UNM

Chemical & Nuclear Engineering

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Subject: Docket No. 50-252, Facility License R-102
Request for Additional Information Regarding the AGN-201M Reactor Application for License Renewal (TAC No. ME1590).

Transmitted herewith is our formal response to your Request for Additional Information (RAI), dated August 20, 2010, regarding the renewal of the AGN-201M facility license. The enclosure contains the revised technical specifications and a matrix of our responses to the 41 RAIs.

If there are any questions or concerns with this response please contact me at (505) 277-8027, and/or e-mail me at busch@unm.edu

I declare under penalty of perjury that the foregoing is true and correct. Executed on November 19th, 2010.

Respectfully Submitted

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NRR

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REQUEST FOR ADDITIONAL INFORMATION
UNIVERSITY OF NEW MEXICO – AGN-201M REACTOR – DOCKET NO. 50-252A.

#	ISSUE	YES ? ? ? NO *	What? How?
A. **Technical Specifications** – The U. S. Nuclear Regulatory Commission (NRC) staff has reviewed the revised Technical Specifications (TS) submitted by letter dated February 21, 2007. During our review, we have identified areas where we require additional information and/or clarification. Please provide responses to the following requests for additional information.			
1.	TS Section 1, Definitions, definition 1.1.1, *Certified Operator.* This definition has been removed from American Nuclear Society Institute/ American National Standards (ANSI/ANS) 15.1 – 2007, and has been replaced with definitions for Reactor Operator and Senior Reactor Operator. Please update TS to the more current industry standard.	YES	Deleted Definition and added definitions of Reactor Operator and Senior Reactor Operator as per ANS 15.1
2.	TS Section 1, Definitions, definition 1.1.10, *Explosive Material.* Two references in this definition, Dangerous Properties of Industrial Materials, by N.I. Sax, 3rd ed., (1968), and National Fire Protection Association in its publication 704-M, 1966, have subsequent editions. Is the facility still using the 1966 and 1968 editions of these publications? If not, please update your reference in this definition.	YES	Deleted other references and updated to refer to the NFPA 704 Diamond Hazard Rating System.
3.	TS Section 1, Definitions, definition 1.1.11, *Fine Control Rod.* This definition is missing information, the fact that the fine rod does NOT withdraw automatically on a scram signal and the fact that it has a relatively small reactivity worth (¼ the value of the other rods). Please either add this information to the definition or explain why the definition as written is acceptable.	YES	Revised the definition to include the worth versus the other rods and the fact that it does not scram, but does withdraw automatically on a scram signal.

#	ISSUE	YES ? ? ? NO *	What? How?
4.	TS Section 1, Definitions, definition 1.1.20, *Reactor Operation.* ANSI/ANS 15.1-2007 suggests three operational states for the reactor: reactor operation, reactor shutdown and reactor secure. Normally a reactor that has been secured can be left unattended (e.g. reactor staff goes home for the night) and requires a startup checkout to return to operation whereas a reactor that is shutdown is not left unattended and may be restarted without performing startup checks. Your definition of reactor operation only refers to a reactor state of "Reactor Shutdown." However, there is no definition for reactor shutdown in your TS. To be consistent with your definitions, "Reactor Shutdown" should be changed to "Reactor Secured." If you choose to add a definition to the TS for Reactor Shutdown, the following is modification of the definition given in ANSI/ANS 15.1 and acceptable to the NRC staff: The reactor is shut down if it is subcritical by at least one dollar in the reference core condition with the reactivity worth of all installed experiments included and the following conditions exist: (a) No work is in progress involving core fuel, core structure, installed control rods, or control rod drives unless they are physically decoupled from the control rods; (b) No experiments are being moved or serviced that have, on movement, a reactivity worth exceeding the maximum value allowed for a single experiment, or one dollar, whichever is smaller. If you add a definition for Reactor Shutdown, the definition of Reactor Operation should be modified so that operation is when the reactor is not shutdown or secured.	YES	The Definitions and Technical Specifications have been revised to reflect that there are only two conditions for the reactor: either operational or secured. The definition of reactor secured has been modified to indicate that the Cd rod must be in the glory hole if the reactor is to be secured. With the Cd rod in the glory hole, no experiments can be introduced. With the rod in the glory hole, there is sufficient negative reactivity to ensure that the reactor is subcritical.

