APPENDIX A

FACILITY LICENSE NO. R-117

TECHNICAL SPECIFICATIONS

FOR

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOW POWER REACTOR ASSEMBLY (LOPRA)

DOCKET NO.: 50-356

Amendment No. 5
Dated: September 1989

8910050077 890929
PDR ADOCK 05000356
P PDC

TABLE OF CONTENTS

Included in this document are the Technical Specifications and the "Bases" for the Technical Specifications. These bases, which provide the technical support for the individual technical specifications are included for information purposes only. They are not part of the Technical Specifications, and they do not constitute limitations or requirements to which the licensee must adhere.

1.0 DEFINITIONS

The following frequently used terms are defined to aid in the uniform interpretation of these specifications.

1.1 LOPRA Shutdown - The LOPRA is in a shutdown condition when sufficient safety control rods are inserted to assure that it is subcritical by at least $1.00 of reactivity.

1.2 LOPRA Secured - The LOPRA is secured when all of the following conditions are satisfied.

a. The LOPRA is shutdown.

b. Power to the safety control rod magnets is off and the key is removed.

c. No work is in progress involving fuel or incore experiments, maintenance of the core structure, or maintenance of the control rods unless the LOPRA is inoperative or disassembled.

1.3 LOPRA Inoperative - The LOPRA is inoperative when both the following conditions are satisfied:

a. Sufficient fuel has been removed from the assembly to assure that $k_{eff} < 0.99$ with all safety control rods, poison rod, and measuring devices removed from the core region.

b. The LOPRA has been de-coupled from the Illinois Advanced TRIGA by placing a neutron absorbing curtain, equivalent to 20 mils of boral, between the assembly and the graphite column and/or by moving the assembly away from the graphite column to provide at least the equivalent effect.

1.4 LOPRA Disassembled - The LOPRA is disassembled when sufficient fuel has been removed from the bulk shielding facility to assure that a subcritical assembly cannont be formed with a $k_{eff} < 0.99$. Subcritical experiments as defined in Section 3.9 of the Technical Specifications of the Illinois Advanced TRIGA may be performed under these conditions.

1.5 LOPRA Operation - The LOPRA is in operation when it is not secured.

1.6 Safety Control Rod - An assembly of rods connected to a bar having scram capabilities.

1.7 Poison Rod - A neutron absorbing rod with an electric motor drive.

1.8 Cold Critical - The LOPRA is in the cold critical condition when it is critical with the fuel and bulk water temperature the same ambient temperature (~25°C.).

1.9 Experiment - An experiment is a measurement performed to determine the characteristics of the LOPRA or the coupling effect between the LOPRA and the Illinois Advanced TRIGA.

1.10 Steady-state Operation - The LOPRA is in steady-state operation when its power is held constant or is changed on periods greater than five seconds.

1.11 Transient Operation - The LOPRA is in transient operation when its power is increased on periods less than five seconds as a result of operation of the Illinois Advanced TRIGA in the pulse or square-wave mode.

1.12 Reportable Occurrence - A reportable occurrence is any of the following:

a. Any actual safety system setting less conservative than specified in Section 2 of these specifications;

b. Violation of a limiting condition for operation;

c. Malfunction of a required reactor or experiment safety system component which could render or threaten to render the system incapable of performing its intended safety function;"

d. Release of fission products from a fuel element;

e. An uncontrolled or unanticipated change in reactivity; and

f. An observed inadequacy in the implementation of either administrative or procedural controls, such that the inadequacy could have caused the existence or development of an unsafe condition in connection with the operation of the reactor.

1.13 Operable - A system or device is operable when it is capable of performing its intended functions in its normal manner.

1.14 Operating - Operating means a component or system is performing its intended functions in its normal manner.

1.15 LOPRA Safety System - The LOPRA safety system is that combination of measuring channels and associated circuitry which forms the automatic protective system for the LOPRA or provides information which requires manual protective action to be initiated.

1.16 Measured Value - The measured value of a process variable is the value of the variable as it appears on the output of a channel.

1.17 Measuring Channel - A measuring channel is the combination of sensor, lines, amplifiers and output devices which are connected for the purpose of measuring the value of a process variable.

1.18 Channel Check - A channel check is a qualitative verification of acceptable performance by observation of channel behavior. This verification shall include comparison of the channel with other independent channels or methods measuring the same variable.

1.19 Channel Test - A channel test is the introduction of a signal into the channel to verify that it is operable.

1.20 Channel Calibration - A channel calibration is an adjustment of the channel such that its output responds with acceptable range and accuracy to known values of the parameter which the channel measures.

