UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUTION BY THE

OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 15 TO

FACILITY LICENSE NO. R-56

UNIVERSITY OF FLORIDA TRAINING REACTOR

DOCKET NO. 50-83

Background

The University of Florida Training Reactor (UFTR) received a 20 year license renewal in August 1982. By letter dated October 27, 1982, UFTR requested that certain corrections and changes be made to the Technical Specifications to eliminate typographical erros, to reflect consistency within the Technical Specifications, the University of Florida SAR, and the staff SER and to clarify and amplify certain Technical Specifications.

Safety Review

Most of the changes are typographical error corrections, clarification and modifications to make various sections of the Technical Specifications consistent with other safety evaluations. One section of the Technical Specifications inadvertently included the air conditioning system as part of the ventilation system. The air conditioning system is used only for personnel comfort, and the ventilation system is activated as part of reactor operation. Accordingly, reference to the air conditioning system should be removed from Sections 3.3.1(3) and 4.2.3(2)(b).

Evaluation

None of the requested changes have any effect on the safety of the reactor. For the reasons mentioned above, the staff concurs in the need for the requested modifications to the respective portions of the Technical Specifications.

Environmental Consideration

We have determined that this amendment will not result in any significant environmental impact and that it does not constitute a major Commission action significantly affecting the quality of the human environment. We have also determined that this action is not one of those covered by 10 CFR 51.5(a) or (b). Having made these determinations, we have concluded that, pursuant to 10 CFR §51.5(d)(4), an environmental impact statement, negative declaration, or environmental impact appraisal need not be prepared in connection with issuance of this amendment.

Conclusion

We have concluded, based on the considerations discussed above, that: (1) because the amendment does not involve a significant increase in the probability or consequences of accidents previously considered and does not involve a significant decrease in a safety margin, the amendment does not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Dated:

ATTACHMENT TO LICENSE AMENDMENT NO. 15

FACILITY LICENSE NO. R-56

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Revised Appendix A Technical Specifications are as follows:

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Changes on the revised pages are identified by marginal lines.

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 Safety System: The reactor safety system is that combination of measuring channels and associated circuitry that forms the automatic protective action to be initiated, or provides information which requires the 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 rods, to attain criticality under optimum available conditions of moderation and reflection,

or

(1) the reactor is shut down, (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 rods or control rod drives unless they are physically decoupled from the control rods, 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 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.

Specifications: The limiting safety system settings shall be

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

(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 the following 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 2.2.3 (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 for the six fuel boxes, are monitored and recorded in the control room. LSSS 2.2.3 (11) are 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 2.2.3 (12) are established to protect reactor personnel from potential external radiation hazards caused by loss of biological shielding.

Table 3.1 Specifications for reactor safety system trips.

Specification	Type of safety system trip
Automatic Trips	
Period less than 3 sec	Full
Power at 125% of full power	Full
Loss of chamber high voltage($\geq$ 10%)	Full
Loss of electrical power to control console	Full
Primary cooling system	Rod-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)	Rod-drop
Loss of flow (well water < 60 gpm, city water < 8 gpm)	
Loss of pump power	
High primary coolant average outlet temperature ($\geq$ 155°F)	Rod-drop
Shield Tank	Rod-drop
Low water level (6" below established normal level)	
Ventilation system	Rod-drop
Loss of power to dilution fan	
Loss of power to core vent system	
Manual Trips	
Manual scram bar	Rod-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 hr, <u>and</u> after repair <u>or</u> 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 temture	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

3.2.4 Bases

The reactor control system provides the operator with reactivity control devices to control the reactor within the specified range of reactivity insertion rate and power level. The operator has available digital 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. 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 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 function 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. 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 provides 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.

3.3 Reactor Vent System

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.

3.3.1 Specification

(1) 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. The reactor air cavity flow shall be periodically calibrated to minimize argon-41 releases to the environment while maintaining a negative pressure within the reactor cavity to minimize radioactive hazards to reactor personnel.

(2) 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.

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

(4) All doors to the reactor cell shall normally be closed while the reactor is operating. Transit is not prohibited through air lock and control room doors.

3.3.2 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 emergency conditions, the reactor vent system will be shut down and the damper closed, thus minimizing leakage of radioactivity from the reactor cell.

3.4 Radiation Monitoring Systems and Radioactive Effluents

3.4.1 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

3.4.3 Reactor Vent System

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). Whenever the reactor vent system is operating, air drawn through the reactor vent system shall be continuously monitored for gross concentration of radioactive gases. The output of the monitor shall be indicated and recorded in the control room. 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.

3.4.4 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.

3.4.5 Liquid Effluents Discharge

(1) The liquid waste from the radioactive liquid waste holding tanks shall be sampled and the activity measured before release to the sanitary sewage system.

(2) Releases of radioactive liquid waste from the holding tanks/campus sanitary sewage system shall be in compliance with the limits specified in 10 CFR 20, Appendix B, Table 1, Column 2, as specified in 10 CFR 20.303.

3.4.6 Solid Radioactive Waste Disposal

Solid radioactive waste disposal shall be accomplished in compliance with applicable regulations and under the control of the Radiation Control Office of the University of Florida.

3.4 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 maintain 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 representative) 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 the experiments and that may have safety significance. When experiments contain substances that irradiation in the reactor can convert into a material with significant

(1) The evacuation alarm is actuated automatically when two area radiation monitors alarm high ($\geq$ 25 mrems/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.

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.

3.7 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 the 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.

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

3.9.2 Radiological Environmental Monitoring

(1) Monthly environmental radioactivity 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 mrems/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/cm^2 beta-gamma or greater than 50 dpm/100 cm^2 alpha are limiting conditions for operation 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 are limiting conditions for operation requiring review and possible radiological safety control actions.

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

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

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

3.9.3 Bases

The bases for establishing the Radiological Environmental Surveillance Program are the established limits for internal and external radiation exposure <u>and</u> requirements that radiation doses be maintained ALARA.

(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.

4.2.3 Reactor Vent System Surveillance

(1) The reactor vent system flow rates shall be measured annually at intervals not to exceed 14 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.

4.2.4 Radiation Monitoring Systems and Radioactive Effluents Surveillance

(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.

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

(3) Releases of radioactive liquid waste from the holdup tanks shall be monitored before discharging to the sanitary sewage system to ensure compliance with 10 CFR 20 regulations.

(4) The reactor shall be placed in a reactor shutdown condition whenever Specification 4.2.4(1) is not met.

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

4.2.5 Surveillance of Experimental Limits

(1) Surveillance to ensure that experiments meet the requirements of Section 3.5 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.

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.

5.3 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 receiving, 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.

5.4 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 these 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	14.5 g U-235 nominal

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 top 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.

5.5 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 given below.

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 sec and the insertion time under trip conditions is stipulated to be less than 1 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 rod drives, transmit rod 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 1% $\Delta k/k$. The rod worths, drive speeds, and drop-time values are sufficiently conservative to ensure compliance with the

5.8 Fuel Storage

5.8.1 New Fuel

Unirradiated new fuel elements are stored in a vault-type room security area equipped with intrusion alarms in accordance with the 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.

5.8.2 Irradiated Fuel

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

(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 the senior operating individual present, in order to deal with special or unusual circumstances or conditions. Such deviations shall be documented and reported to Level 2 or designated alternates.

6.4 Experiments Review and Approval

(1) Experiments review and approval shall be conducted as specified under Section 3.5, "Limitations on Experiments," of these Technical Specifications.

(2) The experiments 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.

6.5 Required Actions

6.5.1 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: