TECHNICAL SPECIFICATIONS
for
University of Maryland Training Reactor

1.0 DEFINITIONS

Abnormal Occurrence - An abnormal occurrence is any of the following which occurs during reactor operation:

a. Operation with any safety system setting less conservative than specified in Section 2.2., Limiting Safety System Settings;

b. Operation in violation of a Limiting Condition for Operation;

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

d. Any unanticipated or uncontrolled change in reactivity greater than $1.00;

e. An observed inadequacy in the implementation of either administrative or procedural controls, such that the inadequacy could have caused the existence or development of a condition which could result in operation of the reactor outside the specified safety limits; and

f. Abnormal release of fission products from a fuel element.

Channel Calibration- A channel calibration consists of comparing a measured value from the measuring channel with a corresponding known value of the parameter so that the measuring channel output can be adjusted to respond, with acceptable accuracy, to known values of the measured variable.

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

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

Cold Critical- The reactor is in the cold critical condition when it is critical with the fuel and bulk water temperatures both at ambient temperature.

1.0 DEFINITIONS (Continued)

Experiment- An experiment is (a) any device or material which is exposed to significant radiation from the reactor and is not a normal part of the reactor, or (b) any operation designed to measure reacter chanracteristics. (Normal control rod calibrations are not considered experiments.)

a. Routine Experiments - Routine Experiments are those which have been previously performed in the course of the reactor program.

b. Modified Routine Experiments - Modified routine experiments are those which have not been performed previously but are similar to routine experiments in that the hazards are neither greater nor significantly different than those for the corresponding routine experiments.

c. Special experiments - Special experiments are those which are not routine or modified routine experiments.

Experimental Facilities - Experimental facilities are facilities used to perform experiments and include, for example, the beam ports, pneumatic transfer systems and any in-core facilities.

Experiment Safety Systems - Experiment safety systems are those systems, including their associated input circuits, which are designed to initiate a scram for the primary purpose of protecting an experiment or to provide information which requires manual protective action to be initiated.

Full Power - Full licensed power is defined as 250 kilowatts.

Measured Value - The measured value is the magnitude of that variable as it appears on the output of a measuring channel.

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

On Call - A senior operator will be available "on call" either on the College Park campus or within 10 miles from the facility and can reach the facility within one half hour following the request.

Operable - A system or component shall be considered operable when it is capable of performing its intended functions in a normal manner.

Reactor Operation - The reactor is in operation when it is not secured or a senior reactor operator is in charge of work in progress under Reactor Secured, part c.

Reactor Safety Systems - Reactor safety systems are those systems, including their associated input circuits, which are designed to initiate a reactor scram for the primary purpose of protecting the reactor or to provide information which requires manual protective action to be initiated.

Reactor Secured - The reactor is secured when all the following conditions are satisfied:

a. The reactor is shut down,

b. Power to the control-rod magnets and actuating solenoids has been switched off and the key removed and under the control of a licensed operator or stored in a locked storage area, and

c. No work is in progress involving in-core fuel handling or refueling operations.

Reactor Shutdown - The reactor is in a shutdown condition when sufficient control rods are inserted to assure that the reactor is subcritical by at least $1.00 of reactivity.

Standard Control Rod - A standard control rod is a control rod having an electric motor drive and scram capabilities.

Standard Thermocouple Fuel Element - A standard thermocouple fuel element is a fuel element of standard shape and of known and specified composition containing sheathed thermocouples imbedded near the axial and radial center of the fuel element.

Unscheduled Shutdown - An unscheduled shutdown is defined as any unplanned shutdown of the reactor caused by a response to conditions that could adversely affect safe operation, not to include shutdowns that occur during testing or checkout operations.

2.0 SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTING

2.1 SAFETY LIMIT

APPLICABILITY

This Specification applies to the temperature of the reactor fuel.

OBJECTIVE

The objective is to define the maximum fuel element temperature that can be permitted with confidence that no damage to the fuel element cladding will result.

SPECIFICATIONS

The temperature in a standard TRIGA fuel element shall not exceed 1000°C.

2.2 LIMITING SAFETY SYSTEM SETTING

APPLICABILITY

This specification applies to the reactor scram setting which prevent the reactor from reaching the safety limit.

OBJECTIVE

The object is to provide a reactor scram to prevent the safety limit fuel element temperature of 1000°C from being reached.

SPECIFICATION

The limiting safety system setting shall be 400°C as measured by the INSTRUMENTED TRIGA FUEL ELEMENT. The instrumented element may be located at any position in the core.

BASES
FOR
SECTION 2.0
SAFETY LIMITS
AND
LIMITING SAFETY SYSTEM SETTING

NOTE

The BASES contained in this section summarize the reasons for the specifications of Section 2.0 but in accordance with 10CFR50.36 are not a part of these Technical Specifications.

