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August 2, 2010

Document Control Desk
U.S, Nuclear Regulatory Commission
Washington, DC 20555
Attn: Mr. Duane Hardesty

Dear Mr. Hardesty,

Subject: University of Florida Training Reactor (UFTR) License Renewal (TAC NO. ME 1586), DOCKET NO. 50-83

In response to the RAI's, dated July 9, 2010, please find enclosed the modified UFTR Technical Specifications and a spreadsheet providing justifications for the considered modifications. This is in support of the renewal application for the UFTR with Facility Operating License No. R-56.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on August 2, 2010

Sincerely,

[signature]

David Hintenlang, PhD
Director of UFTR

Alachua County, Florida
[signature]
Lisa L. Purvis
Commission # DD608673
Expires November 3, 2010
Bonded Troy Fain - Insurance, Inc. 800-385-7019

Cc Jack Donohue, NRC
Gabriel Ghita, UF
Alireza Haghighat, UF
Glenn Sjoden, RSRS Chair
UFTR – NRC file

A020
NRC

Item	Location New TS	Location Old TS	Add/ Remove/ Change/ Format	Justification
1		1.1	R	Removed the second paragraph since the definition for "safety-related" is contained in 10 CFR 50.2, which is applicable to the UFTR. Further, "Reactor Safety Systems" is already defined in section 1.2 of the UFTR TS.
2	1.2		A	Added a new definition for "Control Blade" consistent with ANSI 15.1
3	1.2		A	Added a new definition for "Core Configuration" consistent with ANSI 15.1
4	1.2	1.2	C	Modified the definition of "Excess Reactivity" by removing "... or a specified set of conditions" since the reference core condition is the specified core condition.
5	1.2	1.2	C	Modified the definition of "Experiment" by removing "pool" because does not apply to UFTR, and by adding the "Classification of the experiments". Class IV was removed because the experiments from this class are not peformed at UFTR.
6	1.2	1.2	C	Modified the definition of "License" by replacing the "responsible authorithy" with "US Nuclear Regulatory Commission" which is responsible authority for UFTR.
7	1.2		A	Added a new definition for "Regulating Blade" consistent with ANSI 15.1
8	1.2		A	Added a new definition for "Safety Blade"
9	2.1	2.1	C	Change the Bases by adding a sentence at the end of the paragraph: "The analysis is presented in the SAR Chapter 4, Section 4.7.3" as a reference for the SL bases.
10	2.2	2.2	C	Modified the Objective to be more clear ".. to terminate the abnormal situation before the safety limit reached."
11	3.2.1 Spec(3)	3.2.1 Spec(3)	C	Modified the wording specifying that for "any" of the control blades the specification shall apply.
12	3.2.1 Spec(4)(e)	3.2.1 Spec(4)(e)	C	Changed the inequality from "grater than" to the appropriate one: "less than or equal"
13	3.3 Spec (2)	3.3 Spec (2)	C	Changed to "The primary coolant switch, linked to a quantitative flow indicator, shall indicate coolant flow" to clearly describe a positive indication of the flow
14	3.3 Bases	3.3 Bases	C	Changed the numbering of the specifications bases, updated to the actual specifications, removing the left over bases of the specification (6) that was previousely removed.
15	3.5 Spec (5)	3.5 Spec (5)	C	Changed the "air-lock" with the self describing "contamination-monitoring room"
16	3.5 Bases	3.5 Bases	C	Modified the bases by adding the sentence "In such situation, the Ariel Radiation Monitors quantify the level of radioactivity" to clarify bases for the specification (6).
17	3.6.2 Spec (1)	3.6.2 Spec (1)	C	Modified the Specification by adding the reference "Regulatory Guide 2.2 Technical Specifications for Experiments in Research Reactors" for definition of the explosive materials.
18		3.6.2 Spec (4)	R	Removed Specification (4) since no fueled experiments at UFTR are anticipated.
19	3.6.2 Spec (4)	3.6.2 Spec (5)	C	Removed the reference "see Section 6.5" because the classes of the experiments are now incorporated in the definition of the "Experiments"
20	3.8 Spec (4)	3.8 Spec (4)	C	Reworded for clarification, no change in meaning.
21	3.8 Spec (5)	3.8 Spec (5)	C	Reworded for clarification, no change in meaning.
22	Table 3.2	Table 3-2	C	Changed Table 3.2 by adding the "Secondary coolant flow indicator" and the "Shield tank level" as operable channels as required in Table 3-1.

23	4.2.1 Spec (7)	4.2.1 Spec (7)	C	Modified the 6 hours time period to 2 hours and added a note to the specification "Note that if the reactor operator(s) leave the reactor cell, it is necessary that the reactor is left in secure mode" based on the operator experience.
24	4.3 Spec (7)		A	Added Specification (7) as a clear surveillance testing after maintenance or modifications.
25	4.3 Bases	4.3 Bases	C	Changed the Bases by adding the bases for specification (7) to ensure that the Coolant System is operable.
26	4.4 Spec (4)		A	Added Specification (4) as a clear surveillance testing after maintenance or modifications.
27	4.4 Bases	4.4 Bases	C	Changed the Bases by adding the bases for specification (4) to ensure that the monitors are operable.
28	4.5 Spec (4)		A	Added Specification (4) as a clear surveillance testing after maintenance or modifications.
29	4.5 Bases	4.5 Bases	C	Changed the Bases by adding the bases for specification (4) to ensure that the reactor vent is operable.
30	4.7 Spec (3)		A	Added Specification (3) as a clear surveillance testing after maintenance or modifications.
31	4.7 Bases	4.7 Bases	C	Changed the Bases by adding the bases for specification (3) to ensure that the reactor building evacuation alarm is operable.
32	4.8 Bases	4.8 Bases	C	Changed the Bases by removing the bases for the Specification (2), a left over from the previous change of the TS.
33	4.10 Spec (2)		A	Added Specification (2) as a clear surveillance testing after maintenance or modifications.
34	Table 4-1	Table 4-1	C	Modified the 6 hours frequency time period to 2 hours, according to 4.2.1 Spec (7), and the statement of the bottom of the Table by adding "... and a complete surveillance shall be conducted before startup" in order to evaluate if the SL were exceeded
35	5.0	5.0	C	Modified entire Section of the TS by adding applicability, objective and bases statements per Title 10, Code of Federal Regulations, Part 50.36 (10 CFR 50.36).
36	6.1.1	6.1.1	C	Changed the last paragraph by inserting the abreviation URCC for the University Radiation Control Committee
37	6.1.3 Spec (2)	6.1.3 Spec (2)	C	Changed the Specification (2) by stating "designated" second person based on the guidance provided in ANS/ANSI 15.1 that recommends that a second designated person shall be present.
38	6.2.2	6.2.2	C	Changed the third paragraph by leaving just the abbreviation "URCC"
39	6.2.3	6.2.3	C	Changed the last paragraph by leaving just the abbreviation "URCC"
40	6.2.4	6.2.4	C	Changed the last paragraph by leaving just the abbreviation "URCC"
41	6.3	6.3	C	Changed the paragraph by leaving just the abbreviation "URCC"
42	6.4 (11)		A	Added item (11) on the list of written procedures that shall be maintained, "Procedures for the use, receipt, and transfers of by-product material," considering the possibility of using or transfer byproduct material under the reactor license.
43	6.5(1)	6.5(1)	C	Change item (1) by adding the requirement for review and approval "... in writing by the RSRS, by Level 2 or designated alternates according to the limits specified..." according to the guidance provided in ANS/ANSI 15.1
44	6.5(2)	6.5(2)	C	Change item (2) by adding the reference "(as specified under Section 3.6 of these Technical Specifications)".
45		6.5(4)	R	Removed item (4) and add the Clasification of Experiments to the definition of the Experiment on Section 1.2.
46		6.8.3(5)	R	Removed Item (5); the requirements for records are in the next added Section 6.8.4
47	6.8.4		A	Added Section 6.8.4 "Records to be retained until the US NRC terminates the license
48	Figure 6.1	Figure 6.1	C	Change the Figure by inserting the abreviation of the University Radiation Control Committee (URCC); no change in responsibilities