#	ISSUE	YES ? ? ? NO *	What? How?
5.	TS Section 1, Definitions, definition 1.1.22, *Reactor Secured.* This definition does not take into consideration reactivity effects due to experiment insertion or removal, and work on either the core or the control or the safety rods. Please update this definition to take into consideration the reactivity effects of experiments, work on the reactor core or control or safety rods or explain why this is not necessary for your reactor.	YES	As noted above, The definition of reactor secured has been modified to indicate that the Cd rod must be in the glory hole if the reactor is to be secured. With the rod in the glory hole, there is sufficient negative reactivity to provide adequate shutdown even in the presence of experiments.
6.	TS Section 1, Definitions, definition 1.1.30, *Shutdown Margin.* This definition does not take into consideration reactivity effects due to operation of the fine control rod. Please either add the reactivity effect of the fine rod failing in its most reactive state to this definition or explain why non-scramming rods do not need to be considered in the definition of shutdown margin.	YES	The definition has been revised to match that of ANS 15.1 including the non-scramming fine control rod.

#	ISSUE	YES ? ? ? NO *	What? How?
7.	TS, Section 3, LIMITING CONDITIONS FOR OPERATION (LCO), Specifications 3.1.a and 3.1.d. These TS appear to limit experiment worth to 0.4% Δk/k by limited excess reactivity. However, ANSI/ANS 15.1 recommends limits on individual experiment worth and total experiment worth by limiting the sum of the absolute value of the worths of individual experiments. Your proposed TS do not limit total experiment worth (e.g. placing an experiment into the reactor with a worth of +0.3% Δk/k and an experiment with a worth of -0.3% Δk/k does not change the excess reactivity of the reactor. This could be repeated. But then if only the experiments with positive reactivity upon removal are taken out of the reactor the limit on excess reactivity is violated.). Please propose a limit on the sum of the absolute reactivity values of experiments or justify not needing a limit. In addition, these TS refer to all control and safety rods. From Definition 1.1.5, it appears that safety rods are control rods. Please verify that the calculation of excess reactivity involves all four control rods or explain why this is not necessary. Please revise the TS as needed.	YES	Specifications 3.1.a and 3.1.d have been revised to specifically identify that all four control rods are involved in the reactivity calculations. In addition, Specification 3.1.a has been revised to note that the absolute value of an experiment must be included in the evaluation of excess reactivity.
8.	TS Section 3, LCO, Specification 3.1.b. This specification does not take into consideration reactivity effects due to operation of the fine control rod. Please either add the reactivity effect of the fine rod failing in its most reactive state to this definition or explain as to why this reactivity is not applicable at your reactor.	YES	The Specification has been revised to note that the fine control rod is assumed to be in its most reactive position.
9.	TS Section 3, LCO, Specifications 3.2.c. and 3.2.e. Please verify that this specification applies to the fine control rod. If not, explain why this limitation is not needed for the fine control rod.	YES	Specification has been revised to explicitly list all four control rods.

