ARMED FORCES RADIOBIOLOGY RESEARCH INSTITUTE
8901 WISCONSIN AVENUE
BETHESDA, MARYLAND 20889-5603

5002
25 March 99

RSDR

SUBJECT: Submission of Anr.ual Report

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

Dear Sir:

Attached please find the 1998 Annual Report for the AFRRI TRIGA reactor facility, submitted as required by license R-84, facility docket 50-170.

Should you nee. .ny further information, please contact the undersigned at (301) 295-1290.

Attachment:
as stated

Stephen Miller
Reactor Facility Director

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U.S. Nuclear Regulatory Commission
ATTN: Mr. Marvin Mendonca, Mail Stop 11B20
Washington, DC 20555

Regional Administrator
U.S. Nuclear Regulatory Commission, Region I
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475 Allendale Road
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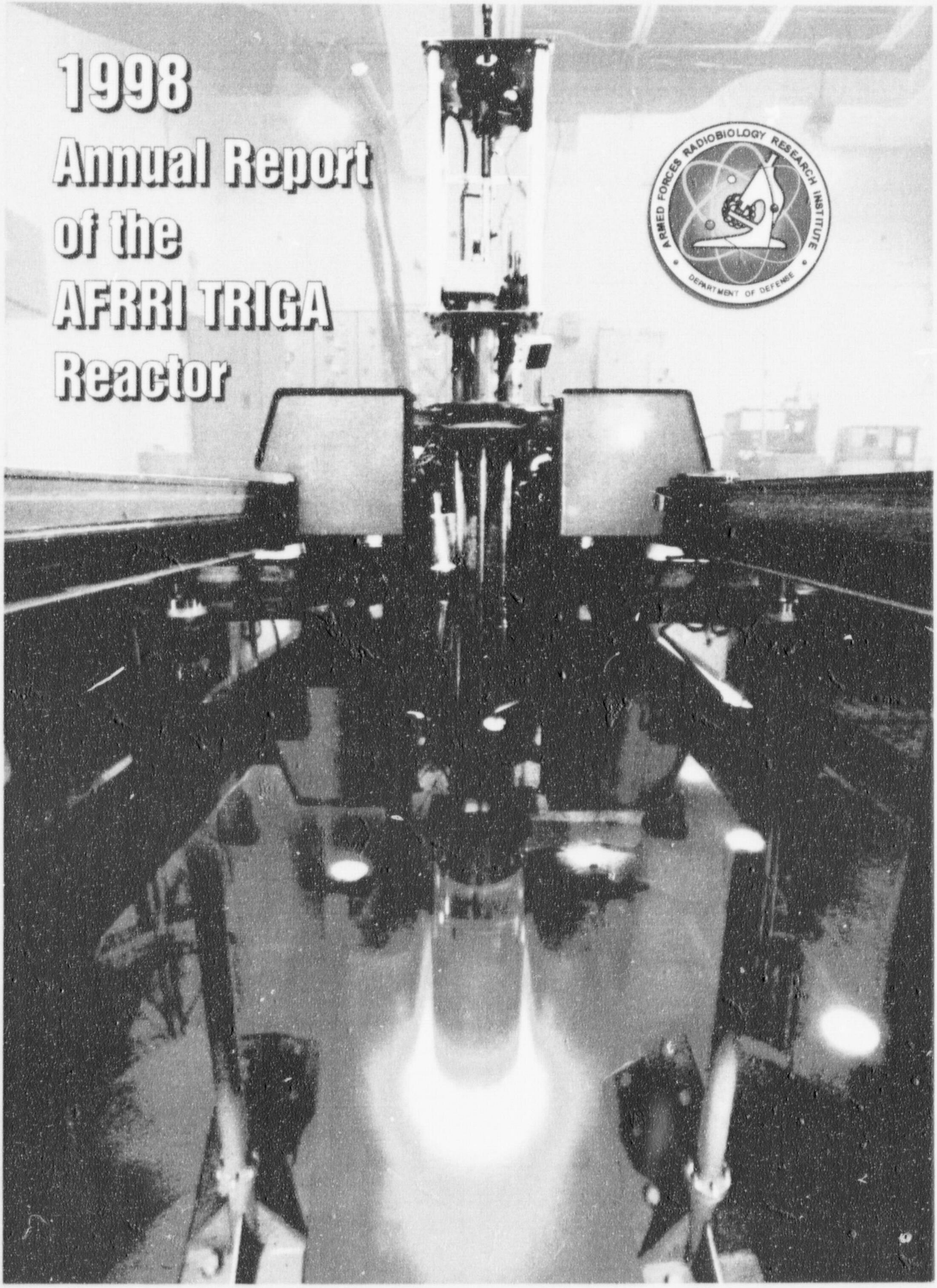
1998 Annual Report of the AFRRI TRIGA Reactor



Submission of 1998 Annual Report

Submitted by

3/25/99

STEPHEN I. MILLER
Reactor Facility Director

Date

Approved

25 Mar 99

ROBERT R. ENG
COL, MS, USA
Director

Date

Armed Forces Radiobiology Research Institute
AFRRI Triga Reactor Facility

1 January 1998 - 31 December 1998

To satisfy the requirements of
U.S. Nuclear Regulatory Commission, License No. R-84 (Docket No. 50-170),
Technical Specification 6.6.1.b.