2.0 SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

BASES

2.1 SAFETY LIMIT

The important parameter for TRIGA reactor is the fuel element temperature. This parameter is well suited as a single specification especially since it can be measured. A loss in the integrity of the fuel element cladding could arise from a build-up of excessive pressure between the fuel-moderator and the cladding if the fuel temperature exceeds the safety limit. The pressure is caused by the presence of air, fission product gases, and hydrogen from the dissociation of the hydrogen and zirconium in the fuel-moderator. The magnitude of this pressure is determined by the fuel-moderator temperature and the ratio of hydrogen to zirconium in the alloy. Experiments performed by G.A. have shown that the measured pressure rise was only 24 psi at a calculated temperature of 1100°C. (1,2)

If we assume that the cladding temperature is in equilibrium with the fuel , this pressure of 24 psi is far below the rupture pressure of 450 psi at 800°C. Of course it is unreasonable to expect that the cladding will be as hot as the core. Calculation shows that the maximum clad temperature is about 2/3 of the maximum fuel temperature. Thus, even at a calculated fuel temperature of 1100° C, the cladding does not exceed 733°C.

2.2 LIMITING SAFETY SYSTEM SETTINGS

A Limiting Safety System Setting of 400° C provides a safety margin of 600°C. A part of the safety margin is used to account for the difference between the temperature at the hot spot in the fuel and the measured temperature resulting from the actual location of the thermocouple. If the thermocouple element is located in the hottest position in the core, the difference between the true and measured temperatures will be only a few degrees since the thermocouple junction is at the mid-plane of the element and close to the anticipated hot spot. If the thermocouple element is located in a region of lower temperature, such as on the periphery of the core, the measured temperature will differ by a greater amount from that actually occcurring at the core hot spot. Calculations have shown that if the thermocouple element were located on the periphery of the core the true temperature at the hottest

location in the core will differ from the measured temperature by no more than a 2.0 SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

BASES

LIMITING SAFETY SYSTEM SETTINGS (Continued)

Thus, when the temperature in the thermocouple element reaches the setting of 400° C, the true temperature at the hottest location would be no greater than 800° C providing a margin to the safety limit of at least 200° C. This margin is ample to account for the remaining uncertainty in the accuracy of the fuel temperature measurement channel and any overshoot in reactor power resulting from a reactor transient during steady state mode operation.

(1) G.B. West, et al, "Kinetic Behavior of TRIGA Reactors", General Atomic Publication, GA- 882, March 31,1967, page 2.

(2) C.O. Coffer, et al, "Characteristics of Large Reactivity Insertion in a High Performance TRIGA U-ZrH Core", General Atomic Publication, GA-6216, April 12, 1965, pp.23-26.

3.0 LIMITING CONDITIONS FOR OPERATIONS

3.1 REACTIVITY LIMITS

APPLICABILITY

These specifications shall apply to the reactor core.

OBJECTIVE

The objectives are to ensure that the reactor can be controlled and shut down at all times and that the SAFETY LIMITS will not be exceeded.

SPECIFICATIONS

(1) The shutdown margin relative to the cold critical conditions with the greatest worth control rod fully withdrawn, shall not be less than \$0.50.

(2) The excess reactivity relative to the cold critical conditions, with or without experiments in place shall not be greater than \$3.50.

3.2 REACTOR CONTROL AND SAFETY SYSTEM

APPLICABILITY

These specifications apply to reactor control and safety systems and safety-related instrumentation.

OBJECTIVE

The objective of these specifications is to specify the lowest acceptable level of performance or the minimum number of operable components for the reactor control and safety systems.

SPECIFICATIONS

(1) The drop time of each STANDARD CONTROL ROD from the fully withdrawn position to the fully inserted position shall not exceed one second.

(2) The reactor safety channels are OPERABLE in accordance with Table 3-1a, including the minimum number of channels and the indicated maximum or minimum set points, for the scram channels.

LIMITING CONDITIONS FOR OPERATIONS

REACTOR CONTROL AND SAFETY SYSTEM

SPECIFICATIONS (Continued)

(3) Maximum reactivity insertion rate shall not exceed $0.30 per second.

Table 3-1a

REACTOR SAFETY CHANNELS

Scram Channels

Scram Channel	Minimum Operable	Scram Setpoint
Linear Power Level	2	not to exceed 120% of full power
Fuel Element Temperature	1	not to exceed 400°C
Linear Power Channel Detector Power Supply	2	Loss of supply voltage
Manual Scram	1	N/A

Interlocks

Interlock/Channel	Function
Log Power Level	Provide signal to period rate and minimum source channels
Startup Countrate	Inhibit control rod withdrawal when neutron count rate is less than 1 cps.
Rod Drive Control	Prevent simultaneous manual withdrawal of two control rods in the steady state mode of operation.

3.3 REACTOR COOLANT SYSTEM

APPLICABILITY

This specification applies to the purity of the primary coolant

OBJECTIVES

The objectives of this specification is to:

1. minimize the possibility for corrosion of the cladding on the fuel elements,

2. minimize neutron activation of dissolved materials and insoluble materials.

SPECIFICATION

The conductivity of the pool water shall not exceed five micromhos per centimeter.

3.4 RADIATION MONITORING SYSTEM

APPLICABILITY

This specification applies to the radiation monitoring information which must be available to the reactor operator during reactor operation.