APPENDIX 14.1

TECHNICAL SPECIFICATIONS

Prepared by
Alireza Haghighat
Gabriel Ghita

Approved by
UFTR RSRS Committee

(July 31, 2010)

Table of Contents

INDEX OF TABLES

INDEX OF FIGURES

1.0 INTRODUCTION

1.1 Scope

This document describes the Technical Specifications (TS) for the University of Florida Training Reactor (UFTR). Areas addressed are definitions, safety limits, limiting safety system settings, limiting conditions for operation, surveillance requirements, design features, and administrative controls.

1.2 Definitions

Blade-Drop Time: The blade-drop time is the measured time it takes, once power is removed from the control blade clutch, for the control blade to travel from the upper limit to the bottom limit. .

Channel: A channel is the combination of sensor, line, amplifier, and output devices that are connected for the purpose of measuring the value of a parameter.

Channel Calibration: A channel calibration is an adjustment of the channel such that its output corresponds with acceptable accuracy to known values of the parameter which the channel measures. Calibration shall encompass the entire channel, including equipment actuation, alarm, or trip, and shall be deemed to include a channel test.

Channel Check: A channel check is a qualitative verification of acceptable performance by observation of channel behavior, or by comparison of the channel with other independent channels or systems measuring the same parameter.

Channel Test: A channel test is the introduction of a signal into the channel for verification that it is operable.

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

Control Blade: A control blade is a device fabricated from neutron-absorbing material or fuel, or both, that is used to establish neutron flux changes and to compensate for routine reactivity losses. A control blade can be coupled to its drive unit allowing it to perform a safety function when the coupling is disengaged.

Core Configuration: The core configuration includes the number, type, or arrangement of fuel elements, reflector elements, and regulating/control blades occupying the core grid.

Excess Reactivity: Excess reactivity is that amount of reactivity that would exist if all reactivity control blades were moved to the maximum reactive conditions from the point where the reactor is exactly critical ($k_{eff}=1$), at reference core conditions.

Experiment: Any operation, hardware, or target (excluding devices such as detectors, foils, etc.) that is designed to investigate non-routine reactor characteristics or that is

intended for irradiation within the beam port or irradiation facility. Hardware rigidly secured to a core or shield structure so as to be a part of its design to carry out experiments is not normally considered an experiment.
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, 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).

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

License: The written authorization, by the US Nuclear Regulatory Commission, for an individual or organization to carry out the duties and responsibilities associated with a personnel position, material, or facility requiring licensing.

Licensee: An individual or organization holding a license.

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

Movable Experiment: A movable experiment is one where it is intended that all or part of the experiment may be moved in or near the core or into and out of the reactor while the reactor is operating.

Operable: Operable means a component or system is capable of performing its intended function.

Operating: Operating means a component or system is performing its intended function.

Protective Action: Protective action is the initiation of a signal or the operation of equipment within the reactor safety system in response to a parameter or condition of the reactor facility having reached a specified limit.

Reactivity Worth of an Experiment: The reactivity worth of an experiment is the value of the reactivity change that results from the experiment, being inserted into or removed from its intended position.

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

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

Reactor Safety System: Reactor safety systems are those systems, including their associated input channels 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

(1) *Either* there is insufficient moderator available in the reactor to attain criticality or there is insufficient fissile material present in the reactor to attain criticality under optimum available conditions of moderation and reflection;

(2) *Or* when all the following conditions exist:
   a. The reactor is shutdown;
   b. The console key switch is in the off position, and the key is removed from the console;
   c. 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;
   d. No experiments are being moved or serviced that have, on movement, a reactivity worth exceeding the maximum value allowed for a single experiment.

Reactor Shutdown: The reactor is shut down if it is subcritical by at least one dollar in the reference core condition with the reactivity worth of all installed experiments included.

Reactor Trip: A reactor trip is considered to occur whenever one of the following two actions takes 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 temperature (20 C / 68 F) and the reactivity worth of the xenon is zero.

Regulating Blade: The regulating blade is a low worth control blade used primarily to maintain an intended power level, and need not have scram capability.

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 defined as a device designed to support a self-sustaining neutron chain reaction for research, developmental, educational, training, or experimental purposes, and that may have provisions for the production of radioisotopes.

Safety Blade: The safety blade is a high worth control blade used primarily to scram (shutdown) the reactor.