2.0 SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

2.1 Safety Limit - LOPRA Power Level

Applicability

The specification applies to the LOPRA power level.

Objective

The objective is to define a LOPRA power level such that the fuel element temperature will never exceed 550°C either during LOPRA operation or if water should be lost from the system.

Specification

a. The steady-state reactor power level shall not exceed 250 kilowatts under any condition of operation.

b. The peak LOPRA power level from a transient shall not exceed 1,000 megawatts.

Bases

The safety limit is set at power levels that will assure that the fuel temperature will not exceed 550°C. This avoids a phase change in the zirconium hydride which might cause excessive distortion of a fuel element. An accumulation of past data on TRIGA operation shows that the maximum fuel temperature will be less than 500°C for 1.0 megawatt operation (page III-28 of the Safety Analysis Report for the Illinois Advanced TRIGA). TRIGA data also shows that the maximum fuel temperature will be less than 500°C for transients where the peak power level reaches 1,000 megawatts.

Amendment No. 5

The lower LOPRA power level safety limit assures that the fuel temperature would not exceed the limiting temperature if a loss of water should occur. This is based on the 'Loss of Coolant Calculations', Proposed Amendment to the Utilization Facility License Number R-69 and on a two-dimensional, transient heat transport computer code, entitled RAT, developed at Gulf General Atomic. In both cases, calculations are made on the maximum temperature in a TRIGA core after a water loss. Additional information on the phase change in the zirconium-hydride is given in "Technical Foundations of the TRIGA," Report GA-471, pages 63-72, August 1958.

2.2 Limiting Safety System Settings

Applicability

The specification applies to the trip settings for the power level monitoring channels.

Objective

The objective is to assure that the safety limit will not be exceeded and to limit the external radiation hazard from the operation of the LOPRA.

Specification

a. The steady-state LOPRA power level trip setting shall not exceed 10 kilowatts.

b. The peak LOPRA level trip setting for transient operation shall not exceed 10 megawatts.

Bases

Since the trip settings for the power level monitoring channels are specified well below the safety limit, there is no danger of reaching levels that could damage the integrity of the fuel. The limiting safety system settings are based on the estimated radiation levels in the region around the bulk shielding facility. These levels are given on page 18 of the Safety Analysis Report for the LOPRA. At the specified power levels the dose rates are at a value where compliance with the provisions of 10 CFR 20, regarding personnel exposure, restricted areas and unrestricted areas, can be assured. It is anticipated that for steady-state operations above one kilowatt, restrictions on the time of operation will be required. Restrictions may also be required for the number of transients in a given period of time.

3.0 LIMITING CONDITIONS FOR OPERATION

3.1 Reactivity

Applicability

These specifications apply to the reactivity conditions of the LOPRA and to the reactivity worths of control rods and measuring devices.

Objective

The objective is to limit the maximum power level in terms of the negative temperature coefficient and to assure that the LOPRA can be shutdown under all conditions.

Specifications

The LOPRA shall not be operated unless the following conditions exist:

a. The excess reactivity is less than 60 cents.

b. The shutdown margin referred to the cold critical condition, with the highest worth control rod fully withdrawn, is greater than $1.00.

c. The total reactivity worth of all measuring devices is limited so that the shutdown margin, referred to the cold critical condition with all rods in, is at least $1.50.

d. The reactivity worth of the poison rod is greater than 80 cents.

e. The drop time of a safety control rod from the fully withdrawn position to 90 percent of full reactivity insertion is less than two seconds.

Bases

The excess reactivity limit places a limit on the equilibrium power level as shown by Figure 7 of the SAR for the LOPRA. This is caused by the prompt negative temperature coefficient of TRIGA fuel. The level is such that steps could be initiated to shut down the LOPRA if all controls should fail (Section XIV of the SAR for the LOPRA). Specification 3.1.b. assures that the LOPRA can be shut down even if one control rod should stick in the fully withdrawn position. Specification 3.1.c places a limit on the reactivitv worths of measuring devices to assure that the LOPRA can be shut down even if these devices are removed.

Specification 3.1.d. assures that the LOPRA would not go critical unless the poison rod is partially withdrawn and thus control over the power level is attained with this neutron absorbing rod. The rod drop time assures a prompt shutdown in the event a scram signal is received.

3.2 LOPRA Instrumentation

Applicability

The specification applies to the information which must be available to the LOPRA operator during LOPRA operation.

