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DEPARTMENT OF NUCLEAR ENGINEERING SCIENCES

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July 18, 1986

Office of Nuclear Reactor Regulations
Division of PWR Licensing-B
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Herbert N. Berkow, Director
Standardization and Special Projects Directorate

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

Dear Sir:

The enclosed package contains Revision 2 pages for the UFTR Safety Analysis Report dated January, 1981 submitted as part of our relicensing effort.

This Revision 2 is submitted as a result of an NRC inspection of our facility conducted on February 18-21, 1986, and as cited in Inspection Report No. 50-83/86-01 as Inspector Followup Item IFI 083/86-01-02. As requested in the Inspection Report and committed in our reply, our facility has committed to update Paragraph 7.2.3 of the UFTR Safety Analysis Report "which describes operation of the control rod inhibit system and automatic control system, which is different from the performance described in Technical Specification 3.2.1. Surveillance procedures confirm performance in conformance to the requirements of Technical Specifications." As a result of the review of Paragraph 7.2.3, this revision package also includes revisions to Sections 7.3 and 7.6 as well as Figure 1-8 from Chapter 1.

All text changes are clearly indicated by vertical lines in the margins. The two figure changes can be noted by comparison with original figures. Many of the changes represent simple typographical errors or omissions, though several involve facility description discrepancies discovered as a result of the NRC Inspection in February, 1986. All changes have been reviewed by UFTR staff and by the Reactor Safety Review Subcommittee as required by Technical Specifications. A more detailed description of the revision is included as Attachment I. A summary table of the changed pages, along with the Revision 2 pages, is enclosed as Attachment II.

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The enclosure consists of:

1. Three (3) signed originals and nineteen copies of this letter of transmittal.

2. Twenty-five (25) copies of the attachments containing a description of Revision 2 to the UFTR Safety Analysis Report as well as the Revision 2 pages.

If further information is required, please let us know.

Sincerely,

William G. Vernetson

William G. Vernetson
Associate Engineer and
Director of Nuclear Facilities

Joan Morehouse
Notary Public

WGV:lmc
Enclosures

ATTACHMENT I

DETAILED DESCRIPTION
UFTR SAR REVISION 2

As noted in NRC Inspection Report No. 50-83/86-01, Paragraph 7.2.3 (Non-Nuclear Instrumentation Channels) describes operation of the control rod inhibit system and automatic control system, which is somewhat different from the performance described in Technical Specifications Paragraph 3.2.1. It was also noted that surveillance procedures confirm performance in conformance with the requirements of the Technical Specifications. As a result of IFI 083/86-01-02, Paragraph 7.2.3 and Sections 7.3, 7.4, 7.5 and 7.6 as well as Figure 7-3 referenced in Section 7.2 and Figure 1-8 (duplicate of Figure 7-3) have been reviewed and revised as necessary.

First, Figure 7-3 in Section 7.2 and Figure 1-8 were noted to indicate a BF_3 proportional chamber detector for the source range detector in Nuclear Instrumentation Channel 1. This detector is described as a B-10 proportional detector in the text of Section 7.2, Paragraph 7.2.2.1.1; in addition, the B-10 detector, not a BF_3 detector was in place when the SAR was submitted. To correct the improper indication of the source range detector from a BF_3 detector to a B-10 detector, a corrected Figure 1-8 is attached. The same change is made on Figure 7-3.

Next, Paragraph 7.2.3 was reviewed and revised to include the following clarifications:

1. Much of Section 7.2.3 was reworded to delineate more clearly the non-nuclear instrumentation system as existing and as described in the SAR; no substantive changes are included in this rewording.

2. Paragraph 7.2.3.2 describing the Control-Blade Withdrawal Inhibit System was rewritten to correspond exactly to the description on the UFTR Technical Specifications with some clarifications for ease of understanding. No substantive changes are included in this rewritten paragraph.

3. Paragraph 7.2.3.3 containing the description of the Automatic Control System was rewritten for clarification, again with no substantive changes.