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

Secured Experiment: A secured experiment is any experiment, experimental apparatus, or component of an experiment that is held in a stationary position relative to the reactor by mechanical means. The restraining forces must be substantially greater than those to which the experiment might be subjected by hydraulic, pneumatic, buoyant, or other forces that are normal to the operating environment of the experiment, or by forces that can arise as a result of credible malfunctions.

Senior Reactor Operator: Any individual who is licensed to direct the activities of Reactor Operators. Such an individual is also a reactor operator.

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

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

Surveillance Intervals: Allowable surveillance intervals shall not exceed the following:

(1) 10 years – interval not to exceed 12 years

(2) 5 years – interval not to exceed 6 years

(3) Biennial – intervals not to exceed 2 ½ years

(4) Annual – intervals not to exceed 15 months

(5) Semiannual – intervals not to exceed 8 months

(6) Quarterly – intervals not to exceed 4 months

(7) Monthly – intervals not to exceed 6 weeks

(8) Weekly – intervals not to exceed 10 days

(9) Daily – completed prior to reactor startup

Unscheduled Shutdown: An unscheduled shutdown is defined as any unplanned shutdown of the reactor caused by actuation of the reactor safety system, operator error, equipment malfunction, or a manual shutdown in response to conditions that could adversely affect safe operation, not including shutdowns that occur during testing or checkout operations.

2.0 SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

2.1 Safety Limit (SL)

Applicability: This specification applies to the temperature of the reactor fuel.

Objective: To ensure fuel cladding integrity.

Specification: The fuel and cladding temperatures shall be < 986°F (530°C).

Bases: Safety limits for nuclear reactors are limits upon important process variables that are found to be necessary to reasonably protect the integrity of certain physical barriers that guard against the uncontrolled release of radioactivity. The principal physical barrier shall be the fuel cladding. Operating experience and detailed calculations of Argonaut reactors and for the HEU to LEU conversion have demonstrated that the Specification suffices to maintain the fuel and fuel cladding below temperatures at which fuel degradation would occur. The analysis is presented in the SAR Chapter 4, Section 4.7.3.

2.2 Limiting Safety System Settings (LSSS)

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

Objective: To ensure that automatic protective action is initiated to terminate the abnormal situation before the safety limit is reached.

Specifications: The limiting safety system settings shall be

(1) Power level shall be < 119 kW_{th}.

(2) The primary coolant flow rate shall be > 41 gpm.

(3) The primary coolant,

  (a) Inlet temperature shall be < 99°F.

  (b) Outlet temperature shall be < 155°F when measured at any fuel box outlet.

(4) The reactor period shall be > 3 sec.

Bases: Limiting safety system settings for nuclear reactors are settings for automatic protective devices related to those variables having significant protective functions. The UFTR LSSS's are established based on operating experience and safety considerations, which are established for the protection of the fuel, the fuel cladding, and the reactor core integrity.

3.0 LIMITING CONDITIONS FOR OPERATION (LCO)

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 the melting point, that the reactor can be safely shutdown under any condition and to limit the reactivity insertion rate to levels commensurate 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, at core reference conditions, and with installed experiments at their most reactive state, shall be$\geq$ one dollar.

(2) Excess Reactivity: The core excess reactivity at core reference conditions shall be $\leq$ 1.4% $\Delta k/k$.

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

Bases: Limiting conditions for operation are the lowest functional capabilities or performance levels required of equipment for safe operation of the facility. Specification (1) ensures that a reactor shutdown can be established. Specification (2) is based on analysis documented in SAR Chapter 4, Section 4.1.2 and Chapter 13 to prevent the possibility that an inadvertent sudden excess of reactivity insertion could release significant energy to damage the fuel or cladding. Specification (3) limits the reactivity insertion rate to levels commensurate with efficient and safe reactor operation. These limits are also established based on UFTR operating experience.

3.2 Reactor Control and Safety Systems

3.2.1 Reactor Control System

Applicability: These specifications apply to the reactor control systems.

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

Specifications:

(1) 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.

(2) The reactor shall not be started unless the reactor control system is operable.

(3) The reactor shall not operate if any of the control blades' drop time is > 1.5 seconds.

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

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

   (b) A reactor period < 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 ≤ 30 sec.

Bases: Specification (1) limits the reactivity insertion rate to levels commensurate with efficient and safe reactor operation. Specification (2) ensures the reactor control system operability for startup and that the automatic controller is operable if needed. Specification (3) ensures that the reactor can be shut down promptly when a scram signal is initiated. Specifications (4) (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 (4) (c) ensures that the operator is capable of monitoring power changes during blade movement

3.2.2 Reactor Safety System

Applicability: These specifications apply to the reactor safety systems.

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

Specifications:

(1) The reactor shall be shut down when the main alternating current (ac) power is not available.

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

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

Bases: Specification (1) ensures that the reactor is shut down during power outages. Specification (2) ensures that the operator has proper indication of power while operating the reactor. Specification (3) 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. These limits were set based on operating experience and safety considerations.

3.2.3 Reactor Control and Safety Systems Channels

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

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

Specification: The minimum number and type of channels operable and providing information to the control room operator required for reactor operation are presented in Table 3-2.

Bases: Table 3-2 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 Coolant Systems

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

Objective: To specify minimum operating equipment for the coolant systems and to minimize corrosion of the aluminum cladding of fuel plates and activation of dissolved materials.

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

(1) The primary coolant pump and the dump valve shall be energized during reactor operations.

(2) The primary coolant switch, linked to a quantitative flow indicator shall indicate coolant flow.

(3) The primary coolant core level shall be > 2 inches above the fuel.

(4) The secondary coolant flow shall satisfy the following conditions when the reactor is being operated at power levels ≥ 1 kW;

(a) Power shall be provided to the well pump, and

(b) Well water flow rate shall be > 60 gpm.

(5) Primary water shall be demineralized, light water with a specific resistivity≥ 0.5 MΩ-cm.

(6) The primary equipment pit water level shall be≤ 1 inch above the equipment pit floor level.

(7) Primary water pH shall be < 7.0.

Bases: Specification (1) ensures that the reactor is shut down when the primary coolant pump is not energized. Specification (2) and (3) ensure core is covered with water for reactor operations. Specification (4) ensures there is heat removal capability when needed. Specifications (5) and (7) are designed to protect fuel element cladding integrity and are based upon operating experience. At the specified quantity, the activation products (of trace minerals) do not exceed acceptable limits. Specification (6) is 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.