OBJECTIVE

The objective is to assure that sufficient radiation monitoring information is available to the operator to assure safe operation of the reactor.

SPECIFICATIONS

(1) The reactor shall not be operated unless the radiation area monitor channels listed in Table 3-2 are OPERABLE

(2) For a period of time for maintenance or calibration to the radiation monitor channels, the intent of specification 3.4(1) will be satisfied if they are replaced with portable gamma sensitive instruments

having their own alarms or which shall be observable by the reactor operator.

(3) The alarm set points shall be stated in a facility operating procedure.

TABLE 3-2
MINIMUM RADIATION MONITORING CHANNELS

Radiation Area Monitors

Function	Minimum Number Operable
Monitor radiation levels in reactor bay area	1

3.5 LIMITATION OF EXPERIMENTS

APPLICABILITY

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

OBJECTIVE

The objective is to prevent damage to the reactor or excessive release of radioactive material in the event of an experiment failure.

SPECIFICATIONS

The reactor shall not be operated unless the following conditions governing experiments exist.

1. Non-secured experiments shall have reactivity worths less than one dollar.

2. The reactivity worth of any single experiment shall be less than 2.0 dollars.

3. The total reactivity worth of in-core experiments shall not exceed 3.00 dollars, including the potential reactivity which might result from experimental malfunction and experiment flooding or voiding.

4. Experiments containing materials corrosive to reactor components, compounds highly reactive with water, potentially explosive materials, and liquid fissionable materials shall be doubly encapsulated.

5. Explosive materials, such as gunpowder, TNT, PETN, or nitroglycerin, in quantities greater than 25 milligrams shall not be irradiated in the reactor or experimental facilities. Explosive materials in quantities less than 25 milligrams may be irradiated provided the pressure produced upon detonation of the explosive has been calculated and/or experimentally demonstrated to be less than the design pressure of the container.

6. Experiment materials, except fuel materials, which could off-gas, sublime, volatilize, or produce aerosols under (1) normal operating conditions of the experiment or reactor, (2) credible accident conditions in the reactor or (3) possible accident conditions in the experiment shall be limited in activity such that if 100% of the gaseous activity or radioactive aerosols produced escaped to the reactor room or the atmosphere, the airborne concentration of radioactivity averaged over a year would not exceed the limit of Appendix B of 10 CFR Part 20.

In calculations pursuant to 6. above, the following assumptions shall be used:

(a) If the effluent from an experimental facility exhausts through a holdup tank which closes automatically on high radiation level, at least 10% of the gaseous activity or aerosols produced will escape.

(b) If the effluent from an experimental facility exhausts through a filter installation designed for greater than 99% efficiency for 0.3 micron particles, at least 10% of these vapors can escape.

LIMITING CONDITIONS FOR OPERATIONS

LIMITATION ON EXPERIMENTS

SPECIFICATIONS (Continued)

7. Each fueled experiment shall be controlled such that the total inventory of iodine isotopes 131 through 135 in the experiment is no greater than 5 millicuries.

8. If a capsule fails and releases material which could damage the reactor fuel or structure by corrosion or other means, removal and physical inspection shall be performed to determine the consequences and need for corrective action. The results of the inspection and any corrective action taken shall be reviewed by the Director, or his designated alternate and determined to be satisfactory before operation of the reactor is resumed.

BASES
FOR
SECTION 3.0

LIMITING CONDITIONS FOR OPERATIONS

NOTE

The BASES contained in this section summarize the reasons for the specifications of Seciton 3.0 but in accordance with 10 CFR 50.36 are not a part of these Technical Specifications.

3.0 LIMITING CONDITIONS FOR OPERATIONS

BASES

3.1 REACTIVITY LIMITS

(1) The value of the shutdown margin as required by specification 3.1(1) assures that the reactor can be shutdown from any operating condition even if the highest worth control rod should remain in the fully withdrawn position.

(2) While specification 3.1(2), in conjunction with specification 3.1(1) tends to overconstrain the excess reactivity, it helps ensure that the operable core is similar to the core analyzed in the FSAR.

3.2 REACTOR CONTROL AND SAFETY SYSTEM

(1) Specification 3.2(1) assures that the reactor will be shutdown promptly when a scram signal is initiated. Experiments and analysis have indicated that for the range of transients anticipated for a TRIGA reactor, the specified control rod drop time is adequate to assure the safety of the reactor.

(2) Specificaiton 3.2(2) provides protection against the reactor operating outside of the safety limits. Table 3-1b describes the bases for each of the reactor safety channels.

(3) Specification 3.2(3) establishes limits on the rate of change of power to ensure that the normally available reactivity and insertion rates cannot generate operating conditions that exceed the Safety Limit.

Table 3-1b
REACTOR SAFETY CHANNELS

Scram Channels

Scram Channel	Bases
Linear Power Level Fuel Element Temp	Provides protection to assure that the reactor can be shut down before the safety limit on the fuel element temperature will be exceeded.
Linear Power Channel Detector Power Supply	Provides protection to assure that the reactor cannot be operated unless the neutron detectors which input to each of the linear power channels are operable.
Manual Scram	Allows the operator to shut down the reactor if an unsafe or abnormal condition occurs.
Period Scram	Assures that the rate of change of power is orderly and manually controllable.