4. A new Paragraph 7.2.3.4, "Process Monitoring and Control Systems" which expands upon the paragraphs following the description of the Automatic Control System was added. Again, the contents are not substantively changed; however, the section is now labelled and individual subsections are delineated in more detail as follows:

   7.2.3.4.1, "Primary Coolant System"
   7.2.3.4.2, "Secondary Coolant System"
   7.2.3.4.3, "Shield Tank System"

   Again this delineation of Paragraphs makes locating specific items easier; in addition, the information contained in these sections is better written and organized.

Section 7.3 Reactor Trip System has also been reviewed and one change made to correct an SAR error in classifying trips. Section 7.3.1 "Nuclear Induced Trips (Full Trips)" currently delineates four (4) trip conditions while Section 7.3.2 "Process Instrumentation Induced Trips (Rod-Drop Trips)" currently delineates thirteen (13) trip conditions. The last trip listed under Section 7.3.2 is "AC power failure (fail-safe criterion)." This trip condition has always caused a full trip (this is one of two methods used to dump the primary coolant to the storage tank) with two control blades partially removed so the rewritten Section 7.3 lists this trip under Section 7.3.1 so there are five trip conditions listed under Section 7.3.2 and only twelve (12) trip conditions listed under 7.3.2. Section 7.3.2 is also relabelled as Process Instrumentation Induced Trips (Blade Drop Trips) to reflect UFTR use of control blades, not control rods. Again, the change simply reflects an accurate description of a preexisting and licensed system that was incorrectly described in the Section 7.3 of the SAR submitted in 1981.

The review of Sections 7.4 and 7.5 does not show the need for any changes. The same is true for Sections 7.7 and 7.8. However, the review of Section 7.6 on Safety-Related Display Instrumentation showed one incorrect reference at the end of the first paragraph. The reference to "Section 7.1.1.1" is changed to the proper reference which is "Section 7.1.2." In addition the remainder of Section 7.6 is rewritten to provide a better, more accurate description of the Safety-Related Display Instrumentation. The only change in the description is in the final paragraph of 7.6 where the location of the portal monitoring system is changed from "in the airlock" to "outside the airlock" to reflect the current and pre-existing location of the portal monitor. This location is the preferred location to facilitate monitoring of personnel exiting not only from the airlock but also directly from the control room if necessary. Again, the revision of this Section is not considered to involve any substantive changes from the system as relicensed but only to reflect a more accurate and clearer description of the Safety-Related Display Instrumentation Systems.

In summary, this proposed revision simply corrects a number of typographical or other inadvertent non-substantive errors and also provides a better, clearer and more accurate description of systems that are unchanged since submittal of the UFTR Safety Analysis Report in 1981. The UFTR SAR Revision 2 along with a list of changed pages is included as Attachment II.

ATTACHMENT II

FINAL SAFETY ANALYSIS REPORT
UNIVERSITY OF FLORIDA TRAINING REACTOR
FACILITY LICENSE R-56; DOCKET NUMBER 50-83

Revision 2

The attached Revision 2 pages revise the University of Florida Training Reactor Final Safety Analysis Report as of July, 1986. Revision 2 pages should be substituted to replace original pages as indicated in the following table.

Original Pages	Revision 2 Replacement Pages
1-21	1-21
7-7	7-7
7-9	7-9
7-11	7-11
7-13	7-13
7-15	7-15
7-16	7-16 and 7-17

Due to added material there is one more page of text in Chapter 7 than previously. Replacement of pages as noted here will put all pages in the proper position.