Objective

The objective is to require that sufficient information is available to the LOPRA operator to assure safe operation of the LOPRA.

Specification

The LOPRA shall not be operated unless the measuring channels described in the table are operable and the information is displayed in the control room.

Measuring Channel	Minimum Number	Type of Operation
LOPRA Power Level	2	Steady-state
Peak Power Level	1	Transient
Startup Count Rate	1	During LOPRA Startup
Area Radiation Monitors	3	All Operations
Continuous Air Radiation Monitor	1	All Operations

Bases

Since the safety of the LOPRA has been defined in terms of the LOPRA power level, two independent measurements of this parameter will be available during steady-state operation. A separate channel will be utilized to assure that sufficient neutrons are available in the core to provide a signal to a startup channel during approaches to critical. During transient operation (pulsed operation of the Illinois Advanced TRIGA), one power channel will be set to record the peak power level of the LOPRA.

The radiation monitors provide information on the radiation levels in the laboratory. Audible and visible alarms will alert personnel to allow sufficient time to evacuate the facility should any impending or existing danger from radiation occur, and allow the necessary steps to be taken to prevent the spread of radioactivity to the surroundings.

3.3 LOPRA Safety System

Applicability

This specification applies to the LOPRA safety system channels.

Amendment No. 5

Objective

The objective is to assure that a sufficient number of safety system channels is operable such that automatic and manual protection is provided for sudden increases in the LOPRA power level or the radiation level.

Specification

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

Measuring Channel	Minimum Number	Type of Operation
LOPRA Power Level	2	Steady-state
Peak Power Level	1	Transient
Manual Button	2	All Operations

Bases

The LOPRA power level scrams are initiated if the maximum safety system setting is exceeded. This setting is well below the safety limit and thus assures that the safety limit will not be exceeded. The scrams also limit the radiation level in the laboratory. Manual scrams are provided in the control room and at the bulk shielding facility. These allow manual protection to be initiated from either region should there be an abnormal condition which is not protected by the automatic safety systems.

3.4 Release of Argon-41

Applicability

This specification applies to the release of argon-41 from the facility stack.

Objective

The objective is to assure that exposures to the public resulting from the release of argon-41 generated by reactor operation will not exceed the limits of 10 CFR Part 20 for unrestricted areas.

Specification

Releases of argon-41 from the reactor stack shall not be made in concentrations greater than 2×10^{-6} μc/ml, averaged over a year.

Amendment No. 5

Bases

The above limit is the same as the limit specified for the Illinois Advanced TRIGA reactor, located in the same building. It was shown in the SAR for that reactor that the above stack concentrations will not result in exposures in excess of the limits of 10 CFR Part 20.

3.5 Ventilation System

Applicability

This specification applies to the operation of the reactor facility ventilation system.

Objective

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

Specification

The LOPRA shall not be operated unless the facility ventilation system is in operation, except for periods of time not to exceed two days to permit repairs to the system. During such periods of repair:

a. The LOPRA shall not be operated at power levels above 100 watts;

b. The LOPRA will not be subjected to pulsed operation; and

c. The LOPRA shall not be operated with experiments in place whose failure could result in the release of radioactive gases or aerosols.

Bases

It is shown in Section XIV of the SAR that operation of the ventilation system sufficiently reduces off-site doses to below 10 CFR Part 20 limits in the event of a TRIGA fuel element failure. The specifications governing operation of the reactor while the ventilation system is undergoing repair preclude the likelihood of fuel element failure during such times.

3.6 Experiments

Applicability

This specification applies to items that may be placed in the core region of the LOPRA.

Objective

The objective is to prevent damage to the core components and to minimize flux perturbation in the core region.

Specification

The LOPRA shall not be operated unless the following conditions exist:

a. Experiments placed in the core region are limited to those devices to be used to measure the neutron or gamma flux.

b. Fuel experiments are limited such that the total inventory of iodine isotopes 131 through 135 in the experiment is not greater than 1.5 curies and the strontium-90 inventory is not greater than 5 millicuries.

c. Materials rosive to the LOPRA components or known explosive materials not being used.

Bases

The LOPRA was built strictly for the purpose of measuring its neutron characteristics and the coupling between the LOPRA and the Illinois Advanced TRIGA. Thus, experiments involving irradiation of samples other than flux measuring devices will not be done with this reactor system. The limitation on fuel experiments is the same as in the Technical Specifications for the Illinois Advanced TRIGA. It was shown in the Safety Analyses Report for the Illinois Advanced TRIGA that this limit would prevent the dose in unrestricted areas, resulting from failure of experiments, from exceeding the 10 CFR 20 limits.

