taken a job with another group on campus and had not been able to maintain his proficiency at the reactor. As stipulated by the requalification program, the individual had been notified that he would need to re-establish proficiency before resuming the duties of an SRO. The individual was not able to do this and the licensee submitted a letter to terminate that individual's license on January 4, 1999.

A review of the logs and records showed that training had been conducted in the areas outlined in the licensee's requalification and training program. It was noted that lectures had been given as stipulated and that training reviews and examinations had been documented. Records of quarterly reactivity manipulations, other operations activities,

and Reactor Operator (RO) and SRO activities were being maintained. Records of the annual oral and demonstrational reactor proficiency and written examination results were also on file. All the operators had successfully completed the various tasks outlined and were current in their training and requalification programs.

The inspector also verified that the operators were receiving the required medical examinations at a more frequent interval than that specified in the TS. This was due in part to the need for an annual physical to demonstrate their capability to use Self-Contained Breathing Apparatus (SCBAs).

c. Conclusions

The requalification/training program was up-to-date and acceptably maintained. Medical examinations were being completed as required.

4. Procedures (IP 69001)

a. Inspection Scope

To determine whether facility procedures met the requirements outlined in TS Section 6.3, the inspector reviewed:

- selected sections of the PULSTAR Operations Manual,
- selected Health Physics and Special Procedures, and
- procedural reviews and updates.

b. Observations and Findings

The various types of procedures reviewed were acceptable for the facility and the current staffing level. The procedures specified the responsibilities of the various members of the staff and provided them instructions for performing their duties. The procedures were being reviewed annual, as required and updated as needed. The operations that were observed during this inspection were completed in accordance with the applicable procedures.

c. Conclusions

Facility procedures and document reviews satisfied TS Section 6.3 requirements. Procedural compliance was acceptable.

5. Fuel Movement (IP 69001)

a. Inspection Scope

In order to verify adherence to fuel handling and inspection requirements, the inspector reviewed:

- Fuel Handling Checklists,
- PULSTAR Surveillance (PS) procedures, and

- applicable logs and PS records.

b. Observations and Findings

The inspector determined that the licensee was maintaining the required records of fuel movements that were completed and verified that the movements were conducted in compliance with procedure. The reactor fuel was being inspected upon initial receipt and biennially as required by TS. The procedures used and the controls established were acceptable.

The inspector confirmed that fuel movements and handling were infrequent. However, it was noted that data recorded for fuel movement was clear and concise. Fuel movements, inspection, log keeping, and recording followed facility procedures.

c. Conclusions

Reactor fuel movements were made and documented in accordance with procedure and the fuel was being inspected biennially as required by TS 4.1.

6. Surveillance (IP 6900.1)

a. Inspection Scope

To determine that surveillance and Limiting Conditions for Operation (LCO) verifications were being completed as required by TS Section 4, the inspector reviewed:

- selected PS procedures,
- selected PS data and records,
- Limiting Conditions for Operation, and
- associated logs and reports.

b. Observations and Findings

The inspector noted that selected monthly, quarterly, semiannual, annual, and biennial checks, tests, and/or calibrations for TS-required surveillance and LCO verifications were completed as stipulated. The verifications reviewed were completed on schedule and in accordance with licensee procedures. All the recorded results were within the TS and procedurally prescribed parameters. The records and logs were noted to be complete and were being maintained as required.

c. Conclusions

The program for surveillance and LCO confirmations was being carried out in accordance with TS requirements.



## 7. Experiments (IP 69001)

### a. Inspection Scope

In order to verify that experiments were being conducted within approved guidelines, the inspector reviewed:

- PULSTAR Projects (Experiments) Manual,
- Request for Reactor Operation Run Sheets,
- experiment review and approval by the RPC,
- potential hazards identification, and
- control of irradiated items.

### b. Observations and Findings

The inspector noted that all the projects/experiments conducted were well-established, "routine" procedures that had been in place for several years. No new ("hi-worth" or "unknown"-type) experiments had been initiated, reviewed, or approved since the last inspection. The experiments that were conducted were completed under the cognizance of the Reactor Operations Manager and the Chief Reactor Operator as required. The results of the experiments were documented on the appropriate Request for Reactor Run Sheets. The inspector verified that the experiments that had been performed had received approval by the reactor operations staff and that the individuals requesting the reactor operations were authorized to do so. It was noted that engineering controls were used to limit exposure to radiation.

The inspector observed the insertion and removal of a set of experiment samples using the Pneumatic Transfer System from the Control Room. It was noted that licensee personnel followed procedure and established protocol.

### c. Conclusions

The license's program for the control of experiments satisfied regulatory requirements and licensee commitments.