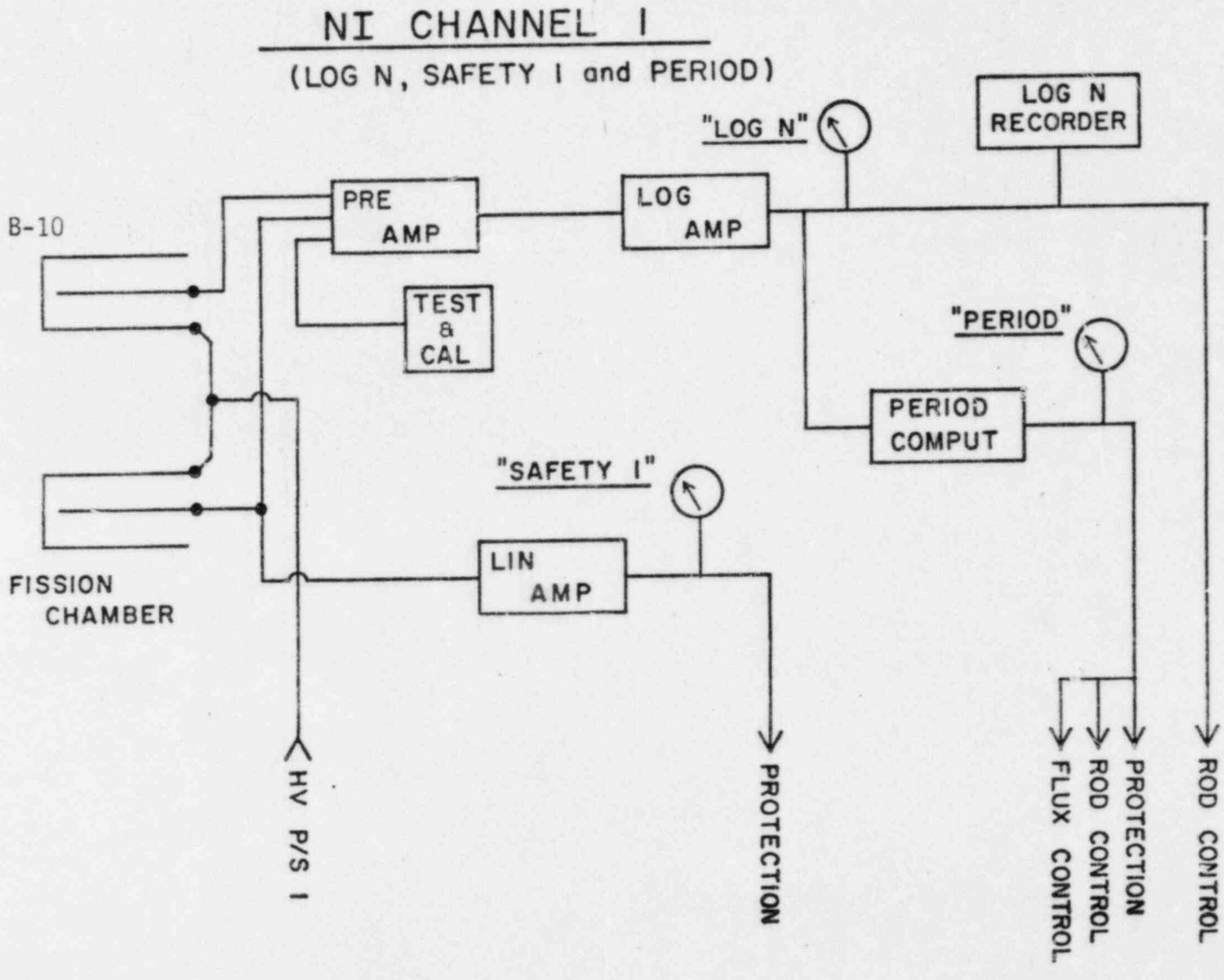

Figure 1-8. NI CHANNEL 1: UFTR Nuclear Instrumentation Channel 1 Diagram (Log N, Safety #1 and Period Channels).