The Reactor Facility Director acknowledges the participation of the following personnel for their contributions to this annual report.

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ET1 Steven Pierson, USN
John Nguyen

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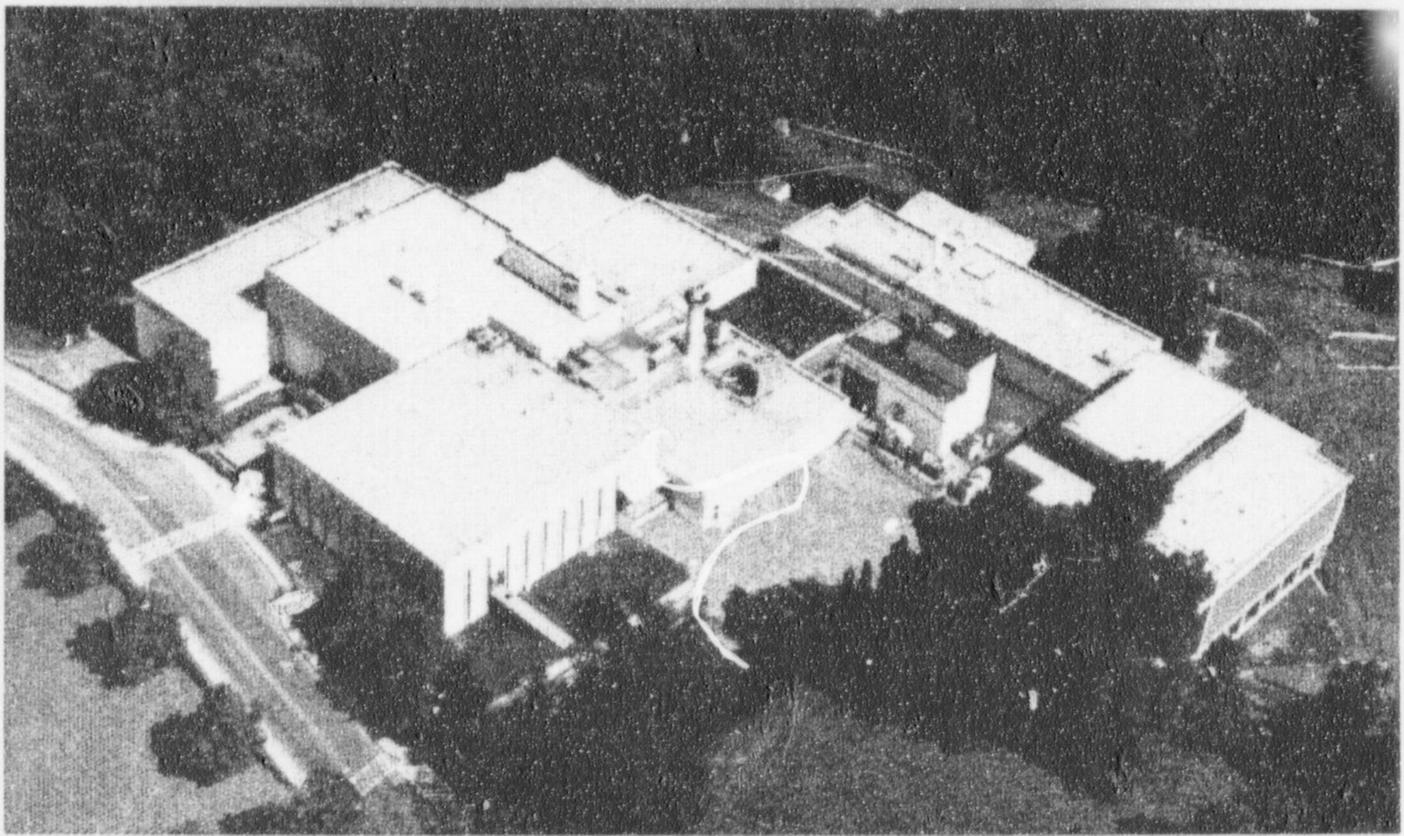
1998 Annual Report of the AFRRI TRIGA Reactor