#	ISSUE	YES ? ? ? NO *	What? How?
10.	TS Section 3, LCO, Specification 3.2.e. Your TS requires nuclear safety instrumentation to be operable if the control rods are not in their fully withdrawn position. Normally, this instrumentation needs to be operable if the reactor is in operation (e.g. this would require instrumentation to be operable when removing experiments from the reactor that could impact reactivity even if the control rods are fully withdrawn). Please explain the basis for your proposed TS or modify it to require instrumentation when the reactor is in operation.	YES	The Specification has been revised to note that all instrumentation needs to be operable if the reactor is not secured.
11.	TS Section 3, LCO, Specification 3.3.a. The wording of the TS allows experiments that violate the reactivity limitations to not be subject to the TS. Please correct.	YES	A new specification was added to indicate that experiments outside the reactivity limits would not be permitted.
12.	TS Section 3, LCO, Specifications 3.3.a. and 3.3.c. Your TS allow the conduct of fueled experiments. Because of the number of isotopes produced in fueled experiments, please provide an example calculation showing how you meet the occupational (please justify the evacuation time used in the calculations) and unrestricted dose requirements (for the maximum exposed individual and at the nearest residence) if a fueled experiment were to fail.	YES	Based on research published in 1992, the maximum hazards analysis for the UNM AGN-201M reactor resulted in a whole body dose rate of 1.61×10^{-5} mrem/sec to individuals located in the reactor room. Thus, it would take at least 17 hours in the restricted area before a dose of 1 mrem would be received.
13.	TS Section 3, LCO, Specification 3.3.c. TS 3.3.c.(1) limits dose to a 2-hour period starting at the time of release. However, the EPZ is the Nuclear Engineering Laboratory Building (operations boundary). Based on this, dose limits in the unrestricted area should be based on continual occupancy. Please address. There is no TS limit on the doses from failure of experiments that are not doubly encapsulated. Please explain or correct.	YES	The Specification has been revised. The ventilation system would take any release in the reactor and pass the gasses through HEPA filters before releasing to the outside. There is no TS limit on doses from experiments as there is no failure mechanism for solid material within the reactor due to the low energy deposition.

#	ISSUE	YES ? ? ? NO *	What? How?
14.	TS Section 3, LCO, Specification 3.4.b. The definition of restricted area from Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20 is: "*Restricted area* means an area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area." Please explain why the reactor room is not considered a restricted area when the reactor is secure.	YES	When the reactor is secured, radiation levels at all points in the reactor room are below 100 μR/hr. Therefore the area is not a restricted area. Specification 3.4.c was deleted as the revised 3.4.b provides the information. This specification allows the reactor room to be used for other activities without the 10CFR 20 requirements of a restricted area.
15.	TS Section 3, LCO, Specification 3.1.c. This LCO requires the reactor to be subcritical upon withdrawal of certain control rods. Section 4, SURVEILLANCE REQUIREMENTS, does not contain a corresponding surveillance to ensure this requirement is met. Please either add a surveillance to section 4 of the TSs or explain why a surveillance is not required.	YES	The specification 4.1.a has been revised to indicate the surveillance applies to TS 3.1.c.
16.	TS Section 3, LCO, Specification 3.2.d. This LCO discusses the rod interlocks required for AGN reactor operation. TS Section 4, SURVEILLANCE REQUIREMENTS, does not contain a corresponding surveillance to ensure this requirement is met. Please either add a surveillance to section 4 of the TSs or explain why a surveillance is not required.	YES	A new specification 4.2.c has been added to 4.2 to require daily channel check of the rod interlock.
17.	TS Section 3, LCO, Specification 3.2.j. This LCO discusses the requirement that the AGN reactor scram on a loss of power. TS Section 4, SURVEILLANCE REQUIREMENTS, does not contain a corresponding surveillance to ensure this requirement is met. Please either add a surveillance to section 4 of the TSs or explain why a surveillance is not required.		A new specification 4.2.k has been added to 4.2 to annually verify that a loss of electrical power causes a scram. This will be a channel test.

