UNM SCHOOL *of* ENGINEERING

Department of Nuclear Engineering

December 15, 2014

U.S. Nuclear Regulatory Commission
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Washington D.C. 20555

Based on comments from our Reactor Safety Advisory Committee, we have reviewed and revised the technical specifications for the AGN-201M reactor located at the University of New Mexico, Docket 50-252. Changes have been made to reflect the split of the department into a stand-alone Nuclear Engineering Department. Other changes of an editorial nature have been made to make the document easier to read and use. Changes are noted by bars on the right hand side of the page and are described in the pages following this transmittal letter. An original and one copy of the revised document are submitted for approval.

If you have any questions or comments, please let us know.

Sincerely,

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copies (1): Linh Tran

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UNM SCHOOL of ENGINEERING

Department of Nuclear Engineering

December 15, 2014

Linh Tran
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Mail Stop O12 - D20
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Rockville, MD 20852

Dear Ms. Tran:

Based on comments from our Reactor Safety Advisory Committee, we have reviewed and revised the technical specifications for the AGN-201M reactor located at the University of New Mexico, Docket 50-252. Changes have been made to reflect the split of the department into a stand-alone Nuclear Engineering Department. Other changes of an editorial nature have been made to make the document easier to read and use. Changes are noted by bars on the right hand side of the page and are described in the pages following this transmittal letter. An original and one copy of the revised document have been submitted for approval. I am enclosing a copy of that submittal for your information.

If you have any questions or comments, please let us know.

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REVIEW OF TECHNICAL SPECIFICATIONS

Changes are noted below:

Definitions have been renumbered with the addition of 3 items and the removal of 1 item.

Pg. 2, 1.1.9 – current definition of explosive material was vague. It has been replaced with the following based on a definition from 10 CFR 61.

Explosive Material - any chemical compound, mixture, or device, which produces a substantial instantaneous release of gas and heat spontaneously or by contact with sparks or flame.

For ease of reference, definitions for Safety Limit (SL), Limiting System Safety Setting (LSSS), and Limiting Condition of Operation (LCO) have been placed in the document definitions. The following definitions based on 10CFR50.36 have been added to the definitions list and the introductory sentence referencing 10CFR50.36 has been modified to indicate that the definitions are provided for ease of reference.

Pg. 2, 1.1.11 – Limiting Conditions for Operation (LCO) - the lowest functional capability or performance levels of equipment required for safe operation of the facility.

Pg. 2, 1.1.12 – Limiting Safety System Settings (LSSS) - settings for automatic protective devices related to those variables having significant safety functions.

Pg. 4, 1.1.29 – Safety Limits (SL) - limits on important process variables that are necessary to reasonably protect the integrity of certain of the physical barriers that guard against the uncontrolled release of radioactivity.

Pg. 5, The term 'true value' is not used anywhere in the document, so that definition will be removed.

Pg. 8, 3.1.b – The phrase "with the most reactive safety or coarse control rod fully inserted and the fine rod fully inserted" has been moved to the definition of shutdown margin.

Pg. 12, 3.3.d – English equivalent units have been added to paragraph. "...in excess of 0.1 rem (1 mSv) or ..." and "...restricted area in excess of 5 rem (0.05 Sv).

Pg. 13, 3.4 Specification – Editorial change to make it read easier. Section has been changed to read – During Reactor Operation: a. An operable ..., and then removed the phrases relating to reactor operation from parts a, b, c, d, and e.

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Pg. 13, 3.4 Basis – radiation levels in the second paragraph now have a dose equivalent of 100 μrem/hr listed rather than an exposure level.

Pg. 14, 15, 16, and 17, Startup check requirements need to be defined in a consistent manner on these pages. That is, which are required for the first startup of the day and which are required before any startup or operation. Specifically, have changed 4.4.b to read, "The reactor access control (Ref 3.4c) shall be verified to be operable prior to the first reactor startup of the day or prior to each reactor operation extending more than one day."

Pg. 17, 4.4.b and the Basis section – both referenced 3.4.d, which was incorrect. These have been changed to the correct reference - 3.4.c.

Due to the split in departments, department name and title corrections were required in Section 6.1 and in Figure 1.

Pg. 22, 6.1.2 – changed to Chair, Nuclear Engineering.

Pg. 22, 6.1.3 – changed the wording of the second sentence to read, "... is selected by the Chair of the Nuclear Engineering Department and ...". Also removed the last phrase of the last sentence because the NE Lab Supervisor has control over the locks on the NE Lab.

Pg. 23, Fig. 1 – changed the title of the Chair to Chair, NE Department, and removed the NE Lab Supervisor as this position has no direct responsibility to the Reactor.

Pg. 24, 6.1.4 – changed the wording of the second sentence to read, "The UNM Radiation Safety Officer or designee normally ..."

Pg. 26, 6.1.12 – For consistency, changed reactor control room to reactor room on a.1, and on c. Also, changed a.3 to read, "One radiation safety staff member who can ..."

The RSAC agreed that these changes were editorial in nature and will not affect the intent or coverage of the Technical Specifications.

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LICENSE NUMBER R-102

TECHNICAL SPECIFICATIONS

FOR

THE UNIVERSITY OF NEW MEXICO AGN-201M REACTOR

SERIAL NUMBER 112

DOCKET NUMBER 50-252

REVISED NOVEMBER 2014

TABLE OF CONTENTS

1.0 DEFINITIONS

The terms Safety Limit (SL), Limiting Safety System Setting (LSSS), and Limiting Conditions for Operation (LCO) are as defined in 10 CFR 50.36. Those definitions are included here for ease of reference.

1.1 Definitions

1.1.1 Cadmium Rod – An aluminum rod wrapped with Cd and inserted into the glory hole to assure that the reactor is secured. The rod is worth at least $7 of negative reactivity.

1.1.2 Channel Calibration - A channel calibration is an adjustment of the channel such that its output responds, within acceptable range and accuracy, to known values of the parameter that the channel measures. Calibration shall encompass the entire channel, including equipment, actuation, alarm, or trip.

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

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

1.1.5 Coarse Control Rod - The control rod with a scram function that can be mechanically withdrawn/inserted at two possible speeds (40-50 seconds full insertion time or 80-100 seconds full insertion time).

1.1.6 Excess Reactivity - The amount of reactivity above a $k_{eff} = 1$. This is the amount of reactivity that would exist if all control rods were moved to the maximum reactive condition from the point where the reactor is exactly critical ($k_{eff} = 1$)

1.1.7 Experiment - An experiment is any of the following:

a. An activity utilizing the reactor system or its components or the neutrons or radiation generated therein;
b. An evaluation or test of a reactor system operational, surveillance, or maintenance technique;
c. The material content of any of the foregoing, including structural components, encapsulation or confining boundaries, and contained fluids or solids.

1.1.8 Experimental Facilities - Experimental facilities are those portions of the reactor assembly used for the introduction of experiments into or adjacent to the reactor core region or to allow beams of radiation to exist outside the reactor shielding. Experimental facilities shall include the thermal column, glory hole, and access ports.

1.1.9 Explosive Material – Any chemical compound, mixture, or device, which produces a substantial instantaneous release of gas and heat spontaneously or by contact with sparks or flame.

1.1.10 Fine Control Rod - A low worth control rod (about 25% of the worth of the other control rods) used primarily to maintain an intended power level. Its position may be varied manually. The fine control rod does not drop on a scram signal, but withdraws automatically.

1.1.11 Limiting Conditions for Operation (LCO) – The lowest functional capability or performance levels of equipment required for safe operation of the facility.

1.1.12 Limiting Safety System Settings (LSSS) – Settings for automatic protective devices related to those variables having significant safety functions.

1.1.13 Major Change - Any change in reactor configuration which affects the probability or consequences of an event.

1.1.14 Measured Value - The measured value is the value of a parameter as it appears on the output of a channel.

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

1.1.16 Movable Experiment - A movable experiment is one that may be inserted, removed, or manipulated while the reactor is critical.

1.1.17 Operable - Operable means a component or system is capable of performing its intended function in its normal manner.

1.1.18 Operating - Operating means a component or system is performing its intended function in its normal manner.

1.1.19 Potential Reactivity Worth - The potential reactivity worth of an experiment is the maximum absolute value of the reactivity change that would occur as a result of intended or anticipated changes or credible malfunctions that alter experiment position or configuration.

1.1.20 Reactor Component - A reactor component is any apparatus, device, or material that is a normal part of the reactor assembly.

1.1.21 Reactor Operation - Reactor operation is any condition wherein the reactor is not secured.

1.1.22 Reactor Operator - An individual who is licensed to manipulate the controls of a reactor.

1.1.23 Reactor Safety System - The reactor safety system is that combination of safety channels and associated circuitry which forms an automatic protective system for the reactor or provides information that requires manual protective action be initiated.

1.1.24 Reactor Secured - The reactor shall be considered secured whenever:

a. either: 1. The safety and control rods are fully withdrawn from the core; or
2. The core fuse melts resulting in separation of the core.

and:

b. the reactor console key switch is in the "off" position; the key is removed from the console and under the control of a certified operator; and the Cd rod is in the glory hole.

1.1.25 Removable Experiment - A removable experiment is any experiment, experimental facility, or component of an experiment, other than a permanently attached appurtenance to the reactor system, which can reasonably be anticipated to be moved one or more times during the life of the reactor.

1.1.26 Research Reactor - A research reactor is a device designed to support a self-sustaining neutron chain reaction for research, development, educational, training, or experimental purposes, and which may have provisions for producing radioisotopes.

1.1.27 Safety Channel - A safety channel is a measuring channel in the reactor safety system.

1.1.28 Safety Control Rod - One of two scrammable control rods that can be mechanically withdrawn/inserted at only one speed (35 to 50 seconds full insertion time).

1.1.29 Safety Limit (SL) – Limits on important process variables that are necessary to reasonably protect the integrity of certain of the physical barriers that guard against the uncontrolled release of radioactivity.

1.1.30 Scram Time - The time for the control rods acting under gravity to change the reactor from a critical to a subcritical condition. In most cases, this is less than or equal to the time it takes for the rod to fall from full-in to full-out position.

1.1.31 Secured Experiment - Any experiment, or component of an experiment is deemed to be secured, or in a secured position, if it is held in a stationary position relative to the reactor by mechanical means. The restraint shall exert sufficient force on the experiment to overcome the expected effects of hydraulic, pneumatic, buoyant, or other forces which are normal to the operating environment of the experiment or which might arise as a result of credible malfunctions.

1.1.32 Senior Reactor Operator – An individual who is licensed to direct the activities of reactor operators. Such an individual is also a reactor operator.

1.1.33 Shall, Should and May - The word "shall" is used to denote a requirement; the word "should" to denote a recommendation; and the word "may" to denote permission--neither a requirement nor a recommendation.

1.1.34 Shutdown Margin - Shutdown margin shall mean the minimum shutdown reactivity necessary to provide confidence that the reactor can be made subcritical by means of the control and safety systems starting from any permissible operating condition with the most reactive safety or coarse control rod fully inserted and the fine control rod fully inserted, and that the reactor will remain subcritical without further operator action.

1.1.35 Static Reactivity Worth - The static reactivity worth of an experiment is the value of the reactivity change measurable by calibrated control or regulating rod comparison methods between two defined terminal positions or configurations of the experiment. For removable experiments, the terminal positions are fully removed from the reactor and fully inserted or installed in the normal functioning or intended position.

1.1.36 Surveillance Time - A surveillance time indicates the frequency of tests to demonstrate performance. Allowable surveillance intervals shall not exceed the following:

a. Two-year (interval not to exceed 30 months)
b. Annual (interval not to exceed 15 months)
c. Semiannual (interval not to exceed seven and one-half months)
d. Quarterly (interval not to exceed four months)
e. Monthly (interval not to exceed six weeks).

2.0 SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

2.1 Safety Limits

Applicability

This specification applies to the maximum core temperature during operation.

Objective

To assure that the integrity of the fuel material is maintained and that all fission products are retained in the core matrix.

Specification

a. The maximum core temperature shall not exceed 200°C during operation.

Basis

The polyethylene core material does not melt below 200°C and is expected to maintain its integrity and retain essentially all of the fission products at temperatures below 200°C. The Hazards Summary Report dated February 1962 submitted on Docket F-15 by Aerojet-General Nucleonics (AGN) calculated a core maximum temperature rise of 71.3°C while the Safety Analysis Report submitted during the 1986 relicensing of the UNM AGN calculated a core maximum temperature rise of 100.7°C . In either case, assuming operation at 20°C, the corresponding maximum core temperature would be 120.7°C or 91.3°C, both of which are well below 200°C thus assuring integrity of the core and retention of fission products.