3.7 Primary Coolant Quality

Applicability

This specification applies to the quality of the primary coolant water in contact with the cladding of the fuel in the reactor core.

Objective

a. To limit the possibility for corrosion of the cladding on the fuel elements.

b. To limit the concentration of dissolved materials which could be activated by neutron exposure.

Specification

The LOPRA shall not be operated if the conductivity of the water in the reactor pool is higher than 4×10^{-6} mho-cm-1.

Bases

a. Corrosion may occur continuously in a water-metal system. In order to limit the rate of corrosion, and thereby extend the life and integrity of the fuel cladding, a water clean-up system is required. Experience with water quality control at many reactor facilities has shown that maintenance within the specified limit provides acceptable corrosion control.

b. Limiting the concentration of material dissolved in the water limits the radioactivity of neutron activation products. This tends to decrease the inventory of radionuclides in the entire coolant system, which will decrease personnel radiation exposures during both maintenance and operations. This trend is consistent with the ALARA principle.

4.0 SURVEILLANCE REQUIREMENTS

4.1 Control Rods

Applicability

This specification applies to the surveillance requirements for the control rods.

Objective

The objective is to assure the integrity of the control rods.

Specifications

a. The reactivity worth of each control rod shall be determined semiannually, but at intervals not to exceed eight months. If LOPRA is inoperative at the end of the eight month period, the interval may be extended to fourteen months or until the LOPRA is made operable, whichever occurs first.

b. Control rod drop times shall be determined semi-annually, but at intervals not to exceed eight months.

c. The control rods shall be visually inspected for deterioration at intervals not to exceed two years.

Bases

The reactivity worth of the control rods is measured to assure that the required shutdown margin is available and to provide a means for determining the reactivity worths of experiments inserted in the core. The visual inspection of the control rods and measurements of their drop times are made to determine whether the control rods are capable of performing properly.

Amendment No. 5

4.2 Fuel Elements

Applicability

This specification applies to the surveillance requirements for the fuel elements.

Objective

The objective is to assure the integrity of the fuel elements.

Specification

The fuel elements shall be visually inspected yearly, but at intervals not to exceed 14 months. If indication of deterioration or distortion is found, the fuel element(s) shall be replaced.

Bases

The visual inspection of the fuel elements specified has been shown to be adequate from experience with other low power TRIGA reactors.

4.3 LOPRA Safety System

Applicability

This specification applies to the surveillance requirements for the measuring channels of the LOPRA safety system.

Objective

The objective is to assure that the safety system will remain operable to prevent the safety limits from being exceeded.

Specifications

a. A channel test of each of the LOPRA safety system channels shall be performed prior to each day's operation or prior to each operation extending more than one day.

b. A channel check of the power level measuring channels shall be performed daily whenever the LOPRA is in operation.

c. A channel calibration using the prompt negative temperature coefficient technique or by comparative flux measurements shall be made on the power level monitoring channels semi-annually, but at intervals not exceeding eight months. If the LOPRA is inoperative at the end of the eight month period, the interval may be extended to fourteen months or until the LOPRA is made operable, whichever occurs first.

Bases

The daily tests prescribed will assure that the safety channels are operable. The semi-annual calibration will permit any drift in the power instrumentation to be corrected.

4.4 Radiation Monitoring Equipment

Applicability

This specification applies to the radiation monitoring equipment required by Section 3.2 of these specifications.

Objective

The objective is to assure that the radiation monitoring equipment is operating and to verify the appropriate alarm settings.

Specification

The alarm set points for the radiation monitoring equipment shall be verified weekly when the reactor is in operation.

Bases

Because of the redundancy of radiation monitoring instrumentation provided, weekly surveillance of the equipment will be adequate to assure that sufficient protection against radiation is available.

4.5 Maintenance

Applicability

This specification applies to the surveillance requirements following maintenance of a control or safety system.

Objective

The objective is to assure that a system is operable before being used after maintenance has been performed.

Specification

Following maintenance or modification of a control or safety system or component, it shall be verified that the system is operable prior to its return to service.

Amendment No. 5

Bases

The intent of the specification is to assure that work on the system or component has been properly carried out and that the system or component has been properly reinstalled or reconnected.

4.6 Primary Coolant Quality

Applicability

This specification applies to the surveillance of the quality of the primary coolant water in the pool.

Objective

The objective is to insure that the quality of the primary coolant water in contact with the fuel cladding does not deteriorate over extended periods of time even if the reactor is not operated.

Specifications

The conductivity of the primary coolant water in the pool shall be measured at least once every two weeks, and shall not exceed 5×10^{-6} mho-cm-1 for more than 5 consecutive days.

Bases

Section 3.7 (limiting conditions for operation) ensures that the water quality is acceptable during reactor operation. Section 4.6 ensures that the fuel cladding is not exposed to a significantly more corrosive environment for an extended period of time in the event that the reactor is not actually operated.

5.0 DESIGN FEATURES

5.1 LOPRA Fuel

Applicability

This specification applies to the fuel elements used in the reactor core.

Objective

The objective is to assure that the fuel elements are of such a design and fabricated in such a manner as to permit their use with a high degree of reliability with respect to their mechanical integrity.

Amendment No. 5

Specifications

a. Standard Fuel Element: The standard fuel element shall contain uranium-zirconium hydride, clad in 0.020 inch of 304 stainless steel. It shall contain a maximum of 9.0 weight percent uranium which has a maximum enrichment of 20 percent. There shall be 1.55 to 1.80 hydrogen atoms to 1.0 zirconium atom.

b. Low Hydride Fuel Element: This fuel element shall contain uranium-zirconium hydride, clad in 0.030 inch of aluminum or 0.020 inch of 304 stainless steel. It shall contain a maximum of 9.0 weight percent uranium which has a maximum enrichment of 20 percent. There shall be 0.9 to 1.54 hydrogen atoms to 1.0 zirconium atom.

c. Sandia Fuel Element: This fuel element shall contain uranium-zirconium hydride, clad in 0.020 inch of 304 stainless steel. It shall contain a maximum of 12.0 weight percent uranium which has a maximum enrichment of 20 percent. There shall be 1.55 to 1.80 hydrogen atoms to 1-0 zirconium atom.

d. Loading: The elements shall be placed in a closely packed array except for experimental facilities or for single positions occupied by control rods and a neutron start-up source.

Bases

These types of fuel elements have a long history of successful use in TRIGA reactors.

5.2 Reactor Building

Applicability

This specification applies to the building which houses the reactor.

Objective

The objective is to assure that provisions are made to restrict the amount of release of radioactivity into the environment.

Specifications

a. The reactor shall be housed in a closed room of a building designed to restrict leakage.

b. The minimum free volume of the reactor room shall be 70,000 cubic feet.

c. The reactor building shall be equipped with a ventilation system capable of exhausting air or other gases from the reactor room from a stack at a minimum of 60 feet above ground level.

Bases

In order that the movement of air can be controlled, the building contains no windows that can be opened. The room air is exhausted through absolute filters and discharged through a stack to provide dilution.

5.3 Fuel Storage

Applicability

This specification applies to the storage of reactor fuel at times when it is not in the reactor core.

Objective

The objective is to assure that fuel which is being stored will not become supercritical and will not reach an unsafe temperature.

Specifications

a. All fuel elements shall be stored in a geometrical array where the keff is less than 0.8 for all conditions of moderation.

b. Irradiated fuel elements and fueled devices shall be stored in an array which will permit sufficient natural convection cooling by water or air such that the fuel element of fueled device temperature will not exceed 800°C for the stainless steel clad LOPRA fuel and 500°C for the aluminum clad LOPRA fuel.

Bases

New fuel is stored in its shipping containers or in a 15-position rack in a locked storage room, Hot fuel is stored in pits described in Section IX of the SAR for the Advanced TRIGA reactor. These pits are designed to hold 24 elements, an amount which cannot form a critical array. Very hot fuel is stored in racks in the main tank or the bulk shielding tank where cooling water is provided.