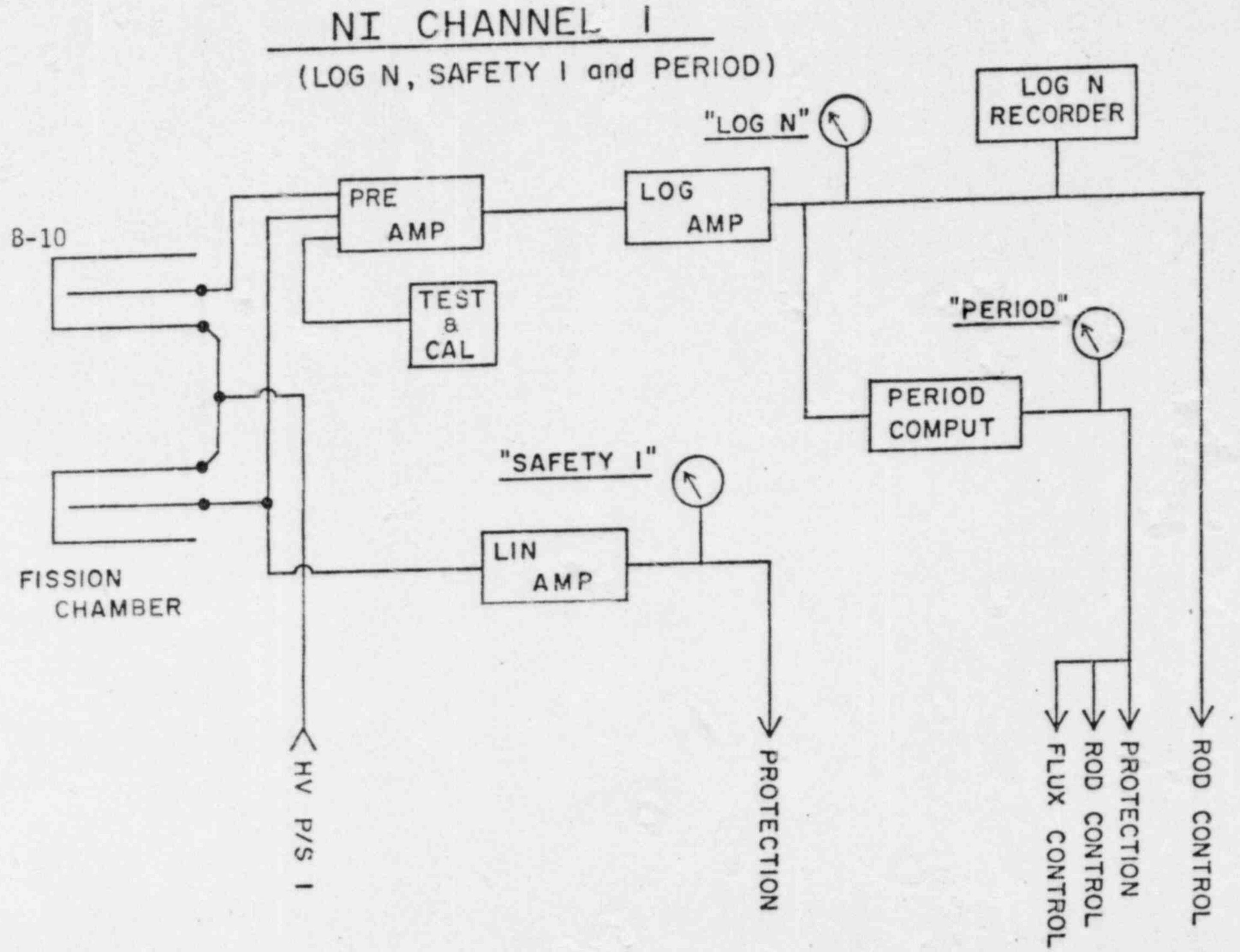

Figure 7-3. UFTR Nuclear Instrumentation Channel 1 Schematic (Log N, Safety #1 and Period Channels).

servo amplifier, the signal is compared with the signal from the servo flux control.

7.2.2.2.2 Safety Channel #2. As indicated in Figure 7-4, the safety channel receives a signal from an uncompensated ion chamber and consists of the ion chamber (with an independent high voltage supply), an operational amplifier, an adjustable bi-stable trip, and a meter ranging from 1% to 150% rated power. The Safety Channel #2 system initiates a reactor trip at 125% power. Safety Channel #2 also initiates a reactor trip whenever the high voltage applied to the chamber drops by 10%. The channel also generates test signals to check the functioning of the channel.

7.2.3 Non-Nuclear Instrumentation Channels

The UFTR is supplied with several process instrumentation channels to monitor the normal operation of the various systems, to aid in maintaining a steady-state power level and to trip the system whenever a potentially unsafe situation occurs or an instrument fails. Other channels supply information needed to safely operate the reactor but do not have protective functions. These Non-Nuclear Instrumentation Channels are described in the next four subsections.

