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U.S. Nuclear Regulatory Commission
Washington, DC 20555

Changes to Support UFTR Relicensing Application: ***Technical Specifications***

University of Florida Training Reactor
Facility License R-56, Docket No. 50-83

Completely reformatted Technical Specifications are enclosed as Chapter 14 of the Final Safety Analysis Report (FSAR) to support the relicensing request for the University of Florida Training Reactor (UFTR) R-56 License. Most of the requested changes to the Technical Specifications are considered to be minor; however, because of the number of changes and reorganization, the changes are not marked with the usual vertical line in the margin. Nevertheless, the following paragraphs provide a summary of the more significant requested changes where all the section and paragraph designations refer to the new reformatted and reorganized Technical Specifications generated as part of Chapter 14 of the FSAR to support relicensing.

First, in Section 3.2.1, "Reactor Control System," Paragraph (3), a clarification is added to allow the reactor to be operated without the autocontroller function available provided the autocontroller is not needed and not used for the operation. This change is justified in that there are many times, especially when operating at low power levels or for relatively short periods of time for training, irradiations or other operations, when the autocontroller function is neither needed nor used. Except for lengthy runs at constant power, the autocontroller function is primarily a convenience versus a necessary safety-related feature. There have been occasions in the past when the autocontroller has been out of order and despite not being needed, the reactor is then unavailable. Therefore, this change is supported as not reducing safety but assuring more efficient use of resources. This change also affects the second item in Table 3-3.

Second, in Section 3.2.1, "Reactor Control System," Paragraph (4), the control blade drop time is changed from not exceeding 1.0 seconds to not exceeding 1.5 seconds from initiation of blade drop to full insertion. This change will prevent unnecessary unstacking and entry into the core to make repairs to assure the 1.0 second limit is met. The 1.5 second limit in conjunction with other control system actions, especially the continuing limiting condition for operation (LCO) requiring that a 2.0% $\Delta k/k$ shutdown margin exist even with the most reactive control blade stuck fully out, assures control system operability and effectiveness. The other LCOs on reactivity assure that 1.5 seconds for the drop time is more than acceptable. The change simply lengthens the time before the unstacking and refurbishment of the control blade shaft system would be needed, especially to prevent extra core area entries to minimize radiation dose commitment in agreement with ALARA considerations and to assure efficient utilization of resources.

Third, in Section 3.6, "Limitations on Experiments," Paragraph (4), "Explosive Materials," the previous requirement that such materials not be irradiated is eased to allow limited quantities of such materials to be irradiated provided the experiment has been reviewed and approved by the Reactor Safety Review Subcommittee. This change will allow reactor usage for radiographing, beam transmission checks or irradiation of small samples of such materials in core, all subject to assuring proper protection of the reactor, personnel and the public. The quantities here in all cases would be small enough to preclude the possibility of safety significant damage to the reactor; this will be assessed by the experiment review and approval process.

Fourth, in Section 4.1, "Reactor Core Parameter Surveillance," the surveillance interval for the reactivity checks in Section 4.1(1), for the temperature coefficient of reactivity in Section 4.1(2), and in Section 4.1(8) for the annual "power" calibrations all remain the same but the allowable interval is changed to 15 months for all as a standard surveillance interval maximum to allow easier tracking.

Fifth, in Section 4.7(3), the surveillance interval for evacuation drills is changed from quarterly at intervals not to exceed 4 months to semiannually at intervals not to exceed 8 months. In the past, the results of drills have shown no significant problems and extending the drill interval will provide for more efficient use of resources, both in not disturbing facility and building activities and in reducing commitment of personnel time to plan and conduct drills. One drill will continue to be a large drill involving outside agencies and the requirement for two drills per year assures proper awareness of response procedures, especially since the instructional training requirements for building occupants, facility staff and the University Police Department remain in place as does staff practical training on emergency equipment.

Sixth, in Section 5.5.1, "Reactor Control System," the control blade insertion time under trip conditions, as in Section 3.2.1, is stipulated to be less than 1.5 seconds versus the previous 1.0 seconds per the previous explanation. Also in Section 5.5.1, the regulating blade reactivity worth is referenced better as being about 0.8%–1.0% $\Delta k/k$ versus the previous 1.0% $\Delta k/k$ to represent the current and likely range of conditions more accurately.

Seventh, in Section 5.2.2, "Secondary Cooling System," an always understood situation is clarified to note that operability of the city water cooling system is not a limiting condition for operation. This system is frequently unavailable and almost never used. This clarification simply formalizes the situation. Similarly, the trip on the city water system has no delay versus the ~10 second delay on the well water system. The city water system does have, and always has had, an initial ~10 second delay on reaching the 1 kW power level after which the trip is prompt. This condition is now also made explicit in this section.

Eighth, in Section 5.5.2, "Reactor Safety System," Paragraph (4), "Linear Neutron Channel and Automatic Flux Control System," a sentence is added indicating the automatic flux controller is not required to be operable for reactor operations where it is not needed and not used, to match the change in Section 3.2.1 as explained previously.

Ninth, Section 6.3.1, "As Low As Is Reasonably Achievable (ALARA)," is moved into the main part of the Technical Specifications, where previously it was Section 7.0 of the specifications, but is essentially unchanged.

Tenth, in Section 6.8, "Records," added to the list of allowable forms included for record keeping purposes is "computer storage media" to recognize efficient, convenient and easily accessed modern means of record keeping.

Eleventh, in Figure 6-1 UFTR Organization Chart, the organization is updated to reflect the fact that the University of Florida has recently, on July 1, 2001, converted to operation under a Board of Trustees to whom the UF President reports versus the previous Board of Regents. The University's Office of General Counsel indicates that this is now the proper way to present the UFTR Organization Chart though the Dean of the College of Engineering remains the effective Level 1 administrator for overseeing the reactor.

Twelfth, in Section 6.7.1, "Operating Reports," the requirement for submittal of the routine annual report covering the activities of the reactor facility during the previous calendar year is changed from being within six (6) months following the end of the prescribed year to being within nine (9) months following the end of the prescribed year. This change is administrative in nature to allow sufficient time after the end of classes in early May each year to produce a quality report in a timely manner.

Finally, in Section 6.7.3, "Other Special Reports," Paragraph (1), the requirement to report changes in facility organization involving Level 1, 2 or 3 personnel is changed to exclude only changes in the University of Florida Board of Trustees since this board consists of a number of individuals who will change periodically. Attempting to report all these changes as they are made would be a nonproductive use of resources, especially since the UF President remains the individual who administers all University of Florida affairs and the Dean of the College of Engineering remains the effective Level 1 administrator for overseeing the reactor and reporting to those above this position only as necessary.

In addition to the previously mentioned changes, there are many changes which are considered to be minor in nature and many additional changes simply from reformatting and reorganizing the Technical Specifications in standardized form or even clarifying wording in many cases. In Section 1.1, a number of definitions are added including Blade-Drop Time, Certified Operator, Confinement, Reactor Operator, Blade-Drop Trip (versus Rod-Drop Trip), Reference Core Condition, Senior Reactor Operator and Shutdown Reactivity. These definitions are all considered standard definitions defined to be specific for the UFTR to make the Technical Specifications more complete.

In Section 3.5.1, a clarification is added at the end of the paragraph noting that more conservative setpoints are allowed. Such conservatism has always been allowed but is specifically noted here. In Section 3.5.3, Paragraph (3), the periodic analysis of air flow is no longer required but allowed on the basis of investigating significant changes. Since the periodic interval was never specified, this requirement is not really relaxed since the only time when such analysis would be warranted would be for changes but, since the effluent is the only concern here, even this is not needed since the requirement for measurements to assure meeting Part 20 requirements continues in place. Finally, the existing Technical Specifications in many cases did not have bases specified even when they were understood. These are now included for completeness.

In Section 3.9, Paragraph (1), the radioactivity surveillance in line 1 is clarified to be on radiation dose, as always understood. The same is true in line 1 of Paragraph (3), with radiation dose becoming dose rate in line 1 of Paragraph (3)(a) and line 1 of Paragraph (3)(b) as the proper terminology. In Paragraph (2)(a), the surface contamination levels are taken as action levels versus limiting conditions for operation with the beta-gamma action level at 100 dpm/100 cm^2 versus the previous typographical error of 100 dpm/cm^2. In Paragraph (2)(b), the same correction is made with the airborne particulate contamination level becoming an action level versus a limiting condition for operation since neither of these conditions should necessarily prevent operation of the reactor.

Throughout Chapter 4, the annual surveillance limits in Section 4.1, Paragraph (1) and Paragraph (2), in Section 4.2, Paragraph (8), and in Section 4.4, Paragraph (1), are all brought into conformity by specifying "at intervals not to exceed 15 months." This uniformity has negligible safety impact but simplifies record keeping. In Section 4.3, Paragraph (1)(a) and Paragraph (1)(b), the reference to SOLU Bridge is changed to conductivity meter to avoid references to specific types of meters.

The changes summarized in the above paragraphs and all the other changes involved in standardizing, reformatting and reorganizing the Technical Specifications as requested are not considered to have any significant effect on safe operation of the UFTR. These changes have been reviewed by UFTR management and by the Reactor Safety Review Subcommittee who concur on this evaluation.

This submittal consists of one signed original letter of transmittal with the appended completely reformatted and reorganized UFTR Technical Specifications. These same Technical Specifications are also contained within Chapter 14 of the updated Final Safety Analysis Report; therefore, no additional copies are included here.

We appreciate your consideration of this request. Please let us know if you need additional information.

Sincerely,

William G. Vernetson
Director of Nuclear Facilities

WGV/dms
Enclosure

cc: A. Adams, NRC Project Manager
NRC Region II
Reactor Safety Review Subcommittee

Sworn and subscribed this 29th day of July 2002.

Daniel J. Sanetz
MY COMMISSION # DD061176 EXPIRES
September 30, 2005
BONDED THRU TROY FAIN INSURANCE, INC

Notary Public

CHAPTER 14

TECHNICAL SPECIFICATIONS

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14 TECHNICAL SPECIFICATIONS

Section 50.36 of 10 CFR Part 50 requires that each operating license issued by the Nuclear Regulatory Commission contain Technical Specifications that set forth the limits, operating conditions, and other requirements imposed on facility operation for the protection of the health and safety of the public. The UFTR established Technical Specifications on July 22, 1970, according to Amendment 10 to Facility License R-56. More detailed relicensing Technical Specifications were established in 1982 and have been periodically updated up through Amendment 23 approved in December 2001.

The actual Technical Specifications (TS) for the UFTR included in this FSAR are an upgrade of the current set of TS to better satisfy NRC requirements, the ANSI/ANS 15.1-1990 Standard for the Development of Technical Specifications for Research Reactors and to better describe and establish limits for the facility safety-related and overall capabilities and especially to provide bases where none were listed previously.

Many of the design bases for setpoints and trip-points are historical for the UFTR and other Argonauts. Revisions of these specifications have been made to match and upgrade previous modifications and present capabilities of UFTR systems. For example, the primary coolant flow safety limit has been historically set at 18 gpm and proven sufficiently conservative safety-wise; however, the actual UFTR trip setpoint for primary coolant flow has been 30 gpm for the past twenty-five years (after improvements to the reactor coolant system) and has therefore been established as the TS trip setpoint for coolant flow.

The selection of the UFTR trip-points follows a conservative and practical approach to the operational safety of the UFTR, often without the liberalization of margin/ setpoints resulting from detailed analysis and measurements. Operating experience demonstrates that the historical and upgraded setpoints will maintain fuel and coolant temperatures well within conservative safety limits.