6.0 ADMINISTRATIVE CONTROLS

6.1 Organization

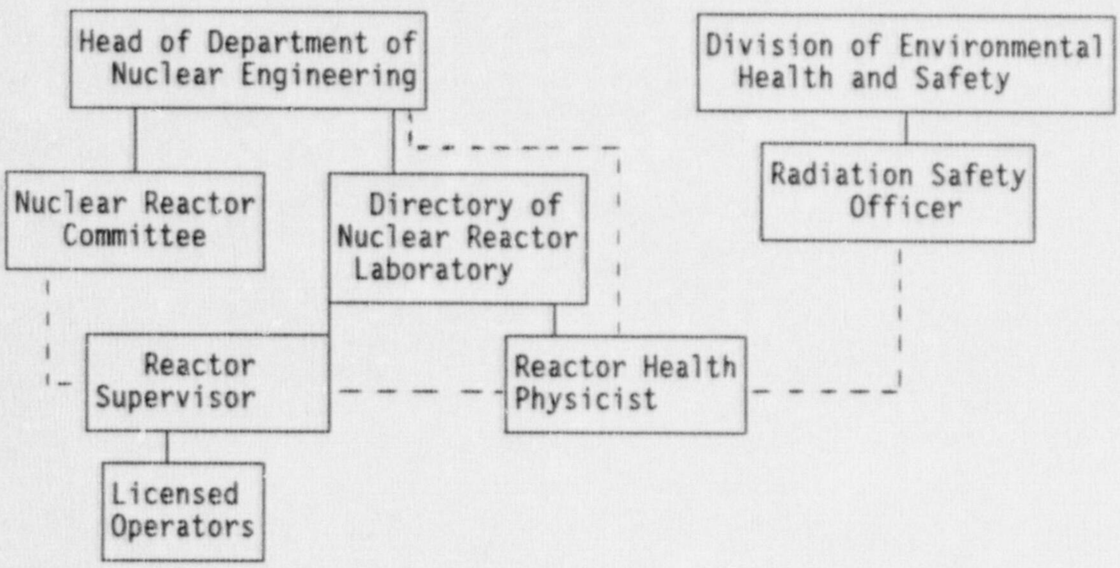
a. The LPORA facility shall be an integral part of the Department of Nuclear Engineering of the College of Engineering of the University of Illinois. The LOPRA shall be related to the University structure as shown in Chart I.

Amendment No. 5

b. The LOPRA facility shall be under the supervision of the Reactor Supervisor who shall have qualified as a licensed senior operator for the LOPRA. He shall be responsible for assuring that all operations are conducted in a safe manner and within the limits prescribed by the facility license and the provisions of the Nuclear Reactor Committee.

c. There shall be a Reactor Health Physicist responsihle for assuring the day to day and routine radiological safety activities at the Nuclear Reactor Laboratory. The University of Illinois Radiation Safety Officer shall be responsible for monitoring, planning and promoting radiological safety at the Nuclear Reactor Laboratory. He has the responsibility and authority to stop, secure or otherwise control as necessary any operation or activity that poses an unacceptable radiological hazard.

CHART I



Reactor Operation

Chart I. Administrative organization of the reactor facility. Dashed lines indicate reporting paths outside the operational chain of supervision, indicated by solid lines.

6.2 Review

a. There shall be a Nuclear Reactor Committee which shall review LOPRA operations to assure that the facility is operated in a manner consistent with public safety and within the terms of the facility license.

b. The responsibilities of the Committee include, but are not limited to the following:

1. Review and approval of experiments utilizing the LOPRA facilities;

2. Review and approval of all proposed changes to the facility, procedures, and Technical Specifications;

3. Determination of whether a proposed change, test, or experiment would constitute an unreviewed safety question or a change in the Technical Specifications;

4. Review of the operation and operational records of the facility;

5. Review of abnormal performance of plant equipment and operating anomalies;

6. Review of unusual occurrences and incidents which are reportable under 10CFR§20 and 20CFR§20; and

7. Approval of individuals for the supervision and operation of the LOPRA.

c. The Committee shall be composed of at least five voting members, one of whom shall be a Health Physicist designated by the Health Physics Office of the University, and one whom shall be the Director of the Reactor Laboratory, Three members shall be appointed by the Head of the Department of Nuclear Engineering, chosen from the faculty of Nuclear Engineering so as to maintain a balanced knowledge of reactor safety and regulation. The Reactor Supervisor and the Reactor Health Physicist shall be non-voting members.

d. The Committee shall have a written statement defining such matters as the authority of the Committee, the subjects within its purview, and other such administrative provisions as are required for effective functioning of the Committee. Minutes of all meetings of the Committee shall be kept.

e. A quorum of the Committee shall be a majority of not less than one half of the members and the reactor operating staff shall not constitute a voting majority.

f. The Reactor committee shall meet at least quarterly with the interval between meetings not to exceed 5 months.

6.3 <u>Operating Procedures</u>

Written procedures, reviewed and approved by the Nuclear Reactor Committee, shall be in effect and followed for the following items. The procedures shall be adequate to assure the safety of the LOPRA, but should not preclude the use of independent judgment and action should the situation require such.

a. Startup, operation, and shutdown of the LOPRA.

b. Installation or removal of fuel elements, control rods, experiments, and experimental facilities.

c. Actions to be taken to correct specific and foreseen potential malfunctions of systems or components, including responses to alarms and abnormal reactivity changes.

d. Emergency conditions involving potential or actual release of radioactivity, including provisions for evacuation, re-entry, recovery, and medical support.

e. Maintenance procedures which could have an effect on LOPRA safety.

f. Periodic surveillance of LOPRA instrumentation and safety systems, area monitors and continuous air monitors.