## 8. Year 2000 Concerns Review

### a. Inspection Scope

To determine the status of the licensee's preparations to deal with the potential computer problems caused by the upcoming Year 2000 (Y2K), the inspector reviewed:

- the licensee's operating system,
- the licensee's security system,
- responses received by the licensee from vendors, and
- the North Carolina State University approach to the problem.

b. Observations and Findings

The licensee had completed an extensive review/analysis of the various types of equipment and computer based applications supporting TS requirements at the facility. They had concluded that the only problem concerning Y2K that might exist is with a recorder used to record the outputs of the radiation monitors at the facility. However, it was noted that the problem did not affect the operation of the recorder. In order to correct the situation, the licensee was buying new software that would alleviate the problem. In their review of the current status of the facility, the licensee had not identified anything that would pose a problem to reactor operations and no instances were identified that could pose a threat to public health and safety.

A separate vendor was maintaining the security system at the facility. The vendor had supplied the licensee with a letter indicating that the security system was Y2K compliant. The university had also analyzed the Y2K status campus-wide and was taking actions as needed.

c. Conclusions

No problems had been identified concerning reactor operations with respect to Y2K concerns but the recorder that indicated the results of the radiation monitor was not Y2K compliant. The licensee had ordered new software to correct the problem.

9. Emergency Preparedness

a. Changes to the Emergency Plan (IP 69001)

(1) Inspection Scope

To determine compliance with the requirements of 10 CFR 50.54(q) and the licensee's Emergency Plan, the inspector reviewed:

- the PULSTAR Emergency Plan and Procedures,
- RPC and RSAC meeting minutes,
- recent plan and procedure revisions and updates, and
- applicable letters and documents concerning the Emergency Plan.

(2) Observations and Findings

The licensee submitted a revised Emergency Plan to the NRC on August 23, 1998. The NRC reviewed the changes and found them to be in accordance with 10 CFR 50.54(q). The inspector confirmed that the changes did not decrease the effectiveness of the Emergency Plan (E-Plan). The inspector also noted that the plan was reviewed biennially by the RSAC as required by the TS.

(3) Conclusions

The PULSTAR Emergency Plan was found to be acceptable after the last major revision in 1998.

b. Emergency Plan Implementing Procedures (IP 69001)

(1) Inspection Scope

In order to verify the adequacy of the licensee's Emergency Procedures, the inspector reviewed:

- the Emergency Plan and Procedures,
- RPC and RSAC meeting minutes, and
- recent revisions and updates of the procedures.

(2) Observations and Findings

The licensee had continually reviewed and revised the Emergency Procedures as required. The latest revision to the procedures became effective January 1, 1999. The procedures were acceptable to implement the provisions stipulated in the E-Plan.

(3) Conclusions

The Emergency Procedures were being updated as required and were adequate to implement the provisions of the Emergency Plan.

c. Emergency Preparedness Program Implementation (IP 69001)

(1) Inspection Scope

To determine the adequacy of the licensee's Emergency Preparedness Program, the inspector reviewed:

- emergency response facilities,
- equipment and instrumentation staged for emergency response, and
- emergency response personnel training.

(2) Observations and Findings

The inspector and a licensee representative conducted an inventory of the equipment and supplies that were required to be located in the Emergency Lockers in the Burlington Engineering Laboratory building. With the exception of two bullhorns or loud speakers that were not in the Emergency Lockers in the building Foyer and the Change Room, the facilities and equipment set aside for emergency response were being maintained as required in the Emergency Plan. When notified of the problem, the licensee determined that the old bullhorns no longer functioned and had been discarded. The licensee immediately purchased two new bullhorns to replace the ones that were removed from service.

Through drill critique reviews and interviews with licensee personnel, emergency responders were determined to be knowledgeable of the proper actions to take in case of an emergency.

(3) Conclusions

With one minor exception, the emergency response facilities and equipment were being maintained as required. This discrepancy was corrected immediately. First responders were knowledgeable of proper actions to take in case of an emergency.

d. Offsite Support (IP 69001)(1) Inspection Scope

To verify the adequacy of the offsite support that would be provided to the licensee in case of an emergency, the inspector reviewed:

- the Emergency Plan and Implementing Procedures,
- Letters of Agreement, and
- communications capabilities.

(2) Observations and Findings

Updated Letters of Agreement were on file indicating that various state and local agencies were available to respond in case of an emergency. An agreement also had been established with Rex Healthcare (Hospital) in case a contaminated, injured person required medical treatment. A separate agreement with a local ambulance provider was not necessary because transportation of an injured person to the hospital would be rendered by the Wake County Emergency Medical Services when required.

Communications capabilities with these agencies were acceptable and had been tested on a periodic basis.

(3) Conclusions

The licensee maintained current Letters of Agreement with offsite agencies that indicated that support would be available in case of an emergency.

e. Emergency Preparedness Exercises and Drills (IP 69001)(1) Inspection Scope

To determine that the licensee was conducting the exercises and drills as specified in the Emergency Plan, the inspector reviewed:

- recent drill scenarios and time lines used in drills,
- the critiques of drill performance by emergency responders and controllers, and
- other associated documentation of recent drills.