#	ISSUE	YES ? ? ? NO *	What? How?
18.	TS Section 3, LCO, Specifications 3.3.a, 3.3.b and 3.3.c. These three LCOs are all missing corresponding surveillances. Please add corresponding surveillances for all three LCOs or explain why surveillances are not required.	YES	A new Specification Section 4.5 has been added to cover Conduct of Experiments. All new experiments have RSAC approval and the Chief Reactor Supervisor reviews all experiments through a Request for Use (RFU) form. In this process, the signature at the bottom of the RFU indicates that Specifications 3.3.a, 3.3.b, 3.3.c, and 3.3.d have been met.
19.	TS Section 3, LCO, Specification 3.4.d. This specification requires the gate to the top of the reactor to be locked any time the reactor is in operation. This would preclude anyone from ever going to the top of the reactor during operation. Is this the intent of this LCO? If not, please modify.	YES	The Specification has been revised to indicate that the gate has a lock to control entry into a potential high radiation area.
20.	TS Section 3, LCO, Specifications 3.4.d and 3.4.e. Neither of these LCOs have a corresponding surveillance requirement in Section 4. Please add surveillance requirements for both of these LCOs similar to specification 4.2.c.	YES	A new Specification has been added to 4.2 to require a daily check of the high radiation area control. Specification 4.4.c has been modified to indicate that the annual operating survey is also to verify that the thermal column is providing shielding.

#	ISSUE	YES ? ? ? NO *	What? How?
21.	TS Section 4, SURVEILLANCE REQUIREMENTS, Specification 4.0. This specification allows for the deferral of surveillances if the reactor is not in operation. However, the reason why deferral is acceptable is not clear for some of the surveillances. For TS 4.3, explain why periodic inspections of the shield tank to verify integrity is not needed if the reactor is not operated. For TSs 4.4.a. and 4.4.c, explain why radiation instrument calibrations and surveys are not needed if the reactor is not operated.	YES	When the reactor is secured, radiation levels at all points in the reactor room are below 100 μR/hr. Verification of the shield tank integrity, radiation instrument calibrations, and surveys are not needed to assure personnel protection. The shield tank integrity does not affect radiation levels when the reactor is secured. When the reactor is secured, the radiation levels in the room would not change even if water was lost from the shield tank.
22.	TS Section 4, SURVEILLANCE REQUIREMENTS, Specification 4.2.i. The first part of this specification, referring to the melting of the fuse, should be added to specification 3.2, as a LCO. The rest of this specification should be modified for proper wording as a surveillance requirement for the added LCO. Or please provide a justification if you believe that the specification is acceptable as written.	YES	This Specification has been removed as the melting of the core fuse precludes reactor operation. The ability to operate the reactor is verification that the core fuse is intact.
23.	TS Section 4, SURVEILLANCE REQUIREMENTS, Specification 4.3. The TS allows operation with a known leaking shield tank. Please explain why operation in this condition is not a radiation safety issue. The TS limit of leakage sufficient to leave a puddle on the floor is subjective. If leakage is acceptable, please quantify the amount of leakage that can occur before correction. Should the limit on leakage be an LCO? Please address.	YES	The Specification has been revised to indicate that leakage sufficient to activate the shield water level safety interlock must be corrected prior to subsequent operation. When the reactor is secured, the radiation levels in the room would not change even if water was lost from the shield tank.

#	ISSUE	YES ? ? ? NO *	What? How?
24.	TS Section 4, SURVEILLANCE REQUIREMENTS, Specification 4.4.a. The specification requires an annual check of the remote area monitor at the top of the reactor. There is no corresponding LCO for this radiation monitor. Please add an LCO, or explain why an LCO is not required.	YES	This Specification has been removed as there is no reactor operational safety function associated with the RAM. The only purpose of the RAM is to give guidance on potential doses if the high radiation area is accessed. If the RAM fails or is not operational, then access to the high radiation area at the top of the reactor will not be permitted during reactor operation.
25.	TS Section 4, SURVEILLANCE REQUIREMENTS, Specification 4.4.b. The specification requires a daily check of the reactor access high radiation area alarm. There is no corresponding LCO. Please add a LCO, or explain why an LCO is not required.	YES	The Specification has been revised to indicate that it is the access control that is to be verified. The reference to the RAM has been removed as there is no safety function associated with the RAM.
26.	TS Section 4, SURVEILLANCE REQUIREMENTS, Specification 4.4.c. The specification requires a radiation survey annually. The regulations in 10 CFR 20.1501 require surveys be made as may be necessary. This may require surveys to be performed more often than annually. Please revise the specification to be consistent with the regulations.	YES	The Specification has been revised to indicate surveys as necessary, but at least annually.