The definition of Abnormal Occurrences in the TS, Section 1.1 is intended to address specifically those occurrences which have potential safety significance, or could lead the reactor to be operated in violation of a Safety Limit, a Limiting Safety System Setting or in violation of a Limiting Condition for Operation. In this regard, occurrences affecting the reactivity of the reactor which are due to the expected and proper functioning of the Control and Safety System are not considered to be "an uncontrolled or unanticipated change in reactivity as in section 1.1(5) where reactor trips resulting from a known cause are excluded from the definition of abnormal occurrences." Therefore, the following situations are accepted as normal regarding reactivity insertions:

- Reactor trips caused by loss of power to the reactor console or to any component of the Control and Safety Systems when the systems respond as specified.

- Reactor trips caused by operator, operator-in-training, or student trainee, or induced by failsafe components when the Reactor Safety System is performing its intended function.

- The controlling actions of an operator, operator-in-training, or student trainee and occurrences which do not result in Safety System actuation and do not violate Limiting Conditions for Operation.

APPENDIX 14.1

TECHNICAL SPECIFICATIONS

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TECHNICAL SPECIFICATIONS FOR THE UNIVERSITY OF FLORIDA TRAINING REACTOR

1.0 GENERAL

The University of Florida Training Reactor (UFTR) is operated by the Department of Nuclear and Radiological Engineering of the University of Florida. The UFTR is a non-power reactor used for instructional and research activities. The reactor is a modified Argonaut type, a light water and graphite moderated, graphite reflected, light water cooled reactor and operates at a nominal maximum steady state power level of 100 kWth.

1.1 Definitions

Abnormal Occurrences: An abnormal occurrence is any one of the following:

(1) operating the reactor with a safety system setting less conservative than specified in the Limiting Safety System Setting section of the Technical Specifications;

(2) operating the reactor in violation of a limiting condition for operation;

(3) a malfunction of a safety system component or other component or system malfunction that could, or threatens to, render the system incapable of performing its intended safety function;

(4) a release of fission products from the reactor fuel of a magnitude to indicate a failure of the fuel cladding;

(5) an uncontrolled or unanticipated change in reactivity greater than one dollar (Reactor trips resulting from a known cause are excluded.);

(6) an observed inadequacy in the implementation of either administrative or procedural controls such that the inadequacy could have caused the existence or development of an unsafe condition in connection with the operation of the reactor;

(7) an uncontrolled or unanticipated release of radioactivity to the environment.

Blade-Drop Time: The blade-drop time is the elapsed time between the instant a limiting safety system set point is reached or a manual scram is initiated and the instant that the blade is fully inserted.

Certified Operator: An individual authorized by the Nuclear Regulatory Commission to carry out the duties and responsibilities associated with the position requiring the certification.

Channel Calibration: A channel calibration is an adjustment of the channel components such that its output responds, within specified range and accuracy, to known values of the parameter which the channel measures. Calibration shall encompass the entire channel, including readouts, alarms, or trips.

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

Channel Test: A channel test is the introduction of an input signal into the channel to verify that it is operable.

Confinement: Confinement means a closure on the reactor room air volume such that the movement of air into it and out of the reactor room is through a controlled path.

Independent Experiment: An independent experiment is one that is not connected by a mechanical, chemical, or electrical link.

Inhibit: An inhibit is a device that prevents the withdrawal of control blades under a potentially unsafe condition.

Measured Value: The measured value of a parameter is the value as it appears at the output of a measuring channel.

Measuring Channel: The measuring channel is the combination of sensor, lines, amplifiers, and output devices that are connected for the purpose of measuring the value of a process variable.

Movable Experiment: A movable experiment is one where it is intended that the entire experiment may be moved in or near the core or into and out of the reactor while the reactor is operating, or having incore components during operation.

Nonsecured Experiment: A nonsecured experiment, where it is intended that the experiment should not move while the reactor is operating, is held in place with less restraint than a secured experiment.

Operable: A system or component is operable when it is capable of performing its intended function in a normal manner.

Operating: A system or component is operating when it is performing its intended function in a normal manner.

Reactor Operating: The reactor is considered to be operating whenever it is not secured or shutdown.

Reactor Operator (Class B Reactor Operator): Any individual who is certified to manipulate the controls of the reactor.

Reactor Safety System: The reactor safety system is that combination of measuring channels and associated circuitry that are designed to initiate automatic protective action or to provide information for initiation of manual protective action.

Reactor Secured: The reactor is secured when it contains insufficient fissile material or moderator present in the reactor, adjacent experiments or control blades, to attain criticality under optimum available conditions of moderation and reflection,

or

(1) the reactor is shutdown, (2) electrical power to the control blade circuits is switched off and the switch key is in proper custody, (3) no work is in progress involving core fuel, core structure, installed control blades or control blade drives unless they are physically decoupled from the control blades, and (4) 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.

Reactor Shutdown: The reactor is shut down when all control blades are inserted and the reactor is subcritical by a margin greater than 2%Δk/k. When calculating the subcritical margin, no credit shall be taken for experiments, temperature effects or xenon poisoning.

Reactor Startup: A reactor startup is a series of operator manipulations of reactor controls (in accordance with approved procedures) intended to bring the reactor to a k_{eff} of 0.99 or greater. It does not include control blade manipulations made for purposes of testing equipment or component operability within a k_{eff} of 0.99 or less.

Reactor Trip: A reactor trip is considered to occur whenever one of the following two actions take place:

(1) Blade-Drop Trip — a gravity drop of all control blades into the reactor core as a result of terminating electrical power to the blade drive magnetic clutches.

(2) Full-Trip — the water is dumped from the reactor core by the safety actuation of the dump valve in addition to the blade-drop trip.

Reference Core Condition: The condition of the core when it is at ambient cold temperature (~20°C) and the reactivity worth of xenon is negligible (cold, clean of xenon and critical).

Reportable Occurrence: A reportable occurrence is any of the conditions described in Section 6.7.2 of this specification.

Research Reactor: A research reactor is a device designed to support a self-sustaining neutron chain reaction to supply neutrons or ionizing radiation for research, developmental, educational, training, or experimental purposes, and which may have provisions for the production of nonfissile radioisotopes.

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

Secured Experiment: A secured experiment is a stationary experiment held firmly in place by a mechanical device secured to the reactor structure or by gravity, providing that the weight of the experiment is such that it cannot be moved by a force of less than 60 lb.

Secured Experiment with Movable Parts: A secured experiment with movable parts is one that contains parts that are intended to be moved while the reactor is operating.

Senior Reactor Operator (Class A Reactor Operator): Any individual who is certified to direct the activities of Reactor Operators (Class B reactor operators); such an individual is also a reactor operator.

Should, Shall, 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.

Shutdown Margin: Shutdown margin is the minimum shutdown reactivity necessary to provide confidence that the system can be made subcritical by means of the control and safety systems starting from any permissible operating condition and with the most reactive blade in its most reactive position, and that the reactor will remain subcritical without further operator action.

Shutdown Reactivity: Shutdown reactivity is the value of the reactivity of the reactor with all control blades in their least reactive positions (e.g., all inserted). The value of the shutdown reactivity includes the reactivity value of all installed experiments and is determined with the reactor at ambient conditions.

Unscheduled Shutdown: An unscheduled shutdown is any unplanned shutdown of the reactor after startup has been initiated.

2.0 SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

2.1 Safety Limits

Safety limits for nuclear reactors are limits upon important process variables that are found to be necessary to reasonably protect the integrity of certain of the physical barriers that guard against the uncontrolled release of radioactivity. The principal physical barrier shall be the fuel cladding.

Applicability: These specifications apply to the variables that affect thermal, hydraulic, and materials performance of the core.

Objective: To ensure fuel cladding integrity.

Specifications:

(1) The steady-state power level shall not exceed 100 kWth.

(2) The primary coolant flow rate shall be greater than 18 gpm at all power levels greater than 1 watt.

(3) The primary coolant outlet temperature from any fuel box shall not exceed 200°F.

(4) The specific resistivity of the primary coolant water shall not be less than 0.4 megohm-cm for periods of reactor operation exceeding four (4) hours.

Bases: Operating experience and detailed calculations of Argonaut reactors have demonstrated that Specifications (1) and (2) suffice to maintain the maximum fuel temperature below 200°F, which is well below the temperature at which fuel degradation would occur. For the readily available flow rate of up to 65 gpm, it has been shown that the fuel temperature will be well below 200°F for steady-state power operation of up to 500 kWth. No fuel damage is known to occur from transient operation up to 500% full power at the present 40 - 45 gpm primary coolant flow rate. Specification (3) is included to prevent boiling of the primary coolant at any fuel box. Specification (4) suffices to maintain adequate water quality conditions to prevent deterioration of the fuel cladding and still allow for expected transient changes in the water resistivity.

2.2 Limiting Safety System Settings

Limiting safety system settings for nuclear reactors are settings for automatic protective devices related to those variables having significant safety functions.

Applicability: These specifications are applicable to the reactor safety system setpoints.

Objective: To ensure that automatic protective action is initiated before exceeding a safety limit or before creating a radioactive hazard that is not considered under safety limits.

Specifications: The limiting safety system settings shall be

(1) Power level at any flow rate shall not exceed 125 kWth.

(2) The primary coolant flow rate shall be greater than 30 gpm at all power levels greater than 1 watt.

(3) The average primary coolant outlet temperature shall not exceed 155°F when measured at any fuel box outlet.

(4) The reactor period shall not be faster than 3 sec.

(5) The high voltage applied to Safety Channels 1 and 2 neutron chambers shall be 90% or more of the established normal value.

(6) The primary coolant pump shall be energized during reactor operations.

(7) The primary coolant flow rate shall be monitored at the return line.

(8) The primary coolant core level shall be at least 2 in. above the fuel.

(9) The Secondary coolant flow shall satisfy one of the following two conditions when the reactor is being operated at power levels equal to or larger than 1 kW:

    (a) Power shall be provided to the well pump and the well water flow rate shall be larger than 60 gpm when using the well system for secondary cooling;

    or

    (b) The water flow rate shall be larger than 8 gpm when using the city water system for secondary cooling.

(10) The reactor shall be shut down when the main alternating current (AC) power is not operating.

(11) The reactor vent system shall be operating during reactor operations.

(12) The water level in the shield tank shall not be reduced 6 in. below the established normal level.

Bases: The University of Florida Training Reactor (UFTR) limiting safety system settings (LSSS) are established from operating experience and safety considerations. The

LSSS 2.2 (1) through (10) are established for the protection of the fuel, the fuel cladding, and the reactor core integrity. The primary and secondary bulk coolant temperatures, as well as the outlet temperatures of at least four of the six fuel boxes, are monitored and recorded in the control room. LSSS 2.2 (11) is established for the protection of reactor personnel in relation to accumulation of argon-41 in the reactor cell and for the control of radioactive gaseous effluents from the cell. LSSS 2.2 (12) is established to protect reactor personnel from potential external radiation hazards caused by loss of biological shielding.

3.0 LIMITING CONDITIONS FOR OPERATION

Limiting conditions for operation are the lowest functional capabilities or performance levels required of equipment for safe operation of the facility.

3.1 Reactor Core Parameters

Applicability: These specifications apply to the parameters which describe the reactivity condition of the core.

Objectives: To ensure that the reactor cannot achieve prompt criticality, that the fuel temperature does not reach melting point, that the reactor can be safely shutdown under any condition and to limit the reactivity insertion rate to levels commensurable with efficient and safe reactor operation .

Specifications: The reactor shall not be critical unless the following conditions exist:

(1) Shutdown Margin: The minimum shutdown margin, with the most reactive control blade fully withdrawn, shall not be less than 2% Δk/k.

(2) Excess Reactivity: The core excess reactivity at cold critical, without xenon poisoning, shall not exceed 2.3% Δk/k.

(3) Coefficients of Reactivity: The primary coolant void and temperature coefficients of reactivity shall be negative.