7.2.3.1 Control-Blade Drive System. The control-blade drive circuit is shown in Figure 7-5; it consists of switches and indicating devices used in operating the four control blade drives. The twelve backlit push button switches are arranged in the center of the control panel in three rows of four vertical sets, one set for each control blade. Each set of switches contains a white DOWN switch, a red UP switch, and a yellow ON (magnet on) switch.

When the white DOWN light is illuminated, the control blade drive motor power circuit is prevented from drive action via the down backlit pushbutton switch. When the red UP light is illuminated, control blades in manual control are similarly prevented from up motion. The yellow ON light is series-connected in the magnetic clutch power circuit so that if the yellow light is on, the magnetic clutch is energized; if the yellow ON light is off, the magnetic clutch is deenergized.

When any ON push button switch is depressed, magnet current is interrupted by actuation of the backlit switch, and the ON light remains extinguished for as long as the switch is depressed. If the control blade is above its down limit, the blade will gravity fall back into the core. Turning off the reactor key has the same effect. In the event of a loss of power, these blades fail safe, falling into the core by gravity.

7.2.3.2 Control-Blade Withdrawal Inhibit System. The Control Blade Withdrawal Inhibit System is depicted in Figure 7-5; this Inhibit System is part of the reactor protection system and functions to prevent blade withdrawal for the following conditions:

1. Insufficient neutron source counts to assure the proper functioning of the source level instrumentation. A minimum source count rate of 2 cps (as measured by the wide range drawer operating on extended range) is required by the technical specifications.

2. A reactor period of 10 seconds or faster.

3. Safety Channels 1 and 2 and wide range drawer Calibrate (or Safety 1 Trip Test) switches not in "OPERATE" or "OFF" condition. This inhibit condition assures the monitoring of neutron level increases and prevents disabling protective functions as control blades are raised.

4. 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. This multiple blade withdrawal interlock is provided to prevent exceeding the maximum reactivity addition rate authorized by the UFTR Technical Specifications.

5. Power is raised in the automatic control mode at a period faster than 30 sec. The automatic controller action is to inhibit further regulating blade withdrawal or drive the regulating blade down until the period is greater than or equal to 30 seconds.

7.2.3.3 Automatic Control System. The UFTR Automatic Control System is used to hold reactor power at a steady power level during extended reactor operation at power and may be used to make minor power changes within the maximum range of the switch setting. While the automatic mode of reactor control is selected, the manual mode of operation is disabled; the control mode switch must be placed back in MANUAL before the regulating blade will respond to its UP or DOWN control switches. The neutron flux controller shown in Figure 7-6 compares the linear power signal from the pico-ammeter with the power demand signal and moves the regulating blade in order to reduce any difference, thereby maintaining a steady power level.

7.2.3.4 Process Monitoring and Control Systems:

7.2.3.4.1 Primary Coolant System: A primary coolant flow monitor, with a sensor located in the primary fill line, indicates flow at the control console and prevents reactor operation, or trips the reactor, if flow is below the set point of 30 gpm (normal flow is about 40 gpm).

A coolant flow switch, located in the return line of the primary coolant system to the primary coolant storage tank, initiates a reactor trip in case of a loss of return flow. This flow switch serves as a backup for the low flow reactor trip in the fill line and activates only after the return line has been drained of water or the flow is reduced to less than about 10 gpm.

A sight glass, attached to the north wall of the reactor room, at the east side of the primary equipment pit, shows the water level in the core allowing a visual check of the primary coolant level. A float switch, located behind the sight glass, is wired to the reactor protection system. It prevents reactor operation, or activates the reactor trip system, when the water level in the core is below pre-set limits.

Type "T" (copper-constantan) themocouples are located at each of the fuel box discharge lines to monitor water temperature from each fuel box to the primary coolant storage tank, and 2 thermocouples monitor the temperature of the bulk primary water going to and exiting from the core. The temperature information is sent to the 12 point recorder in the reactor control room. If any monitored temperature point exceeds preset levels, an audible alarm occurs at 150°F, and the reactor trips at 155°F.