#	ISSUE	YES ? ? ? NO *	What? How?
27.	TS Section 5, DESIGN FEATURES. Regulation 10 CFR 50.36(a)(1) states "Each applicant for a license authorizing operation of a production or utilization facility shall include in his application proposed technical specifications in accordance with the requirements of this section. A summary statement of the bases or reasons for such specifications, other than those covering administrative controls, shall also be included in the application, but shall not become part of the technical specifications." Please rewrite Section 5 to convert the statements to specifications and add applicability, objective and bases for each of these specifications.	YES	Bases have been added to ensure that major alterations to safety-related components or equipment are not made prior to appropriate safety reviews and NRC approval.
28.	TS Section 5, DESIGN FEATURES, Specification 5.2. The exact location of fuel storage by room need not be given in the TS. The location can be given in a controlled document such as the security procedures. Please address.	YES	The Specification has been revised to remove the room number.
29.	TS Section 5, DESIGN FEATURES, Specification 5.3.b. Please add the room number(s) of the area under the jurisdiction of the reactor license so that the licensed area is clearly defined.	YES	The Room number has been added to the Specification.
30.	TS Section 6, ADMINISTRATIVE CONTROLS, Specification 6.1.1. The specification refers to a Radiation Control Committee, which has responsibility for "control of all University of New Mexico (UNM) activities involving sources of ionizing radiation." Please add this committee to the organizational chart, or explain why this committee does not belong on the chart.	YES	Added to the organizational chart.

#	ISSUE	YES ? ? ? NO *	What? How?
31.	TS Section 6, ADMINISTRATIVE CONTROLS, Specification 6.1.2. The organizational chart shows the position of the Dean of the school of engineering. However, the Dean does not seem to have any responsibility for the operation of the reactor. Please either add text to this section delineating the responsibilities of the Dean of the school of engineering with respect to the reactor, or remove this position.	YES	Dean has been removed from the organizational chart.
32.	TS Section 6, ADMINISTRATIVE CONTROLS, Specification 6.1.3. The specification states that the position of Reactor Administrator is selected by the Chair of the Nuclear Engineering Department. Please add this position to the organizational chart or explain why it is not needed.	YES	Chair has been added to the organizational chart as Level 1.
33.	TS Section 6, ADMINISTRATIVE CONTROLS. The reporting relationships delineated in the organizational chart do not match the reporting relationships delineated in the text of this section. Please modify the organization chart and the text of this section to agree on reporting relationships.	YES	The relationships have been revised.
34.	TS Section 6, ADMINISTRATIVE CONTROLS, Specification 6.1.8. The regulations in 10 CFR 50.54 (m)(1) require the presence of a senior reactor operator for refueling. Please revise your TS or explain why a senior reactor operator is not needed.	YES	The Specification has been revised to indicate that a SRO must be present whenever fuel is handled.
35.	TS Section 6, ADMINISTRATIVE CONTROLS, Specification 6.3. The specification refers to ANSI standard ANS 15.4-1977. This standard has been updated several times since 1977. Please modify this specification to update the reference or show why later versions of this standard are not applicable at your facility.	YES	The date on the Standard has been changed to 2007.