(4) Maximum Single Blade Reactivity Insertion Rate: The reactivity insertion rate for a single control blade shall not exceed 0.06% Δk/k/sec, when determined as an average over any 10 sec of blade travel time from the characteristic experimental integral blade reactivity worth curve.

(5) Experimental Limitations: The reactivity limitations associated with experiments are specified in Section 3.6 of these specifications.

Bases: Specification (1) ensures that a reactor shutdown can be established with the most reactive blade out of the core. Specification (2) is based on analysis documented in SAR Chapter 4, Section 4.1.2 and Chapter 13 to prevent that an inadvertent sudden excess reactivity insertion release enough energy to melt the fuel. Specification (3) is based on safe inherently controlling requirements for operation of reactors. Specification (4) limits the reactivity insertion rate to levels commensurate with efficient and safe reactor operation and Specification (5) is based on the reactor control system capabilities (20-sec positive period limitation). These limits are also established based on extensive UFTR operating experience.

3.2 Reactor Control and Safety Systems

Applicability: These specifications apply to the reactor control and safety systems.

3.2.1 Reactor Control System

Objectives: To specify minimum acceptable equipment requirements and capability for the reactor control system, range of reactivity insertion rate and interlocks to assure safe operation of the reactor.

Specifications:

(1) Four cadmium-tipped, semaphore-type blades shall be used for reactor control. The control blades shall be protected by shrouds to ensure freedom of motion.

(2) Only one control blade can be raised by the manual reactor controls at any one time. The safety blades shall not be used to raise reactor power simultaneously with the regulating blade when the reactor control system is in the automatic mode of operation.

(3) A reactor startup shall not be commenced unless the reactor control system is operable. The reactor may be operated without the autocontroller function available provided the autocontroller is not needed and not used for the operation.

(4) The control-blade-drop time shall not exceed 1.5 sec from initiation of blade drop to full insertion (blade-drop time), as determined according to surveillance requirements.

(5) The following control blade withdrawal inhibit interlocks shall be operable for reactor operation for the following conditions:

   (a) a source (startup) count rate of less than 2 cps (as measured by the wide range drawer operating on extended range).

   (b) a reactor period less than 10 sec.

   (c) safety channels 1 and 2 and wide range drawer calibration switches not in OPERATE condition.

   (d) attempt to raise any two or more blades simultaneously when the reactor is in manual mode, or two or more safety blades simultaneously when the reactor is in automatic mode.

(e) power is raised in the automatic mode at a period faster than 30 sec. (The automatic controller action is to inhibit further regulating blade withdrawal or drive the regulating blade down until the period is ≥30 sec.)

(6) Following maintenance or modification to the reactor control system, an operability test and calibration of the affected portion of the system, including verification of control blade drive speed, shall be performed before the system is considered operable.

Bases: The operator has available digital control blade position indicators for the three safety blades and the regulating blade. The three safety blades can only be manipulated by the UP-DOWN blade switches (manual); the regulating blade can be manually controlled or placed under automatic control, which uses the linear channel as the measuring channel, and a percent of power setting control. Specifications (1) and (4) ensure that the reactor can be shut down promptly when a scram signal is initiated. Specification (2) ensures there is no possibility to reach a prompt critical condition and to limit the reactivity insertion rate to levels commensurable with efficient and safe reactor operation. Specification (3) ensures the reactor control system operability for startup. Specification (5) (a), (b), (d) and (e) ensure that blade movement is performed under proper monitoring with assured source count rate and safe period either under manual or automatic control. Specification (5) (c) ensures that the operator is monitoring the power increase during blade movement. Specification (6) ensures checking for proper functioning of the control blade system prior to operations after maintenance has been conducted.

3.2.2 Reactor Safety System

Objective: To ensure that sufficient information is available to the operator to assure safe operation of the reactor.

Specifications:

(1) The reactor shall not be started unless the reactor safety system is operable in accordance with Table 3-1.

(2) Tests for operability shall be made in accordance with Table 3-2.

Bases: Specification (1) ensures that no operation will be performed under abnormal conditions as listed in Table 3-1 and that the necessary reactor control system trip functions are operable in case of occurrence of any of these conditions. The two independent reactor safety channels provide redundant protection and information on reactor power in the range 1%-150% of full power. The linear power channel is the most accurate neutron instrumentation channel and also provides a signal for reactor control in automatic mode. The percent of power information is displayed by the linear channel two-pen recorder. It does not provide a protective function. The log wide range drawer provides a series of information, inhibit, and protection functions from extended source range to full power. The safety channel 1 signal and the period protection signal are derived from the wide range drawer. The wide range drawer provides protection during startup through the source count rate interlock (2 cps), 10-sec period inhibit and the 3-sec period trip. The primary and secondary coolant flow rate, temperature and level sensing instrumentation provide information and protection over the entire range of reactor operations and is proven to be conservative from a safety viewpoint. The key switch prevents unauthorized operation of the reactor and is an additional full trip (manual scram) control available to the operator. The core level trip provides redundant protection to the primary flow trip. The core level trip acts as an inhibit during startup until the minimum core water level is reached. As stated in Section 2, these limits were set based on operating experience and safety considerations.

Specification (2) ensures proper surveillance of the components of the reactor safety system and scram functions to assure operability.

3.2.3 Reactor Control and Safety Systems Measuring Channels

Objective: To specify the minimum number and type of acceptable measuring channels for the reactor safety system and safety related instrumentation.

Specification: The minimum number and type of measuring channels operable and providing information to the control room operator required for reactor operation are presented in Table 3-3.

Bases: Table 3-3 specifies the minimum number of acceptable components for the reactor safety system and related instrumentation to assure the proper functioning of the reactor safety systems as specified in SAR Chapter 7.

3.3 Reactor Coolant System

Applicability: These specifications apply to the reactor cooling system and water in contact with fuel plates or elements.

Objective: To ensure that adequate cooling is provided to maintain the fuel temperature below the limiting safety system settings with water of high quality to minimize corrosion of the aluminum cladding of fuel plates as well as activation of dissolved materials and corrosion products.

Specifications:

(1) Primary water temperature shall not exceed 155°F in accordance with Table 3-1.

(2) Primary water shall be demineralized, light water with a specific resistivity of not less than 0.5 megohm-cm after the reactor is operated for more than 6 hr.

(3) Primary equipment pit water level sensor shall alarm in the control room whenever a detectable amount of water (1 in. above floor level) exists in the equipment pit.

(4) Primary coolant level switch shall annunciate in the control room whenever the water level in the core falls below 42.5 inches in accordance with Table 3-1.

(5) The primary and secondary flow rates shall be maintained as specified in Table 3-1.

Basis: Specifications 3.3(1) and 3.3(2) are designed to protect the fuel element integrity and are based upon operating experience. At the specified quality, the activation products (of trace minerals) do not exceed acceptable limits. Specifications 3.3 (3) and 3.3 (4) are designed to alert the operator to potential loss of primary coolant, to prevent reactor operations with a reduced water inventory, and to minimize the possibility of an uncontrolled release of primary coolant to the environs. Specification 3.3 (5) is designed to assure adequate cooling of the fuel plates.

3.4 Reactor Vent System

Applicability: These specifications apply to the equipment required for controlled release of gaseous radioactive effluent to the environment via the stack or its confinement within the reactor cell.

Objective: To limit the amount and concentration of radioactivity in effluent from the reactor cell and reduce the back leakage of radioactivity into the reactor cell under normal operations and from the cell under emergency conditions.

Specifications:

(1) The reactor vent system shall be operated at all times during reactor operation. In addition, the vent system shall be operated until the stack monitor indicates less than 10 counts per second (cps) unless otherwise indicated by facility conditions to include loss of building electrical power, equipment failure or maintenance, cycling console power to dump primary coolant or to conduct tests and surveillances and initiating the evacuation alarm for tests and surveillances including emergency drills and demonstrations. The reactor vent system shall be immediately secured upon detection of: a failure in the monitoring system, a failure of the absolute filter, or an unanticipated high stack count rate.

(2) The reactor vent system shall be capable of maintaining an air flow rate between 1 and 400 cfm from the reactor cavity whenever the reactor is operating and as specified in these Technical Specifications.

(3) The diluting fan shall be operated whenever the reactor is in operation and as otherwise specified in these Technical Specifications, at an exhaust flow rate larger than 10,000 cfm.

(4) The air conditioning/ventilation system and reactor vent system are automatically shut off whenever the reactor building evacuation alarm is automatically or manually actuated.

(5) All doors to the reactor cell shall normally be closed while the reactor is operating. Transit is not prohibited through the exit chamber and control room doors.

(6) The reactor vent system shall have a backup means for quantifying the radioactivity in the effluent during abnormal or emergency operating conditions where venting could be used to reduce cell radionuclide concentrations for ALARA considerations.

Bases: Under normal conditions, to effect controlled release of gaseous activity through the reactor vent system, a negative cell pressure is required so that any building leakage will be inward. Under normal shutdown conditions with significant Argon-41 inventory in the reactor cavity, operation of the core vent system prevents unnecessary exposure from gas leakage back into the cell. Under emergency conditions, the reactor vent system will be shut down and the damper closed, thus minimizing leakage of radioactivity from the reactor cell unless venting is required.

3.5 Radiation Monitoring Systems and Radioactive Effluents

Applicability: These specifications apply to the radiation monitoring systems and to the limits on radioactive effluents.

Objective: To specify the minimum equipment or the lowest acceptable level of performance for the radiation monitoring systems and limits for effluents.

Specifications: The reactor shall not be operated unless the conditions presented in Sections 3.5.1 through 3.5.6 are met.

3.5.1 Area Radiation Monitors

The reactor cell shall be monitored by at least three area radiation monitors, two of which shall be capable of audibly warning personnel of high radiation levels. The output of at least two of the monitors shall be indicated and recorded in the control room. The number required and setpoints for the radiation monitors shall be in accordance with Table 3-4 including more conservative setpoints if desired.

3.5.2 Argon-41 Discharge

The following operational limits are specified for the discharge of Argon-41 to the environment:

(1) The concentration of Argon-41 in the gaseous effluent discharge of the UFTR is determined by averaging it over a consecutive 30-day period.

(2) The dilution resulting from the operation of the stack dilution fan (flow rate of 10,000 cfm or more) and atmospheric dilution of the stack plume (a factor of 200) may be taken into account when calculating this concentration.

(3) When calculated as above, discharge concentration of Argon-41 shall not exceed 1.0×10^{-8} μCi/ml. Operation of the UFTR shall be such that this maximum concentration (averaged over a month) is not exceeded.

3.5.3 Reactor Vent/Stack Monitoring System

(1) Whenever the reactor vent system is operating, air drawn through the reactor vent system shall be continuously monitored for gross count rate of radioactive gases. The output of the monitor shall be indicated and recorded in the control room. Operable functions and alarm settings shall be as delineated in Table 3-4.

(2) Whenever venting is to be used to reduce cell radionuclide concentrations during abnormal or emergency conditions, then the radioactivity in the effluent shall be quantified prior to initiating controlled venting.

(3) Whenever significant changes are noted, the reactor air cavity flow may be periodically analyzed to minimize Argon-41 releases to the environment while maintaining a negative pressure within the reactor cavity to minimize potential radioactive hazards to reactor personnel.

3.5.4 Air Particulate Monitor

The reactor cell environment shall be monitored by at least one air particulate monitor, capable of audibly warning personnel of radioactive particulate airborne contamination in the cell atmosphere. Operable functions and alarm settings shall be as delineated in Table 3-4.

3.5.5 Liquid Effluents Discharge

The above ground (external) waste water holdup tank and the internal condensate tanks(s) shall be available to collect potentially contaminated liquid effluents. The liquid effluent from the aboveground holdup tank shall be sampled and the radioactivity measured before release to the sanitary sewage system which is allowed in conformance with 10 CFR 20.1301. Releases of radioactive effluents from the external waste water holdup tank shall be in compliance wit the limits specified in 10 CFR 20, Appendix B, Table 2, Column 2, as specified in 10 CFR 20.1302.

