March 3, 2005

Mr. Andrew T. Cook
Associate Director, Nuclear Reactor Program
Department of Nuclear Engineering
Campus Box 7909
Raleigh, NC 27695-7909

SUBJECT: ISSUANCE OF AMENDMENT NO. 15 TO FACILITY OPERATING LICENSE NO. R-120 — NORTH CAROLINA STATE UNIVERSITY (NCSU) PULSTAR NUCLEAR REACTOR (TAC NO. MC5123)

Dear Mr. Cook:

The Commission has issued the enclosed Amendment No. 15 to Facility Operating License No. R-120 for the NCSU Nuclear Reactor. The amendment is in response to NCSU's letter dated September 28, 2004. The amendment incorporates changes to the Technical Specifications (TS). The first and second changes correct typographical errors (TS 3.8.2). The third change (TS 3.6.a and c and TS 5.2.c) was requested to allow a building modification. A change to TS 3.7 is to allow the possibility of using cryogenic liquids as a component of reactor experiments. A change to TS 6.2.3.a makes the wording more compatible with the present 10 CFR Section 50.59. Two administrative changes were made to TS 6.2.3 and 6.2.4 and changes to TS 6.4.1 and 6.4.2 were made to increase terminology consistency and grammar. Lastly, a change was made to TS 6.7.4 to change the period of review and date of submission for the annual report. A copy of the related safety evaluation supporting Amendment No. 15 is also included.

This amendment becomes effective on the date of issuance except for the change to TS 5.2 which will become effective after the amendment issuance date and when the modification commences. In addition the changes to TS 3.6 will become effective after the amendment date of issuance and when the modification is complete. This allows you to make the modification without violating TSs.

The change to TS 6.7.4 necessitates a report for the review period from July 1, 2004 through December 13, 2004. You are required to submit a report for that review period sixty (60) days from the date of issuance for this amendment.

Should you have any questions on this amendment, I would be pleased to hear from you. My telephone number is (301) 415-1631.

Sincerely,

/RA/

Daniel E. Hughes, Project Manager
Research and Test Reactors Section
New, Research and Test Reactors Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No. 50-297

Enclosures: 1. Amendment No. 15
2. Safety Evaluation

cc w/enclosures: Please see next page

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Test, Research, and Training
Reactor Newsletter
University of Florida
202 Nuclear Sciences Center
Gainesville, FL 32611

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Research and Test Reactors Section
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cc w/enclosures: Please see next page

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NORTH CAROLINA STATE UNIVERSITY (NCSU) PULSTAR NUCLEAR REACTOR

DOCKET NO. 50-297

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 15
Licensee No. R-120

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:

   A. The application filed by the North Carolina State University (NCSU or the licensee), dated September 28, 2004, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the regulations of the Commission as stated in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public and (ii) that such activities will be conducted in compliance with the rules and regulations of the Commission;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public;

   E. This amendment is issued in accordance with 10 CFR Part 51 of the regulations of the Commission and all applicable requirements have been satisfied; and

   F. Prior notice of this amendment was not required by 10 CFR 2.105 and publication of notice for this amendment is not required by 10 CFR 2.106.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the enclosure to this license amendment, and paragraph 2.C.(2) of License No. R-120 is hereby amended to read as follows:

   Technical Specifications

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 15, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective on the date of issuance except for TS 5.2, which becomes effective when the facility modification commences, and TS 3.6, which becomes effective when the facility modification is completed.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Patrick M. Madden, Section Chief
Research and Test Reactors Section
New, Research and Test Reactors Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Enclosure: Appendix A Technical Specifications Changes

Date of Issuance: March 3, 2005

ENCLOSURE TO LICENSE AMENDMENT NO. 15

FACILITY LICENSE NO. R-120

DOCKET NO. 50-297

Replace the following pages of the Appendix A Technical Specifications with the enclosed pages. The revised pages are identified by amendment number and contain vertical lines indicating the areas of change.

Remove	Insert
15	15
21	21
24	24
26	26
40	40
50	50
53	53
56	56

3.3 Reactor Safety System

Applicability

These specifications apply to the reactor safety system channels.

Objective

The objective is to require the minimum number of reactor safety system channels which must be operable in order to assure that the Safety Limits are not exceeded.