Substantive changes to the above procedures shall be made only with the approval of the Nuclear Reactor Committee. Temporary changes to the procedures that do not change their original intent may be made with the approval of the Reactor Supervisor. All such temporary changes to procedures shall be documented and subsequently reviewed by the Nuclear Reactor Committee.

6.4 Review and Approval of Experiments

a. All proposed experiments utilizing the LOPRA shall be evaluated by the experimenter and a staff member approved by the Nuclear Reactor Committee. The evaluation shall be reviewed by a licensed senior operator of the facility (and the Reactor Health Physicist when appropriate) to assure compliance with the provisions of the utilization license, the Technical Specifications, and 10 CFR 20,

If, in his judgment, the experiment meets with the above provisions and does not constitute a threat to the integrity of the LOPRA, the senior operator shall submit it to the Reactor Supervisor for scheduling or to the Nuclear Reactor Committee for final approval as indicated in Section 6.2 above. When pertinent, the evaluation shall include:

1. The reactivity worth of the experiment;

2. The integrity of the experiment, including the effects of changes in temperature, pressure, or chemical composition;

3. Any physical or chemical interaction that could occur with the reactor components; and

4. Any radiation hazard that may result from the activation of materials or from external beams.

b. Prior to the performing of an experiment not previously performed in the LOPRA, it shall be reviewed and approved in writing by the Nuclear Reactor Committee. Their review shall consider the following information:

   1. The purpose of the experiment;

   2. A procedure for the performance of the experiment; and

   3. The evaluation approved hy a licensed senior operator.

c. For the irradiation of materials, the applicant shall submit an "Irradiation Request" to the Reactor Supervisor or Reactor Health Physicist. This request shall contain information on the target material including the amount, chemical form, and packaging. For routine irradiations (which do not contain nuclear fuel or known explosive materials and which do not constitute a significant threat to the integrity of the LOPRA or to the safety of individuals), the approval for the Nuclear Reactor Committee may be made by the Reactor Supervisor and Reactor Health Physicist.

d. In evaluating experiments, the following assumptions shall be used for the purpose of determining whether failure of the experiment would cause the appropriate limits of 10CFR§20 to be exceeded:

   1. If the possibility exists that airborne concentrations of radioactive gases or aerosols may be released within the facility, 100 percent of the gases or aerosols will escape;

   2. If the effluent exhausts through a filter installation designed for greater than 99 percent efficiency for 0.3 micron particles, at least 10% of the particulates will escape; and

   3. For a material whose boiling point is above 130°F and where vapors formed by boiling this material could escape only through a column of water above the core, at least 10 percent of these vapors will escape.

6.5 <u>Action to be Taken in the Event a Safety Limit is Exceeded</u>

In the event a safety limit is exceeded, or thought to have been exceeded:

a. The LOPRA shall be shut down and LOPRA operation shall not be resumed until authorized by the USNRC.

b. An immediate report of the occurrence shall be made to the Chairman of the Nuclear Reactor Committee and reports shall be made to the USNRC in accordance with Section 6.7 of these specifications.

Amendment No. 5

c. A report shall be made which shall include an analysis of the causes and extent of possible resultant damage, efficacy of corrective action, and recommendations for measures to prevent or reduce the probability of reoccurrence. This report shall be submitted to the Nuclear Reactor Committee for review, and a suitable similar report submitted to the USNRC when authorization to resume operation of the LOPRA is sought.

6.6 Action to be Taken in the Event of a Reportable Occurrence

In the event of a reportable occurrence, as defined in Section 1.12 of the specifications, the following actions shall be taken.

a. The Reactor Supervisor shall be notified and corrective action taken prior to resumption of the operation involved.

b. A report shall be made which shall include an analysis of the cause of the occurrence, efficacy of corrective action, and recommendations for measures to prevent or reduce the probability of reoccurrence. This report shall be submitted to the Nuclear Reactor Committee for review.

c. Where appropriate, a report shall be submitted to the USNRC in accordance with Section 6.7 of these specifications.