Interlocks

Interlock/Channel	Bases
Log Power Level	This channel is required to provide a neutron detector input signal to the startup count rate channel.
Startup Countrate	Assures that sufficient amount of startup neutrons are available to achieve a controlled approach to criticality.
Rod Drive Control	Limits the maximum positive reactivity insertion rate available for steady state operation.

3.3 REACTOR COOLANT SYSTEM

(1) A small rate of corrosion continuously occurs in a water-metal system. In order to limit this rate, and thereby extend the longevity and integrity of the fuel cladding, a water cleanup system is required. Experience with water quality control at many reactor facilities has shown that maintenance within the limits of specification 3.3 provides acceptable control.

By limiting the concentrations of dissolved materials in the water, the radioactivity of neutron activation products is limited. This is consistent with the ALARA principle, and tends to decrease the inventory of radionuclides in the entire coolant system, which will decrease personnel exposures during maintenance and operations.

3.4 RADIATION MONITORING SYSTEM

The radiation area monitors provide information to operating personnel of any impending or existing danger from radiation so that there will be sufficient time to evacuate the facility and take the necessary steps to prevent the spread of radioactivity to the surroundings.

The additional function of the radiation area monitor that monitors the reactor bay area is to warn personnel entering the building of high radiation levels if the pool water level should decrease to the level of inadequate biological shielding.

3.5 LIMITATION ON EXPERIMENTS

1. This specification is intended to provide assurance that the worth of a single unfastened experiment will be limited to a value such that the safety limit will not be exceeded if the positive worth of the experiment were to be inserted suddenly.

2. The maximum worth of a single experiment is limited so that its removal from the cold critical reactor will not result in the reactor achieving a power level high enough to exceed the core temperature safety limit. Since experiments of such worth must be fastened in place, its removal from the reactor operating at full power would result in a relatively slow power increase such that the reactor protective systems would act to prevent high power levels from being attained.

LIMITATION ON EXPERIMENTS (Continued)

3. The maximum worth of all experiments is also limited to a reactivity value such that the cold reactor will not achieve a power level high enough to exceed the core temperature safety limit if the experiments were removed.

4. Double encapsulation is required to lessen the experimental hazards of some types of materials.

5. This specification is intended to prevent damage to reactor components resulting from failure of an experiment involving explosive materials.

6. This specification is intended to reduce the likelihood that airborne activities in excess of the limits of Appendix B of 10 CFR Part 20 will be released to the atmosphere outside the facility boundary.

7. The 5-millicurie limitation on iodine 131 through 135 assures that in the event of failure of a fueled experiment leading to total release of the iodine, the exposure dose at the exclusion area boundary will be less than that allowed by 10 CFR Part 20 for an unrestricted area.

8. Operation of the reactor with the reactor fuel or structure damaged is prohibited to avoid release of fission products.

4.0 SURVEILLANCE REQUIREMENTS

4.1 REACTIVITY LIMITS

APPLICABILITY

These specifications apply to the surveillance requirements for reactivity limits.

OBJECTIVE

The objective of these specifications is to ensure that the specifications of Section 3.1 are satisfied.

SPECIFICATIONS

(1) The reactivity worth of each standard control rod and the reactor shutdown margin shall be determined biennially, but at intervals not to exceed 28 months, and after each time the core fuel configuration is changed.

(2) The control rods shall be visually inspected for deterioration biennially, but at intervals not to exceed 28 months.

4.2 REACTOR CONTROL AND SAFETY SYSTEM

APPLICABILITY

These specifications apply to the surveillance requirements of the reactor safety system.

OBJECTIVE

The objective of these specifications is to ensure the operability of the reactor safety system as described in Section 3.2.

SPECIFICATIONS

(1) Control rod drop times shall be measured annually, but at intervals not to exceed 15 months, or whenever maintenance or repairs are made that could affect their drop time.

(2) A CHANNEL CALIBRATION shall be made of the linear power level monitoring channels annually, but at intervals not to exceed 15 months.

SURVEILLANCE REQUIREMENTS

REACTOR CONTROL AND SAFETY SYSTEM

SPECIFICATIONS (Continued)

(3) A CHANNEL TEST shall be performed for each scram channel listed on TABLE 3-1a and the log power channel prior to the first day's operation or prior to the startup of an operation extending more than one day.

(4) All reactor safety scram channels listed on TABLE 3-1a or the log power channel requiring maintenance or repair shall be verified OPERABLE prior to being returned to service.

4.3 REACTOR COOLANT SYSTEM

APPLICABILITY

These specifications apply to the surveillance requirements for the pool water.

OBJECTIVE

The objective of these specifications is to ensure that the specifications of Section 3.3 are satisfied.

SPECIFICATIONS

Pool water conductivity and gross beta-gamma activity shall be determined monthly, but at intervals not to exceed six weeks.

4.4 RADIATION MONITORING SYSTEM

APPLICABILITY

This specification applies to the surveillance requirements for the Radiation Area Monitoring System (RAMS).