Specifications

The reactor shall not be operated unless the reactor safety system channels described in the following table are operable:

	Measuring Channel	Function	
a.	Startup Power Level[1]	Inhibits Control Rod withdrawal when neutron count is # 2 cps.	
b.	Safety Power Level	SCRAM at # 1.3 MW (LSSS), Enable for Flow/Flapper SCRAMs at # 250 kW (LSSS).	
c.	Linear Power Level	SCRAM at # 1.3 MW (LSSS).	
d.	Log N Power Level	Enable for Flow/Flapper SCRAMs at # 250 kW (LSSS).	
e.	Flow Monitoring[2]	SCRAM when flapper not closed and Flow/Flapper SCRAMs are enabled.	
f.	Primary Coolant Flow[2]	SCRAM at $ 450 gpm (LSSS) when Flow/Flapper SCRAMs are enabled.	
g.	Pool Water Temperature Monitoring Switch	Alarm and Manual SCRAM at # 117EF (LSSS).	
h.	Pool Water Temperature Measuring Channel	SCRAM at # 117EF (LSSS).	
i.	Pool Water Level	SCRAM at $ 14 feet 2 inches.	*
j.	Manual Button	Manual SCRAM	

3.6 Confinement and Main HVAC Systems

Applicability

This specification applies to the operation of the Reactor Building confinement and main HVAC systems.

Objective

The objective is to assure that the confinement system is in operation to mitigate the consequences of possible release of radioactive materials resulting from reactor operation.

Specification

The reactor shall not be operated, nor shall irradiated fuel be moved within the pool area, unless the following equipment is operable, and conditions met:

	Equipment/Condition	Function	
a.	All doors, except the Control Room and basement corridor entrance, self-latching, self-closing, and locked.	To maintain reactor building negative differential pressure (dp).(1)	*
b.	Control room and basement corridor entrance door: self-latching, self-closing and closed.	To maintain reactor building negative differential pressure.(2)	
c.	Reactor Building under a negative differential pressure of not less than 0.2" H_2O with the normal ventilation system or 0.1" H_2O with one confinement fan operating.	To maintain reactor building negative differential pressure with reference to outside ambient.(3)	* * * * * *
d.	Confinement system	Operable(4)(5)(7)	* *
e.	Evacuation system	Operable(6)	*

ii. Attempts will be made to identify and limit the quantities of elements having very large thermal neutron absorption cross sections, in order to quantify reactivity effects.

iii. Explosive material[(1)], shall not be allowed in the reactor. Experiments reviewed by the Radiation Safety Committee in which the material is considered to be potentially explosive, either while contained, or if it leaks from the container, shall be designed to maintain seal integrity even if detonated, to prevent damage to the reactor core or to the control rods or instrumentation and to prevent any change in reactivity.

iv. Each experiment will be evaluated with respect to radiation-induced physical and/or chemical changes in the irradiated material, such as decomposition effects in polymers.

v. Experiments involving cryogenic liquids[(1)] within the biological shield or flammable materials[(1)] or highly toxic materials[(1)] require specific procedures for handling and shall be limited in quantity as approved by the Radiation Safety Committee. * *

f. Credible failure of any experiment shall not result in releases or exposures in excess of the annual limits established in 10 CFR 20.

[(1)]Defined as follows (reference - "Handbook of Laboratory Safety" - Chemical Rubber Company, 4th Ed., 1995, unless otherwise noted):

Toxic: A substance that has the ability to cause damage to living tissue when inhaled, ingested, injected, or absorbed through the skin ("Safety in Academic Chemistry Laboratories" - The American Chemical Society, 1994).

Flammable: Having a flash point below 73EF and a boiling point below 100EF. The flash point is defined as the minimum temperature at which a liquid forms a vapor above its surface in sufficient concentration that it may be ignited as determined by appropriate test procedures and apparatus as specified.

Explosive: Any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion with substantially simultaneous release of gas and heat, the resultant pressure being capable of destructive effects. The term includes, but is not limited to, dynamite, black powder, pellet

3.8 Operation with Fueled Experiments

Applicability

This specification applies to the operation of the reactor with any fueled experiment.

Objective

To assure that the confinement leak rate and fission product inventory are within the limits used in the PULSTAR Safety Analysis and are consistent with present U. S. Nuclear Regulatory Commission guides and the Code of Federal Regulations.

Specifications

Fueled experiments may be performed in experimental facilities of the PULSTAR reactor with the following conditions and limitations:

(1) The maximum mass of uranium-235 is limited to 400 milligrams.

(2) The thermal power (or fission rate) generated in the experiment is not greater than 5.5×10^7 fissions per second (1.77 milliwatt). *

(3) The total exposure of the material is not greater than the limits set in Figure 3.8-1.

(4) The reactor shall not be operated with a fueled experiment unless the ventilation system is operated in the confinement mode.

(5) The specifications pertaining to reactor experiments, detailed in Section 3.7 Limitations of Experiments, apply to fueled experiments.