2.2 Limiting Safety System Settings

Applicability

This specification applies to the parts of the reactor safety system which will limit maximum power and core temperature.

Objective

To assure that automatic protective action is initiated to prevent a safety limit from being exceeded.

Specification

a. The safety channels shall initiate a reactor scram at the following limiting safety system settings:

Channel	Condition LSSS
Nuclear Safety #2	High Power 6 watts
Nuclear Safety #3	High Power 6 watts

b. The polystyrene core thermal fuse melts when heated to a temperature of about 120°C resulting in core separation and a reactivity loss greater than 5% $\Delta k/k$.

Basis

Based on instrumentation response times and scram tests, the AGN Hazards Report concluded that reactor periods in excess of 30-50 milliseconds would be adequately arrested by the scram system. Since the maximum available excess reactivity in the reactor is less than one dollar, the reactor cannot become prompt critical, and the corresponding shortest possible period is greater than 200 milliseconds. The high power LSSS of 6 watts in conjunction with automatic safety systems, and the maximum temperature rise of 100.7°C, and/or manual scram capabilities will assure that the safety limits will not be exceeded during normal operation or as a result of the most severe credible transient.

In the event of failure of the reactor to scram, the self-limiting characteristics due to the high negative temperature coefficient, and the melting of the thermal fuse at a temperature below 120°C will assure safe shutdown without exceeding a core temperature of 200°C (the Safety Limit).

3.0 LIMITING CONDITIONS FOR OPERATION

3.1 Reactor Core Parameters

Applicability

This specification applies to the reactivity condition of the reactor and the reactivity worths of control rods and experiments.

Objective

To assure that the reactor can be shut down at all times and that the safety limits will not be exceeded.

Specification

a. The available excess reactivity with the coarse, fine, and safety control rods fully inserted and including the potential absolute value of the reactivity worth of all experiments shall not exceed 0.65% $\Delta k/k$.

b. The shutdown margin shall be at least one dollar.

c. The reactivity worth of the control rods shall ensure subcriticality on the withdrawal of the coarse control rod or any one safety rod.

d. The excess reactivity with no experiments in the reactor and the coarse, fine, and safety control rods fully inserted shall not exceed 0.25% $\Delta k/k$.

Basis

The limitations on total core excess reactivity assure reactor periods of sufficient length so that the reactor protection system and/or operator action will be able to shut the reactor down without exceeding any safety limits. The shutdown margin and control and safety rod reactivity limitations assure that the reactor can be brought and maintained subcritical if the highest reactivity rod fails to scram and remains in its most reactive position.

3.2 Reactor Control and Safety Systems

Applicability

These specifications apply to the reactor control and safety systems.

Objective

To specify lowest acceptable level of performance, instrument set points, and the minimum number of operable components for the reactor control and safety systems.

Specification

a. The fine control rod, coarse control rod, and the two safety rods shall be operable and the carriage position of the fine and coarse control rods shall be displayed at the console whenever any rod is above its lower limit.

b. The total scram withdrawal time of the safety rods and coarse control rod shall be less than 1 second.

c. The average reactivity addition rate for each control rod (fine, coarse, or safety rod) shall not exceed 0.065% $\Delta k/k$ per second.

d. The safety rods and coarse control rod shall be interlocked such that:

   1. Reactor startup cannot commence unless both safety rods and the coarse control rod are fully withdrawn from the core.

   2. Only one safety rod can be inserted at a time.

   3. The coarse control rod cannot be inserted unless both safety rods are fully inserted.

   4. At any operating power below 50×10^{-6} watts, none of the rods can be moved to a more reactive position.

e. Nuclear safety channel instrumentation shall be operable in accordance with Table 3.1 whenever the reactor is in operation.

f. A manual scram shall be provided on the reactor console, and the safety circuitry shall be designed so that no single failure can negate both the automatic and manual scram capability.

g. The shield water level interlock shall be set to prevent reactor startup and scram the reactor if the shield water level falls more than 18 cm below the highest point on the reactor shield tank manhole opening.

h. The shield water temperature interlock shall prevent reactor startup or scram the reactor if the shield water temperature falls below 18°C.

i. The seismic displacement interlock shall be installed in such a manner to prevent reactor startup or to scram the reactor during a seismic displacement.

j. A loss of electric power shall cause the reactor to scram.

Basis

The specification on operability of the rods assures console control over reactivity conditions within the reactor. Display of the positions of the fine and coarse control rods assures that the positions of these rods are available to the operator to evaluate the configuration of the reactor.

The specifications on scram withdrawal time in conjunction with the safety system instrumentation and set points assure safe reactor shutdown during the most severe foreseeable transients. Interlocks on control rods assure an orderly approach to criticality and an adequate shutdown capability. The limitations on reactivity addition rates allow only relatively slow increases of reactivity so that ample time will be available for manual or automatic scram during any operating conditions.

The neutron detector channels (Nuclear Safety Channels #2 and #3) assure that reactor power levels are adequately monitored during reactor startup and operation. The power level scrams initiate redundant automatic protective action at power levels low enough to assure safe shutdown without exceeding any safety limits. The manual scram assures a method of shutdown without reliance on safety channels and circuitry.

The AGN-201's negative temperature coefficient of reactivity causes a reactivity increase with decreasing core temperature. The shield water temperature interlock will prevent reactor operation at temperatures below 18°C thereby limiting potential reactivity additions associated with temperature decreases.

Water in the shield tank is an important component of the reactor shield and operation without the water may produce excessive radiation levels. The shield tank water level interlock will prevent reactor operation without adequate water levels in the shield tank.

The reactor is designed to withstand 0.6 g accelerations and 6 cm displacements. A seismic instrument causes a reactor scram whenever the instrument receives a horizontal acceleration that causes a horizontal displacement of 0.16 cm or greater. The seismic displacement interlock assures that the reactor will be scrammed and brought to a subcritical configuration during any seismic disturbance that may cause damage to the reactor or its components.

The manual scram allows the operator to manually shutdown the reactor if an unsafe or otherwise abnormal condition occurs that does not scram the reactor. A loss of electrical power de-energizes the safety and coarse control rod holding magnets causing a reactor scram thus assuring safe and immediate shutdown in case of a power outage.

Table 3.1

Nuclear Safety Channel Instrumentation

Channel No.	Function	Operating Limits
2	High Power Scram	120% of licensed power (6 Watts)
3	High Power Scram	120% of licensed power (6 Watts)

3.3 Limitations on Experiments

Applicability

This specification applies to experiments installed in the reactor and its experimental facilities.

Objective

To prevent damage to the reactor or excessive release of radioactive materials in the event of an experimental failure.

Specification

a. Experiments outside the reactivity limits defined in TS 3.1 shall not be permitted.

b. Experiments within the reactivity limits defined in TS 3.1 containing materials corrosive to reactor components or which contain gaseous or liquid fissionable materials shall be doubly encapsulated.

c. Explosive materials or materials which might combine violently shall not be inserted into experimental facilities of the reactor or irradiated in the reactor.

d. The radioactive material content, including fission products, of any doubly encapsulated experiment should be limited so that the complete release of all gaseous, particulate, or volatile components from the encapsulation could not result in:

    (1) a total effective dose equivalent to any person occupying an unrestricted area in excess of 0.1 REM (0.001 Sv) or
    (2) a total effective dose equivalent to any person occupying a restricted area during the length of time required to evacuate the restricted area in excess of 5 rem (0.050 Sv).

Basis

These specifications are intended to reduce the likelihood of damage to reactor components and/or radioactivity releases resulting from an experimental failure and to protect operating personnel and the public from excessive radiation doses in the event of an experimental failure. Specification 3.3d conforms to 10 CFR 20 as of the date of this revision.

3.4 Radiation Monitoring, Control And Shielding

Applicability

This specification applies to radiation monitoring, control, and reactor shielding required during reactor operation.

Objective

The objective is to protect facility personnel and the public from radiation exposure.

Specification

During Reactor Operation:

a. An operable portable radiation survey instrument capable of detecting gamma radiation shall be immediately available to reactor operating personnel whenever the reactor is in operation.

b. The reactor room shall be considered a restricted area according to 10CFR20.

c. The top of the reactor shall be considered a high radiation area, and the access stairs to the top of the reactor shall be equipped with a gate and a lock for access control. The keys for the gate shall be in control of the reactor operator during operation.

d. The following shielding requirement shall be fulfilled:
   The thermal column shall be filled with water or graphite except during a critical experiment (core loading) or during other approved experiments that require the thermal column to be empty.

e. The core tank shall be sealed.

Basis

Radiation surveys performed under the supervision of a qualified health physicist have shown that the total gamma, thermal neutron, and fast neutron radiation dose rate in the reactor room, at the closest approach to the reactor but without access to reactor top, is less than 50 mrem/hr at reactor power levels of 5.0 watts.

When the reactor is secured, radiation levels at all points in the reactor room are below 100 μrem/hr. The facility shielding in conjunction with radiation monitoring, control, and restricted areas is designed to limit radiation doses to facility personnel and to the public to a level below 10 CFR 20 limits under all conditions.

4.0 SURVEILLANCE REQUIREMENTS

Actions specified in sections 4.1, 4.2, and 4.3 are not required to be performed if during the specified surveillance period the reactor has not been brought critical or is maintained in a secured condition extending beyond the specified surveillance period. However, the surveillance requirements shall be fulfilled prior to subsequent startup of the reactor.

4.1 Reactivity Limits

Applicability

This specification applies to the surveillance requirements for reactivity limits.

Objective

To assure that reactivity limits for Specification 3.1 are not exceeded.

Specification

a. Control rod reactivity worths shall be measured annually to verify 3.1c.

b. Total excess reactivity and shutdown margin shall be determined annually.

c. The reactivity worth of an experiment shall be estimated or measured, as appropriate, before or during the first startup subsequent to the experiment's first insertion.

Basis

The control and safety rod reactivity worths are measured annually to assure that no degradation or unexpected changes have occurred which could adversely affect reactor shutdown margin or total excess reactivity. The shutdown margin and total excess reactivity are determined to assure that the reactor can always be safely shut down with one rod not functioning and that the maximum possible reactivity insertion will not result in reactor periods shorter than those that can be adequately terminated by either operator or automatic action. Based on experience with AGN reactors, significant changes in reactivity or rod worth are not expected within a 12 month period.

4.2 Control and Safety Systems

Applicability

This specification applies to the surveillance requirements of the reactor control and safety systems.

Objective

To assure that the reactor control and safety systems are operable as required by Specification 3.2.

Specification

a. A channel test of Nuclear Safety Channels #2 and #3 shall be performed prior to the first reactor startup of the day or prior to each reactor operation extending more than one day.

b. A channel check of Nuclear Safety Channels #2 and #3 shall be performed daily whenever the reactor is in operation.

c. Prior to each day's reactor operation the rod interlock shall be checked to make sure it is operating.

d. Prior to each day's reactor operation or prior to each reactor operation extending more than one day, safety rod #1 shall be inserted and scrammed to verify operability of the manual scram system.

e. Prior to each day's reactor operation, it shall be verified that the lock on the gate for the access stairs is locked.

f. Control rod scram times and average reactivity insertion rates shall be measured annually.

g. Control rods and drives shall be inspected for proper operation annually.

h. A channel test of the seismic displacement interlock shall be performed annually.

i. The power level measuring channels shall be calibrated and set points verified annually.

j. The shield water level interlock and shield water temperature interlock shall be calibrated annually.

k. It shall be verified annually that loss of electrical power causes a scram.

Basis

The channel tests and checks required daily or before each startup will assure that the safety channels and scram functions are operable. Based on operating experience with reactors of this type, the annual scram measurements, channel calibrations, set point verifications, and inspections are of sufficient frequency to assure, with a high degree of confidence, that the safety system settings will be within acceptable drift tolerance for operation.

4.3 Reactor Structure

Applicability

This specification applies to surveillance requirements for reactor components other than control rods.

Objective

The objective is to assure integrity of the reactor structures.

Specification

Visual inspection for water leakage from the shield tank shall be performed prior to each startup. Leakage sufficient to activate the shield water level safety interlock shall be corrected prior to subsequent reactor operation.

Basis

Based on experience with reactors of this type, the frequency of inspection and leak test requirements of the shield tank will assure capability for radiation protection during reactor operation. The shield water level safety interlock is checked annually and provides assurance that sufficient water is in the tank for adequate personnel shielding.

4.4 Radiation Monitoring and Control

Applicability

This specification applies to the surveillance requirements of the radiation monitoring and control systems.

Objective

To assure that the radiation monitoring and control systems are operable and that all radiation and high radiation areas within the reactor facility are identified and controlled as required by Specification 3.4.

Specification

a. All portable radiation survey instruments assigned to the reactor facility shall be calibrated annually under the supervision of the Radiation Safety Office.

b. The reactor access control (Ref 3.4c) shall be verified to be operable prior to the first reactor startup of the day or prior to each reactor operation extending more than one day.

c. A radiation survey of the reactor room shall be performed under the supervision of the Radiation Safety Officer to determine the location of radiation and high radiation areas corresponding to reactor operating power levels and to verify that the thermal column is providing shielding. This survey shall be performed as necessary but at least annually.

Basis

The periodic calibration of radiation monitoring equipment and the surveillance of the reactor access control (Ref 3.4c) will assure that the radiation monitoring and control systems are operable during reactor operation.

The periodic radiation surveys will verify the location of radiation and high radiation areas and will assist reactor facility personnel in properly labeling and controlling each location in accordance with 10 CFR 20.

4.5 Conduct of Experiments

Applicability

This specification applies to the surveillance requirements for experiments inserted in the reactor.

Objective

To prevent the conduct of experiments that may damage the reactor or release excessive amounts of radioactive materials as a result of experiment failure.

Specification

a. The reactivity worth of an experiment shall be estimated or measured, as appropriate, before reactor operation with said experiment.

b. An experiment shall not be installed in the reactor or its irradiation facilities unless a safety analysis has been performed and reviewed for compliance with Section 3.3 by the Chief Reactor Supervisor and the Reactor Safety Advisory Committee in full accord with Section 6.4.2 of these Technical Specifications.

Basis

Experience has shown that experiments reviewed by the Chief Reactor Supervisor and RSAC can be conducted without endangering the safety of the reactor or exceeding the limits in the Technical Specifications.

5.0 DESIGN FEATURES

5.1 Reactor

Applicability

This specification applies to basic design features of the reactor.

Objective

To specify specific reactor design features.

Specification

a. The reactor core, including control rods, contains approximately 667 grams of U-235 in the form of <20% enriched UO_2 dispersed in approximately 11 kilograms of polyethylene. The lower section of the core is supported by an aluminum rod hanging from a fuse link. The fuse melts at a fuse temperature of about 120°C causing the lower core section to fall away from the upper section reducing reactivity by at least 5% $\Delta k/k$. Sufficient clearance between core and reflector is provided to ensure free fall of the bottom half of the core during the most severe transient.

b. The core is surrounded by a 20 cm thick high density (1.75 gm/cm^3) graphite reflector followed by a 10 cm thick lead gamma shield. The core and part of the graphite reflector are sealed in a fluid-tight aluminum core tank designed to contain any fission gases that might leak from the core.

c. The core, reflector and lead shielding are enclosed in and supported by a fluid-tight steel reactor tank. An upper or "thermal column tank" may serve as a shield tank when filled with water or a thermal column when filled with graphite.

d. The 198 cm diameter, fluid-tight shield tank is filled with water constituting a 55 cm thick fast neutron shield. The fast neutron shield is formed by filling the tank with approximately 3785 liters of water. The complete reactor shield shall limit doses to personnel in unrestricted areas to levels less than permitted by 10 CFR 20 under operating conditions.

e. Two safety rods and one coarse control rod (identical in size) contain less than 15 grams of U-235 each in the same form as the core material. These rods are lifted into the core by electromagnets, driven by reversible DC motors through lead screw assemblies. De-energizing the magnets causes a spring-driven, gravity-assisted scram. The fourth rod or fine control rod (approximately one-half the diameter of the other rods) is driven directly by a lead screw. This rod may contain polyethylene with or without fuel.

NOTE: All dimensions, masses, and densities given in the above description are nominal values.

Basis

These basic design criteria are relevant to the safe operation of the reactor and should not be changed or modified without NRC approval.

5.2 Fuel Storage

Applicability

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

Objective

To assure that fuel being stored shall be secured and shall not become critical.

Specification

Fuel, including fueled experiments and fuel devices not in the reactor, shall be stored in a secured location when not in use. The storage array shall be such that k_{eff} is no greater than 0.9 for all conditions of moderation and reflection.

Basis

The limits imposed are conservative and assure safe storage (NUREG-1537).

5.3 <u>Reactor Room (065)</u>

Applicability

This specification applies to the reactor location.

Objective

To specify the characteristics of specific facility design features.

Specification

a. The reactor room houses the reactor assembly and accessories required for its operation and maintenance, and the reactor control console.

b. The reactor room is a separate room (065) in the Nuclear Engineering Laboratory, constructed with adequate shielding and other radiation protective features to limit doses in restricted and unrestricted areas to levels no greater than permitted by 10 CFR 20.

c. The access doors to the reactor room shall contain locks.

Basis

The reactor room provides a secure, controlled access area with appropriate shielding for personnel radiation protection.

6.0 ADMINISTRATIVE CONTROLS

6.1 Organization

The current administrative organization for control of the reactor facility and its operation is as set forth in Figure 1. Levels 1, 2, and 3 refer to administrative levels for which changes in staffing must be communicated to the Nuclear Regulatory Commission as set forth in 6.9.3. The authorities and responsibilities set forth below are designed to comply with the intent and requirements for administrative controls of the reactor facility as set forth by the Nuclear Regulatory Commission.

6.1.1 *UNM Administration*

Has administrative responsibilities for all activities on Campus. The President (Level 1) is the chief administrative officer responsible for the University and in whose name the application for licensing is made. The Radiation Control Committee is a permanent committee established to act on behalf of the President of the University for control of all University of New Mexico (UNM) activities involving sources of ionizing radiation. The Committee consists of members from the UNM faculty/staff. Meetings are held regularly. Responsibilities are: to establish policy and disseminate rules for radiation safety and control at UNM; to serve as the UNM liaison with the NRC in matters of registration, licensing, and radiation control; and to ensure periodic inspections and radiation surveys for the purpose of assuring the safety of radiation operations within any UNM facility.

6.1.2 *Chair, Department of Nuclear Engineering*

The chair (Level 1) is the administrative officer responsible for the operation of the Department, for its financial affairs and for appointing the Reactor Administrator. The Chair is responsible for appointing members of the Reactor Safety Advisory Committee (RSAC) and the RSAC reports to the chair on all matters.

6.1.3 *Reactor Administrator*

Provides final policy decisions on all phases of reactor operation and regulations for the facility. The Reactor Administrator (Level 2) is selected by the Chair of the Nuclear Engineering Department and shall hold a graduate degree in Engineering. The Reactor Administrator is advised on matters concerning personnel health and safety by the Radiation Safety Officer and/or the Radiation Control Committee. The Reactor Administrator is advised on matters concerning safe operation of the reactor by the Reactor Operations Committee and/or the Reactor Safety Advisory Committee; designates Reactor Supervisors and names the Chief Reactor Supervisor; approves all regulations, instructions and procedures governing facility operation; submits the annual report to NRC.

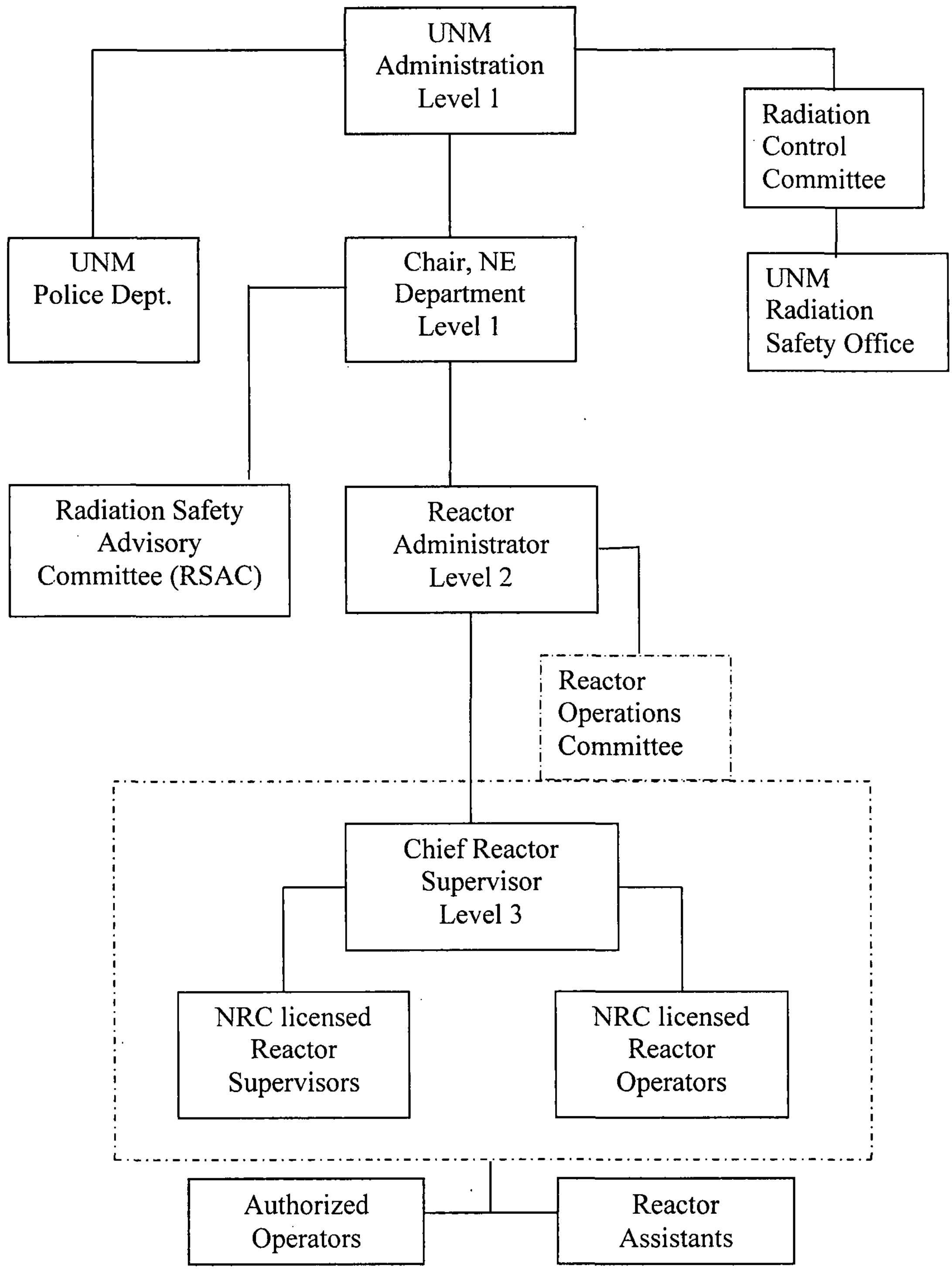
UNM Administration Level 1
UNM Police Dept.
Chair, NE Department Level 1
Radiation Control Committee
UNM Radiation Safety Office
Radiation Safety Advisory Committee (RSAC)
Reactor Administrator Level 2
Reactor Operations Committee
Chief Reactor Supervisor Level 3
NRC licensed Reactor Supervisors
NRC licensed Reactor Operators
Authorized Operators
Reactor Assistants

Figure 1

6.1.4 *Radiation Safety Office*

The Radiation Safety Office will provide emergency direction and assistance for situations involving radiation safety. The UNM Radiation Safety Officer or designee normally represents the Radiation Control Committee in matters concerning the radiation safety aspects of reactor operation.

6.1.5 *Reactor Safety Advisory Committee*

Reviews, evaluates, and audits reactor operations and procedures to ensure that the reactor shall be operated in a safe and competent manner. There shall be at least four members on the RSAC with at least two members from organizations outside the University. The Committee is available for advice and assistance on reactor operation problems. Any major change in the facility shall be approved by the RSAC. Members of the RSAC are appointed by the Department Chair and shall not be members of the Reactor Operations Committee. The RSAC reports to the Chair and advises the Reactor Administrator.

6.1.6 *Reactor Operations Committee*

Consists of the Reactor Supervisors with the Chief Reactor Supervisor. Other qualified persons may also be members. They are directly responsible to the Reactor Administrator for the preparation and submission of detailed procedures, regulations, forms, and rules to ensure the maintenance, safe operation, competent use and security of the facility. The Committee ensures that all the activities, experiments, and maintenance involving the facility are properly logged and are in accordance with established local and U.S. Nuclear Regulatory Commission regulations. They review all proposed changes in procedure or changes in the facility and approve any minor change before the change is implemented.

6.1.7 *Chief Reactor Supervisor*

Shall hold a Senior Reactor Operator's license issued by the NRC. He/she is responsible for the distribution and enforcement of rules, regulations and procedures concerning operation of the facility. The Chief Reactor Supervisor (Level 3) is directly responsible for enforcing operating procedures and ensuring that the facility is operated in a safe, competent and authorized manner. He/she is directly responsible for all prescribed logs and records; is the Emergency Director for emergencies not involving radiation; and has the authority to authorize experiments or procedures which have received appropriate prior approval by the Reactor Operations Committee, the Reactor Safety Advisory Committee and/or the Radiation Control Committee (or the Radiation Safety Officer) and have received prior authorization by the Reactor Administrator. He/she shall not authorize any proposed changes in the facility or in procedure until appropriate evaluation and approval has been made by the Reactor Operations Committee or the Reactor Safety Advisory Committee and authorization given by the Reactor Administrator.