OBJECTIVE

The objective of these specifications is to ensure the operability of each radiation area monitoring channel as required by Section 3.4.

SURVEILLANCE REQUIREMENTS

RADIATION MONITORING SYSTEM (Continued)

SPECIFICATIONS

(1) A CHANNEL CALIBRATION shall be made for each channel listed in TABLE 3-2 annually but at intervals not to exceed 15 months or whenever maintenance or repairs are made that could affect their calibration.

(2) A CHANNEL TEST shall be made for each channel listed in TABLE 3-2 quarterly, but at intervals not to exceed 15 weeks.

BASES
FOR
SECTION 4.0

SURVEILLANCE REQUIREMENTS

NOTE

The BASES contained in this Section summarize the reasons for th specifications of Section 4.0 but in accordance with 10CFR50.36 are not a part of these Technical Specifications.

4.0 SURVEILLANCE REQUIREMENTS

BASES

4.1 REACTIVITY LIMITS

(1) The reactivity worth of the control rods is measured as required by specification 4.1(1) to assure that the required shutdown margin is available and to provide a means for determining the reactivity worth of experiments inserted in the core. Long term effects of TRIGA reactor operation are such that measurements of the reactivity worths on a biennual basis is adequate to insure no significant changes in shutdown margin and no changes in shut down margin in the nonconservative direction.

(2) Specification 4.1(2) assures that a visual inspection of control rods is made to evaluate corrosion and wear characteristics caused by operation in the reactor.

4.2 REACTOR CONTROL AND SAFETY SYSTEM

(1) Measurement of the control rod drop time, specification 4.2(1), ensures that the rods can perform their safety function properly.

(2) The linear power level channel calibration will assure that the reactor will be operated at the licensed power levels.

(3) The surveillance requirement specified in specification 4.2(2) for the reactor safety scram channels ensures that the overall functional capability is maintained.

(4) The surveillance tests performed after maintenance or repairs to the reactor safety system as required by specification 4.2(3) ensures that the affected channel will perform as intended.

4.3 REACTOR COOLANT SYSTEM

Specification 4.3(1) ensures that poor pool water quality could not exist for long without being detected. Years of experience at the MUTR have shown that pool water analysis on a monthly basis is adequate to detect degraded conditions of the pool water in a timely manner.

Gross beta-gamma activity measurements are conducted

to detect fission product releases from damaged fuel element cladding.

4.4 RADIATION MONITORING SYSTEM

Specifications 4.4(1) and (2) ensure that the various radiation area monitors are checked and calibrated on a routine basis.

5.0 DESIGN FEATURES

REACTOR FUEL

APPLICABILITY

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

OBJECTIVE

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

SPECIFICATIONS

Standard TRIGA fuel

The individual unirradiated standard TRIGA fuel elements shall have the following characteristics:

(1) Uranium content: a maximum of 9.0 Wt-% uranium enriched to a nominal 20% Uranium -235.

(2) Zirconium hydride atom ratio: nominal 1.5-1.8 hydrogen-to-zirconium, ZrH_x.

(3) Cladding: 304 stainless steel, nominal .020 inches thick.

5.2 REACTOR COOLANT SYSTEM

APPLICABILITY

This specification applies to the pool containing the reactor and to the cooling of the core by the pool water.

OBJECTIVE

The objective is to assure that coolant water shall be available to provide adequate cooling of the reactor core and adequate radiation shielding.

SPECIFICATIONS

a. The reactor core shall be cooled by natural

convective water flow.

b. The pool water outlet pipe shall be a 1.5 inch diameter pipe and shall not extend more than 20 inches below the overflow outlet pipe when fuel is in the core.

c. The pool water inlet pipe is equipped with a siphon break at the surface of the pool.

5.3 VENTILATION SYSTEM

APPLICABILITY

This specification applies to that part of the facility which contains the reactor, its controls and shielding.

OBJECTIVE

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

SPECIFICATION

(a) The reactor shall be housed in a closed room designed to restrict leakage. This does not include the West balcony area.

(b) The minimum free air volume of the reactor room shall be 1.7×10^9 cm^3.

(c) The reactor room air conditioning system shall be contained and shall circulate air within the confines of the reactor room. Air and exhaust gases from the reactor room shall be released to the environment only through the ventilation exhaust system (Ventilation fan) or as a result of leakage around exit doors.

5.4 FUEL STORAGE

APPLICABILITY

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

OBJECTIVE

DESIGN FEATURES

SPECIFICATIONS

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

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

b. Irradiated fuel elements and fueled devices shall be stored in an array which will permit sufficient natural convection cooling by water or air such that the fuel element or fueled device temperature will not exceed design values.

BASES
FOR
SECTION 5.0

DESIGN FEATURES

5.1 REACTOR FUEL

BASES

The design basis of the standard TRIGA core demonstrates that 250 kilowatt steady state operation presents a conservative limitation with respect to safety limits for the maximum temperature generated in the fuel.

5.2 REACTOR COOLANT SYSTEM

Specification 5.2 is based on thermal and hydraulic calculations and operation of other TRIGA reactors which show that a core can operate in a safe manner at power levels up to 1500 kW with natural convection flow of the coolant.