3.4 Radiation Monitoring Systems and Radioactive Effluents

3.4.1 Area Radiation Monitors and Air Particulate Detectors

Applicability: These specifications apply to the area radiation monitors and air particulate detectors.

Objective: To specify the minimum equipment or the lowest acceptable level of performance for the area radiation monitors and air particulate detectors.

Specifications: The reactor shall not be operated unless the area radiation monitors and air particulate detectors are operated in accordance with Table 3-3 to ensure the operator has sufficient knowledge of the area radiation and air contamination within the cell.

Bases: The area radiation monitoring system and air particulate detector(s) 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.

3.4.2 Argon-41 (Ar-41) Discharge

Applicability: These specifications apply to the limits on radioactive gaseous effluents.

Objective: To specify the limits for gaseous effluents.

Specifications: The following operational limits are specified for the discharge of Ar-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 and atmospheric dilution of the stack plume may be taken into account when calculating this concentration.

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

Bases: 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.

3.4.3 Reactor Vent/Stack Monitoring System

Applicability: These specifications apply to the gaseous effluent monitoring system.

Objective: To specify the minimum equipment or the lowest acceptable level of performance for the gaseous effluent monitoring systems.

Specifications: The reactor shall not be operated if the reactor vent system is not operating. The 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 3-3.

Bases: The vent/stack monitoring system provides information to the operator on the condition of the air entering the stack from the reactor vent system. 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.

3.4.4 Liquid Effluents Discharge

Applicability: These specifications apply to the limits on radioactive liquid effluents released to the environment.

Objective: To specify the limits for liquid effluents.

Specifications: The following operational limits are specified for the discharge of liquid effluents to the environment:

(1) The liquid effluent from the 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 20.1301.

(2) Releases of radioactive effluents from the waste water holdup tank shall be in compliance with the limits specified in 10 CFR 20, Appendix B, Table 2, Column 2, as specified in 10 CFR 20.1302.

Bases: Liquid and solid radioactive wastes are regulated and controlled to assure compliance with legal requirements.

3.5 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 the 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 the following: 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 operable whenever the reactor is operating.

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

(4) The diluting fan shall be operated whenever the reactor is operating and as otherwise specified in these Technical Specifications.

(5) All doors to the reactor cell shall be locked while the reactor is operating. Transit is permitted through the contamination-monitoring room 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 affect 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. In such situation, the Aerial Radiation Monitors quantify the level of radioactivity.

3.6 Limitations on Experiments

3.6.1 Reactivity Limits

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

Objectives: To assure operational safety and prevent damage to the reactor facility, reactor fuel, reactor core, and associated equipment; to prevent exceeding the reactor safety limit; and to minimize potential personnel and equipment hazards from experimental devices.

Specifications:

(1) The absolute reactivity worth of any single experiment shall be $\leq 0.6\%$ $\Delta k/k$.

(2) The total absolute reactivity worth of all experiments shall be $\leq 1.4\%$ $\Delta k/k$.

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

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

Bases: These specifications generally ensure that an adequate review process is followed to assure the safe operation, proper conditions, and adherence to 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 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).

3.6.2 Materials

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

Objectives: To assure operational safety and prevent damage to the reactor facility, reactor fuel, reactor core, and associated equipment; to prevent exceeding the reactor safety limit; and to minimize potential personnel and equipment hazards from experimental devices.

Specifications:

(1) Explosive materials (See Regulatory Guide 2.2 Technical Specifications for Experiments in Research Reactors) shall not be irradiated.

(2) Thermal-Hydraulic Effects - Experiments shall be designed so that during normal operation, or failure, the thermal hydraulic parameters of the core do not cause the safety limit to be exceeded.

(3) 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.

(4) 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: These specifications generally ensure that an adequate review process is followed to assure the safe operation, proper conditions, and adherence to 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. These specifications limits the type of materials and in the case of fissile materials, the amount that can be irradiated in the reactor, to their 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:

a. Two area radiation monitors alarming high, causing an automatic actuation of the evacuation alarm.

b. An air particulate detector is in a valid alarm condition, causing the operator to manually actuate the evacuation alarm.

c. A potentially hazardous radiological condition exists, causing the operator to manually actuate the evacuation alarm.

Bases: 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: To establish the maximum core loading for reactivity control purposes, to establish proper fuel storage conditions and to establish fuel performance and fuel handling specifications with regard to radiological safety considerations.

Specifications:

(1) Fuel elements exhibiting release of fission products because of cladding failure shall, upon positive identification, be removed from the core.

(2) The reactor shall not be operated if there is evidence of fuel element failure other than to locate the failed fuel

(3) Prior to the removal of the last two levels of concrete shielding above the core, the reactor will be shut down for at least three days.

(4) The reactor shall not be operated if any change in Core Configuration has not been analyzed.

(5) The reactor shall not be operated if fuel inspections are not up-to-date based on surveillance requirements (see Section 4.8).

Bases: The reactor systems do not have adequate engineering safeguards to continue operating with a detectable release of fission products into the primary coolant. Specification (3) limits the possible/potential consequences of fuel handling accidents. Specification (4) states that the UFTR core design is fixed and any changes require the necessary analysis and documentations according to NUREG 1537. Specification (5) Fuel inspection is necessary to assess its condition/health.

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: 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 3.4 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.

The reactor shall not be considered operable if the following radiation surveys, using portable radiation monitors, are not complete:

(a) Surveys measuring radiation dose rates in the restricted area shall be conducted. Dose rates 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. 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 and document that UFTR operations are conducted to be within the established limits.

3.10 UFTR Shield Tank

Applicability: This specification applies to the shield tank water level during operation.

Objectives: To specify the minimum water level required in the shield tank.

Specifications: The reactor shall not be operated if the water level in the shield tank is > 6 inches below the established normal value.

Bases: This specification is established to protect reactor personnel from potential external radiation hazards caused by loss of biological shielding.