6.7 Reporting Requirements

In addition to the requirements of applicable regulations, and in no way substituting therefore, reports will be made to the USNRC as follows:

a. An immediate report (by telephone and telegraph to the Regional Administrator, USNRC, Region III) of:

   1. Any accidental off-site release of radioactivity above permissible limits, whether or not the release resulted in property damage, personal injury or exposure; and

   2. Any violation of a safety limit.

b. A report within 24 hours (by telephone and telegraph to the Regional Administrator, USNRC, Region III) of:

   1. Any significant variation of measured values from a corresponding predicted or previously measured value of safety-connected operating characteristics occurring during operation ofthe LOPRA;

   2. Incidents or conditions relating to operation of the facility which prevented or could have prevented the performance of engineered safety features as described in these specifications; and

Amendment No. 5

3. Any reportable occurrences as defined in Section 1.12 of these specifications.

c. A report within 14 days (in writing to the Director, Office of Nuclear Reactor Regulation, Document Control Desk, USNRC Headquarters) of:

1. Any significant variation of measured values from a corresponding predicted or previously measured value of safety-connected operating characteristics occurring during operation of the LOPRA;

2. Incidents or conditions relating to operation of the facility which prevented or could have prevented the performance of engineered safety features as described in these specifications; and

3. Any reportable occurrences as defined in Section 1.12 of these specifications.

d. A report within 30 days (in writing to the Director, Office of Nuclear Reactor Regulation, Document Control Desk, USNRC Headquarters) of:

1. Any substantial variance from performance specifications contained in these specifications;

2. Any significant change in the transient or accident analyses as described in the Safety Analysis Report;

3. Any changes in facility organization; and

4. Any observed inadequacies in the implementation of administrative or procedural controls.

e. A report within 60 days after criticality of the LOPRA (in writing to the Director, Office of Nuclear Reactor Regulation, Document Control Desk, USNRC Headquarters) upon receipt of a new facility license or an amendment to the license authorizing an increase in LOPRA power level or the installation of a new core, describing the measured values of the operating conditions or characteristics of the LOPRA under the new conditions, including:

1. Total control rod reactivity worth;

2. Reactivity worth of the single control rod of highest reactivity worth;

3. Total and individual reactivity worths of any experiments inserted in the LOPRA; and

4. Minimum shutdown margin both at room and operating temperatures.

f. A routine report (in writing to the Director, Office of Nuclear Reactor Regulation, Document Control Desk, USNRC Headquarters) within 60 days after completion of the first six months of facility operation and at the end of each 12-month period thereafter, providing the following information:

1. A narrative summary of operating experience (including experiments performed) and of changes in facility design, performance characteristics and operating procedures related to LOPRA safety occurring during the reporting period;

2. A tabulation showing the energy generated by the LOPRA (in megawatt-hours), the amount of pulse operation, the number of hours the LOPRA was critical.

3. The number of emergency shutdowns and inadvertent scrams, including the reasons therefore;

4. Discussion of the major maintenance operations performed during the period, including the effect, if any, on the safe operation of the LOPRA, and the reasons for any corrective maintenance required;

5. A summary of each change to the facility or procedures, tests, and experiments carried out under the conditions of Section 50.59 of 10CFR50;

6. A summary of the nature and amount of radioactive effluents released or discharged to the environs beyond the effective control of the licensee as measured at or prior to the point of such release or discharge;

7. A description of any environmental surveys performed outside the facility; and

8. A summary of radiation exposures received by facility personnel and visitors, including the dates and times of significant exposures, and a summary of the results of radiation and contamination surveys performed within the facility,

6.8 <u>Records</u>

<u>Records to be Retained for a Period of at Least Five Years</u>:

a. Normal reactor facility operations (including scheduled and unscheduled shutdowns)

b. Principal maintenance operations

c. Reportable occurrences

d. Surveillance activities required by Technical Specifications

e. Facility radiation and contamination surveys

f. Experiments performed with the reactor

g. Approved changes to operating procedures

h. Records of meetings of the Nuclear Reactor Committee

Records to be Retained for the Life of the Facility:

a. Records of gaseous and liquid radioactive effluents released to the environment.

b. Appropriate off-site environmental monitoring surveys.

c. Fuel inventories and fuel transfers.

d. Radiation exposures for all personnel.

e. Updated as-built drawings of the facility.

f. Records of transient or operational cycles for those components designed for a limited number of transients or cycles.

g. Records of training and qualification for members of the facility staff.

h. Records and reviews performed for changes made to procedures or equipment or reviews of tests and experiments pursuant to 10 CFR 50-59.

These records may be coordinated for both the LOPRA and Advanced TRIGA Reactor facilities.