Specification 5.2 assures that the pool water level can normally decrease only by 20 inches if the coolant piping were to rupture and siphon water from the reactor tank. Thus, the core will be covered by at least 15 feet of water.

5.3 VENTILATION SYSTEM

The facility is designed such that in the event that excessive airborne radioactivity is detected the ventilation system shall be shutdown to minimize transport of airborne materials. Analysis indicates that in the event of a major fuel element failure personnel would have sufficient time to evacuate the facility before the maximum permissible dose (10CFR.20) is exceeded.

5.4 FUEL STORAGE

The limits imposed by Specifications 5.4a and 5.4b are conservative and assure safe storage.

6.0 ADMINISTRATION

6.1 MANAGEMENT

The Maryland University Training Reactor (MUTR) is owned and operated by the University of Maryland. Its position in the university structure is shown in Figure 6.1.

The university will provide whatever resources are required to maintain the facility in a condition that poses no hazard to the general public or to the environment.

6.1.1 FACILITY STAFF REQUIREMENTS

(1) Figure 6.2 shows the MUTR Organization Structure

(2) The Facility Director shall have overall responsibility for the safe operation of the facility and radiological safety of the reactor facility.

(3) A licensed reactor operator (RO) or a licensed senior reactor operator (SRO) shall be present in the control room whenever the reactor is operating.

(4) A minimum of two persons must be present in the facility or in the Chemical and Nuclear Engineering Building when the reactor is operating: the operator in the control room and a second person who can be reached from the control room.

(5) The following operations must be supervised by a senior reactor operator:

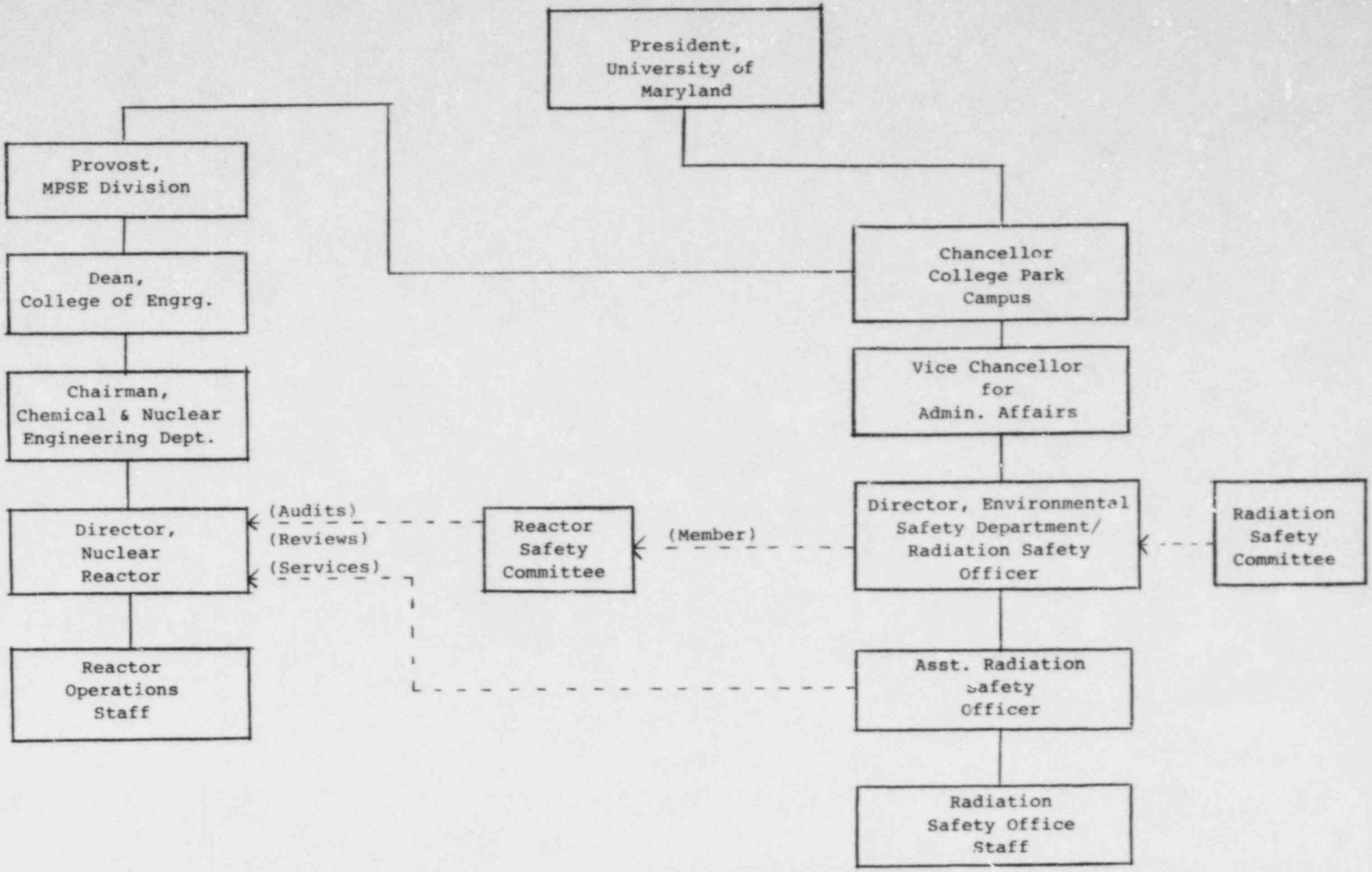
(a) fuel manipulations in the core

(b) when experiments are being manipulated in the core that have an estimated worth greater than $0.80.