Table 3-1 Specification for Reactor Safety System Trips

Specification	Type of safety system trip
Automatic Trips	
Period ≤ 3 sec	Full
Power ≥ 119% of full power (Safety Channel 1 and 2)	Full
Loss of chamber high voltage (≥ 10%) Loss of electrical power to control console	Full Full
Primary cooling system Loss of primary pump power Low water level in core (≤ 42.5") No outlet flow Low inlet water flow (≤ 41 gpm)	Blade-drop
Secondary cooling system (≥ 1 kW) Loss of flow (well water ≤ 60 gpm) Loss of secondary well pump power	Blade-drop
High primary coolant inlet temperature (≥ 99°F)	Blade-drop
High primary coolant outlet temperature (≥ 155°F)	Blade-drop
Shield tank low water level (6" below established normal level)	Blade-drop
Ventilation system Loss of power to stack dilution fan Loss of power to core vent fan	Blade-drop
Manual Trips	
Manual scram bar	Blade-drop
Console key-switch OFF (two blades off bottom)	Full

Table 3-2 Minimum Number and Type of Channels Operable

Channel	Number of operable
Safety 1 and 2 power channels	2
Linear Channel (with auto controller as appropriate)	1
Log N and period channel*	1
Startup channel*	1
Blade position indicator	4
Primary coolant flow indicator	1
Secondary coolant flow indicator	1
Coolant temperature indicator	
Primary	7
Secondary	1
Core level	1
Ventilation system	
Core vent annunciator	1
Dilute fan annunciator	1
Dilute fan *rpm*	1
Shield tank level	1

*Subsystems of the wide range drawer

Table 3-3 Radiation Monitoring System* Settings

Type	No. of Required Operable Functions	Alarm(s) Setting	Purpose
Area Radiation Monitors	3 detecting 2 audio alarming 2 recording	5 mR/hr low level 20 mR/hr high level	Detect/alarm/record low and high level external radiation
Air Particulate Monitors	1 detecting 1 audio alarming 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 audio alarming 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

*Note: For maintenance or repair, the required radiation monitors may be replaced by suitable portable instruments provided the intended function is being accomplished. Service, calibration, and testing interruptions for brief periods are permissible when the reactor is not in operation.

**Air Particulate Detector

4.0 SURVEILLANCE REQUIREMENTS

4.1 Reactor Core Parameters

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

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

Specifications: The reactivity worth and reactivity insertion rate of each control blade, the shutdown margin and excess reactivity shall be measured annually or whenever physical or operational changes create a condition requiring reevaluation of core physics parameters.

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 Systems

4.2.1 Reactor Control System

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

Objective: To specify the frequency and type of testing or calibration to assure that reactor control system operating parameters conform to specifications in Section 3.2.1.

Specifications:

(1) Control blade drop times, from the fully withdrawn position, shall be measured semiannually. 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.

(3) The control blade withdrawal inhibit interlock checks shall be performed as listed in Table 4-2 to ensure the system is operable.

(4) The mechanical integrity of the control blades and drive system shall be inspected during each in core inspection but shall be fully checked at least once every 10 years.

(5) Following maintenance or modification to the control blade system, a 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 hours prior to startup, and

(c) No known condition exists that would prevent successful completion of the weekly or daily check.

(7) The limitations established under Specification (6) (a) and (b) can be deleted if a reactor startup is made within 2 hours of a normal reactor shutdown on any one calendar day. Note that if the reactor operator(s) leave the reactor cell, it is necessary that the reactor is left in secure mode.

Bases: The frequency and type of test or calibration are defined based on operating experience and/or in accordance with ANSI/ANS-15.1-2007 to assure proper functioning of the systems and equipment that comprise the reactor control system.

4.2.2 Reactor Safety System

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

Objective: To specify the frequency and type of testing or calibration to assure that reactor safety system operating parameters conform to specifications in Section 3.2.2.

Specifications:

(1) Safety system scram functions or components shall be determined to be operable in accordance with Table 4-1.

(2) The following channels shall be calibrated annually:

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

(3) 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-15.1-2007 to assure proper functioning of the systems and equipment that comprise the reactor safety system.

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

Specifications:

(1) Safety system scram functions or components shall be determined to be operable in accordance with Table 4-1.

(2) The primary coolant dump valve shall be tested during the weekly checkout.

(3) The primary equipment pit water level sensor shall be tested during the weekly checkout.

(4) The primary water resistivity shall be measured during the daily and weekly checkouts.

(5) The primary water pH value shall be measured during the weekly checkout.

(6) The primary water radioactivity shall be measured during the weekly checkout for gross β-γ and gross α activity.

(7) Following maintenance or modification to the reactor coolant system, the system shall be tested before it is considered operable.

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. Specifications (1), (2), and (7) ensure all trip signals are tested for the reactor coolant system. The frequency and type of monitoring are based on operating experience.

4.4 Radiation Monitoring Systems and Radioactive Effluents

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 in Section 3.4.

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.

(2) The Ar-41 concentration in the stack effluent shall be measured semiannually.

(3) Releases of liquid effluents from the 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) Following maintenance or modification to the area radiation monitors, the stack monitor, and the air particulate monitor the monitors shall be tested before they are considered operable.

Bases: Specifications (1) and (4) assure that 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.

4.5 Reactor Vent System

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 3.5.

Specifications:

(1) The reactor vent system flow rates shall be measured annually.

(2) The interlock of the core vent system damper being closed if the diluting fan is not operating shall be tested as part of the weekly checkout.

(3) All doors to the cell will be verified locked prior to operation of the reactor.

(4) Following maintenance or modification to the reactor vent system, the system shall be tested before it is considered operable.

Bases: These specifications assure the reactor vent system is operating as specified. The frequency and type of monitoring are based on operating experience and ANSI/ANS-15.1- 2007.

4.6 Limitations on Experiments

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

Objective: To prevent the performance of experiments or irradiations that 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 the experiment.

Bases: 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

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

Objective: To specify the frequency and type of testing to assure the building alarm evacuation conforms to the specifications presented in Section 3.7.

Specifications:

(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) Following maintenance or modification to the reactor building evacuation alarm, the alarm shall be tested before it is considered operable.

Bases: Specifications (1) and (3) ensure that the actuation of the building evacuation alarm is operable to alert occupants of 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.

4.8 Surveillance Pertaining to Fuel

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

Objective: To verify integrity of the fuel.

Specifications: The in-core reactor fuel elements shall be inspected every 10 years, in a randomly chosen pattern, as deemed necessary. At least 8 elements will be inspected.

Bases: The specification assures that reactor and support staff is properly qualified to perform fuel handling and related activities.

4.9 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: 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 3.4 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 Radiological Services Department personnel.

(2) Radioactivity surveillance of the restricted area (reactor cell) shall be conducted during the weekly checkout.