#	ISSUE	YES ? ? ? NO *	What? How?
36.	TS Section 6, ADMINISTRATIVE CONTROLS, Specification 6.4.1. The specification is missing information. Please modify the specification to specify who has responsibility for appointing members to this committee. Also, please either add a requirement stating that the majority of a quorum cannot consist of reactor staff members or state why this limitation should not be a requirement for your facility.	YES	Specification 6.1.2 has been revised to indicate that RSAC members are appointed by the Dept. Chair (Level 1). The membership of the RSAC has been specified in 6.1.5 such that staff can not be RSAC members.
37.	TS Section 6, ADMINISTRATIVE CONTROLS, Specification 6.4.2. The specification covers the changing of procedures, equipment and experiments, but does not cover the creation of new procedures and experiments, and the addition of new equipment. Please add text to cover the addition of new experiments, procedures and equipment or state why these reviews should not be a requirement for your facility.	YES	The Specification has been revised. New experiments are covered under TS 6.4.2.c.
38.	TS Section 6, ADMINISTRATIVE CONTROLS, Specification 6.4.3. ANSI/ANS 15.1-2007, contains recommendations about reporting deficiencies uncovered by audits to management and about submission of audit written reports. Please revise your TS to agree with ANSI/ANS 15.1-2007 or explain why your current wording is acceptable.	YES	A new Specification, 6.4.3.f has been added with the wording from ANS-15.1.
39.	TS Section 6, ADMINISTRATIVE CONTROLS, Specification 6.6, last paragraph. The paragraph refers to a 'safety question'. The term is no longer defined in 10 CFR 50.59. Please modify the paragraph to refer to a 10 CFR 50.59 review.	YES	All references to safety question have been removed and replaced with a 10CFR50.59 review.
40.	TS Section 6, ADMINISTRATIVE CONTROLS, Specification 6.9. Instances in the TSs where written reports are sent to the Director, Office of Nuclear Reactor Regulation can be replaced with Document Control Desk. References to communicating by telegraph can be removed from the TS.	YES	The Specification has been revised.

#	ISSUE	YES ? ? ? NO *	What? How?
41.	TS Section 6, ADMINISTRATIVE CONTROLS, Specification 6.10.2. The regulations in 10 CFR 50.36 Sections c.1(i)(A), c.1(i)(B) and c.2 list requirements to retain reports related to the violation of Safety Limits, Limiting Safety System Settings and LCO respectively for the life of the facility license. Please add these requirements to this section of the TS.	YES	Specification 6.10.2.h has been added to require retention of these records.

LICENSE NUMBER R-102

TECHNICAL SPECIFICATIONS

FOR

THE UNIVERSITY OF NEW MEXICO AGN-201M REACTOR

SERIAL NUMBER 112

DOCKET NUMBER 50-252

REVISED NOVEMBER 2010

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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.

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 - Explosive material is any solid or liquid which is given an Identification of Reactivity (Stability) index of 2, 3, or 4 by the National Fire Protection Association in its 704 Diamond, Hazard Rating System.

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

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

1.1.13 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.

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

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

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

1.1.17 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.

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

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

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

1.1.21 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.

1.1.22 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.

1.1.23 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.

1.1.24 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.

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

1.1.26 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).

1.1.27 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.

1.1.28 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.

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

1.1.30 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.

1.1.31 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 rod in its most reactive condition, and the fine control rod in its most reactive position, and that the reactor will remain subcritical without further operator action.

1.1.32 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.

1.1.33 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).

1.1.34 True Value - The true value is the actual value of a parameter.

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 with the most reactive safety or coarse control rod fully inserted and the fine control rod fully inserted 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 1 mSV 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 50 mSv.

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

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. When the reactor is operating, the reactor room shall be considered a restricted area according to 10CFR20.

c. Whenever the reactor is operated, 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 during reactor operation:
   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 during reactor operation.

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 μR/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. Prior to each day's reactor operation or prior to each reactor operation extending more than one day, the reactor access control (Ref 3.4d) shall be verified to be operable.

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 3.4d) 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 Chemical and 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 Chemical and 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; and is responsible for control of and changes to the cipher locks of the Nuclear Engineering Laboratory Building.