(2) Observations and Findings

The inspector noted that drills had been conducted annually as required by the Emergency Plan. Critiques were held following the drills to discuss the positive and negative aspects of the exercise, to develop recommendations of ways to improve personnel performance, and to suggest possible solutions to problems identified. Corrective actions were taken to resolve problems noted, as deemed appropriate by the licensee. The licensee acknowledged the importance of conducting appropriate drills and that drills usually highlight areas for improvement.

(3) Conclusions

Annual drills were held as required, critiques were used to identify strengths and weaknesses, and corrective actions were taken to resolve problems identified.

f. Emergency Preparedness Training (IP 69001)

(1) Inspection Scope

In order to verify the adequacy of the licensee's emergency training, the inspector reviewed:

- the Emergency Plan and Procedures,
- training requirements specified for staff and off-site personnel, and
- training records.

(2) Observations and Findings

With respect to Emergency Preparedness and Response training, the inspector noted that it was being completed and documented as required for licensee and off-site personnel. The training was acceptable.

(3) Conclusions

Emergency preparedness training was being conducted and documented for staff and off-site personnel.

10. Follow-up on Previously Identified Items

a. Inspection Scope (92701, 92702)

The inspector reviewed the licensee's actions taken in response to a previously identified Inspector Follow-up Item and a previous violation.

b. Observation and Findings

- (1) (Closed) Inspector Follow-up item (IFI) 50-297/96-02-02 - Follow-up to verify that training was offered to hospital personnel and corrective actions were completed to resolve the inconsistency between the Emergency Plan and the procedure concerning training.

During a previous inspection it was noted that personnel from Rex Hospital, the hospital that had agreed to handle patients from the NRP facility, had not been included in the training offered to staff and off-site personnel. This oversight was attributed to an inconsistency between the Emergency Plan and the implementing procedure. The licensee had taken steps to correct this problem and had trained staff members from the Rex Hospital. The procedure had also been changed to include the staff of Rex Hospital as those needing training on a recurring basis. This item is considered closed.

- (2) (Closed) Violation (VIO) 50-297/98-201-01 - Failure to have changes to methods and/or acceptance criteria (procedures) reviewed and approved by the RPC.

During an inspection in January 1998 it was noted that certain HP procedures had been changed and made into "instructions." These "instructions" were not considered as procedures and had not been reviewed and approved by the RPC.

In order to correct this situation, the licensee had revised Special Procedure (SP) 2.1, "Review and Approval of Changes and Deviations." Revision 6 of SP 2.1, dated February 3, 1998, was a complete revision of the procedure to clarify the instructions for making design and procedure changes and to specify what constituted a minor change. With this new guidance, the licensee then revised the Health Physics "instructions" used at the facility and wrote them as procedures. The HP procedures had subsequently been reviewed and approved by the RSAC on April 27, 1998, and by the RPC on April 30, 1998. The procedures appeared to be acceptable. This item is considered closed.

c. Conclusions

Two open items identified during previous inspections were closed.

11. Exit Interview

The inspection scope and results were summarized on February 12, 1999, with licensee representatives. The inspector discussed the findings for each area reviewed. The licensee acknowledged the findings and did not identify as proprietary any of the material provided to or reviewed by the inspector during the inspection.

## PARTIAL LIST OF PERSONS CONTACTED

### Licensee

S. Bilyj, Reactor Operations Manager  
N. Couch, Radiation Safety Officer, NCSU  
D. Dudziak, Nuclear Engineering Department Head  
K. Kincaid, Chief of Reactor Maintenance  
C. Mayo, Director, Nuclear Reactor Program  
P. Perez, Associate Director, Nuclear Reactor Program  
C. Plavney, Chief Reactor Operator  
J. Weaver, Manager, Nuclear Services  
G. Wicks, Reactor Health Physicist

## INSPECTION PROCEDURE USED

IP 69001 Class II Non-Power Reactors

## ITEMS OPENED, CLOSED, AND DISCUSSED

### Opened

None

### Closed

50-297/96-02-02	IFI	Follow-up to verify that training was offered to hospital personnel and corrective actions were completed to resolve the inconsistency between the Emergency Plan and the procedure concerning training.
50-297/98-201-01	VIO	Failure to have changes to methods and/or acceptance criteria (procedures) reviewed and approved by the RPC.

## LIST OF ACRONYMS USED

CFR	Code of Federal Regulations
E-Plan	Emergency Plan
FSAR	Final Safety Analysis Report
HP	Health Physics
IFI	Inspector Follow-up Item
IP	Inspection Procedure
LCO	Limiting Conditions for Operation
MW	Megawatt
NCSU	North Carolina State University
NPR	Non-Power Reactor
NRP	Nuclear Reactor Program
NRC	Nuclear Regulatory Commission
PS	PULSTAR Surveillance (Procedure)
RO	Reactor operator
RPC	Radiation Protection Committee
RSAC	Reactor Safety and Audit Committee
SCBA	Self-contained Breathing Apparatus
SP	Special Procedure
SRO	Senior reactor operator
TS	Technical Specifications
TRTR	Test, Research, and Training Reactor
VIO	Violation
Y2K	(The upcoming) Year 2000