Bases

In the event of the failure of a fueled experiment with the subsequent release of fission products the inhalation exposure to these isotopes at any location is bounded by the Fuel Pin Clad Failure Analysis. The failed fueled experiment analysis is described in SAR Section 13.

5.2 Reactor Building

a. The reactor shall be housed in the Reactor Building, designed for confinement. The minimum free volume in the Reactor Building shall be 2.25×10^9 cm^3 (refer to SAR Section 13 analysis).

b. The Reactor Building ventilation and confinement systems shall be separate from the Burlington Engineering Laboratories building systems and shall be designed to exhaust air or other gases from the building through a stack with discharge at a minimum of 100 feet above ground level.

c. The openings into the Reactor Building are the truck entrance door, personnel entrance doors, and air supply and exhaust ducts. *

d. The Reactor Building is located within the Burlington Engineering Laboratory complex on the north campus of North Carolina State University at Raleigh, North Carolina. Restricted Areas as defined in 10 CFR 20 include the PULSTAR Reactor Bay, Mechanical Equipment Room, Primary Piping Vault, and Waste Tank Vault. The PULSTAR Control Room is part of the Reactor Building, however it is also a controlled access area and a Controlled Area as defined in 10 CFR 20. The facility license applies to the Reactor Building and Waste Tank Vault. Figure 5.2-1 depicts the licensed area as being within the operations boundary.

c. A quorum shall consist of not less than a majority of the full RSC or RSAC and shall include the chairman or his designated alternate. Members from the line organization shown in Figure 6.1-1 shall not form a quorum.

d. RSC and RSAC shall meet at least four times per year, with intervals between meetings not to exceed six months. Both committees may also meet upon call of the Chair.

6.2.3 RSC/RSAC Review and Approval Function

The following items shall be reviewed and approved by the RSC or by referral to the RSAC, as needed:

a. Determinations that proposed changes in equipment, systems, test, experiments, or procedures meet license requirements. *

b. All new procedures and major revisions thereto having safety significance, proposed changes in reactor facility equipment, or systems having safety significance.

c. All new experiments or classes of experiments that could affect reactivity or result in the release of radioactivity.

d. Proposed changes to the Technical Specifications or facility license.

e. Violations of technical specifications or license. Violations of internal procedures or instructions having safety significance.

f. Operating abnormalities having safety significance.

g. Reportable Events (as per technical specification definition 1.22).

h. Audit reports.

RSC summaries and meeting minutes shall be provided to the Chancellor, Provost, Vice Chancellor for Research, Vice Chancellor for Business and Finance, Faculty Senate, and University Archives.

A summary of RSAC meeting minutes, reports, and audit recommendations approved by RSAC shall be submitted to Dean of the College of Engineering, Head of the Nuclear Engineering Department, Director of the Nuclear Reactor Program, the RSC, Director of * Environmental Health and Safety, and the RSAC prior to the next scheduled RSAC * meeting. Recommendations of the annual audit made by RSAC are forwarded to the RSC for concurrence before being implemented.

6.4 Review of Experiments

6.4.1 New (untried) Experiments

All new experiments or class of experiments, referred to as "untried" experiments, shall be reviewed and approved by the Associate Director of the Nuclear Reactor Program, Reactor Health Physicist, and the Radiation Safety Committee (or RSAC as applicable), prior to initiation of the experiment.

The review of new experiments shall be based on the limitations prescribed by Technical Specifications 3.7 and 3.8 and other Nuclear Regulatory Commission regulations, as applicable. If the Radiation Safety Committee, the Associate Director of the Nuclear Reactor Program, and the Reactor Health Physicist jointly agree that the experiment can be safely performed within the limitations of the technical specifications and other applicable Nuclear Regulatory Commission regulations, then an authorized experiment can be issued by the RSC. *

6.4.2 Tried Experiments

All proposed experiments are reviewed by the Reactor Operations Manager and the Reactor Health Physicist (or their designated alternates). Either of these individuals may deem that the proposed experiment is not adequately covered by the documentation/ analysis associated with an existing authorized experiment and therefore constitutes an untried experiment that will require the approval process detailed under Technical Specification 6.4.1. If the Reactor Operations Manager and the Reactor Health Physicist concur that the experiment is a tried experiment, then the request is approved and the experiment can be scheduled within the limitations of the reactor operating schedule. *

Substantive changes to previously approved experiments shall be made only after review and approval by the Associate Director of the Nuclear Reactor Program, Reactor Health Physicist, and the Radiation Safety Committee (or RSAC as applicable).