A resistivity meter mounted on the east wall of the control room enables monitoring resistivity of the primary coolant and functioning of the primary coolant purification demineralizer system. The meter annunciates if system resistivity drops below an adjustable, preset value.

To monitor water leakage from any source into the primary equipment pit, a level switch in a small sump at the lowest point of the pit floor will activate an alarm upon collecting as little as two cups of water. The primary equipment pit sump alarm annunciates at a control unit mounted on the east wall of the control room.

7.2.3.4.2 Secondary Coolant System: The principal source of cooling water to remove reactor heat is the deep well, nominally rated at 200 gpm. A reduction of flow to 140 gpm will illuminate a yellow warning light on the right side of the control console. A reduction of flow to 60 gpm will illuminate a red scram warning light on the right side of the console, and will illuminate a red warning light on the secondary flow scram annunciator light. Ten seconds later, the trip will occur. When using city water for reactor cooling, a low water flow of 8 gpm will trip the reactor. In either instance, the trip function is active only when reactor power is 1% or higher. A key operated switch on the console rear door switches secondary scram modes between well water or city water modes of operation.

7.2.3.4.3 Shield Tank System: A water level switch in the top of the reactor shield tank will trip the reactor when the water level drops below a preset value. This switch prevents reactor operation because of shield tank water loss due to evaporation or leakage. The purification loop on the west side of the shield tank has a flow indicator to monitor proper functioning of the loop.

7.3 Reactor Trip System

The UFTR facility is provided with two types of reactor trips, both initiating the gravity insertion of all the control blades into the core. These reactor trips can be classified into two categories:

1. Nuclear Instrumentation Induced Trips, which involve the insertion of the control blades into the core and the dumping of the primary water into the storage tank (this type of trip will dump primary water only if 2 or more control blades are not at bottom position);

2. Process Instrumentation Induced Trips, which involve only the insertion of the control blades into the reactor core (without dumping of the primary water). Figure 7-7 shows a schematic diagram of the Protection System provided for the UFTR.

7.3.1 Nuclear Instrumentation Induced Trips (Full Trips)

One of five conditions must exist for the initiation of the Reactor Trip System with dump of primary water (Nuclear-Type Trip); these five conditions include:

1. Fast Period (3 seconds or less),
2. High Power, safety channel #1 (125%) or safety channel #2 (125%),
3. Reduction of high voltage to the neutron chambers of 10% or more,
4. Turning off the console magnet power switch.
5. A.C. power failure (fail-safe criterion).

7.3.2 Process Instrumentation Induced Trips (Blade-Drop Trips)

The conditions which must exist for the initiation of the Reactor Trip System without dump of primary water (process type trips) include:

1. Loss of power to the Reactor Vent Blower System.
2. Loss of power to Reactor Vent Diluting System.
3. Loss of power to the secondary system deep well pump when operating at or above 1 Kw and using this system for secondary cooling.
4. Dropping of secondary flow below 60 gpm (normal flow 200 gpm, alarm at 140 gpm) when operating at or above 1 Kw when using the well water system for secondary cooling.
5. Dropping of secondary flow below 8 gpm when at or above 1 Kw when using city water for secondary cooling.
6. Drop in water level of the shield tank (about 4 in.)
7. Loss of power to primary coolant pump.
8. Reduction of primary coolant flow (normal 40 gpm, trip at 30 gpm); flow sensor is located in the fill line.
9. Loss of primary coolant flow (return line).
10. Reduction of primary coolant level.
11. High temperature primary coolant return from the reactor (alarms at 150°F, trips at 155°F).
12. Manual reactor trip button depressed.

A set of annunciator lights located on the left side of the control console indicates all scrams and 3 interlock conditions. In case of high reactor temperature, an audible alarm is set off at 150°F and the reactor trips at 155°F. The alarm continues to sound until the indicated temperature drops below 150°F.

A red rotating beacon located in the reactor cell together with three "reactor on" lighted signs located on the outside of the east side of the Reactor building on the second floor level, on the entrance hallway leading to the control room, and on the north outside reactor building wall, are all energized whenever the console key switch is turned to the "ON" position.