6.1.8 *Reactor Supervisors*

Shall hold valid Senior Reactor Operator's licenses issued by the Nuclear Regulatory Commission. A Reactor Supervisor shall be in charge of the facility at all times during reactor operation and shall witness the startup and intentional shutdown procedures. A Senior Reactor Operator is required to be present whenever fuel is handled. The Reactor Supervisors are directly responsible to the Chief Reactor Supervisor. A Reactor Supervisor shall be present when the reactor is going critical, being intentionally shut down, or when reactor experiments are loaded or unloaded. The location of the Reactor Supervisor shall be known to the Reactor Operator at all times during operation so that it is possible to contact him/her if required.

6.1.9 *Reactor Operators*

Shall hold a valid Reactor Operator's license issued by the NRC. They shall conform to the rules, instructions and procedures for the startup, operation and shutdown of the reactor, including emergency procedures. Within the constraints of the administrative and supervisory controls outlined above, a reactor operator will be in direct charge of the control console at all times that the reactor is operating. The reactor operator shall maintain complete and accurate records of all reactor operations in the operational logs.

6.1.10 *Authorized Operators*

Individuals authorized by the Reactor Supervisor to operate the reactor controls and who do so with the knowledge of the Supervisor and under the direct supervision of a Reactor Operator.

6.1.11 *Reactor Assistants*

These are individuals who are present during reactor operation to provide assistance to the Operator as needed, with the exception that a Reactor Assistant does not operate the controls of the reactor. In an emergency, or if asked, they may push the Reactor Scram button.

6.1.12 *Operating Staff*

a. The minimum operating staff during any time in which the reactor is not secured shall consist of all of the following:

1. One Reactor Operator or Reactor Supervisor in the reactor room.
2. One other person in the reactor room or Nuclear Reactor Laboratory qualified to activate manual scram and initiate emergency procedures.
3. One radiation safety staff member who can be readily contacted by telephone and who can arrive at the reactor room within 30 minutes.
4. One Reactor Supervisor readily available on call. This requirement can be satisfied by having a licensed Reactor Supervisor perform the duties stated in paragraph 1 or 2 above or by designating a licensed Reactor Supervisor who can be readily contacted by telephone and who can arrive at the reactor facility within 30 minutes.

b. A Senior Reactor Operator shall supervise all reactor maintenance or modification that could affect the reactivity of the reactor.

c. A listing of reactor facility personnel by name and phone number shall be conspicuously posted in the reactor room.

6.2 Staff Qualifications

The Chief Reactor Supervisor, licensed Reactor Supervisors and Reactor Operators, and technicians performing reactor maintenance shall meet the minimum qualifications set forth in ANSI 15.4, "Standards for Selection and Training of Personnel for Research Reactors". Reactor Safety Advisory Committee members shall have a minimum of five (5) years experience in a technical profession or a baccalaureate degree and two (2) years of professional experience. The Radiation Safety Officer shall have a baccalaureate degree in biological or physical science and have at least two (2) years experience in health physics.

6.3 Training

The Reactor Administrator shall be responsible for directing training as set forth in ANSI 15.4-2007, "Standards for Selection and Training of Personnel for Research Reactors". All licensed reactor operators shall participate in requalification training as set forth in 10 CFR 55.

6.4 Reactor Safety Advisory Committee

6.4.1 Meetings and Quorum

The Reactor Safety Advisory Committee shall meet as often as deemed necessary by the Reactor Safety Advisory Committee Chair but shall meet at least semiannually (interval not to exceed seven and one-half months). A quorum for the conduct of official business shall be three members.

6.4.2 Reviews

The Reactor Safety Advisory Committee shall review:

a. Safety evaluations for changes to procedures, equipment or systems, and tests or experiments, conducted without Nuclear Regulatory Commission approval under the provision of 10 CFR 50.59 to verify that such actions do not require a license amendment.

b. Proposed changes to or additional procedures, new or existing equipment or systems that change the original intent or use, and are non-conservative, or those that are covered in 10 CFR 50.59.

c. Proposed tests or experiments which are significantly different from previous approved tests or experiments, or those that are covered in 10 CFR 50.59.

d. Proposed changes in Technical Specifications or other license documents.

e. Violations of applicable statutes, codes, regulations, orders, Technical Specifications, license requirements, or internal procedures or instructions having nuclear safety significance.

f. Significant operating abnormalities or deviations from normal and expected performance of facility equipment that affect nuclear safety.

g. Reportable occurrences.

h. Audit reports.

6.4.3 Audits

Audits of facility activities shall be performed at least annually (interval not to exceed 15 months) under the cognizance of the Reactor Safety Advisory Committee but in no case by the personnel responsible for the item audited. These audits shall examine the operating records and encompass, but shall not be limited to, the following:

a. The conformance of the facility operation to the Technical Specifications and applicable license conditions, at least annually (interval not to exceed 15 months).

b. The Facility Emergency Plan and implementing procedures, at least every two years (interval not to exceed 30 months).

c. The Facility Security Plan and implementing procedures, at least every two years (interval not to exceed 30 months).

d. Operator requalification program and records, at least every two years (interval not to exceed 30 months).

e. Results of actions taken to correct deficiencies, at least annually (interval not to exceed 15 months).

f. Deficiencies uncovered that affect reactor safety shall immediately be reported to Level 1 management. A written report of the findings of the audit shall be submitted to Level 1 management and the review and audit group members within 3 months after the audit has been completed.

6.4.4 Authority

The Reactor Safety Advisory Committee shall report to the Nuclear Engineering Department Chair and shall advise the Reactor Administrator the Chief Reactor Supervisor on those areas of responsibility outlined in Section 6.1.5 of these Technical Specifications.

6.4.5 Minutes of the Reactor Safety Advisory Committee

One member of the Reactor Safety Advisory Committee shall be designated to direct the preparation, maintenance, and distribution of minutes of its activities. These minutes shall include a summary of all meetings, actions taken, audits, and reviews. Minutes shall be distributed to all RSAC members, all administrative levels, and the Radiation Safety Officer within 2 months (interval not to exceed 10 weeks) after each meeting.

6.5 Approvals

The procedure for obtaining approval for any change, modification, or procedure which requires approval of the Reactor Safety Advisory Committee is as follows:

a. The Chief Reactor Supervisor shall prepare the proposal for review and approval by the Reactor Administrator.

b. The Reactor Administrator shall submit the proposal to the Reactor Safety Advisory Committee for review, comment, and possible approval.

c. The Reactor Safety Advisory Committee shall approve the proposal by majority vote.

d. The Reactor Administrator shall provide final approval after receiving the approval of the Reactor Safety Advisory Committee.

6.6 Procedures

There shall be written procedures that cover the following activities:

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

b. Fuel movement and changes to the core and experiments that could affect reactivity.

c. Conduct of irradiations and experiments that could affect the operation or safety of the reactor.

d. Preventive or corrective maintenance which could affect the safety of the reactor.

e. Routine reactor maintenance.

f. Radiation Safety Protection for all reactor related personnel.

g. Surveillance, testing and calibration of instruments, components, and systems as specified in Section 4.0 of these Technical Specifications.

h. Implementation of the Security Plan and Emergency Plan.

The above listed procedures shall be approved by the Reactor Administrator and the Reactor Safety Advisory Committee. Temporary procedures which do not change the intent of previously approved procedures and which do not involve a 10CFR50.59 review may be employed on approval by the Chief Reactor Supervisor.

6.7 Experiments

a. Prior to initiating any new reactor experiment, an experimental procedure shall be prepared by the Chief Reactor Supervisor and reviewed and approved by the Reactor Safety Advisory Committee.

b. Experiments shall only be performed under the cognizance of the Chief Reactor Supervisor.

6.8 Safety Limit Violations

The following actions shall be taken in the event a Safety Limit is violated:

a. The reactor will be shut down immediately and reactor operation will not be resumed without authorization by the Nuclear Regulatory Commission (NRC).

b. The Safety Limit Violation shall be reported to the NRC Operations Center, the Director of NRR, the Reactor Safety Advisory Committee, and Reactor Administrator not later than the next work day.

c. A Safety Limit Violation Report shall be prepared for review by the Reactor Safety Advisory Committee. This report shall describe the applicable circumstances preceding the violation, the effects of the violation upon facility components, systems, or structures, and corrective action to prevent recurrence.

d. The Safety Limit Violation Report shall be submitted to the NRC and the Reactor Safety Advisory Committee within 14 days of the violation.

6.9 Reporting Requirements

In addition to the applicable reporting requirements of Title 10, Code of Federal Regulations, the following reports shall be submitted to the Document Control Desk, USNRC, Washington D.C., 20555.

6.9.1 Annual Operating Report

Routine annual operating reports shall be submitted no later than ninety (90) days following June 30. The annual operating reports shall provide a comprehensive summary of the operating experience having safety significance gained during the year, even though some repetition of previously reported information may be involved. References in the annual operating report to previously submitted reports shall be clear.

Each annual operating report shall include:

a. A brief narrative summary of

1. Changes in facility design, performance characteristics, and operating procedures related to reactor safety that occurred during the reporting period.

2. Results of major surveillance tests and inspections.

b. A tabulation showing the hours the reactor was operated and the energy produced by the reactor in watt-hours.

c. List of the unscheduled shutdowns, including the reasons therefore and corrective action taken, if any.

d. Discussion of the major safety related corrective maintenance performed during the period, including the effects, if any, on the safe operation of the reactor, and the reasons for the corrective maintenance required.

e. A brief description of:

1. Each change to the facility to the extent that it changes a description of the facility in the application for license and amendments thereto.

2. Changes to the procedures as described in Facility Technical Specifications.

3. Any new experiments or tests performed during the reporting period.

f. A summary of the safety evaluation made for each change, test or experiment not submitted for NRC approval pursuant to 10 CFR 50.59 which clearly shows the reason leading to the conclusion that no license amendment was required and that no Technical Specifications change was required.

g. A summary of the nature and amount of radioactive effluent released or discharged to the environs beyond the effective control of the licensee as determined at or prior to the point of such release or discharge.

1. Liquid Waste (summarized for each release)

   a. Total estimated quantity of radioactivity released (in Curies) and total volume (in liters) of effluent water (including diluent) released.

2. Solid Waste (summarized for each release)

   a. Total volume of solid waste packaged (in cubic meters)

   b. Total activity in solid waste (in Curies)

   c. The dates of shipment and disposition (if shipped off site).

h. A description of the results of any environmental radiation surveys performed outside the facility.

i. Radiation Exposure - A summary of personnel exposures received during the reporting period by facility personnel and visitors.

6.9.2 Reportable Occurrences

Reportable occurrences, including causes, probable consequences, corrective actions and measures to prevent recurrence, shall be reported to the NRC as described in Section 6.9.

Supplemental reports may be required to fully describe final resolution of the occurrence. In case of corrected or supplemental reports, an amended licensee event report shall be completed and reference shall be made to the original report date.

a. Prompt Notification with Written Follow-up

The types of events listed below are considered reportable occurrences and shall be reported as expeditiously as possible by telephone and confirmed by facsimile transmission to the NRC Operations Center no later than the first work day following the event, with a written follow-up report within two weeks as described in Section 6.9. Information provided shall contain narrative material to provide complete explanation of the circumstances surrounding the event.

1. Failure of the reactor protection system or other systems subject to limiting safety system settings to initiate the required protective function by the time a monitored parameter reached the set point specified as the limiting safety system setting in the Technical Specifications or failure to complete the required protective function.

2. Operation of the reactor or affected systems when any parameter or operation subject to a limiting condition is less conservative than the limiting condition for operation established in the Technical Specifications - without taking permitted remedial action.

3. Abnormal degradation discovered in a fission product barrier.

4. Reactivity balance anomalies involving:

a. Disagreement between expected and actual critical rod positions of approximately 0.3% $\Delta k/k$.

b. Exceeding excess reactivity limit.

c. Shutdown margin less conservative than specified in Technical Specifications.

d. If sub-critical, an unplanned reactivity insertion of more than approximately 0.5% $\Delta k/k$ or any unplanned criticality.

5. Failure or malfunction of one (or more) component(s) which prevents or could prevent, by itself, the fulfillment of the functional requirements of system(s) used to cope with accidents analyzed in the Safety Analysis Report.

6. Personnel error or procedural inadequacy which prevents, could prevent, by itself, the fulfillment of the functional requirements of system(s) used to cope with accidents analyzed in the Safety Analysis Report.

7. Unscheduled conditions arising from natural or manmade events that, as a direct result of the event, require reactor shutdown, operation of safety systems, or other protective measures required by Technical Specifications.

8. Errors discovered in the analyses or in the methods used for such analyses as described in the Safety Analysis Report or in the bases for the Technical Specifications that have or could have permitted reactor operation in a manner less conservative than assumed in the analysis.

9. Release of radiation or radioactive materials from site above allowed limits.

10. Performance of structures, systems, or components that requires remedial action or corrective measures to prevent operation in a manner less conservative than assumed in the accident analysis in the SAR or Technical Specifications that require remedial action or corrective measures to prevent the existence or development of an unsafe condition.

6.9.3 Special Reports

Special reports which may be required by the Nuclear Regulatory Commission shall be submitted to the Director, Office of Nuclear Reactor Regulation, USNRC within the time period specified for each report. This includes personnel changes in Level 1 (University President), 2 (Reactor Administrator) or 3 (Chief Reactor Supervisor) administration, as shown in Figure 1, which shall be reported within 30 days of such a change.

6.10 Record Retention

6.10.1 Records to be Retained for a Period of at Least Five Years

a. Operating logs or data which shall identify:

1. Completion of pre-startup check-out, startup, power changes, and shutdown of the reactor.
2. Installation or removal of fuel elements, control rods, or experiments that could affect core reactivity.
3. Installation or removal of jumpers, special tags or notices, or other temporary changes to reactor safety circuitry.
4. Rod worth measurements and other reactivity measurements.

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. This requirement may be satisfied by the normal operations log book plus,

1. Records of radioactive material transferred from the facility as required by license.
2. Records required by the Reactor Safety Advisory Committee for the performance of new or special experiments.

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

h. Changes to operating procedures.

6.10.2 Records to be Retained for the Life of the Facility

a. Records of liquid and solid radioactive effluent released to the environs.

b. Off-site environmental monitoring surveys.

c. Fuel inventories and fuel transfers.

d. Radiation exposures for all personnel.

e. Drawings of the facility.

f. Records of reviews performed for changes made to procedures or equipment or reviews of tests and experiments pursuant to 10 CFR 50.59.

g. Records of meetings of the Reactor Safety Advisory Committee, and copies of RSAC audit reports.

h. Records of the review of:

- Violations of any safety limit (SL)
- Violations of any limiting safety setting (LSSS)
- Violations of any limiting condition of operation (LCO)

LICENSE NUMBER R-102

TECHNICAL SPECIFICATIONS

FOR

THE UNIVERSITY OF NEW MEXICO AGN-201M REACTOR

SERIAL NUMBER 112

DOCKET NUMBER 50-252

REVISED NOVEMBER 2014

TABLE OF CONTENTS

1.0 DEFINITIONS

The terms Safety Limit (SL), Limiting Safety System Setting (LSSS), and Limiting Conditions for Operation (LCO) are as defined in 10 CFR 50.36. Those definitions are included here for ease of reference.

1.1 Definitions

1.1.1 Cadmium Rod – An aluminum rod wrapped with Cd and inserted into the glory hole to assure that the reactor is secured. The rod is worth at least $7 of negative reactivity.

1.1.2 Channel Calibration - A channel calibration is an adjustment of the channel such that its output responds, within acceptable range and accuracy, to known values of the parameter that the channel measures. Calibration shall encompass the entire channel, including equipment, actuation, alarm, or trip.

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

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

1.1.5 Coarse Control Rod - The control rod with a scram function that can be mechanically withdrawn/inserted at two possible speeds (40-50 seconds full insertion time or 80-100 seconds full insertion time).

1.1.6 Excess Reactivity - The amount of reactivity above a $k_{eff} = 1$. This is the amount of reactivity that would exist if all control rods were moved to the maximum reactive condition from the point where the reactor is exactly critical ($k_{eff} = 1$)

1.1.7 Experiment - An experiment is any of the following:

a. An activity utilizing the reactor system or its components or the neutrons or radiation generated therein;
b. An evaluation or test of a reactor system operational, surveillance, or maintenance technique;
c. The material content of any of the foregoing, including structural components, encapsulation or confining boundaries, and contained fluids or solids.

1.1.8 Experimental Facilities - Experimental facilities are those portions of the reactor assembly used for the introduction of experiments into or adjacent to the reactor core region or to allow beams of radiation to exist outside the reactor shielding. Experimental facilities shall include the thermal column, glory hole, and access ports.

1.1.9 Explosive Material - Any chemical compound, mixture, or device, which produces a substantial instantaneous release of gas and heat spontaneously or by contact with sparks or flame.

1.1.10 Fine Control Rod - A low worth control rod (about 25% of the worth of the other control rods) used primarily to maintain an intended power level. Its position may be varied manually. The fine control rod does not drop on a scram signal, but withdraws automatically.

1.1.11 Limiting Conditions for Operation (LCO) – The lowest functional capability or performance levels of equipment required for safe operation of the facility.

1.1.12 Limiting Safety System Settings (LSSS) – Settings for automatic protective devices related to those variables having significant safety functions.

1.1.13 Major Change - Any change in reactor configuration which affects the probability or consequences of an event.

1.1.14 Measured Value - The measured value is the value of a parameter as it appears on the output of a channel.

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

1.1.16 Movable Experiment - A movable experiment is one that may be inserted, removed, or manipulated while the reactor is critical.

1.1.17 Operable - Operable means a component or system is capable of performing its intended function in its normal manner.

1.1.18 Operating - Operating means a component or system is performing its intended function in its normal manner.

1.1.19 Potential Reactivity Worth - The potential reactivity worth of an experiment is the maximum absolute value of the reactivity change that would occur as a result of intended or anticipated changes or credible malfunctions that alter experiment position or configuration.

1.1.20 Reactor Component - A reactor component is any apparatus, device, or material that is a normal part of the reactor assembly.

1.1.21 Reactor Operation - Reactor operation is any condition wherein the reactor is not secured.

1.1.22 Reactor Operator - An individual who is licensed to manipulate the controls of a reactor.

1.1.23 Reactor Safety System - The reactor safety system is that combination of safety channels and associated circuitry which forms an automatic protective system for the reactor or provides information that requires manual protective action be initiated.

1.1.24 Reactor Secured - The reactor shall be considered secured whenever:

a. either: 1. The safety and control rods are fully withdrawn from the core; or
2. The core fuse melts resulting in separation of the core.

and:

b. the reactor console key switch is in the "off" position; the key is removed from the console and under the control of a certified operator; and the Cd rod is in the glory hole.

1.1.25 Removable Experiment - A removable experiment is any experiment, experimental facility, or component of an experiment, other than a permanently attached appurtenance to the reactor system, which can reasonably be anticipated to be moved one or more times during the life of the reactor.

1.1.26 Research Reactor - A research reactor is a device designed to support a self-sustaining neutron chain reaction for research, development, educational, training, or experimental purposes, and which may have provisions for producing radioisotopes.

1.1.27 Safety Channel - A safety channel is a measuring channel in the reactor safety system.

1.1.28 Safety Control Rod - One of two scrammable control rods that can be mechanically withdrawn/inserted at only one speed (35 to 50 seconds full insertion time).

1.1.29 Safety Limit (SL) – Limits on important process variables that are necessary to reasonably protect the integrity of certain of the physical barriers that guard against the uncontrolled release of radioactivity.

1.1.30 Scram Time - The time for the control rods acting under gravity to change the reactor from a critical to a subcritical condition. In most cases, this is less than or equal to the time it takes for the rod to fall from full-in to full-out position.

1.1.31 Secured Experiment - Any experiment, or component of an experiment is deemed to be secured, or in a secured position, if it is held in a stationary position relative to the reactor by mechanical means. The restraint shall exert sufficient force on the experiment to overcome the expected effects of hydraulic, pneumatic, buoyant, or other forces which are normal to the operating environment of the experiment or which might arise as a result of credible malfunctions.

1.1.32 Senior Reactor Operator – An individual who is licensed to direct the activities of reactor operators. Such an individual is also a reactor operator.

1.1.33 Shall, Should and May - The word "shall" is used to denote a requirement; the word "should" to denote a recommendation; and the word "may" to denote permission--neither a requirement nor a recommendation.

1.1.34 Shutdown Margin - Shutdown margin shall mean the minimum shutdown reactivity necessary to provide confidence that the reactor can be made subcritical by means of the control and safety systems starting from any permissible operating condition with the most reactive safety or coarse control rod fully inserted and the fine control rod fully inserted, and that the reactor will remain subcritical without further operator action.

1.1.35 Static Reactivity Worth - The static reactivity worth of an experiment is the value of the reactivity change measurable by calibrated control or regulating rod comparison methods between two defined terminal positions or configurations of the experiment. For removable experiments, the terminal positions are fully removed from the reactor and fully inserted or installed in the normal functioning or intended position.

1.1.36 Surveillance Time - A surveillance time indicates the frequency of tests to demonstrate performance. Allowable surveillance intervals shall not exceed the following:

a. Two-year (interval not to exceed 30 months)
b. Annual (interval not to exceed 15 months)
c. Semiannual (interval not to exceed seven and one-half months)
d. Quarterly (interval not to exceed four months)
e. Monthly (interval not to exceed six weeks).

2.0 SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

2.1 Safety Limits

Applicability

This specification applies to the maximum core temperature during operation.

Objective

To assure that the integrity of the fuel material is maintained and that all fission products are retained in the core matrix.

Specification

a. The maximum core temperature shall not exceed 200°C during operation.

Basis

The polyethylene core material does not melt below 200°C and is expected to maintain its integrity and retain essentially all of the fission products at temperatures below 200°C. The Hazards Summary Report dated February 1962 submitted on Docket F-15 by Aerojet-General Nucleonics (AGN) calculated a core maximum temperature rise of 71.3°C while the Safety Analysis Report submitted during the 1986 relicensing of the UNM AGN calculated a core maximum temperature rise of 100.7°C . In either case, assuming operation at 20°C, the corresponding maximum core temperature would be 120.7°C or 91.3°C, both of which are well below 200°C thus assuring integrity of the core and retention of fission products.

2.2 Limiting Safety System Settings

Applicability

This specification applies to the parts of the reactor safety system which will limit maximum power and core temperature.

Objective

To assure that automatic protective action is initiated to prevent a safety limit from being exceeded.

Specification

a. The safety channels shall initiate a reactor scram at the following limiting safety system settings:

Channel	Condition LSSS
Nuclear Safety #2	High Power 6 watts
Nuclear Safety #3	High Power 6 watts

b. The polystyrene core thermal fuse melts when heated to a temperature of about 120°C resulting in core separation and a reactivity loss greater than 5% $\Delta k/k$.

Basis

Based on instrumentation response times and scram tests, the AGN Hazards Report concluded that reactor periods in excess of 30-50 milliseconds would be adequately arrested by the scram system. Since the maximum available excess reactivity in the reactor is less than one dollar, the reactor cannot become prompt critical, and the corresponding shortest possible period is greater than 200 milliseconds. The high power LSSS of 6 watts in conjunction with automatic safety systems, and the maximum temperature rise of 100.7°C, and/or manual scram capabilities will assure that the safety limits will not be exceeded during normal operation or as a result of the most severe credible transient.

In the event of failure of the reactor to scram, the self-limiting characteristics due to the high negative temperature coefficient, and the melting of the thermal fuse at a temperature below 120°C will assure safe shutdown without exceeding a core temperature of 200°C (the Safety Limit).

3.0 LIMITING CONDITIONS FOR OPERATION

3.1 Reactor Core Parameters

Applicability

This specification applies to the reactivity condition of the reactor and the reactivity worths of control rods and experiments.

Objective

To assure that the reactor can be shut down at all times and that the safety limits will not be exceeded.

Specification

a. The available excess reactivity with the coarse, fine, and safety control rods fully inserted and including the potential absolute value of the reactivity worth of all experiments shall not exceed 0.65% $\Delta k/k$.

b. The shutdown margin shall be at least one dollar.

c. The reactivity worth of the control rods shall ensure subcriticality on the withdrawal of the coarse control rod or any one safety rod.

d. The excess reactivity with no experiments in the reactor and the coarse, fine, and safety control rods fully inserted shall not exceed 0.25% $\Delta k/k$.

Basis

The limitations on total core excess reactivity assure reactor periods of sufficient length so that the reactor protection system and/or operator action will be able to shut the reactor down without exceeding any safety limits. The shutdown margin and control and safety rod reactivity limitations assure that the reactor can be brought and maintained subcritical if the highest reactivity rod fails to scram and remains in its most reactive position.

3.2 Reactor Control and Safety Systems

Applicability

These specifications apply to the reactor control and safety systems.

Objective

To specify lowest acceptable level of performance, instrument set points, and the minimum number of operable components for the reactor control and safety systems.

Specification

a. The fine control rod, coarse control rod, and the two safety rods shall be operable and the carriage position of the fine and coarse control rods shall be displayed at the console whenever any rod is above its lower limit.

b. The total scram withdrawal time of the safety rods and coarse control rod shall be less than 1 second.

c. The average reactivity addition rate for each control rod (fine, coarse, or safety rod) shall not exceed 0.065% $\Delta k/k$ per second.

d. The safety rods and coarse control rod shall be interlocked such that:

    1. Reactor startup cannot commence unless both safety rods and the coarse control rod are fully withdrawn from the core.

    2. Only one safety rod can be inserted at a time.

    3. The coarse control rod cannot be inserted unless both safety rods are fully inserted.

    4. At any operating power below 50×10^{-6} watts, none of the rods can be moved to a more reactive position.

e. Nuclear safety channel instrumentation shall be operable in accordance with Table 3.1 whenever the reactor is in operation.

f. A manual scram shall be provided on the reactor console, and the safety circuitry shall be designed so that no single failure can negate both the automatic and manual scram capability.

g. The shield water level interlock shall be set to prevent reactor startup and scram the reactor if the shield water level falls more than 18 cm below the highest point on the reactor shield tank manhole opening.

h. The shield water temperature interlock shall prevent reactor startup or scram the reactor if the shield water temperature falls below 18°C.

i. The seismic displacement interlock shall be installed in such a manner to prevent reactor startup or to scram the reactor during a seismic displacement.

j. A loss of electric power shall cause the reactor to scram.

Basis

The specification on operability of the rods assures console control over reactivity conditions within the reactor. Display of the positions of the fine and coarse control rods assures that the positions of these rods are available to the operator to evaluate the configuration of the reactor.

The specifications on scram withdrawal time in conjunction with the safety system instrumentation and set points assure safe reactor shutdown during the most severe foreseeable transients. Interlocks on control rods assure an orderly approach to criticality and an adequate shutdown capability. The limitations on reactivity addition rates allow only relatively slow increases of reactivity so that ample time will be available for manual or automatic scram during any operating conditions.

The neutron detector channels (Nuclear Safety Channels #2 and #3) assure that reactor power levels are adequately monitored during reactor startup and operation. The power level scrams initiate redundant automatic protective action at power levels low enough to assure safe shutdown without exceeding any safety limits. The manual scram assures a method of shutdown without reliance on safety channels and circuitry.

The AGN-201's negative temperature coefficient of reactivity causes a reactivity increase with decreasing core temperature. The shield water temperature interlock will prevent reactor operation at temperatures below 18°C thereby limiting potential reactivity additions associated with temperature decreases.

Water in the shield tank is an important component of the reactor shield and operation without the water may produce excessive radiation levels. The shield tank water level interlock will prevent reactor operation without adequate water levels in the shield tank.

The reactor is designed to withstand 0.6 g accelerations and 6 cm displacements. A seismic instrument causes a reactor scram whenever the instrument receives a horizontal acceleration that causes a horizontal displacement of 0.16 cm or greater. The seismic displacement interlock assures that the reactor will be scrammed and brought to a subcritical configuration during any seismic disturbance that may cause damage to the reactor or its components.

The manual scram allows the operator to manually shutdown the reactor if an unsafe or otherwise abnormal condition occurs that does not scram the reactor. A loss of electrical power de-energizes the safety and coarse control rod holding magnets causing a reactor scram thus assuring safe and immediate shutdown in case of a power outage.

Table 3.1

Nuclear Safety Channel Instrumentation

Channel No.	Function	Operating Limits
2	High Power Scram	120% of licensed power (6 Watts)
3	High Power Scram	120% of licensed power (6 Watts)

3.3 Limitations on Experiments

Applicability

This specification applies to experiments installed in the reactor and its experimental facilities.

Objective

To prevent damage to the reactor or excessive release of radioactive materials in the event of an experimental failure.

Specification

a. Experiments outside the reactivity limits defined in TS 3.1 shall not be permitted.

b. Experiments within the reactivity limits defined in TS 3.1 containing materials corrosive to reactor components or which contain gaseous or liquid fissionable materials shall be doubly encapsulated.

c. Explosive materials or materials which might combine violently shall not be inserted into experimental facilities of the reactor or irradiated in the reactor.

d. The radioactive material content, including fission products, of any doubly encapsulated experiment should be limited so that the complete release of all gaseous, particulate, or volatile components from the encapsulation could not result in:

   (1) a total effective dose equivalent to any person occupying an unrestricted area in excess of 0.1 REM (0.001 Sv) or

   (2) a total effective dose equivalent to any person occupying a restricted area during the length of time required to evacuate the restricted area in excess of 5 rem (0.050 Sv).

Basis

These specifications are intended to reduce the likelihood of damage to reactor components and/or radioactivity releases resulting from an experimental failure and to protect operating personnel and the public from excessive radiation doses in the event of an experimental failure. Specification 3.3d conforms to 10 CFR 20 as of the date of this revision.

3.4 Radiation Monitoring, Control And Shielding

Applicability

This specification applies to radiation monitoring, control, and reactor shielding required during reactor operation.

Objective

The objective is to protect facility personnel and the public from radiation exposure.

Specification

During Reactor Operation:

a. An operable portable radiation survey instrument capable of detecting gamma radiation shall be immediately available to reactor operating personnel whenever the reactor is in operation.

b. The reactor room shall be considered a restricted area according to 10CFR20.

c. The top of the reactor shall be considered a high radiation area, and the access stairs to the top of the reactor shall be equipped with a gate and a lock for access control. The keys for the gate shall be in control of the reactor operator during operation.

d. The following shielding requirement shall be fulfilled:
   The thermal column shall be filled with water or graphite except during a critical experiment (core loading) or during other approved experiments that require the thermal column to be empty.

e. The core tank shall be sealed.

Basis

Radiation surveys performed under the supervision of a qualified health physicist have shown that the total gamma, thermal neutron, and fast neutron radiation dose rate in the reactor room, at the closest approach to the reactor but without access to reactor top, is less than 50 mrem/hr at reactor power levels of 5.0 watts.

When the reactor is secured, radiation levels at all points in the reactor room are below 100 μrem/hr. The facility shielding in conjunction with radiation monitoring, control, and restricted areas is designed to limit radiation doses to facility personnel and to the public to a level below 10 CFR 20 limits under all conditions.

4.0 SURVEILLANCE REQUIREMENTS

Actions specified in sections 4.1, 4.2, and 4.3 are not required to be performed if during the specified surveillance period the reactor has not been brought critical or is maintained in a secured condition extending beyond the specified surveillance period. However, the surveillance requirements shall be fulfilled prior to subsequent startup of the reactor.

4.1 Reactivity Limits

Applicability

This specification applies to the surveillance requirements for reactivity limits.

Objective

To assure that reactivity limits for Specification 3.1 are not exceeded.

Specification

a. Control rod reactivity worths shall be measured annually to verify 3.1c.

b. Total excess reactivity and shutdown margin shall be determined annually.

c. The reactivity worth of an experiment shall be estimated or measured, as appropriate, before or during the first startup subsequent to the experiment's first insertion.

Basis

The control and safety rod reactivity worths are measured annually to assure that no degradation or unexpected changes have occurred which could adversely affect reactor shutdown margin or total excess reactivity. The shutdown margin and total excess reactivity are determined to assure that the reactor can always be safely shut down with one rod not functioning and that the maximum possible reactivity insertion will not result in reactor periods shorter than those that can be adequately terminated by either operator or automatic action. Based on experience with AGN reactors, significant changes in reactivity or rod worth are not expected within a 12 month period.

4.2 Control and Safety Systems

Applicability

This specification applies to the surveillance requirements of the reactor control and safety systems.

Objective

To assure that the reactor control and safety systems are operable as required by Specification 3.2.

Specification

a. A channel test of Nuclear Safety Channels #2 and #3 shall be performed prior to the first reactor startup of the day or prior to each reactor operation extending more than one day.

b. A channel check of Nuclear Safety Channels #2 and #3 shall be performed daily whenever the reactor is in operation.

c. Prior to each day's reactor operation the rod interlock shall be checked to make sure it is operating.

d. Prior to each day's reactor operation or prior to each reactor operation extending more than one day, safety rod #1 shall be inserted and scrammed to verify operability of the manual scram system.

e. Prior to each day's reactor operation, it shall be verified that the lock on the gate for the access stairs is locked.

f. Control rod scram times and average reactivity insertion rates shall be measured annually.

g. Control rods and drives shall be inspected for proper operation annually.

h. A channel test of the seismic displacement interlock shall be performed annually.

i. The power level measuring channels shall be calibrated and set points verified annually.

j. The shield water level interlock and shield water temperature interlock shall be calibrated annually.

k. It shall be verified annually that loss of electrical power causes a scram.

Basis

The channel tests and checks required daily or before each startup will assure that the safety channels and scram functions are operable. Based on operating experience with reactors of this type, the annual scram measurements, channel calibrations, set point verifications, and inspections are of sufficient frequency to assure, with a high degree of confidence, that the safety system settings will be within acceptable drift tolerance for operation.

4.3 Reactor Structure

Applicability

This specification applies to surveillance requirements for reactor components other than control rods.

Objective

The objective is to assure integrity of the reactor structures.

Specification

Visual inspection for water leakage from the shield tank shall be performed prior to each startup. Leakage sufficient to activate the shield water level safety interlock shall be corrected prior to subsequent reactor operation.

Basis

Based on experience with reactors of this type, the frequency of inspection and leak test requirements of the shield tank will assure capability for radiation protection during reactor operation. The shield water level safety interlock is checked annually and provides assurance that sufficient water is in the tank for adequate personnel shielding.

4.4 Radiation Monitoring and Control

Applicability

This specification applies to the surveillance requirements of the radiation monitoring and control systems.

Objective

To assure that the radiation monitoring and control systems are operable and that all radiation and high radiation areas within the reactor facility are identified and controlled as required by Specification 3.4.

Specification

a. All portable radiation survey instruments assigned to the reactor facility shall be calibrated annually under the supervision of the Radiation Safety Office.

b. The reactor access control (Ref 3.4c) shall be verified to be operable prior to the first reactor startup of the day or prior to each reactor operation extending more than one day.

c. A radiation survey of the reactor room shall be performed under the supervision of the Radiation Safety Officer to determine the location of radiation and high radiation areas corresponding to reactor operating power levels and to verify that the thermal column is providing shielding. This survey shall be performed as necessary but at least annually.

Basis

The periodic calibration of radiation monitoring equipment and the surveillance of the reactor access control (Ref 3.4c) will assure that the radiation monitoring and control systems are operable during reactor operation.

The periodic radiation surveys will verify the location of radiation and high radiation areas and will assist reactor facility personnel in properly labeling and controlling each location in accordance with 10 CFR 20.

4.5 Conduct of Experiments

Applicability

This specification applies to the surveillance requirements for experiments inserted in the reactor.

Objective

To prevent the conduct of experiments that may damage the reactor or release excessive amounts of radioactive materials as a result of experiment failure.

Specification

a. The reactivity worth of an experiment shall be estimated or measured, as appropriate, before reactor operation with said experiment.

b. An experiment shall not be installed in the reactor or its irradiation facilities unless a safety analysis has been performed and reviewed for compliance with Section 3.3 by the Chief Reactor Supervisor and the Reactor Safety Advisory Committee in full accord with Section 6.4.2 of these Technical Specifications.

Basis

Experience has shown that experiments reviewed by the Chief Reactor Supervisor and RSAC can be conducted without endangering the safety of the reactor or exceeding the limits in the Technical Specifications.

5.0 DESIGN FEATURES

5.1 Reactor

Applicability

This specification applies to basic design features of the reactor.

Objective

To specify specific reactor design features.

Specification

a. The reactor core, including control rods, contains approximately 667 grams of U-235 in the form of <20% enriched UO_2 dispersed in approximately 11 kilograms of polyethylene. The lower section of the core is supported by an aluminum rod hanging from a fuse link. The fuse melts at a fuse temperature of about 120°C causing the lower core section to fall away from the upper section reducing reactivity by at least 5% $\Delta k/k$. Sufficient clearance between core and reflector is provided to ensure free fall of the bottom half of the core during the most severe transient.

b. The core is surrounded by a 20 cm thick high density (1.75 gm/cm^3) graphite reflector followed by a 10 cm thick lead gamma shield. The core and part of the graphite reflector are sealed in a fluid-tight aluminum core tank designed to contain any fission gases that might leak from the core.

c. The core, reflector and lead shielding are enclosed in and supported by a fluid-tight steel reactor tank. An upper or "thermal column tank" may serve as a shield tank when filled with water or a thermal column when filled with graphite.

d. The 198 cm diameter, fluid-tight shield tank is filled with water constituting a 55 cm thick fast neutron shield. The fast neutron shield is formed by filling the tank with approximately 3785 liters of water. The complete reactor shield shall limit doses to personnel in unrestricted areas to levels less than permitted by 10 CFR 20 under operating conditions.

e. Two safety rods and one coarse control rod (identical in size) contain less than 15 grams of U-235 each in the same form as the core material. These rods are lifted into the core by electromagnets, driven by reversible DC motors through lead screw assemblies. De-energizing the magnets causes a spring-driven, gravity-assisted scram. The fourth rod or fine control rod (approximately one-half the diameter of the other rods) is driven directly by a lead screw. This rod may contain polyethylene with or without fuel.

NOTE: All dimensions, masses, and densities given in the above description are nominal values.

Basis

These basic design criteria are relevant to the safe operation of the reactor and should not be changed or modified without NRC approval.

5.2 Fuel Storage

Applicability

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

Objective

To assure that fuel being stored shall be secured and shall not become critical.

Specification

Fuel, including fueled experiments and fuel devices not in the reactor, shall be stored in a secured location when not in use. The storage array shall be such that k_{eff} is no greater than 0.9 for all conditions of moderation and reflection.

Basis

The limits imposed are conservative and assure safe storage (NUREG-1537).

5.3 Reactor Room (065)

Applicability

This specification applies to the reactor location.

Objective

To specify the characteristics of specific facility design features.

Specification

a. The reactor room houses the reactor assembly and accessories required for its operation and maintenance, and the reactor control console.

b. The reactor room is a separate room (065) in the Nuclear Engineering Laboratory, constructed with adequate shielding and other radiation protective features to limit doses in restricted and unrestricted areas to levels no greater than permitted by 10 CFR 20.

c. The access doors to the reactor room shall contain locks.

Basis

The reactor room provides a secure, controlled access area with appropriate shielding for personnel radiation protection.

6.0 ADMINISTRATIVE CONTROLS

6.1 Organization

The current administrative organization for control of the reactor facility and its operation is as set forth in Figure 1. Levels 1, 2, and 3 refer to administrative levels for which changes in staffing must be communicated to the Nuclear Regulatory Commission as set forth in 6.9.3. The authorities and responsibilities set forth below are designed to comply with the intent and requirements for administrative controls of the reactor facility as set forth by the Nuclear Regulatory Commission.

6.1.1 *UNM Administration*

Has administrative responsibilities for all activities on Campus. The President (Level 1) is the chief administrative officer responsible for the University and in whose name the application for licensing is made. The Radiation Control Committee is a permanent committee established to act on behalf of the President of the University for control of all University of New Mexico (UNM) activities involving sources of ionizing radiation. The Committee consists of members from the UNM faculty/staff. Meetings are held regularly. Responsibilities are: to establish policy and disseminate rules for radiation safety and control at UNM; to serve as the UNM liaison with the NRC in matters of registration, licensing, and radiation control; and to ensure periodic inspections and radiation surveys for the purpose of assuring the safety of radiation operations within any UNM facility.

6.1.2 *Chair, Department of Nuclear Engineering*

The chair (Level 1) is the administrative officer responsible for the operation of the Department, for its financial affairs and for appointing the Reactor Administrator. The Chair is responsible for appointing members of the Reactor Safety Advisory Committee (RSAC) and the RSAC reports to the chair on all matters.

6.1.3 *Reactor Administrator*

Provides final policy decisions on all phases of reactor operation and regulations for the facility. The Reactor Administrator (Level 2) is selected by the Chair of the Nuclear Engineering Department and shall hold a graduate degree in Engineering. The Reactor Administrator is advised on matters concerning personnel health and safety by the Radiation Safety Officer and/or the Radiation Control Committee. The Reactor Administrator is advised on matters concerning safe operation of the reactor by the Reactor Operations Committee and/or the Reactor Safety Advisory Committee; designates Reactor Supervisors and names the Chief Reactor Supervisor; approves all regulations, instructions and procedures governing facility operation; submits the annual report to NRC.

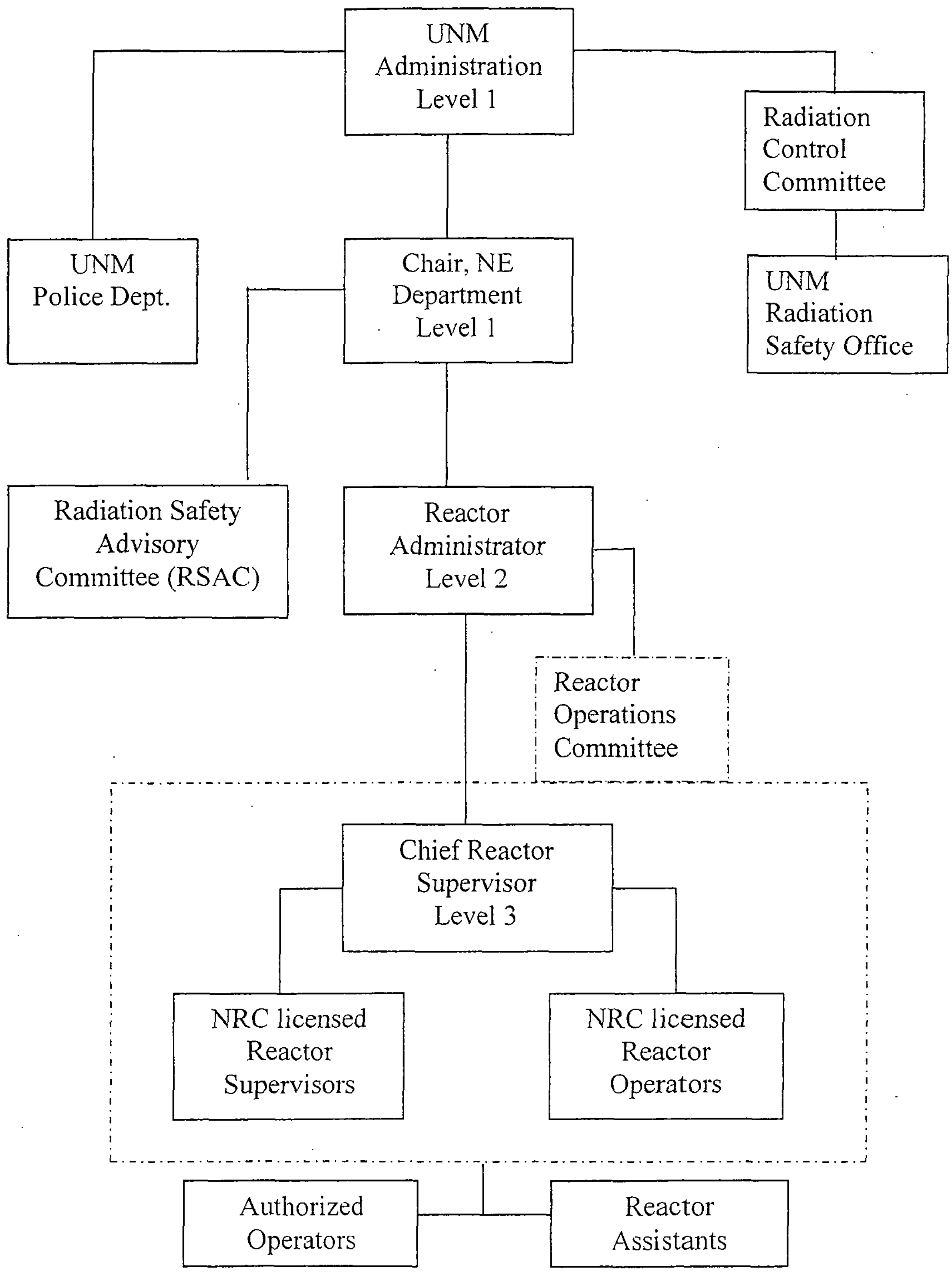
UNM Administration Level 1
Radiation Control Committee
UNM Police Dept.
Chair, NE Department Level 1
UNM Radiation Safety Office
Radiation Safety Advisory Committee (RSAC)
Reactor Administrator Level 2
Reactor Operations Committee
Chief Reactor Supervisor Level 3
NRC licensed Reactor Supervisors
NRC licensed Reactor Operators
Authorized Operators
Reactor Assistants

Figure 1

6.1.4 *Radiation Safety Office*

The Radiation Safety Office will provide emergency direction and assistance for situations involving radiation safety. The UNM Radiation Safety Officer or designee normally represents the Radiation Control Committee in matters concerning the radiation safety aspects of reactor operation.

6.1.5 *Reactor Safety Advisory Committee*

Reviews, evaluates, and audits reactor operations and procedures to ensure that the reactor shall be operated in a safe and competent manner. There shall be at least four members on the RSAC with at least two members from organizations outside the University. The Committee is available for advice and assistance on reactor operation problems. Any major change in the facility shall be approved by the RSAC. Members of the RSAC are appointed by the Department Chair and shall not be members of the Reactor Operations Committee. The RSAC reports to the Chair and advises the Reactor Administrator.

6.1.6 *Reactor Operations Committee*

Consists of the Reactor Supervisors with the Chief Reactor Supervisor. Other qualified persons may also be members. They are directly responsible to the Reactor Administrator for the preparation and submission of detailed procedures, regulations, forms, and rules to ensure the maintenance, safe operation, competent use and security of the facility. The Committee ensures that all the activities, experiments, and maintenance involving the facility are properly logged and are in accordance with established local and U.S. Nuclear Regulatory Commission regulations. They review all proposed changes in procedure or changes in the facility and approve any minor change before the change is implemented.

6.1.7 *Chief Reactor Supervisor*

Shall hold a Senior Reactor Operator's license issued by the NRC. He/she is responsible for the distribution and enforcement of rules, regulations and procedures concerning operation of the facility. The Chief Reactor Supervisor (Level 3) is directly responsible for enforcing operating procedures and ensuring that the facility is operated in a safe, competent and authorized manner. He/she is directly responsible for all prescribed logs and records; is the Emergency Director for emergencies not involving radiation; and has the authority to authorize experiments or procedures which have received appropriate prior approval by the Reactor Operations Committee, the Reactor Safety Advisory Committee and/or the Radiation Control Committee (or the Radiation Safety Officer) and have received prior authorization by the Reactor Administrator. He/she shall not authorize any proposed changes in the facility or in procedure until appropriate evaluation and approval has been made by the Reactor Operations Committee or the Reactor Safety Advisory Committee and authorization given by the Reactor Administrator.

6.1.8 *Reactor Supervisors*

Shall hold valid Senior Reactor Operator's licenses issued by the Nuclear Regulatory Commission. A Reactor Supervisor shall be in charge of the facility at all times during reactor operation and shall witness the startup and intentional shutdown procedures. A Senior Reactor Operator is required to be present whenever fuel is handled. The Reactor Supervisors are directly responsible to the Chief Reactor Supervisor. A Reactor Supervisor shall be present when the reactor is going critical, being intentionally shut down, or when reactor experiments are loaded or unloaded. The location of the Reactor Supervisor shall be known to the Reactor Operator at all times during operation so that it is possible to contact him/her if required.

6.1.9 *Reactor Operators*

Shall hold a valid Reactor Operator's license issued by the NRC. They shall conform to the rules, instructions and procedures for the startup, operation and shutdown of the reactor, including emergency procedures. Within the constraints of the administrative and supervisory controls outlined above, a reactor operator will be in direct charge of the control console at all times that the reactor is operating. The reactor operator shall maintain complete and accurate records of all reactor operations in the operational logs.

6.1.10 *Authorized Operators*

Individuals authorized by the Reactor Supervisor to operate the reactor controls and who do so with the knowledge of the Supervisor and under the direct supervision of a Reactor Operator.

6.1.11 *Reactor Assistants*

These are individuals who are present during reactor operation to provide assistance to the Operator as needed, with the exception that a Reactor Assistant does not operate the controls of the reactor. In an emergency, or if asked, they may push the Reactor Scram button.

6.1.12 *Operating Staff*

a. The minimum operating staff during any time in which the reactor is not secured shall consist of all of the following:

1. One Reactor Operator or Reactor Supervisor in the reactor room.

2. One other person in the reactor room or Nuclear Reactor Laboratory qualified to activate manual scram and initiate emergency procedures.

3. One radiation safety staff member who can be readily contacted by telephone and who can arrive at the reactor room within 30 minutes.