3.5.6 Bases

The area radiation monitoring system, stack monitoring system and air particulate detector provide information to the operator indicating radiation and airborne contamination levels under the full range of operating conditions. Audible indicators and alarm lights indicate (via monitored parameters) when corrective operator action is required, and (in the case of the area radiation monitors) a warning light indicates situations recommending or requiring special operator attention and evaluation. Argon-41 discharges are limited to a monthly average which is less than the effluent concentration limit in 10 CFR 20, Appendix B, Table 2, and liquid and solid radioactive wastes are regulated and controlled to assure compliance with legal requirements.

3.6 Limitations on Experiments

Applicability: These specifications apply to all experiments or experimental devices installed in the reactor core or its experimental facilities.

Objectives: The objectives are to assure operational safety and prevent damage to the reactor facility, reactor fuel, reactor core, and associated equipment; to prevent exceeding the reactor safety limits; and to minimize potential hazards from experimental devices.

Specifications:

(1) General

The reactor manager and the radiation control officer (or their duly appointed representatives) shall review and approve in writing all proposed experiments prior to their performance. The reactor manager shall refer to the Reactor Safety Review Subcommittee (RSRS) the evaluation of the safety aspects of new experiments and all changes to the facility that may be necessitated by the requirements of experiments that may have safety significance. When experiments contain hazardous materials or substances which, upon irradiation in the reactor, can be converted into a material with significant potential hazards, a determination will be made about the acceptable reactor power level and length of irradiation, taking into account such factors as: isotope identity and chemical and physical form and containment; toxicity; potential for contamination of facility or environment; problems in removal or handling after irradiation including containment; transfer; and eventual disposition. Guidance should be obtained from the ANS 15.1- 1990 "The Development of Technical Specifications for Research Reactors". Experimental apparatus, material, or equipment to be inserted in the reactor shall be reviewed to ensure compatibility with the safe operation of the reactor.

(2) Classification of Experiments

Class I —Routine experiments, such as gold foil irradiation. This class shall be approved by the reactor manager; the radiation control officer may be informed if deemed necessary.

Class II— Relatively routine experiments that need to be documented for each new group of experimenters performing them, or whenever the experiment has not been carried out for one calendar year or more by the original experimenter, and that pose no hazard to the reactor, the personnel, or the public. This class shall be approved by the reactor manager and the radiation control officer.

Class III— Experiments that pose significant questions regarding the safety of the reactor, the personnel, or the public. This class shall be approved by the reactor manager and the radiation control officer, after review and approval by the Reactor Safety Review Subcommittee (RSRS).

Class IV — Experiments that have a significant potential for hazard to the reactor, the personnel, or the public. This class shall be approved by the reactor manager and radiation control officer after review and approval by the RSRS and specific emergency operating instructions shall be established for conducting the experiments.

(3) Reactivity Limitations on Experiments

(a) The absolute reactivity worth of any single movable or nonsecured experiment shall not exceed 0.6% $\Delta k/k$.

(b) The total absolute reactivity worth of all experiments shall not exceed 2.3%$\Delta k/k$.

(c) When determining the absolute reactivity worth of an experiment, no credit shall be taken for temperature effects.

(d) An experiment shall not be inserted or removed unless all the control blades are fully inserted or its absolute reactivity worth is less than that which could cause a positive 20-sec stable period.

(4) Explosive Materials

Explosive materials may be irradiated in limited quantities provided the experiment has been reviewed and approved by the RSRS.

(5) Thermal-Hydraulic Effects

Experiments shall be designed so that during normal operation, or failure, the thermal hydraulic parameters of the core do not exceed the safety limits.

(6) Chemical Effects

Experiments shall be designed so that during normal operation, or failure, the physical barrier described in Section 2.1 will not be compromised by either chemical or blast effects from the experiment.

(7) Fueled Experiments

A limit should be established on the inventory of fission products in any experiment containing fissile material, according to its potential hazard and as determined by the RSRS.

(8) Radioactive Releases from Experiments

Class III and Class IV experiments shall be evaluated for their potential release of airborne radioactivity and limits shall be established for the permissible concentration of radioisotopes in the experiments, according to the 10 CFR 20 limitations for exposure of individuals in restricted and unrestricted areas.

Bases: The general specifications ensure that an adequate review process is followed to determine the safety, conditions, and procedures for all experiments. The classification of experiments clearly delineates the responsibility for approving experiments according to their potential hazards, to ensure that potentially hazardous experiments are analyzed for their safety implications, and that appropriate procedures are established for their execution. The reactivity limitations on experiments are established to prevent prompt criticality by limiting the worth of movable or nonsecured experiments, to prevent a reactivity insertion larger than the stipulated maximum step reactivity insertion in the accident analysis, and to allow for reactivity control of experiments within the reactor control system capabilities (20-sec positive period limitation). These specifications limit the irradiation of explosive materials. Explosive materials are defined as those materials normally used to produce explosive or detonating effects, materials that can chemically combine to produce explosion or detonations, or any materials that can undergo explosive decomposition under influence of neutron, gamma, or heat flux of the reactor or as defined by applicable standards. These specifications also limit the amount of fissile materials that can be irradiated in the reactor according to its potential hazard and the reactor system's capability to handle a potential release to the cell environment.

3.7 Reactor Building Evacuation Alarm

Applicability: These specifications apply to the systems and equipment required for the evacuation of the reactor cell and the reactor building (including the reactor annex).

Objective: To specify conditions to actuate the evacuation alarm.

Specifications: The reactor cell and the reactor building shall be evacuated when any of the following conditions exist:

(1) The evacuation alarm is actuated automatically when two area radiation monitors alarm high (≥25 mrem/hr) in coincidence.

(2) The evacuation alarm is actuated manually when an air particulate monitor is in a valid alarm condition.

(3) The evacuation alarm is actuated manually when a reactor operator detects a potentially hazardous radiological condition and preventive actions are required to protect the health and safety of operating personnel and the general public.

Basis: To provide early and orderly evacuation of the reactor cell and the reactor building and to minimize radioactive hazards to the operating personnel and reactor building occupants.

3.8 Fuel and Fuel Handling

Applicability: These specifications apply to the arrangement of fuel elements in core and in storage, as well as the handling of fuel elements.

Objectives: The objectives are to establish the maximum core loading for reactivity control purposes, to establish the fuel storage conditions, and to establish fuel performance and fuel-handling specifications with regard to radiological safety considerations.

Specifications:

(1) The maximum fuel loading shall consist of 24 full fuel elements consisting of 11 plates each containing enriched uranium and clad with high purity aluminum.

(2) Fuel element loading and distribution in the core shall comply with approved fuel-handling procedures.

(3) Fuel elements exhibiting release of fission products because of cladding rupture shall, upon positive identification, be removed from the core. Fission product contamination of the primary water shall be treated as evidence of fuel element failure.

(4) The reactor shall not be operated if there is evidence of fuel element failure.

(5) All fuel shall be moved and handled in accordance with approved procedures.

(6) Fuel elements or fueled devices shall be stored and handled out of core in a geometry such that the k_{eff} is less than 0.8 under optimum conditions of moderation and reflection.

(7) Irradiated fuel elements or fueled devices shall be stored so that temperatures do not exceed design values.

Basis: The fuel loading is based on the present fuel configuration. The reactor systems do not have adequate engineering safeguards to continue operating with a detectable release of fission products into the primary coolant. The fuel is to be stored in a safe configuration and shall be handled according to approved written procedures for radiological safety purposes and adherence to limiting radiation dose to as low as is reasonably achievable (ALARA).

3.9 Radiological Environmental Monitoring Program

Applicability: This specification applies to the environmental radioactivity surveillances and surveys conducted by UFTR personnel and Radiation Control and Radiological Services Department personnel.

Objectives: The UFTR Radiological Environmental Monitoring Program is conducted to ensure that the radiological environmental impact of reactor operations is as low as reasonably achievable (ALARA); it is conducted in addition to the radiation monitoring and effluents control specified under Section 3.5 of these Technical Specifications.

Specifications: The Radiological Environmental Monitoring Program shall be conducted as specified below and under the supervision of the radiation control officer.

(1) Monthly environmental radiation dose surveillance outside the restricted area shall be conducted by measuring the gamma doses at selected fixed locations surrounding the UFTR complex with acceptable personnel monitoring devices. A minimum of six independent locations shall be used. A review of potential causes shall be conducted whenever a measured dose of over 40 mrem/month at two or more locations is determined and a report shall be submitted to the RSRS for review.

(2) Radioactivity surveillance of the restricted area (reactor cell) shall be conducted as follows:

(a) Surface contamination in the restricted area shall be measured by taking random swipes in the reactor cell during the weekly checkout. Measured surface contamination greater than 100 dpm/100cm^2 beta-gamma or greater than 50 dpm/100 cm^2 alpha are action levels requiring review and possible radiological safety control actions.

(b) Airborne particulate contamination shall be measured using a high volume air sampler during the weekly checkout. Measured radioactive airborne contamination 25% above mean normal levels is an action level requiring review and possible radiological safety control actions.

(3) The following radiation surveys, using portable radiation monitors, are limiting conditions for operation:

(a) Surveys measuring radiation dose rates in the restricted area shall be conducted quarterly, at intervals not to exceed 4 months, and at any time a change in the normal radiation levels is noticed or expected. Radiation exposures shall be maintained within 10 CFR 20 limits for radiation workers.

(b) Surveys measuring the radiation dose rates in the unrestricted areas surrounding the UFTR complex shall be conducted quarterly, at intervals not to exceed 4 months, and at any time a change in the normal radiation levels is noticed or expected. Dose rates shall be within 10 CFR 20 limits for the general public.

Bases: The bases for establishing the Radiological Environmental Surveillance Program are the established limits for internal and external radiation exposure and requirements that radiation doses be maintained ALARA and the necessity to confirm UFTR operations are conducted to be within the established limits.