(3) The radiation surveys, using portable radiation monitors, shall be conducted quarterly and at any time a change in the normal radiation levels is observed.

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

4.10 UFTR Shield Tank

Applicability: This specification applies to the shield tank water level during operation.

Objectives: To assure a minimum amount of water in the shield tank to minimize dose rates to the operators.

Specifications:

(1) The water level detector in the shield tank shall be checked periodically based on Table 4-1 to ensure it remains operable.

(2) Following maintenance or modification to the water-level detector in the shield tank, the detector shall be tested before it is considered operable.

Bases: This specification is established to protect reactor personnel from potential external radiation hazards caused by loss of biological shielding.

Table 4-1 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 2 hrs, and after repair or deenergization caused by a power outage.
10% reduction of safety channels high voltage	Quarterly
Loss of electrical power to console Loss of primary coolant pump power	Quarterly Quarterly
Loss of primary coolant level	Quarterly
Loss of primary coolant flow	Quarterly
High primary coolant inlet temperature	Daily checkout
High primary coolant fuel box outlet temperature	Daily checkout
Loss of secondary coolant flow (at power levels above 1 kW)	Daily checkout
Loss of secondary coolant well pump power	Quarterly
Loss of shield tank water level	Quarterly
Loss of power to vent system and dilution fan	Quarterly
Console key to OFF position Manual scram bar	Daily checkout Daily checkout

*Surveillance may not be performed with the specified frequency because of physical or administrative limitations, including equipment failure and maintenance activities; however, surveillance shall be performed before resuming normal operations. Whenever an unscheduled shutdown occurs, an evaluation shall be conducted to determine whether the safety limit was exceeded, and a complete surveillance shall be conducted before startup.

Table 4-2 Control Blade Withdrawal Inhibit Interlocks Checks

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 Any 2 safety blades in Automatic	Daily Checkout
Source count rate	< 2 cps	Verification only when count rate < 2cps during daily checkout

5.0 DESIGN FEATURES

5.1 Site and Facility Description

Applicability: This specification applies to the University of Florida Training Reactor (UFTR) site location and specific facility design features.

Objective: The objective is to specify the location of specific facility design features.

Specifications:

(1) The licensed area includes the UFTR building (#557) (or Reactor Building) and the adjacent fenced area on the west side of the building.

(2) The restricted area is that area inside the boundary of the Reactor Cell.

(3) The exclusion area is that area inside the boundary lines of the Reactor Building.

(4) The Reactor Cell shall be equipped with ventilation systems designed to exhaust air, other gases, or particulates from the reactor core, a fan for dilution of the core effluents, and a stack for releasing the effluents.

(5) Emergency shutdown controls for the ventilation systems shall be located in the reactor control room.

Basis: The Reactor Building (1), the Reactor Cell (2), and exclusion area (3) are strictly defined (FSAR Section 2). The facility is designed such that the ventilation system (4) will normally maintain a negative pressure in the Reactor Cell with respect to the outside atmosphere so that there will be no uncontrolled leakage to the unrestricted environment. Controls for startup and normal operation of the ventilation system are located in the reactor control room. Proper handling of airborne radioactive materials in emergency situations (5) can be conducted from the reactor control room with a minimum of exposure to operating personnel (FSAR Section 9.1).

5.2 Reactor Coolant System

5.2.1 Primary Cooling System

Applicability: This specification applies to the Primary Coolant system.

Objective: The objective is to assure that coolant water shall be available to provide adequate cooling of the reactor core.

Specifications:

(1) The reactor core shall be cooled by demineralized light water, which is pumped from the storage tank via primary side of the heat exchanger 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.

(2) 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.

(3) A pressure surge of about 2 psi above normal in the system will also 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.

(4) Temperature sensing device at each fuel box and the main inlet and outlet (eight total), alarming and recording in the control room.

(5) A flow sensing device in the main inlet line, alarming and displayed in the control room.

(6) A flow sensing device (no flow condition) in the outlet line, alarming in the control room.

(7) Resistivity probes monitoring the inlet and outlet reactor coolant, alarming and displayed in the control room.

(8) 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.

Basis: Specification (1) is based on thermal and hydraulic calculations which show that the UFTR core can operate in a safe manner at power level up to 100 kW with forced flow of the coolant water (FSAR Sections 4.7 and 5). Specification (2) is based on thermal hydraulic analyses which show that the residual heat in the UFTR fuel plate is so low that there is no need for cooling following the reactor shutdown. So, dumping the water out of the core is an additional mechanism for the reactor shutdown. Since there are no pressure measurements conducted within the reactor core, this system provides protection against the sudden change of pressure that is greater than 2 psi (3). Specifications (4) – (7) detail the sensors used to maintain the reactor operating within the specified thermal hydraulic parameters (FSAR Section 4.7). Specification (8) indicates that the primary water is purified in order to meet the requirements set in the FSAR.

5.2.2 Secondary Cooling System

Applicability: This specification applies to the Secondary Coolant system.

Objective: The objective is to assure removal of reactor generated heat to the environment.

Specifications:

(1) A deep well furnishes about 200 gpm of cooling water to the shell side of the heat exchanger, removing primary heat and rejecting it to the storm sewer.

(2) 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 approximate 10-sec warning.

(3) The secondary coolant system inlet and outlet temperatures are monitored by temperature sensing devices, with recording and alarm functions in the control room.

Basis: Specifications (1) and (2) are based on thermal hydraulic calculations which show that the UFTR core can operate in a safe manner at power level up to 100 kW (FSAR Section 4.7). Specification (3) assures that the reactor is operating within the specified thermal hydraulic parameters (FSAR Section 4.7)

5.3 Reactor Coe and Fuel

5.3.1 Reactor Core

Applicability: This specification applies to the configuration of fuel and in-core experiments.

Objective: The objective is to assure that provisions are made to restrict the arrangement of fuel elements and experiments so as to provide assurance that excessive power densities shall not be produced.

Specifications:

(1) The core shall consist of the six aluminum fuel boxes, containing up to four fuel bundles, arranged in two parallel rows of three boxes each, cooled with water and separated by about 30 cm of graphite. The fuel boxes are surrounded by a 5' x 5' x 5' reactor grade graphite assembly.