(c) removal of control rods

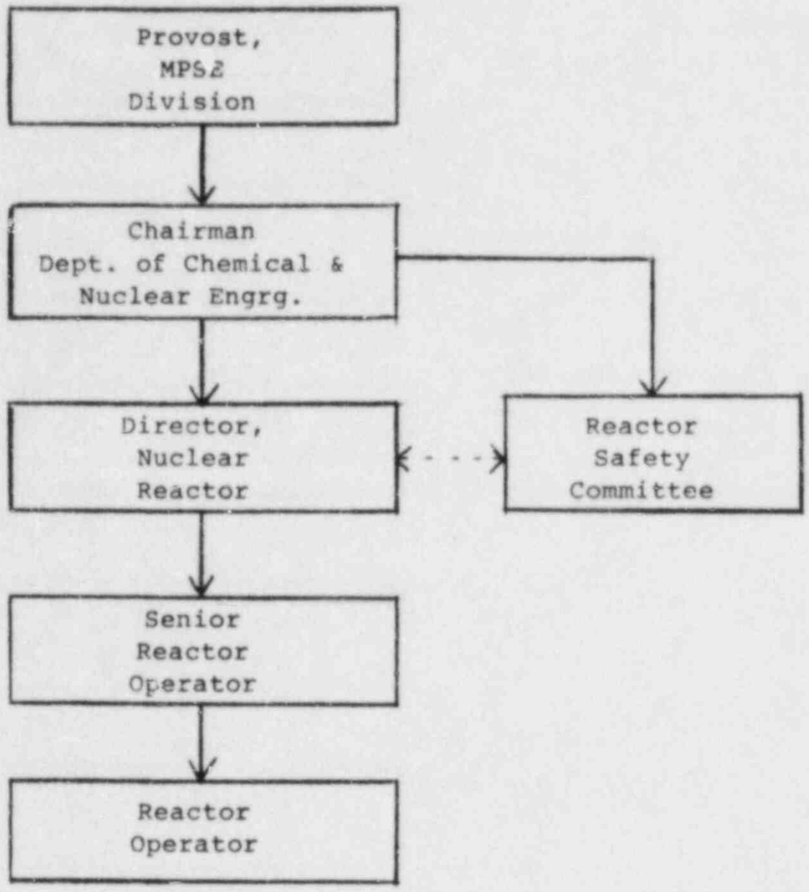
(d) resumption of operation following an unscheduled shutdown. (This requirement is waived if the shutdown is initiated by an interruption of electrical power to the plant.)

(6) A licensed SRO must be present or readily available on call at any time the reactor is in operation.



ADMINISTRATIVE ORGANIZATION

Fig. 6-1



MUTR Organizational Structure

Figure 6-2

6.2 REACTOR SAFETY COMMITTEE

(1) A Reactor Safety Committee (RSC) shall exist for the purpose of reviewing matters relating to the health and safety of the public. It is appointed by and reports to the chairman of the Chemical and Nuclear Engineering Department.

(2) The RSC shall consist of a minimum of five persons with expertise in the physical sciences and preferably some nuclear experience. Permanent members of the committee are the Facility Director and the Campus Radiation Safety Officer.

(3) The RSC shall meet at least twice per year, and more often as required.

(4) A quorum of the RSC must have at least four members present.

(5) Minutes of all meetings will be retained in a file and distributed to all RSC members.

(6) The RSC shall review the following:

(a) experiments referred to it by the Facility Director because of the degree of hazzard involved or the unusual nature of the experiment

(b) reportable occurrences (see Section 6.5)

(c) proposed changes to the facility license, changes to technical specifications, and experiments or changes made pursuant to 10CFR50.59.

6.3 FACILITY AUDIT

(1) A biennial audit and review of the reactor operations will be performed by an outside individual or group familiar with research reactor operations. They shall submit a report to the Facility Director.

(2) The following shall be reviewed:

(a) reactor operators and operational records for compliance with internal rules, procedures, and regulations, and with license provisions

(b) existing operating procedures for adequacy and accuracy

(c) plant equipment performance and its surveillance requirements

(d) records of releases of radioactive effluents to the environment

6.4 EXPERIMENTS REVIEW AND APPROVAL

(1) Routine experiments may be performed at the discretion of the duty senior reactor operator without the necessity of any further review or approval.

(2) Modified routine experiments shall be reviewed and approved in writing by the Facility Director, or designated alternate.

(3) Special experiments shall be reviewed by the RSC and approved by the RSC and the Facility Director or designated alternate prior to initiation.