Table 3-1 Specifications for Reactor Safety System Trips

Specification	Type of Safety System Trip
<u>Automatic Trips</u>	
Period less than 3 sec	Full
Power at 125% of full power	Full
Loss of chamber high voltage (≥10%)	Full
Loss of electrical power to control console	Full
Primary Cooling System	Blade-Drop
Loss of pump power Low water level in core (< 42.5") No outlet flow Low inlet water flow (< 30 gpm)	
Secondary Cooling System (at power levels above 1 kW)	Blade-Drop
Loss of flow (well water < 60 gpm, city water < 8 gpm) Loss of pump power	
High Primary Coolant Average Outlet Temperature (≥155°F)	Blade-Drop
Shield Tank Low water level (6" below established normal level)	Blade-Drop
Ventilation System Loss of power to dilution fan Loss of power to core vent system	Blade-Drop
<u>Manual Trips</u>	
Manual scram bar	Blade-drop
Console key-switch OFF (two blades off bottom)	Full

Table 3-2 Safety System Operability Tests

Component or Scram Function	Frequency
Log-N period channel Power level safety channels	Before each reactor startup following a shutdown in excess of 6 hours, and after repair or deenergization caused by a power outage
10% reduction of safety channels high voltage	4/year (4-month maximum interval)
Loss of electrical power to console	4/year (4-month maximum interval)
Loss of primary coolant pump power	4/year (4-month maximum interval)
Loss of primary coolant level	4/year (4-month maximum interval)
Loss of primary coolant flow	4/year (4-month maximum interval)
High average primary coolant outlet temperature	With daily checkout
Loss of secondary coolant flow (at power levels above 1 kW)	With daily checkout
Loss of secondary coolant well pump power	4/year (4-month maximum interval)
Loss of shield tank water level	4/year (4-month maximum interval)
Loss of power to vent system and dilution fan	4/year (4-month maximum interval)
Manual scram bar	With daily checkout

Table 3-3 Minimum Number and Type of Measuring Channels Operable

Channel	No. operable
Safety 1 and 2 power channel	2
Linear Channel (with auto controller as appropriate)	1
Log N and period channel*	1
Startup channel*	1
Blade position indicator	4
Coolant flow indicator	1
Coolant temperature indicator	
Primary	6
Secondary	1
Core level	1
Ventilation system	
Core vent annunciator	1
Dilute fan annunciator	1
Dilute fan rpm	1

*Subsystems of the wide range drawer

Table 3-4 Radiation Monitoring System Settings

Type	No. of Required Operable Functions	Alarm(s) Setting	Purpose
Area Radiation Monitors	3 detecting 2 audioalarming 2 recording	5 mr/hr low level 25 mr/hr high level	Detect/alarm/record low and high level external radiation
Air Particulate Monitors	1 detecting 1 audioalarming 1 recording	Range adjusted according to APD* type (according to monitoring requirements	Detect/alarm/record airborne radioactivity in the reactor cell
Stack Radiation Monitor	1 detecting 1 audioalarming 1 recording	(1) Fixed alarm at 4000 cps (2) Adjustable alarm per power level	Detect/alarm/record release of gaseous radioactive effluents in the reactor vent duct to the environs

*Air Particulate Detector

4.0 SURVEILLANCE REQUIREMENTS

Surveillance requirements relate to testing, calibration, or inspection to ensure that the necessary quality of systems and components is maintained; that facility operation will be within safety limits; and that the limiting conditions for operation will be met. Tests not performed within the specified frequency because of physical or administrative limitations including equipment failure and maintenance activities shall be performed before resuming normal operations.

General: Surveillance Pertaining to Safety Limits and Limiting Safety System Settings.

Specifications:

(1) Whenever an unscheduled shutdown occurs, an evaluation shall be conducted to determine whether a safety limit was exceeded.

(2) Safety system operability tests shall be performed in accordance with Table 3-2.

4.1 Reactor Core Parameters Surveillance

Applicability: These specifications apply to the surveillance activities required for reactor core parameters.

Objective: To specify the frequency and type of testing to assure that reactor core parameters conform to specifications of Section 3.1 of these Technical Specifications.

Specifications:

(1) The reactivity worth and reactivity insertion rate of each control blade, the shutdown margin and excess reactivity shall be measured annually (at intervals not to exceed 15 months) or whenever physical or operational changes create a condition requiring reevaluation of core physics parameters.

(2) The temperature coefficient of reactivity shall be measured annually at intervals not to exceed 15 months.

(3) The void coefficient of reactivity shall be checked biennially to ensure that it is negative, at intervals not to exceed 30 months.

Bases: The measurements specified are sufficient to provide assurance that the reactor core parameters are maintained within the limits specified in Section 3.1.

4.2 Reactor Control and Safety System Surveillance

Applicability: These specifications apply to the surveillance activities required for the reactor control and safety systems.

Objective: To specify the frequency and type of testing or calibration to assure that reactor control and safety system operating parameters conform to specifications of Section 3.2 of these Technical Specifications.

Specifications:

(1) Control blade drop times, from the fully withdrawn position, shall be measured semiannually at intervals not to exceed 8 months. If maintenance is performed on a blade, the drive mechanism, or associated electronics, the blade-drop time shall be measured before the system is considered operable.

(2) The control blade full withdrawal and controlled insertion times shall be measured semiannually at intervals not to exceed 8 months.

(3) Tests, limits, and frequencies of tests for the control blade withdrawal inhibit interlocks operability tests shall be performed as listed in Table 4-1.

(4) The mechanical integrity of the control blades and drive system shall be inspected during each incore inspection but shall be fully checked at least once every 5 years at intervals not to exceed 6 years.

(5) Following maintenance or modification to the control blade system, an operability test and calibration of the affected portion of the system, including verification of control blade drive speed, shall be performed before the system is to be considered operable.

(6) The reactor shall not be started unless (a) the weekly checkout has been satisfactorily completed within 7 days prior to startup, (b) a daily checkout is satisfactorily completed within 8 hr prior to startup, and (c) no known condition exists that would prevent successful completion of a weekly or daily check.

(7) The limitations established under Paragraph 4.2.(6)(a) and (b) can be deleted if a reactor startup is made within 6 hr of a normal reactor shutdown on any one calendar day.

(8) The following channels shall be calibrated annually, at intervals not to exceed 15 months, and any time a significant change in channel performance is noted:

(a) log N - period channel
(b) power level safety channels (2)

(c) linear power level channel
(d) primary coolant flow measuring system
(e) primary coolant temperature measuring system

(9) Following maintenance or modification to the reactor safety system, a channel test and calibration of the affected channel shall be performed before the reactor safety system is considered operable.

Bases: The frequency and type of test or calibration are defined based on operating experience and/or in accordance with ANSI/ANS- 15.1-1990 to assure proper functioning of the systems and equipment that comprise the reactor control and safety systems.

4.3 Coolant Systems

Applicability: These specifications apply to the surveillance activities required for the reactor coolant system.

Objective: To specify the frequency and type of testing or calibration to assure the reactor coolant system conforms to the specifications presented in Section 3.3 of these Technical Specifications

(1) The primary water resistivity shall be determined as follows:

(a) Primary water resistivity shall be measured during the weekly checkout by a portable conductivity meter using approved procedures. The measured value shall be larger than 0.4 megohm-cm.

(b) Primary water resistivity shall be measured during the daily checkout at both the inlet and outlet of the demineralizers (DM). The measured value, determined by an online conductivity meter annunciating in the control room, shall be larger than 0.5 megohm-cm at the outlet of the DM.

(2) Primary water shall be sampled and evaporatively concentrated, and the gross radioactivity of the residue shall be measured with an adequate measuring channel. This specification procedure shall prevail

(a) during the weekly checkout,

(b) upon the appearance of any unusual radioactivity in the primary water or the primary water demineralizers, and

(c) before the release of any primary water from the site.

(3) The primary water radioactivity shall be measured during the weekly checkout for gross $\beta - \gamma$ and gross α activity.

(a) The measured α activity shall not exceed 50 dpm above background level.

(b) The measured $\beta - \gamma$ activity shall not exceed 25% above mean normal activity level.

(4) The secondary water system shall be tested for radioactive contamination during the weekly checkout according to written procedures.

Bases: These specifications assure that necessary limits are maintained on fission products and other activated materials in primary and secondary coolant samples to provide assurance that the facility is operating in a safe and effective manner. The frequency and type of monitoring is based on operating experience.

4.4 Reactor Vent System Surveillance

Applicability: These specifications apply to the surveillance requirements for the reactor vent system.

Objective: To specify the frequency and type of testing to assure the reactor vent system conforms to the specifications presented in Section 3.4 of these Technical Specifications.

Specifications:

(1) The reactor vent system flow rates shall be measured annually at intervals not to exceed 15 months, as follows:

(a) reactor cavity exhaust duct flow (1 cfm < flow rate < 400 cfm);
(b) stack flow rate > 10,000 cfm.

(2) The following interlocks shall be tested as part of the weekly checkout:

(a) core vent system damper closed if diluting fan is not operating;
(b) reactor vent system shut off when the evacuation alarm is actuated.

Bases: These specifications assure the reactor vent system is operating as specified. The frequency and type of monitoring is based on operating experience and ANSI/ANS-15.1-1990.

4.5 Radiation Monitoring Systems and Radioactive Effluents Surveillance

Applicability: These specifications apply to the surveillance activities required for the radiation monitoring system and effluents released from the facility.

Objective: To specify frequency and type of testing to assure that the radiation monitoring system and effluent releases conform to the specifications of Section 3.5 of these Technical Specifications.

Specifications:

(1) The area radiation monitor channels, the stack monitor, and the air particulate monitor shall be verified to be operable before each reactor startup as required by the daily checkout. Calibration of radiation monitoring channels shall be performed quarterly at intervals not to exceed 4 months. Note: Portable radiation survey meters are not normally considered radiation monitoring channels, so there is no need for them to be calibrated quarterly.

(2) The Ar-41 concentration in the stack effluent shall be measured semiannually at intervals not to exceed 8 months.

(3) Releases of liquid effluents from the aboveground waste water holdup tank shall be sampled and the radioactivity measured before release to the sanitary sewage system which is allowed in conformance with 10 CFR 20 regulations.

(4) The reactor shall be placed in a reactor shutdown condition whenever Specification 4.5 (1) is not met.

(5) The reactor vent system shall be immediately secured upon detection of failure of the stack monitoring system.

Basis: Specification (1) assures the monitors are operable. Specification (2) provides the basis for limiting energy generation to assure Ar-41 releases are in accordance with 10 CFR 20, Appendix B, Table 2. Specification (3) ensures compliance with 10 CFR 20 for liquid releases from the site. Specifications (4) and (5) ensure that all releases of radioactivity will be controlled and monitored.

4.6 Surveillance of Experimental Limits

Applicability: This specification applies to the surveillance requirements for experiments installed in the UFTR core.

Objective: To prevent the conduct of experiments or irradiations which could damage the reactor or release an excessive amount of radioactivity.

Specifications:

(1) Surveillance to ensure that experiments meet the requirements of Section 3.6 shall be conducted before inserting each experiment into the reactor.

(2) The reactivity worth of an experiment shall be determined at approximately 1 W power level or as appropriate within limiting conditions for operation, before continuing reactor operation with said experiment.

Basis: Measurements of the reactivity worth of an experiment shall verify that the experiment is within the authorized reactivity limits.

4.7 Reactor Building Evacuation Alarm Surveillance

Applicability: These specifications apply to the surveillance requirements for the reactor building evacuation alarm.

Objectives: To assure that building alarm actuation, building occupants and reactor staff are responding as expected.

(1) The automatic actuation of the building evacuation alarm in coincidence with actuation of the high level alarm on two area monitors and the manual actuation of the evacuation alarm shall be tested as part of the weekly checkout.

(2) The automatic shutoff of the air handling system and the reactor vent system in coincidence with the building evacuation alarm shall be tested as part of the weekly checkout.

(3) Evacuation drills for facility personnel shall be conducted semiannually at intervals not to exceed 8 months.

Basis: Specification (1) ensures that the actuation of the building evacuation alarm is operable to alert occupants to the need to evacuate. Specification (2) ensures that the system responds correctly to a known input to assure isolation of the cell atmosphere upon actuation of the evacuation alarm. Specification (3) ensures that facility personnel are familiar with emergency response procedures.

4.8 Surveillance Pertaining to Fuel

Applicability: These specifications apply to fuel installed in the core.

Objective: To verify integrity of the fuel

Specifications:

(1) The incore reactor fuel elements shall be inspected every five years at intervals not to exceed 6 years, in a randomly chosen pattern, as deemed necessary. At least 4 elements will be inspected.

(2) Fuel-handling tools and procedures shall be reviewed for adequacy before fuel handling operations. The assignment of responsibilities and training of the fuel-handling crew shall be performed according to written procedures.

Bases: Specification (1) ensures the integrity of the fuel and Specification (2) assures that reactor staff is properly qualified to perform fuel handling.

Table 4-1 Control Blade Withdrawal Inhibit Interlocks Operability Tests

Inhibit	Limit	Frequency
Reactor Period	≤10 sec	Daily Checkout
Safety Channels and Wide Range Drawer not in OPERATE position	-	Daily Checkout
Multiple blade withdrawal	Any 2 or more blades simultaneously in Manual	Daily Checkout
Source count rate	< 2 cps	Verification only when count rate < 2cps during daily checkout

5.0 DESIGN FEATURES

Design features are specified to ensure that items important to safety are not changed without appropriate review. The items of concern are design features and parameters that were considered as limiting values (or significant for the protection of the reactor personnel and the general public) for the purpose of establishing safety limits, limiting safety system settings, or limiting conditions for operation.