7.4 Engineering Safety Feature System

As explained in Chapter 6, there are no separate Engineered Safety Features required in the UFTR aside from those built-in into the facility. Therefore, no instrumentation or control system relative to this system is present.

7.5 Systems Required for Safe Shutdown

The only system required for normal safe shutdown is the safety-control blades drive instrumentation channels allowing the operator to insert the blades into the core to shut the UFTR system down. Proper blade movement can be observed at the display panel where the four blade position indicators are located. In addition, the nuclear instrument channel read-outs provide another way for determining proper decrease in power for reactor shutdown. Nevertheless, the only system really necessary for reactor shutdown is the control blade drive system. In case of failure of this system on a loss of power, the control blade system is designed to fail safe; the blades drop by gravity into the system to shut the reactor down. A semi-annual measurement is made of blade drop times which must be less than 1 second. Normal times are about 0.5 second. If the control blades do not function properly and the core overheats, the negative void and temperature coefficients will cause the core to go subcritical and shut down even without insertion of the control blades. Therefore, instrumentation is not an absolute necessity for shutting the UFTR down because of its inherent safety features. In addition, the reactor can be made subcritical and power reduced by the operator-initiated action of dumping the primary coolant.

7.6 Safety-Related Display Instrumentation

Readouts from all of the nuclear instrumentation and non-nuclear instrumentation channels displayed at the reactor console are described in Section 7.2.1.

The reactor vent system effluent monitor consists of a GM detector and preamplifier, which transmits a signal to the control room to monitor the gamma activity of the effluent in the downstream side of the absolute filter, before dilution occurs. The stack monitoring system also consists of a log rate meter-circuit and indicator, a strip chart recorder, and an auxiliary log rate meter with an adjustable alarm setting capability for monitoring the gross activity concentration of radioactive gases in the room effluent air entering the stack. If the activity reaches the preset (fixed) alarm level or if activity reaches the auxiliary alarm setpoint (operator adjusted to the highest power level permitted or expected during the operation) the monitor will actuate an audible alarm in the control room.

A complete area radiation monitoring system consisting of three independent area monitors with remote detector assemblies and interconnecting cables, and strip chart recorders and count rate meters is available. The signals from these detectors are sent directly to the log count rate meter and recorder, monitoring the gamma activity in the reactor room. Each detector has an energy compensated Geiger Counter with built-in Kr-85 check source which can be operated from the control room. Two levels of alarm are provided. The high level latches in the alarm mode to preclude false indication if a high level of radiation saturates the detector. Any two of the monitors seeing a high level of radiation will automatically actuate the building evacuation alarm. Actuation of the evacuation alarm automatically trips the reactor cell air conditioning system and both the diluting fan and the vent fan.

The stack monitor and 3 area monitor modules in the control room are equipped with test switches and green 'NO FAIL" lights that go out if the modules do not receive signal pulses from the detectors. Floating battery packs supply power to the units in the event of electrical power loss.

The reactor cell air monitoring system is equipped with a flow indicator (LPM), a strip chart recorder and an audible and visible alarm setting. The monitor is a lead-shield, compact airborne particulate Geiger Counter detector.

The portal monitoring system outside the airlock leading from the reactor cell is a Beta-Gamma Portal Monitor (Model PCM-4A) console and portal frame. It contains (eight) channels of Geiger tube detectors providing complete head to foot coverage of beta-gamma radiation plus individual alarm lights for each channel. An audible alarm will be activated any time the preset (count rate limit) is exceeded.

7.7 All Other Instrumentation Systems Required for Safety

There are no other instrumentation systems required for the safe operation of the UFTR; all the necessary instrumentation has been covered in previous sections of this chapter.

7.8 Control Systems Not Required for Safety

There are no control systems in the UFTR facility which do not have safety related functions as considered in this Safety Analysis Report. Consequently, all UFTR control systems have already been described in the preceding sections. Even those controls which do not have a safety operational function do have a safety function in the sense of providing information on safe UFTR operation through read-outs supplied by the appropriate monitoring control.