4. One Reactor Supervisor readily available on call. This requirement can be satisfied by having a licensed Reactor Supervisor perform the duties stated in paragraph 1 or 2 above or by designating a licensed Reactor Supervisor who can be readily contacted by telephone and who can arrive at the reactor facility within 30 minutes.

b. A Senior Reactor Operator shall supervise all reactor maintenance or modification that could affect the reactivity of the reactor.

c. A listing of reactor facility personnel by name and phone number shall be conspicuously posted in the reactor room.

6.2 Staff Qualifications

The Chief Reactor Supervisor, licensed Reactor Supervisors and Reactor Operators, and technicians performing reactor maintenance shall meet the minimum qualifications set forth in ANSI 15.4, "Standards for Selection and Training of Personnel for Research Reactors". Reactor Safety Advisory Committee members shall have a minimum of five (5) years experience in a technical profession or a baccalaureate degree and two (2) years of professional experience. The Radiation Safety Officer shall have a baccalaureate degree in biological or physical science and have at least two (2) years experience in health physics.

6.3 Training

The Reactor Administrator shall be responsible for directing training as set forth in ANSI 15.4-2007, "Standards for Selection and Training of Personnel for Research Reactors". All licensed reactor operators shall participate in requalification training as set forth in 10 CFR 55.

6.4 Reactor Safety Advisory Committee

6.4.1 Meetings and Quorum

The Reactor Safety Advisory Committee shall meet as often as deemed necessary by the Reactor Safety Advisory Committee Chair but shall meet at least semiannually (interval not to exceed seven and one-half months). A quorum for the conduct of official business shall be three members.

6.4.2 Reviews

The Reactor Safety Advisory Committee shall review:

a. Safety evaluations for changes to procedures, equipment or systems, and tests or experiments, conducted without Nuclear Regulatory Commission approval under the provision of 10 CFR 50.59 to verify that such actions do not require a license amendment.

b. Proposed changes to or additional procedures, new or existing equipment or systems that change the original intent or use, and are non-conservative, or those that are covered in 10 CFR 50.59.

c. Proposed tests or experiments which are significantly different from previous approved tests or experiments, or those that are covered in 10 CFR 50.59.

d. Proposed changes in Technical Specifications or other license documents.

e. Violations of applicable statutes, codes, regulations, orders, Technical Specifications, license requirements, or internal procedures or instructions having nuclear safety significance.

f. Significant operating abnormalities or deviations from normal and expected performance of facility equipment that affect nuclear safety.

g. Reportable occurrences.

h. Audit reports.

6.4.3 Audits

Audits of facility activities shall be performed at least annually (interval not to exceed 15 months) under the cognizance of the Reactor Safety Advisory Committee but in no case by the personnel responsible for the item audited. These audits shall examine the operating records and encompass, but shall not be limited to, the following:

a. The conformance of the facility operation to the Technical Specifications and applicable license conditions, at least annually (interval not to exceed 15 months).

b. The Facility Emergency Plan and implementing procedures, at least every two years (interval not to exceed 30 months).

c. The Facility Security Plan and implementing procedures, at least every two years (interval not to exceed 30 months).

d. Operator requalification program and records, at least every two years (interval not to exceed 30 months).

e. Results of actions taken to correct deficiencies, at least annually (interval not to exceed 15 months).

f. Deficiencies uncovered that affect reactor safety shall immediately be reported to Level 1 management. A written report of the findings of the audit shall be submitted to Level 1 management and the review and audit group members within 3 months after the audit has been completed.

6.4.4 Authority

The Reactor Safety Advisory Committee shall report to the Nuclear Engineering Department Chair and shall advise the Reactor Administrator the Chief Reactor Supervisor on those areas of responsibility outlined in Section 6.1.5 of these Technical Specifications.

6.4.5 Minutes of the Reactor Safety Advisory Committee

One member of the Reactor Safety Advisory Committee shall be designated to direct the preparation, maintenance, and distribution of minutes of its activities. These minutes shall include a summary of all meetings, actions taken, audits, and reviews. Minutes shall be distributed to all RSAC members, all administrative levels, and the Radiation Safety Officer within 2 months (interval not to exceed 10 weeks) after each meeting.

6.5 Approvals

The procedure for obtaining approval for any change, modification, or procedure which requires approval of the Reactor Safety Advisory Committee is as follows:

a. The Chief Reactor Supervisor shall prepare the proposal for review and approval by the Reactor Administrator.

b. The Reactor Administrator shall submit the proposal to the Reactor Safety Advisory Committee for review, comment, and possible approval.

c. The Reactor Safety Advisory Committee shall approve the proposal by majority vote.

d. The Reactor Administrator shall provide final approval after receiving the approval of the Reactor Safety Advisory Committee.

6.6 Procedures

There shall be written procedures that cover the following activities:

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

b. Fuel movement and changes to the core and experiments that could affect reactivity.

c. Conduct of irradiations and experiments that could affect the operation or safety of the reactor.

d. Preventive or corrective maintenance which could affect the safety of the reactor.

e. Routine reactor maintenance.

f. Radiation Safety Protection for all reactor related personnel.

g. Surveillance, testing and calibration of instruments, components, and systems as specified in Section 4.0 of these Technical Specifications.

h. Implementation of the Security Plan and Emergency Plan.

The above listed procedures shall be approved by the Reactor Administrator and the Reactor Safety Advisory Committee. Temporary procedures which do not change the intent of previously approved procedures and which do not involve a 10CFR50.59 review may be employed on approval by the Chief Reactor Supervisor.

6.7 Experiments

a. Prior to initiating any new reactor experiment, an experimental procedure shall be prepared by the Chief Reactor Supervisor and reviewed and approved by the Reactor Safety Advisory Committee.

b. Experiments shall only be performed under the cognizance of the Chief Reactor Supervisor.

6.8 Safety Limit Violations

The following actions shall be taken in the event a Safety Limit is violated:

a. The reactor will be shut down immediately and reactor operation will not be resumed without authorization by the Nuclear Regulatory Commission (NRC).

b. The Safety Limit Violation shall be reported to the NRC Operations Center, the Director of NRR, the Reactor Safety Advisory Committee, and Reactor Administrator not later than the next work day.

c. A Safety Limit Violation Report shall be prepared for review by the Reactor Safety Advisory Committee. This report shall describe the applicable circumstances preceding the violation, the effects of the violation upon facility components, systems, or structures, and corrective action to prevent recurrence.

d. The Safety Limit Violation Report shall be submitted to the NRC and the Reactor Safety Advisory Committee within 14 days of the violation.

6.9 Reporting Requirements

In addition to the applicable reporting requirements of Title 10, Code of Federal Regulations, the following reports shall be submitted to the Document Control Desk, USNRC, Washington D.C., 20555.

6.9.1 Annual Operating Report

Routine annual operating reports shall be submitted no later than ninety (90) days following June 30. The annual operating reports shall provide a comprehensive summary of the operating experience having safety significance gained during the year, even though some repetition of previously reported information may be involved. References in the annual operating report to previously submitted reports shall be clear.

Each annual operating report shall include:

a. A brief narrative summary of

1. Changes in facility design, performance characteristics, and operating procedures related to reactor safety that occurred during the reporting period.

2. Results of major surveillance tests and inspections.

b. A tabulation showing the hours the reactor was operated and the energy produced by the reactor in watt-hours.

c. List of the unscheduled shutdowns, including the reasons therefore and corrective action taken, if any.

d. Discussion of the major safety related corrective maintenance performed during the period, including the effects, if any, on the safe operation of the reactor, and the reasons for the corrective maintenance required.

e. A brief description of:

1. Each change to the facility to the extent that it changes a description of the facility in the application for license and amendments thereto.

2. Changes to the procedures as described in Facility Technical Specifications.

3. Any new experiments or tests performed during the reporting period.

f. A summary of the safety evaluation made for each change, test or experiment not submitted for NRC approval pursuant to 10 CFR 50.59 which clearly shows the reason leading to the conclusion that no license amendment was required and that no Technical Specifications change was required.

g. A summary of the nature and amount of radioactive effluent released or discharged to the environs beyond the effective control of the licensee as determined at or prior to the point of such release or discharge.

1. Liquid Waste (summarized for each release)

a. Total estimated quantity of radioactivity released (in Curies) and total volume (in liters) of effluent water (including diluent) released.

2. Solid Waste (summarized for each release)

a. Total volume of solid waste packaged (in cubic meters)

b. Total activity in solid waste (in Curies)

c. The dates of shipment and disposition (if shipped off site).

h. A description of the results of any environmental radiation surveys performed outside the facility.

i. Radiation Exposure - A summary of personnel exposures received during the reporting period by facility personnel and visitors.

6.9.2 Reportable Occurrences

Reportable occurrences, including causes, probable consequences, corrective actions and measures to prevent recurrence, shall be reported to the NRC as described in Section 6.9.

Supplemental reports may be required to fully describe final resolution of the occurrence. In case of corrected or supplemental reports, an amended licensee event report shall be completed and reference shall be made to the original report date.

a. Prompt Notification with Written Follow-up

The types of events listed below are considered reportable occurrences and shall be reported as expeditiously as possible by telephone and confirmed by facsimile transmission to the NRC Operations Center no later than the first work day following the event, with a written follow-up report within two weeks as described in Section 6.9. Information provided shall contain narrative material to provide complete explanation of the circumstances surrounding the event.

1. Failure of the reactor protection system or other systems subject to limiting safety system settings to initiate the required protective function by the time a monitored parameter reached the set point specified as the limiting safety system setting in the Technical Specifications or failure to complete the required protective function.

2. Operation of the reactor or affected systems when any parameter or operation subject to a limiting condition is less conservative than the limiting condition for operation established in the Technical Specifications - without taking permitted remedial action.

3. Abnormal degradation discovered in a fission product barrier.

4. Reactivity balance anomalies involving:

   a. Disagreement between expected and actual critical rod positions of approximately 0.3% $\Delta k/k$.

   b. Exceeding excess reactivity limit.

   c. Shutdown margin less conservative than specified in Technical Specifications.

   d. If sub-critical, an unplanned reactivity insertion of more than approximately 0.5% $\Delta k/k$ or any unplanned criticality.

5. Failure or malfunction of one (or more) component(s) which prevents or could prevent, by itself, the fulfillment of the functional requirements of system(s) used to cope with accidents analyzed in the Safety Analysis Report.

6. Personnel error or procedural inadequacy which prevents, could prevent, by itself, the fulfillment of the functional requirements of system(s) used to cope with accidents analyzed in the Safety Analysis Report.

7. Unscheduled conditions arising from natural or manmade events that, as a direct result of the event, require reactor shutdown, operation of safety systems, or other protective measures required by Technical Specifications.

8. Errors discovered in the analyses or in the methods used for such analyses as described in the Safety Analysis Report or in the bases for the Technical Specifications that have or could have permitted reactor operation in a manner less conservative than assumed in the analysis.

9. Release of radiation or radioactive materials from site above allowed limits.

10. Performance of structures, systems, or components that requires remedial action or corrective measures to prevent operation in a manner less conservative than assumed in the accident analysis in the SAR or Technical Specifications that require remedial action or corrective measures to prevent the existence or development of an unsafe condition.

6.9.3 Special Reports

Special reports which may be required by the Nuclear Regulatory Commission shall be submitted to the Director, Office of Nuclear Reactor Regulation, USNRC within the time period specified for each report. This includes personnel changes in Level 1 (University President), 2 (Reactor Administrator) or 3 (Chief Reactor Supervisor) administration, as shown in Figure 1, which shall be reported within 30 days of such a change.

6.10 Record Retention

6.10.1 Records to be Retained for a Period of at Least Five Years

a. Operating logs or data which shall identify:

1. Completion of pre-startup check-out, startup, power changes, and shutdown of the reactor.
2. Installation or removal of fuel elements, control rods, or experiments that could affect core reactivity.
3. Installation or removal of jumpers, special tags or notices, or other temporary changes to reactor safety circuitry.
4. Rod worth measurements and other reactivity measurements.

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. This requirement may be satisfied by the normal operations log book plus,

1. Records of radioactive material transferred from the facility as required by license.
2. Records required by the Reactor Safety Advisory Committee for the performance of new or special experiments.

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

h. Changes to operating procedures.

6.10.2 Records to be Retained for the Life of the Facility

a. Records of liquid and solid radioactive effluent released to the environs.

b. Off-site environmental monitoring surveys.

c. Fuel inventories and fuel transfers.

d. Radiation exposures for all personnel.

e. Drawings of the facility.

f. Records of reviews performed for changes made to procedures or equipment or reviews of tests and experiments pursuant to 10 CFR 50.59.

g. Records of meetings of the Reactor Safety Advisory Committee, and copies of RSAC audit reports.

h. Records of the review of:

- Violations of any safety limit (SL)
- Violations of any limiting safety setting (LSSS)
- Violations of any limiting condition of operation (LCO)