6.7 Reporting Requirements

6.7.1 Reportable Event

For Reportable Events as defined by section 1.22 of these specifications, there shall be a report not later than the following work day by telephone to the Nuclear Regulatory Commission Operations Center followed by a written report within 14 days that describes the circumstances of the event.

6.7.2 Permanent Changes in Facility Organization

Permanent changes in the facility organization involving either Level 1 or 2 personnel (refer to specification 6.1) shall require a written report within 30 days to the Nuclear Regulatory Commission Document Control Desk.

6.7.3 Changes Associated with the Safety Analysis Report

Significant changes in the transient or accident analysis as described in the Safety Analysis Report shall require a written report within 30 days to the Nuclear Regulatory Commission Document Control Desk.

6.7.4 Annual Operating Report

An annual operating report is required to be submitted no later than February 28th of each year and will cover the period of January 1st through December 31st. The report is transmitted to the Document Control Desk, Nuclear Regulatory Commission, Washington. The annual report shall contain as a minimum, the following information: *

a. A brief narrative summary:

   i. Operating experience including a summary of experiments performed.

   ii. Changes in performance characteristics related to reactor safety that occurred during the reporting period

   iii. Results of surveillance, tests and inspections.

b. Tabulation of the energy output (in megawatt days) of the reactor, hours reactor was critical, and the cumulative total energy output since initial criticality.

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 15 TO

FACILITY OPERATING LICENSE NO. R-120

NORTH CAROLINA STATE UNIVERSITY

DOCKET NO. 50-297

1.0 INTRODUCTION

By letter dated September 28, 2004, the North Carolina State University (the licensee or NCSU) submitted requests to change the Technical Specifications (TS). Two changes proposed are to correct typographical errors (TSs 3.3.i and 3.8.(2)). Further proposed changes (TS 3.6.a and c and TS 5.2.c) were requested to allow a building modification. A change to TS 3.7 was proposed to allow the possibility of using cryogenic liquids as a component of reactor experiments. A change to TS 6.2.3.a was proposed to make the wording more compatible with the present 10 CFR Part 50.59. Two administrative changes were proposed for TS 6.2.3 and 6.2.4 to clarify the chain of command. Changes to TS 6.4.1 and 6.4.2 were proposed to increase terminology consistency and grammar. Lastly, a change was proposed to TS 6.7.4 to change the period of review and date of submission for the annual report.

2.0 EVALUATION

Proposed change to TSs 3.3.i

The licensee proposes that TS 3.3(i) be corrected to state "$ 14 feet 2 inches" rather than the present "#14 feet 2 inches." This is a correction of a typographical error. A SCRAM signal is required at or before the pool water level decreases to 14 feet 2 inches. The safety system operates in this way as it should. The correction is acceptable.

Proposed change to 3.8(2)

The licensee proposes that TS 3.8(2) be corrected to state "5.5×10^7 fissions per second" rather than the present "5.5×10^8 fissions per second." This is a typographical error and is based on Section 13.2.1.6 of the FSAR. The value of 5.5×10^7 fissions per second was used in the FSAR analyses for accidents involving fueled experiments and is equivalent to a thermal power level of 1.77 milliwatts, which is included in the present specification and will remain. The correction is acceptable.

Proposed changes TS 3.6.a and c and TS 5.2.c

The licensee's proposed changes to TS 3.6.a, 3.6.c, and 5.2.c eliminate references to the Primary Piping Vault (PPV) service hatch. The PPV is an underground vault that houses primary coolant piping and the delay tank. An emergency exit is being installed at the loading dock and a walkway is being installed between the South Wing of the Burlington Engineering Laboratory and Reactor Building. As a result of this modification to Burlington Engineering Laboratory, the PPV service hatch will be removed and the PPV ceiling will be sealed. A walkway will be located on top of some fill and the PPV ceiling. Also, the reactor building air intake shaft that is covered by locked, steel grates is located immediately outside the emergency exit door and will become part of the walkway. The air intake will not be affected by this building modification. The staff has determined that this modification and the TS change necessitated by the modification promotes the common defense and security and protects the health and safety of the public and is therefore acceptable.

The change to TS 5.2 will become effective after the amendment issuance date and when the modification commences. The changes to TS 3.6 will become effective after the amendment issuance date and when the modification is complete. This allows the licensee to make the modification without violating TSs.