5.1 Site and Facility Description.

The UFTR is located on the University of Florida campus, at Gainesville, Florida, in the immediate vicinity of the buildings housing the College of Engineering and the College of Journalism. The Nuclear Science Center, which houses the Department of Nuclear and Radiological Engineering, is annexed to the reactor building.

The reactor shall be housed in a reinforced concrete cell in the reactor building. The reactor building is a "vault-type" building as defined in 10 CFR 73.2(o). The reactor building is divided into two distinct parts based upon the difference in utilization and their structure. The overall reactor building measures approximately 60 ft by 80 ft inside. The reactor cell area is 30 ft by 60 ft with 29 ft of head room, located at the north end of the building. The rest of the building is used for research and instructional laboratories, faculty offices, and graduate study areas.

The reactor cell shall have an independent ventilation and air-conditioning system. The reactor vent effluents shall be discharged through the reactor stack, some 30 ft above ground level.

All gases that may cause a hazard through neutron activation shall be exhausted from the reactor cell, reactor cavity, experiments or experimental facilities installed in or adjacent to the core or surrounding graphite and discharged to the environment through the reactor vent system and appropriately monitored for radioactivity, as specified under Chapter 3 of these Technical Specifications.

The 3-ton bridge crane shall not be used during reactor operation in a manner that could damage the control system and prevent it from performing its intended function. No load above 500 lb shall be lifted over the control blade drive units unless the control blades are fully inserted. The crane shall be operated during reactor operations only by a licensed reactor operator.

The following doors penetrate the reactor cell: (1) an exit chamber passageway from the cell to the UFTR building lower hallway, (2) a door from the control room to the UFTR building lower hallway, and (3) a freight door (10 ft x 12 ft) leading to the environs. A panel in the freight door serves as an emergency personnel exit from the reactor cell. The freight door and panel shall be locked to prevent entrance during reactor operation. The freight door and panel shall not be used for general access to or egress from the reactor cell. This is not meant to preclude use of these doors in connection with authorized activities when the reactor is not in operation.

5.2 Cooling Systems

5.2.1 Primary Cooling System

The primary coolant is demineralized light water, which is normally circulated in a closed loop. The flow is from the 200-gal storage (dump) tank to the primary coolant pump; water is then pumped through the primary side of the heat exchanger and to the bottom of the fuel boxes, upward past the fuel plates to overflow pipes located about 6 in. above the fuel, and into a header for return to the storage tank. A purification loop is used to maintain primary water quality. The purification loop pump circulates about 1 gpm of primary water, drawn from the discharge side of the heat exchanger, through mixed-bed ion-exchange resins and a ceramic filter. The purification loop pump automatically shuts off when the primary coolant pump is operating, since flow through the purification system is maintained. Primary coolant may be dumped from the reactor fuel boxes by opening an electrically operated solenoid dump valve, which routes the water to the dump tank. A pressure surge of about 2 psi above normal in the system also will result in a water dump by breaking a graphite rupture disc in the dump line. This drains the water to the primary equipment pit floor actuating an alarm in the control room. The primary coolant system is instrumented as follows:

(1) thermocouples at each fuel box and the main inlet and outlet (eight total), alarming and recording in the control room; six are required (main inlet and outlet plus four on fuel boxes);

(2) a flow sensing device in main inlet line, alarming and displayed in the control room;

(3) a flow sensing device (no flow condition) in the outlet line, alarming in the control room;

(4) resistivity probes monitoring the inlet and outlet reactor coolant flow, alarming and displayed in the control room;

(5) an equipment pit water level monitor, alarming in the control room.

The reactor power is calibrated annually by the use of the coolant flow and temperature measuring channels.

5.2.2 Secondary Cooling System

Two secondary cooling systems are normally operable in the UFTR: a well water secondary cooling system and a city water secondary cooling system. Either system meets the requirements for secondary cooling. The well secondary cooling system is the main system used for removal of reactor generated heat to the environment. A deep well furnishes about 160 gpm of cooling water to the shell side of the heat exchanger, removing primary heat and rejecting it to the storm sewer. Weekly samples monitor the activity of this water. Flow indications in the control room are 140 gpm as a warning and 60 gpm to initiate a trip at or above 1 kW after an approximately 10-sec warning. The city water secondary cooling system can be used for backup cooling or for specific operations requiring reactor coolant temperatures hotter than those obtained with the well cooling system. Operability of this city water system is not a limiting condition for operation unless it is to be used for reactor operation at or above 1 kW. The secondary flow by the city water system is about 30 - 70 gpm, with a reactor trip set at 8 gpm or higher (as measured by a flow switch) for power levels at or above 1 kW with approximately a 10 sec delay only upon first reaching 1 kW. A back flow preventer in the city water line ensures compliance with the requirements of the National Plumbing Code to prevent contamination of the potable water supply. The secondary coolant system inlet and outlet temperatures are monitored by thermocouples, with monitoring, recording and alarm functions in the control room.

5.3 Reactor Core and Fuel

5.3.1 Reactor Fuel

Fuel elements shall be of the general MTR type, with thin fuel plates clad with aluminum and containing uranium fuel enriched to no more than about 93% U-235. The fuel matrix may be fabricated by alloying high purity aluminum-uranium alloy or by the powder metallurgy method where the starting ingredients (uranium-aluminum) are in fine powder form. The fuel matrix also may be fabricated from uranium oxide-aluminum (U_3O_8 -Al) using the powder metallurgy process. There shall be nominally 14.5 g of U-235 per fuel plate.

The UFTR facility license authorizes the receipt, possession, and use of:

(1) up to 4.82 kg of contained uranium-235;
(2) a 1-Ci sealed plutonium-beryllium neutron source;
(3) an up-to-25-Ci antimony-beryllium neutron source.

Other neutron and gamma sources may be used if their use does not constitute an unreviewed safety question pursuant to 10 CFR 50.59 and if the sources meet the criteria established by the Technical Specifications.

5.3.2 Reactor Core

The core shall contain up to 24 fuel assemblies of 11 plates each. Up to six of these assemblies may be replaced with pairs of partial assemblies. Each partial assembly shall be composed of either all dummy or all fueled plates. A full assembly shall be replaced with no fewer than ten plates in a pair of partial assemblies.

Fuel elements shall conform to nominal specifications presented in Table 5-1.

The reactor core shall be loaded so that all fuel assembly positions are occupied.

The fuel assemblies are contained in six aluminum boxes arranged in two parallel rows of three boxes each, separated by about 30 cm of graphite. The fuel boxes are surrounded by a 5 ft x 5 ft x 5 ft reactor grade graphite assembly.

The tops of the fuel boxes are covered during operations at power above 1 kW, by the use of the shield plugs and/or gasketed aluminum covers secured to the top of the fuel boxes. The devices function to prevent physical damage of the fuel, to minimize evaporation / leakage of water from the top of the fuel boxes, and to minimize entrapment of argon in the coolant water for radiological protection purposes.

5.4 Fuel Storage

5.4.1 New Fuel

Unirradiated new fuel elements are stored in a vault-type room security area equipped with intrusion alarms in accordance with the Physical Security Plan. Elements are stored in a steel, fireproof safe in which a cadmium plate separates each layer of bundles to ensure subcriticality under optimum conditions of moderation and reflection.

5.4.2 Irradiated Fuel

Irradiated fuel is stored upright and dry in storage pits within the reactor building in criticality-safe holes.

5.5 Reactor Control and Safety Systems

Design features of the components of the reactor control and safety systems that are important to safety, as specified under Section 3.2 of these Technical Specifications, are delineated in Sections 5.5.1 and 5.5.2.

5.5.1 Reactor Control System

Reactivity control of the UFTR is provided by four control blades, three safety blades and one regulating blade. The control blades are of the swing-arm type consisting of four aluminum vanes tipped with cadmium, protected by magnesium shrouds. They operate in a vertical arc within the spaces between the fuel boxes. Blade motion is limited to a removal time of at least 100 seconds and the insertion time under trip conditions is stipulated to be less than 1.5 sec. The reactor blade withdrawal interlock system prevents blade motion which will exceed the reactivity addition rate of 0.06% $\Delta k/k$ per sec, as specified in these Technical Specifications. The control blade drive system consists of a two-phase fractional horsepower motor that operates through a reduction gear train, and an electrically energized magnetic clutch that transmits a motor torque through the control blade shaft, allowing motion of the control blades. The blades are sustained in a raised position by means of this motor, acting through the electromagnetic clutch. Interruption of the magnetic current results in a decoupling of the motor drive from the blade drive shaft, causing the blades to fall back into the core. Position indicators, mechanically and electronically geared to the blade drives, transmit blade position information to the operator control console. Reactor shutdown also can be accomplished by voiding the moderator/coolant from the core. Two independent means of voiding the moderator/coolant from the core are provided:

(1) water dump via the primary coolant system dump valve opening under full trip conditions.

(2) water dump via the rupture disk breaking under pressure conditions above design value.

The integral worths of the individual safety blades vary from about 1.3 to 2.3% $\Delta k/k$ depending on position in the core and individual characteristics. The regulating blade worth is about 0.8% to 1.0% $\Delta k/k$. The blade worths, drive speeds, and drop-time values are sufficiently conservative to ensure compliance with the specified reactivity limitations. Additional reactivity and power related features are obtained from the control blade withdrawal inhibits. The regulating blade may be engaged by a servo-mechanism controlled by the linear channel for automatic reactor power control.

5.5.2 Reactor Safety System

(1) Power Level Channels

Two independent measuring channels are provided for power level limits; both are required for the reactor to be operable. Each channel covers reliably the range from about 1 to 150% of full power (of 100 kW). One channel (Safety 1) is part of the wide range drawer, and receives its main signal from a fission chamber. The

Safety 2 channel uses an uncompensated ion chamber for neutron detection. Each channel drops all control blades and the moderator coolant from the core by actuating bistable trips in the safety system in a one-out-of-one trip logic. Visual indication of the power measured by each chamber, as well as annunciator of channel status is available to the operator in the control room.

(2) Wide Range Logarithmic Power Level and Period Channel

The logarithmic power channel covers the wide range from reactor startup to full power in 10 decades. It uses a fission chamber for this entire range and uses a B-10 proportional counter only in the startup (source) range. Signals from the fission chamber and the B-10 counter are amplified by a preamplifier before going to the log channel. The preamplifier also processes test signals from the console controls and deenergizes the B-10 proportional counter at about 400 cps. Power level information is displayed on a meter and on a two-pen recorder. The channel provides the following blade withdrawal inhibits or blade trips: minimum source count inhibit of 2 cps, fast period inhibit of 10 sec, fast period trip of 3 sec, and inhibit limiting power escalation in the automatic mode to no faster than 30 sec, and a trip at or above 1% power when secondary coolant flow is below the trip setting. Because this is a wide range channel, a separate startup channel is not used. These control or limiting actions prevent startup or operation of the reactor unless it is properly monitored or if operational restrictions are not met. Period is displayed on a meter and is effective for control over the entire range of operation.

(3) Startup (Neutron) Source(s)

A permanent, regenerable, antimony-beryllium source of up to 25 Ci and/or a removable plutonium-beryllium source of 1 Ci may be used for reactor startup to monitor the approach to criticality. The use of a neutron source ensures that behavior of the reactor is being monitored by the reactor instrumentation during subcritical control blade manipulations.