(4) The review of an experiment listed in subsections (2) and (3) above, shall consider its effect on reactor operation and the possibility and consequences of its failure, including, where significant, consideration of chemical reactions, physical integrity, design life, proper cooling, interaction with core components, and reactivity effects.

6.5 ACTIONS TO BE TAKEN IN THE EVENT OF A REPORTABLE OCCURRENCE

In the event of a reportable occurrence, as defined in these Technical Specifications, the following actions will be taken:

(1) Immediate action will be taken to correct the situation and to mitigate the consequences of the occurrence.

(2) The reactor conditions shall be returned to normal or the reactor shall be shut down.

(3) The Reactor Safety Committee will investigate the causes of the occurrence. The Reactor Safety Committee will report its findings to the NRC and Provost, Division of Mathematics Physical Science and Engineering. The report shall include an analysis of the causes of the occurrence, the effectiveness of corrective actions taken, and recommendations of measures to prevent or reduce the probability or consequences of recurrence.

6.6 OPERATING PROCEDURES

Written procedures, reviewed and approved by the Reactor Safety Committee, shall be in effect and followed for the following items prior to performance of the activity. The procedures shall be adequate to assure the safety of the reactor, but should not preclude the use of independent judgement and action should the situation require such:

a. Start-up, operation, and shutdown of the reactor.

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

c. Maintenance procedures which could have an effect on reactor safety.

d. Periodic surveillance of reactor instrumentation and safety systems and area monitors as required by these Technical Specifications.

Substantive changes to the above procedures may be made with the approval of the Facility Director. All such temporary changes to procedures shall be documented and subsequently reviewed by the Reactor Safety Committee.

6.7 RECORDS

(1) Retraining and requalification records of current licensed operators shall be retained for at least one training cycle.

(2) The following records shall be retained for a period of at least five years:

(a) normal reactor facility operation and maintenance

(b) reportable occurrences

(c) surveillance activities required by Technical Specifications

(d) facility radiation and contamination surveys

(e) incore experiments

(f) reactor fuel inventories, receipts, and shipments

(g) approved changes in procedures required by

these Technical Specifications

(h) minutes of the Reactor Safety Committee meetings

(3) The following records shall be retained for the lifetime of the facility:

(a) liquid radioactive effluents released to the environs

(b) radiation exposure for all facility personnel

(c) As-built facility drawing

(4) Requirement (2)(a) above does not include supporting documents such as checklists, logsheets and recorder charts, which shall be maintained for a period of at least one year.

(5) Applicable annual reports, if they contain all of the required information may be used as records in subsection (3) above.

6.8 REPORTS

6.8.1 ANNUAL OPERATING REPORT

A report summarizing facility operations will be prepared annually for the reporting period ending June 30th. A copy of this report shall be submitted to the NRC Region I Office of Inspection and Enforcement by September 30 fo each year, with a copy to the Director, Division of Licensing, Office of Nuclear Reactor Regulation, NRC. The report shall include the following:

(1) A brief narrative summary of results of surveillance tests and inspections required in section 4.0 of these Technical Specifications.

(2) A tabulation showing the energy generated in megawatt-hours for the year.

(3) A list of unplanned shutdowns including the reasons therefore and corrective action taken, if any.

(4) A tabulation of the major maintenance operations performed during the period, including the effects, if any, on safe operation of the reactor, and the reason for any corrective maintenance required.

(5) A brief description of (a) each change to the

facility to the extent that it changes a description of the facility in the Final Safety Analysis Report and (b) review of changes, tests, and experiments made pursuant to 10CFR50.59

(6) a summary of the nature and amount of radioactive effluents released or discharged to the environment.

(7) a description of any environmental surveys performed outside of the facility.

(8) a summary of exposures received by facility personnel and visitors where such exposures are greater than 25 percent of limits allowed by 10CFR20.

(9) changes in facility organization.

6.8.2 ABNORMAL OCCURRENCE REPORTS

Notification shall be made within 24 hours by telephone or telegraph to the Director of the Regional Inspection and Enforcement Office followed by a written report within 14 days in the event of an abnormal occurrence, as defined in Section 1.0. The written report and, to the extent possible, the preliminary telephone or telegraph notification shall:

(1) describe, analyze, and evaluate safety implications

(2) outline the measures taken to ensure that the cause of the condition is determined

(3) indicate the corrective action taken to prevent repetition of the occurrence including changes to procedures

(4) evaluate the safety implications of the incident in light of the cumulative experience obtained from the report of previous failure and malfunction of similar systems and components.

6.3.3 UNUSUAL EVENT REPORT

A written report shall be forwarded within 30 days to the Director of the Regional Inspection and Enforcement Office in the event of:

(1) discovery of any substantial errors in the transient or accident analysis or in the methods used for such analysis as described in the Safety Analysis Report or in the basis for the Technical Specifications.

(2) discovery of any substantial variance from

performance specifications contained in the Technical Specifications or Safety Analysis Report

(3) discovery of any condition involving a possible single failure which, for a system designed against assumed failure, could result in a loss of the capability of the system to perform its safety function.