(2) The tops of the fuel boxes are covered during operations at power above 1 kW, by the use of the shield plugs and/or aluminum covers secured to the top of the fuel boxes.

(3) The UFTR design yields negative coefficients of reactivity for coolant void, coolant temperature and fuel temperature. The core has an excess reactivity of 0.925 %$\Delta k/k$, which is designed to operate for 20 years at 4 four hours per day at full power.

(4) The experimental locations within the core, including three vertical columns and one horizontal throughput for the rabbit system, shall be maintained.

(5) The shield tank water level shall not decrease more than 6".

Basis: Specification (1) is based on neutronics analysis, a combination of fuel bundles and dummy bundles provide the necessary excess reactivity which can be effectively controlled by the UFTR control blades (see FSAR Section 4). The core is cooled with water, which also provides neutron moderation; the graphite provides both moderation and reflection. The covers (shield plus and/or aluminum) from specification (2) 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 Ar-41 in the coolant water for radiological protection purposes. Specification (3) is based on the operating region for the UFTR (i.e., combination of flow rate, inlet coolant temperature, power) which is set to prevent the occurrence of the Onset of Nucleate Boiling (ONB), thereby avoiding any flow instability. Specification (4) indicates that the allowed experiments shall meet the requirements set for in Section 3.6 of this Technical Specifications. Specification (5) is established to provide the necessary shielding to maintain a low radiation level in the Reactor Cell (See Section 4.10).

5.3.2 Control Blades

Applicability: This specification applies to the control blades used in the reactor core.

Objective: The objective is to assure that the control blades are of such a design as to permit their use with a high degree of reliability with respect to their physical and nuclear characteristics.

Specifications: The safety and regulating control blades shall have scram capability and contain Cd vanes, which are protected by Mg shrouds.

Basis: The poison requirements for the control blades are satisfied by using neutron absorbing Cd vanes. This material must be protected by a shroud to ensure mechanical stability during movement and to isolate the poison from the core water environment. Scram capabilities are provided for rapid insertion of the control blades which is the safety feature of the reactor (SAR 4.2.2).

5.3.3 Reactor Fuel

Applicability: This specification applies to the fuel bundles used in the reactor core.

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

Specifications: Each fuel bundle has up to 14 fuel plates. Each fuel plate is composed of a "sandwich" of fuel "meat" and aluminum cladding, and shall have the following characteristics:
Fuel meat: U_3Si_2-Al; thickness: 0.051 cm; fuel enrichment (nominal): 19.75 wt% U; and,
Cladding: Al 6061, thickness: 0.038 cm.

Basis: A specified fuel concentration and enrichment provides the necessary reactivity for safe operation of the UFTR. The use of Al cladding and thin fuel meat with Al mixture provide excellent heat conduction, and therefore minimal residual heat in the UFTR fuel plate, allowing water dump as a mechanism for the reactor shutdown (FSAR Section 4)

5.4 Fissionable Material Storage

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

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

Specifications:

(1) All fuel elements shall be stored in a geometrical array where the $k_{eff} < 0.9$ for all conditions of moderation and reflection.

(2) Irradiated fuel elements and fuel devices shall be stored in an array which will permit sufficient natural convection cooling by water or air such that the temperature of the fuel element or fueled device will not exceed the safety limit.

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

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 (RSRS) is appointed by, and shall report to, the Chairman of the University Radiation Control Committee (URCC). The Chairman of the URCC reports to the Director of Environmental Health and Safety, who reports to the level 1 of the UFTR organization chart. 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. In addition to having responsibility for the policies and operation of the reactor facility, individuals at various management levels 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. Functions delineated in Figure 6-1 may be fulfilled by combinations of personnel when a position is unfilled.

6.1.3 Staffing

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

(1) A Reactor Operator shall be in the control room.

(2) A designated 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 shall be readily available on call. "Readily Available on Call" means an individual who:

a. Has been specifically designated and the designation is 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 miles 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 presence of a Senior Reactor Operator are:

(1) Initial startup and approach to power,

(2) All fuel or control-blade relocations within the reactor core region,

(3) Relocation of any in core experiment with a reactivity worth > 1 dollar, and

(4) Recovery from unplanned or unscheduled shutdown or a significant power reduction.

6.1.4 Selection and Training of Personnel

The selection, training, and requalification of operations personnel should meet or exceed the requirements of the American National Standard for Selection and Training of Personnel for Research Reactors, ANSI/ANS-15.4-2007 Section 4.7.

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 others familiar with the operation of reactors and with the design of the UFTR and radiological safety, at least one of whom should be from outside the Department of Nuclear and Radiological Engineering.

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 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:

(1) The two technical personnel should 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.

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

(3) 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.

(4) Members appointed to the RSRS shall be reviewed annually, and as appropriate, new appointments made.

Meetings:

(1) At least one meeting shall be held quarterly. Meetings may be held more frequently as circumstances warrant, consistent with the effective monitoring of facility operations as determined by the RSRS Chairman.

(2) 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.

(3) A quorum shall consist of at least three members (and 50% or more of the RSRS membership) and at least three members must agree when voting, regardless of the number present, and the operating staff should not constitute a majority.

6.2.3 Review Function

The following items shall be reviewed:

(1) Determination that proposed changes in equipment, systems, tests, experiments, or procedures do not have safety significance; i.e., no prior NRC approval is needed as indicated in 10 CFR 50.59 rule.

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

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

(4) Proposed changes in technical specifications of the license;

(5) Violations of technical specifications of the license;

(6) Violations of internal procedures or instructions having safety significance;

(7) Operating abnormalities having safety significance;

(8) Reportable occurrences (see Section 6.7.2); and

(9) Audit reports and annual facility reports.

A written report or minutes of the findings and recommendations of the RSRS or its executive committee shall be submitted in a timely manner (no later than the subsequent RSRS meeting) to the Chair of the URCC.

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:

(1) Facility operations for conformance to the technical specifications and applicable license or charter conditions, at least once per calendar year;

(2) The requalification and recertification program for the operating staff, at least once every other calendar year;

(3) The results of action taken to correct those deficiencies in reactor facility equipment, systems, structures, or methods of operations that could affect reactor safety, at least once per calendar; and

(4) The reactor facility emergency plan, and implementing procedures at least once every other calendar year.

Deficiencies uncovered that affect reactor safety shall immediately be reported to the Chair of the URCC 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, Chair of the URCC, and the review and audit group members within three (3) months after the audit has been completed.