(4) Linear Neutron Channel and Automatic Flux Control System

The linear channel is required to be operable when the reactor is to be operated in the automatic mode. The linear channel uses a compensated ion chamber for neutron detection; its signal is transmitted by a multirange picoammeter. The picoammeter sends a signal to the linear channel of the two-pen recorder to display power level from source level to full power. It also sends a signal to the automatic flux controller which, in comparison with a signal from a percent of power setting control acts to establish and/or hold power level at a desired value. The rate of power increase is controlled by the action of a limiter in the linear channel/ automatic control system which maintains the reactor period at or slower than 30 sec. The automatic flux controller is not required to be operable for reactor operations where it is not needed and not to be used.

5.6 Radiological Safety Design Features

5.6.1 Physical Features

The confinement structure consists of the reactor cell, with a free air volume of about 1600 m^3. This structure houses the reactor, reactor control room, the primary cooling system (including the dump tank, heat exchanger and purification loop), secondary coolant piping, and reactor vent system. Access to the reactor cell, which is the designated restricted and security area, is controlled by the specifications established by the Physical Security Plan of the UFTR.* Ventilation is through the independent air handler/ventilation and reactor vent system. The reactor vent system can be secured to prevent uncontrolled discharge of radioactivity to the environment or releases in excess of permissible levels (per 10 CFR 20). Rough and absolute filters are used to eliminate or minimize radioactive air particulate contamination from the exhaust air. The electrically actuated damper in the core exhaust line is fail-safe and closes upon deenergization.

5.6.2 Monitoring System

Area and stacker radiation monitors are used for radioactivity monitoring, as delineated in Sections 3.5.1, 3.5.2, and 3.5.4 of these Technical Specifications. The cell air is monitored by an air particulate detector. Exhaust air drawn from the reactor cavity, reactor cell, or experiments is continuously monitored for gross concentration of radioactive gases and/or airborne radioactivity.

5.6.3 Evacuation Sequence

The emergency evacuation sequence is initiated either automatically by two area monitors alarming high in coincidence or manually by the console reactor operator. The sequence is that the reactor room air handler/ventilation system and the reactor vent system are shut down and the core vent damper is closed.

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* Withheld from public disclosure pursuant to 10 CFR 2.790(d).

Table 5-1 Fuel Element Nominal Specifications

Item	Specification
Overall size (bundle)	2.845 in. x 2.50 in. x 25.625 in.
Clad thickness	0.015 in.
Plate thickness	0.070 in.
Water channel width	0.137 in.
Number of plates	standard fuel element - 11 fueled plates partial element - no fewer than 10 plates in a pair of partial assemblies
Plate attachment	bolted with spacers
Fuel content per plate	14.5g U-235 nominal

6.0 ADMINISTRATIVE CONTROLS

6.1 Organization

6.1.1 Structure

The organization for the management and operation of the reactor facility shall include the structure indicated in Figure 6.1. Job titles are shown for illustration and may vary. Four levels of authority are provided.

Level 1 - individuals responsible for the reactor facility's licenses, charter, and site administration.

Level 2 - individual responsible for reactor facility management.

Level 3 - individual responsible for reactor operations, and supervision of day-to-day facility activities.

Level 4 - reactor operating staff (Senior Reactor Operator, Reactor Operator and trainees).

The Reactor Safety Review Subcommittee is appointed by, and shall report to, the Chairman of the Radiation Control Committee. The Chairman of the Radiation Control Committee reports to the Director of Environmental Health and Safety, who reports to the Vice-President for Finance and Administartion. Radiation safety personnel shall report to Level 2 or higher.

6.1.2 Responsibility

Responsibility for the safe operation of the reactor facility shall be with the chain of command established in Figure 6.1. Individuals at various management levels, in addition to having responsibility for the policies and operation of the reactor facility, shall be responsible for safeguarding the public and facility personnel from undue radiation exposures and for adhering to all requirements of the operating license, charter, and technical specification. In all instances, responsibilities of one level may be assumed by designated alternates or by higher levels, conditional upon appropriate qualifications.

6.1.3 Staffing

The minimum staffing when the reactor is not secured shall be as follows:

(1) A certified reactor operator shall be in the control room.

(2) A second person shall be present at the facility complex able to carry out prescribed written instructions including instructions to initiate the first stages of the emergency plan, including evacuation and initial notification procedures. Unexpected absence for two hours is acceptable provided immediate action is taken to obtain a replacement.

(3) A designated Senior Reactor Operator (Class A Reactor Operator) shall be readily available on call. "Readily Available on Call" means an individual who:

   (a) has been specifically designated and the designation known to the operator on duty,
   (b) keeps the operator on duty informed of where he/she may be rapidly contacted and the phone number or other means of communication available, and
   (c) is capable of getting to the reactor facility within a reasonable time under normal conditions (e.g., 30 min or within a 15 mi radius).

A list of reactor facility personnel by name and telephone number shall be readily available in the Control Room for use by the operator. The list shall include:

(1) management personnel,
(2) radiation safety personnel, and
(3) other operations personnel.

Events requiring the direction of a Senior Reactor Operator are

(1) all fuel or control-blade relocations within the reactor core region,

(2) relocation of any incore experiment with a reactivity worth greater than one dollar, and

(3) recovery from unplanned or unscheduled shutdowns (in this instance, documented verbal concurrence from the Senior Reactor Operator is required).

6.1.4 Selection and Training of Personnel

The selection, training, and requalification of operations personnel shall meet or exceed the requirements of the American National Standard for Selection and Training of Personnel for Research Reactors, ANSI/ANS-15.4-1988, Section 4.

6.2 Review and Audit

A method for the independent review and audit of the safety aspects of reactor facility operations shall be established to advise management. The review and audit functions of the UFTR operations are conducted by the Reactor Safety Review Subcommittee (RSRS).

6.2.1 Composition and Qualifications

The RSRS shall be composed of a minimum of five members, including the Reactor Manager and Radiation Control Officer (both ex-officio voting members), the Chairman of the Nuclear and Radiological Engineering Department and two other members having expertise in reactor technology and/or radiological safety.

6.2.2 Charter and Rules

The review and audit functions shall be conducted in accordance with the following established charter:

Designation - The name of the Subcommittee is Reactor Safety Review Subcommittee (RSRS).

Accountability - The RSRS is a Subcommittee of and reports to the University Radiation Control Committee (URCC). The URCC provides radiological safety recommendations to the Director of Environmental Health and Safety.

Scope - The RSRS shall be responsible for the review of safety-related issues pertaining to the University of Florida Training Reactor (UFTR).

Purpose - The purpose of the RSRS is to ensure the safe operation of the UFTR through the discharge of the Subcommittee review and audit function.

Membership

(a) The RSRS shall consist of at least five members. Membership will include the Chairman of the Nuclear and Radiological Engineering Department, University Radiation Control Officer, Reactor Manager and two technical personnel familiar with the operation of reactors and with the design of the UFTR and radiological safety, at least one of whom is from outside the Department of Nuclear and Radiological Engineering. The two technical personnel will be recommended to the Chairman of the URCC by the Chairman of the Department of Nuclear and Radiological Engineering. Any member may designate a duly qualified representative from a standing URCC approved list to act in their absence.

(b) An Executive RSRS Committee will consist of the Reactor Manager, University Radiation Control Officer and Chairman of the RSRS.

(c) The Chairman of the RSRS will be appointed by the Chairman of the URCC. The Chairman of the RSRS is an ex-officio voting member of the URCC and will serve as liaison between the RSRS and the URCC.

(d) Members appointed to the RSRS shall be reviewed, and as appropriate, new appointments made by October 1 of each calendar year.

Meetings

(a) At least one meeting shall be held quarterly at intervals not to exceed 4 months. Meetings may be held more frequently as circumstances warrant, consistent with the effective monitoring of facility operations as determined by the RSRS Chairman.

(b) Review of draft minutes will be completed before subsequent meetings, at which time they will be submitted for approval. Responsibility to ensure that this is done falls upon the RSRS Chairman. The RSRS Chairman is charged with the responsibility to assure that the minutes are submitted for approval in a timely manner.

(c) A quorum shall consist of at least three members and at least three members must agree when voting, regardless of the number present.

6.2.3 Review Function

The following items shall be reviewed:

(a) determination that proposed changes in equipment, systems, tests, experiments, or procedures do not involve an unreviewed safety question;

(b) all new procedures and major revisions thereto having safety significance, proposed changes in reactor facility equipment or systems having safety significance;

(c) all new experiments or classes of experiments that could affect reactivity or result in the release of radioactivity;

(d) proposed changes in technical specifications, license, or charter;

(e) violations of technical specifications, license, or charter;

(f) violations of internal procedures or instructions having safety significance;

(g) operating abnormalities having safety significance;

(h) reportable occurrences;

(i) audit reports and annual facility reports.

A written report or minutes of the findings and recommendations of the review group shall be submitted to RSRS members in a timely manner after the review has been completed and to the Chairman of the Radiation Control Committee whenever a finding is deemed to require review by Level 1.

6.2.4 Audit Function

The audit function shall include selective (but comprehensive) examination of operating records, logs, and other documents. Where necessary, discussions with cognizant personnel shall take place. In no case shall the individual immediately responsible for the area, audit in the area. The following items shall be audited:

(a) facility operations for conformance to the technical specifications and applicable license or charter conditions, at least once per calendar year (interval between audits not to exceed 15 months).

(b) the requalification and recertification program for the operating staff, at least once every other calendar year (interval between audits not to exceed 30 months).

(c) the results of action taken to correct those deficiencies that may occur in the reactor facility equipment, systems, structures, or methods of operations that affect reactor safety, at least once per calendar year (interval between audits not to exceed 15 months).

(d) the reactor facility emergency plan, and implementing procedures at least once every other calendar year (interval between audits not to exceed 30 months).

Deficiencies uncovered that affect reactor safety shall immediately be reported to the Radiation Control Committee and the Dean of the College of Engineering. A written report of the findings of the audit shall be submitted to the Dean of the College of Engineering and the review and audit group members within three (3) months after the audit has been completed.

6.3 Radiation Safety

The Radiation Control Committee and the Radiation Control Officer shall be responsible for the implementation of the Radiation Control Program for the UFTR. The primary purpose of the program is to assure radiological safety for all University personnel and the surrounding community.

6.3.1 AS LOW AS IS REASONABLY ACHIEVABLE (ALARA) (10 CFR 20.1101(b))

The principal routine emission from the UFTR facility complex is argon-41 discharged by the reactor vent system. There is little biological uptake of argon-41 and exposure limits are based upon external, total body irradiation.

The concentration of argon-41 in the stack effluent is continuously monitored when the reactor is operating, and is normally less than 1×10^{-5} μCi/ml after several hours of full power operation. The annual release is related to the number of equivalent hours of 100 kW operation (kWth per year). Reactor operations are limited by prior agreement, and by these Technical Specifications, to limit argon-41 discharges to the maximum allowed concentration when averaged over a month and using the established atmospheric dilution factor of 200.

The offsite environmental radioactive surveillance program has proven that exposure to the general public from the reactor radioactive effluents consistently approaches the nondetectable level and certainly is always well below the 100 mrem/yr limit.

The ALARA program at the UFTR minimizes unnecessary production of radioactive effluents by selectivity of operations. The potential reduction of argon-41 releases is frequently reviewed, and was a major item of consideration during reviews to upgrade facility operations to 500 kWth. A reduction of the vent flow as well as the argon dissolving in the primary coolant has been proposed in the past, as well as the possibility of utilizing storage tanks.

Radioactive liquid effluents and personnel radioactive exposure are well within ALARA guidelines.

6.4 Procedures

The facility shall be operated and maintained in accordance with approved written procedures. All procedures and major revisions thereto shall be reviewed and approved by the Director of Nuclear Facilities before becoming effective.