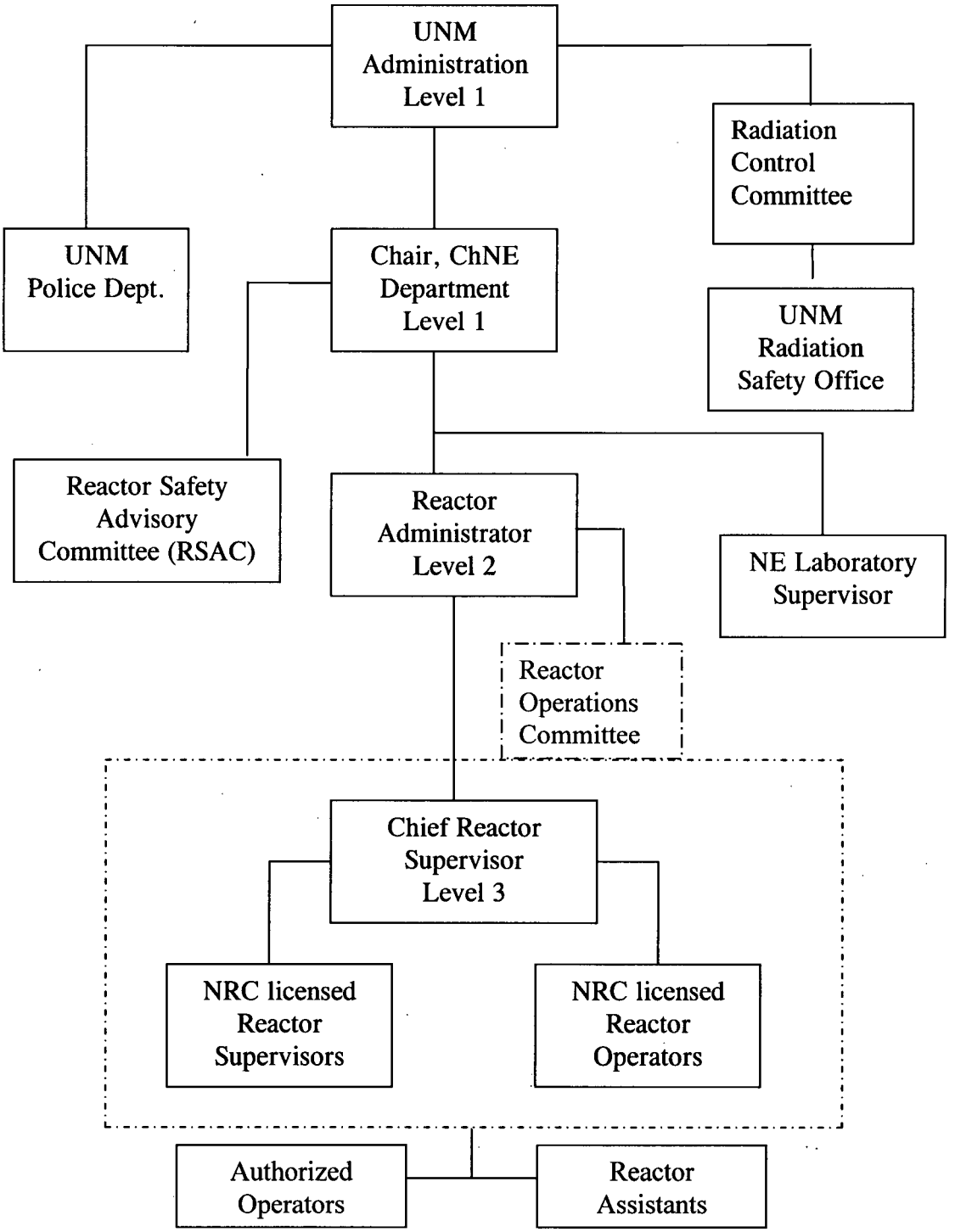
UNM Administration Level 1
Radiation Control Committee
UNM Police Dept.
Chair, ChNE Department Level 1
UNM Radiation Safety Office
Reactor Safety Advisory Committee (RSAC)
Reactor Administrator Level 2
NE Laboratory Supervisor
Reactor Operations Committee
Chief Reactor Supervisor Level 3
NRC licensed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

6.1.12 *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.

6.1.13 *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 control room.

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

3. One health physicist who can be readily contacted by telephone and who can arrive at the reactor facility 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 which 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 control 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 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
- Violations of any limiting safety setting
- Violations of any limiting condition of operation (LCO)