6.3 Radiation Safety and ALARA (As Low As Reasonably Achievable)

The URCC 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.

6.4 Procedures

The UFTR 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 the UFTR before going into effect.

The following types of written procedures shall be maintained:

(1) Normal startup, operation and shutdown procedures for the reactor to include applicable check-off lists and instructions;

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

(3) Procedures for handling irradiated and un-irradiated fuel elements;

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

(5) Surveillances required by the technical specifications;

(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; and

(11) Procedures for the use, receipt, and transfers of by-product material.

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 by the next working day.

6.5 Experiment Review and Approval

(1) All new experiments shall be reviewed and approved in writing by the RSRS, by Level 2, or designated alternates according to the limits specified under Section 3.6, "Limitations on Experiments", of these Technical Specifications.

(2) Substantive changes to previously approved experiments with safety significance (as specified under Section 3.6 of these Technical Specifications) 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.

(3) 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 (NRC).

(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; and

c. Corrective action to be taken to prevent recurrence.

The report shall be reviewed by the RSRS and any follow-up report shall be submitted to the NRC 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 in case of a non-reportable malfunction, otherwise 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 NRC as required.

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

6.7 Reports

In addition to the requirements of the applicable regulations, reports shall be made to the NRC 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 NRC within six (6) 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 and reactor trips including any corrective actions;

(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 FSAR, including reports on activities conducted under 10 CFR 50.59 rule.

(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; and

(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 to the NRC, 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 limit (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 LSSS specified in the Technical Specifications;

b. Operation in violation of LCO established in the Technical Specifications unless prompt remedial action is taken;

c. Operation with a reactor safety system component malfunction that renders the reactor safety system incapable of performing its intended safety function.

   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 > 1 dollar (reactor trips resulting from a known cause are excluded);

e. Abnormal and significant degradation in: (i) reactor fuel, cladding, or both; and/or (ii) 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.

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 or 2 personnel,

(2) Significant changes in the transient or accident analyses as described in the 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. Records 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, unless indicated otherwise, 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 3 years);

(2) Principal maintenance operations;

(3) Reportable occurrences, except for Safety Limit (LS), Limiting Safety System Settings (LSSS), Limiting Conditions of Operation (LCO) violations which have to be maintained until termination of the facility license;

(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; and

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

6.8.2 Records To Be Retained for at Least One Training Cycle

Record of retraining and requalification of operations personnel shall be maintained at all times the individual is employed or until the license is renewed.

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; and Current drawings of the reactor facility.

6.8.4 Records To Be Retained until the US NRC terminates the license

(1) Reviews of exceeding the safety limit.

(2) Reviews of the failure of the automatic safety system that protects the limiting safety system settings.

(3) Reviews of not meeting limiting conditions for operation

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

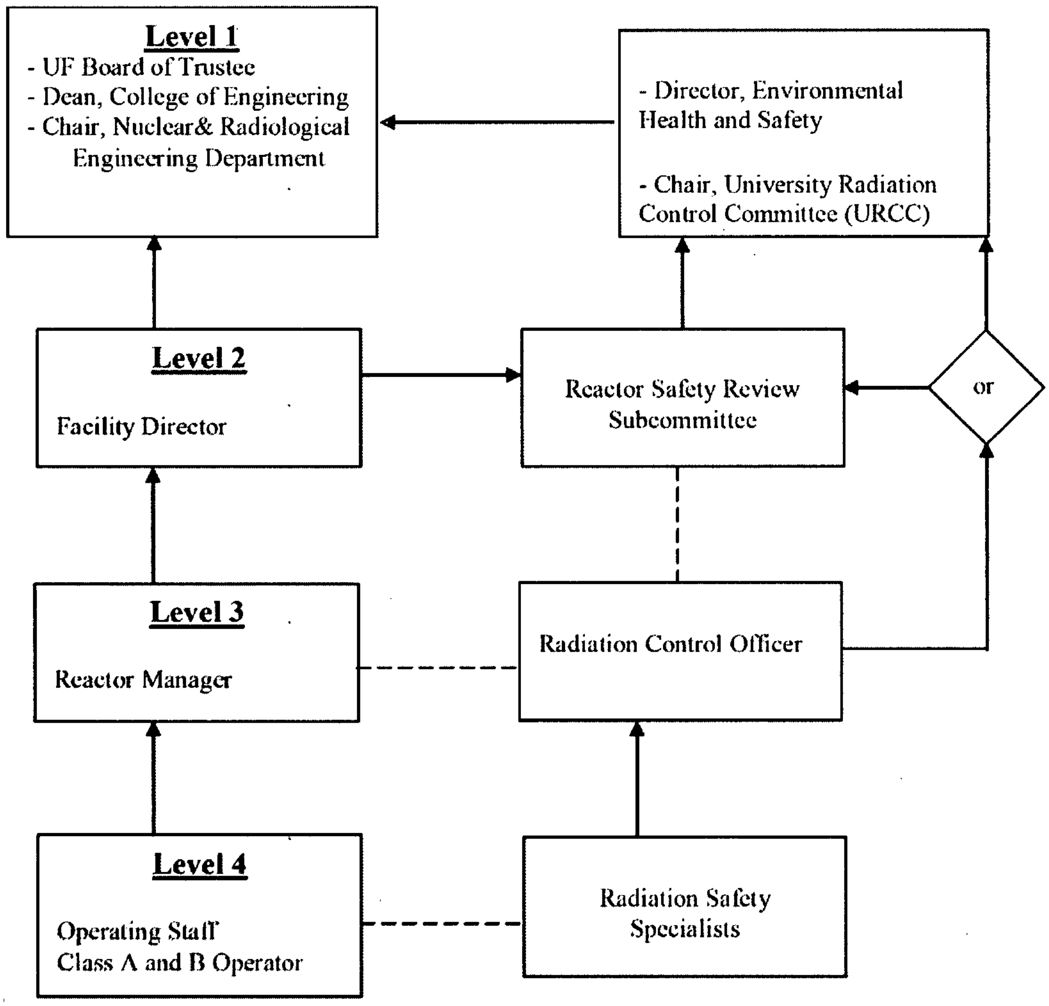

Figure 6-1 UFTR Organizational Chart

Legend: Communication line: ---- Reporting Responsibility: ⟶