The following types of written procedures shall be maintained:

(1) normal startup, operation and shutdown procedures for the reactor to include applicable checkoff lists and instructions;

(2) fuel loading, unloading, and movement within the reactor;

(3) procedures for handling irradiated and unirradiated fuel elements;

(4) routine maintenance of major components of systems that could have an effect on reactor safety;

(5) surveillance tests and calibrations required by the technical specifications or those that may have an effect on reactor safety;

(6) personnel radiation protection, consistent with applicable regulations;

(7) administrative controls for operations and maintenance and for the conduct of irradiations and experiments that could affect reactor safety or core reactivity;

(8) implementation of the Emergency Plan;

(9) procedures that delineate the operator action required in the event of specific malfunctions and emergencies;

(10) procedures for flooding conditions in the reactor facility, including guidance as to when the procedure is to be initiated and guidance on reactivity control.

Substantive changes to the above procedures shall be made effective only after documented review by the RSRS and approval by the facility director (Level 2) or designated alternates. Minor modifications to the original procedures which do not change their original intent may be made by the reactor manager (Level 3) or higher, but modifications must be approved by Level 2 or designated alternates within 14 days. Temporary deviations from the procedures may be made by a senior reactor operator, in order to deal with special or unusual circumstances or conditions. Such deviations shall be documented and reported to Level 2 or designated alternates.

6.5 Experiment Review and Approval

(1) Experiment review and approval shall be conducted as specified under Section 3.6, "Limitations on Experiments", of these Technical Specifications.

(2) Experiment review and approval shall ensure compliance with the requirements of the license, Technical Specifications, and applicable regulations and shall be documented.

(3) Substantive changes to previously approved experiments with safety significance shall be made only after review by the RSRS, approval in writing by Level 2 or designated alternates. Minor changes that do not significantly alter the experiment may be approved by Level 3 or higher.

(4) Approved experiments shall be carried out in accordance with established approved procedures.

6.6 Required Actions

6.6.1 Action to be Taken in Case of Safety Limit Violation

(1) The reactor shall be shut down, and reactor operations shall not be resumed until authorized by the Nuclear Regulatory Commission.

(2) The safety limit violation shall be promptly reported to Level 2 or designated alternates.

(3) The safety limit violation shall be reported to the Nuclear Regulatory Commission.

(4) A safety limit violation report shall be prepared. The report shall describe the following:

   (a) applicable circumstances leading to the violation including, when known, the cause and contributing factors;
   (b) effect of the violation upon reactor facility components, systems, or structures and on the health and safety of personnel and the public;
   (c) corrective action to be taken to prevent recurrence.

   The report shall be reviewed by the RSRS and any followup report shall be submitted to the Commission when authorization is sought to resume operation of the reactor.

6.6.2 Action To Be Taken in the Event of an Occurrence of the Type Identified in Section 6.7.2(2) and 6.7.2(3)

(1) Reactor conditions shall be returned to normal or the reactor shall be shut down. If it is necessary to shut down the reactor to correct the occurrence, operations shall not be resumed unless authorized by Level 2 or designated alternates.

(2) Occurrence shall be reported to Level 2 or designated alternates and to the Commission as required.

(3) Occurrence shall be reviewed by the review group at their next scheduled meeting.

6.7 Reports

In addition to the requirements of the applicable regulations, reports shall be made to the Nuclear Regulatory Commission as follows:

6.7.1 Operating Reports

Routine annual reports covering the activities of the reactor facility during the previous calendar year shall be submitted to the Commission within nine (9) months following the end of each prescribed year. The prescribed year ends August 31 for the UFTR. Each annual operating report shall include the following information:

(1) a narrative summary of reactor operating experience including the energy produced by the reactor and the hours the reactor was critical;

(2) the unscheduled shutdowns including, where applicable, corrective actions taken to preclude recurrence;

(3) tabulation of major preventive and corrective maintenance operations having safety significance;

(4) tabulation of major changes in the reactor facility and procedures, and a tabulation of new tests or experiments, that are significantly different from those performed previously and are not described in the Safety Analysis Report, including conclusions that no unreviewed safety questions were involved;

(5) A summary of the nature and amount of radioactive effluents released or discharged to the environs beyond the effective control of the facility operators as determined at or before the point of such release or discharge. (The summary shall include to the extent practicable an estimate of individual radionuclides present in the effluent. If the estimated average release after dilution or diffusion is less than 25% of the concentration allowed, a statement to this effect is sufficient.);

(6) A summarized result of environmental surveys performed outside the facility;

(7) A summary of exposure received by facility personnel and visitors where such exposures are greater than 25% of that allowed.

The annual report shall be submitted with a cover letter to:

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

6.7.2 Special Reports

There shall be a report not later than the following working day by telephone and confirmed in writing by telegraph or similar conveyance to the Commission, to be followed by a written report that describes the circumstances of the event within 14 days of any of the following:

(1) Violation of safety limits (see Section 6.6.1);

(2) Release of radioactivity from the site above allowed limits (see Section 6.6.2);

(3) Any of the following: (see Section 6.6.2)

(a) Operation with actual safety-system settings for required systems less conservative than the limiting safety-system settings specified in the Technical Specifications;

(b) Operation in violation of limiting conditions for operation established in the Technical Specifications unless prompt remedial action is taken;

(c) A reactor safety system component malfunction that renders the reactor safety system incapable of performing its intended safety function, unless the malfunction or condition is discovered during maintenance test or periods of reactor shutdowns;*
*Note: Where components or systems are provided in addition to those required by the Technical Specifications, the failure of the extra components or systems is not considered reportable provided that the minimum number of components or systems specified or required perform their intended reactor safety function.

(d) An unanticipated or uncontrolled change in reactivity greater than one dollar (reactor trips resulting from a known cause are excluded);

(e) Abnormal and significant degradation in reactor fuel, or cladding, or both, coolant boundary, or confinement boundary (excluding minor leaks), where applicable, which could result in exceeding prescribed radiation exposure limits of personnel or environment or both;

(f) An observed inadequacy in the implementation of administrative or procedural controls such that the inadequacy causes or could have caused the existence or development of an unsafe condition with regard to reactor operations;

(g) A violation of the Technical Specifications or the facility license.

6.7.3 Other Special Reports

There shall be a written report sent to the Commission within 30 days of the following occurrences:

(1) permanent changes in the facility organization involving Level 1 (UF President, Dean of the College of Engineering, and Chairman of the Nuclear and Radiological Engineering Department), 2 or 3 personnel;

(2) significant changes in the transient or accident analyses as described in the UFTR Final Safety Analysis Report.

6.8 Records

Records of the following activities shall be maintained and retained for the periods specified below. The records may be in the form of logs, data sheets, computer storage media, or other suitable forms. The required information may be contained in single, or multiple records, or a combination thereof. Recorder charts showing operating parameters of the reactor (i.e., power level, temperature, etc,) for unscheduled shutdowns and significant unplanned transients including trips shall be maintained for a minimum period of 2 years.

6.8.1 Records To Be Retained for a Period of at Least Five Years

The following records are to be retained for a period of at least five (5) years:

(1) normal reactor facility operation (supporting documents such as checklists, log sheets, etc. shall be maintained for a period of at least 1 year);

(2) principal maintenance operations;

(3) reportable occurrences;

(4) surveillance activities required by the Technical Specifications;

(5) reactor facility radiation and contamination surveys where required by applicable regulations;

(6) experiments performed with the reactor;

(7) fuel inventories, receipts, and shipments;

(8) approved changes in operating procedures;

(9) records of meetings and audit reports of the RSRS.

6.8.2 Records To Be Retained for at Least One Training Cycle

Records of the most recent complete cycle of requalification and recertification training of certified operations personnel shall be maintained at all times the individual is employed.

6.8.3 Records To Be Retained for the Lifetime of the Reactor Facility

The following records are to be retained for the lifetime of the facility:

(1) gaseous and liquid radioactive effluents released to the environs;

(2) offsite environmental monitoring surveys required by the Technical Specifications;

(3) radiation exposure for all personnel monitored;

(4) updated drawings of the reactor facility.

Applicable annual reports, if they contain all of the required information, may be used as records in this section

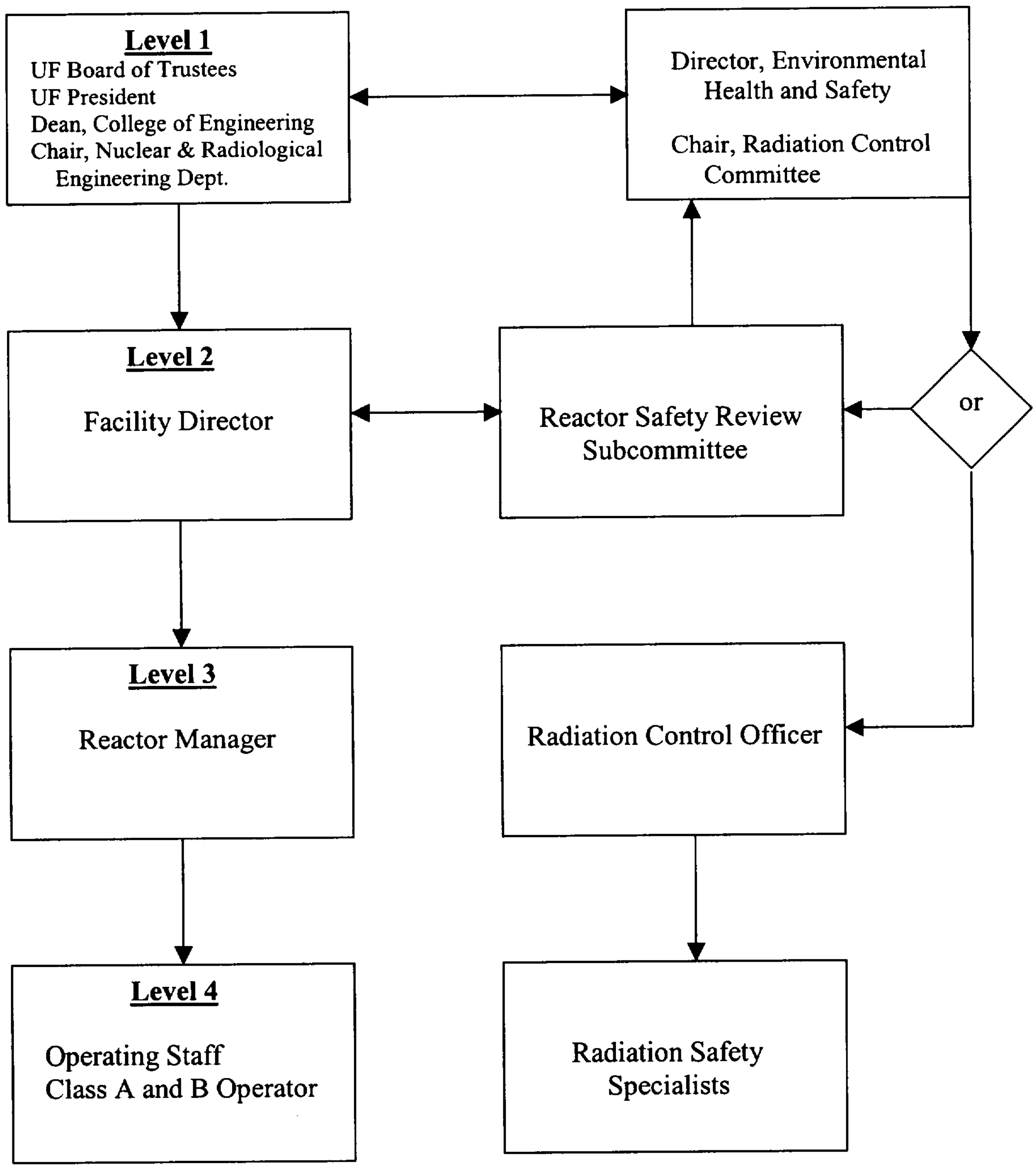

Figure 6-1 UFTR Organization Chart