Proposed change to TS 3.7

The licensee is proposing a change to TS 3.7. The current TS categorically prohibits the use of cryogenic liquids in experiments within the biological shield of the PULSTAR reactor. The licensee wishes to remove the prohibition and allow the possibility of experiments using cryogenic liquids. The proposed changes does not bypass the experimental review and quality assurance procedures that the licensee has in place for experiments. In addition, since a specific experiment would not be approved by this amendment, any proposed experiment using cryogenic liquids is subject to the regulations, specifically 10 CFR 50.59. The licensee's proposed change is consistent with similar TSs for other similar research reactors and is in compliance with the industry standard ANSI/ANS-15.1-1990, *The Development of Technical Specifications for Research Reactors*. Section 3.8.2 of this standard regarding materials used in experiments states the following:

> No material is excluded from experiments at research reactors. However, special requirements shall be established for significant amounts of special materials such as fissionable materials, explosives or metastable materials capable of significant energy release, or materials that are corrosive to reactor components or highly reactive with coolants. Requirements may range from detailed analyses to double encapsulation and prototype testing with larger amounts.

The staff has determined that the change does not exclude experiments using cryogenic liquids from the licensee's established experimental review and quality assurance procedures, continues to meet the regulations, and is consistent with the peer developed standards for research reactors. The staff find these controls protect the health and safety of the public and the environment while not imposing excessive regulation. This is consistent with Section 104.c of the Atomic Energy act of 1954 as amended (the Act). The changes are acceptable to the NRC staff.

Proposed change to TS 6.2.3.a

The licensee proposes that TS 6.2.3(a) be reworded to state that the Radiation Safety Committee (RSC)/ Reactor Safety and Audit Committee (RSAC) will review and approve determinations that proposed changes to equipment, systems, tests, experiments, and procedures "meet license requirements." Specifically, the phrase "which have safety significance do not involve an unreviewed safety question" was replaced with "meet license requirements" to be consistent with the revised 10 CFR 50.59 and the industry standard, ANSI/ANS-15.1-1990, *The Development of Technical Specifications for Research Reactors*, Section 6.2.3(1). This change requires all procedures be reviewed and approved by RSAC and RSC, which is a more conservative requirement than that contained in the current TS. The staff find this change acceptable.

Proposed changes to TS 6.2.3 and 6.2.4

The licensee proposed these changes to clarify the chain of command. In TS 6.2.3, the Associate Director, Nuclear Reactor Program (NRP), will be deleted from those persons receiving a summary of RSAC meeting minutes directly from the RSAC. The Director, NRP, will now assume the responsibility to distribute the summary of RSAC meeting minutes to members within the NRP.

The licensee proposed that in TS 6.2.4 the Associate Director, NRP, be deleted from receiving an immediate report on any deficiencies uncovered from RSAC audits directly from the RSAC. The Director, NRP, is given the responsibility to inform or distribute the report to members within the NRP.

These changes are acceptable to the NRC staff.

Proposed changes to TS 6.4.1 and 6.4.2

The licensee proposed that in TS 6.4.1 the phrase "approved PULSTAR Project Number can be issued by the RSC for the experiment" be replaced with "authorized experiment can be issued by the RSC" for consistency with current University terminology and grammar.

Similarly the licensee proposed that in TS 6.4.2 the phrase "approved PULSTAR Project" was replaced with "authorized experiment" for consistency with current University terminology.

The staff finds that these changes do not have regulatory significance and are therefore acceptable.

Proposed change to TS 6.7.4

The licensee proposed that in TS 6.7.4 the period of review and date of submission for the annual report be changed to a calendar year and February 28th, respectively, for consistency with other reporting requirements, e.g., 10 CFR 20 requirements for personnel dosimetry and effluents. With this change, the licensee also requested sixty (60) days to submit the report for the July 1, 2004 through December 31, 2004, thereby covering the six-month reporting gap created by the change in reporting period. The staff find this change acceptable, and will expect the submission of the report for the above six-month period sixty days after the date of issuance of this amendment.

3.0 ENVIRONMENTAL CONSIDERATION

This amendment involves changes in the installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 or changes in inspection and surveillance requirements. The staff has determined that this amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released off site, and no significant increase in individual or cumulative occupational radiation exposure. Accordingly, this amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of this amendment.

4.0 CONCLUSION

The staff has concluded on the basis of the considerations previously discussed that (1) because the amendment does not involve a significant increase in the probability or consequences of accidents previously evaluated, or create the possibility of a new or different kind of accident from any accident previously evaluated, and does not involve a significant reduction in a margin of safety, the amendment does not involve a significant hazards consideration; (2) there is reasonable assurance that the health and safety of the public will not be endangered by the proposed activities; and (3) such activities will be conducted in compliance with the Commission's regulations, and the issuance of this amendment will not be inimical to the common defense and security or the health and safety of the public.

Principal Contributor: Daniel E. Hughes, Project Manager

Date: March 3, 2005