Docket 50-170 License R-84

Submitted by
Stephen Miller
Reactor Facility Director

1998 ANNUAL REPORT

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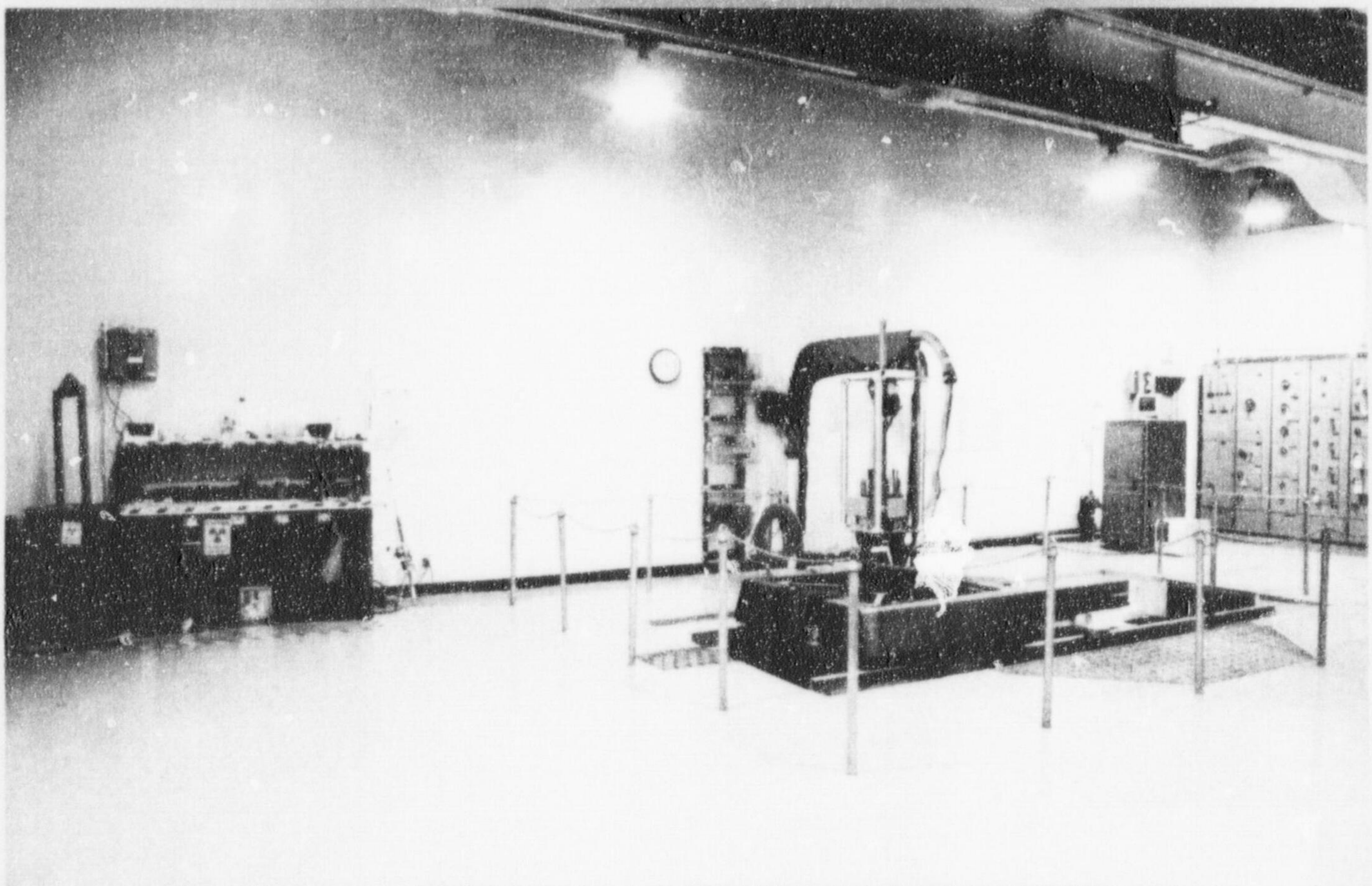
Introduction



1998 ANNUAL REPORT

INTRODUCTION

The AFRRI reactor facility was available for irradiation services throughout the year except for two nonoperational periods: heat exchanger replacement and annual reactor maintenance shutdown.

A plate and frame heat exchanger was installed in July. A bypass valve was added to the primary side of the heat exchanger to allow primary and purification systems to continue operating when the heat exchanger is disassembled for maintenance. The new exchanger is physically smaller but matches the heat transfer specifications of the original unit. The replacement of the heat exchanger is part of a continuing effort to maintain and upgrade the reactor facility to the highest possible standards.

The Nuclear Regulatory Commission inspected the AFRRI TRIGA Reactor during 1998. No violations were issued.

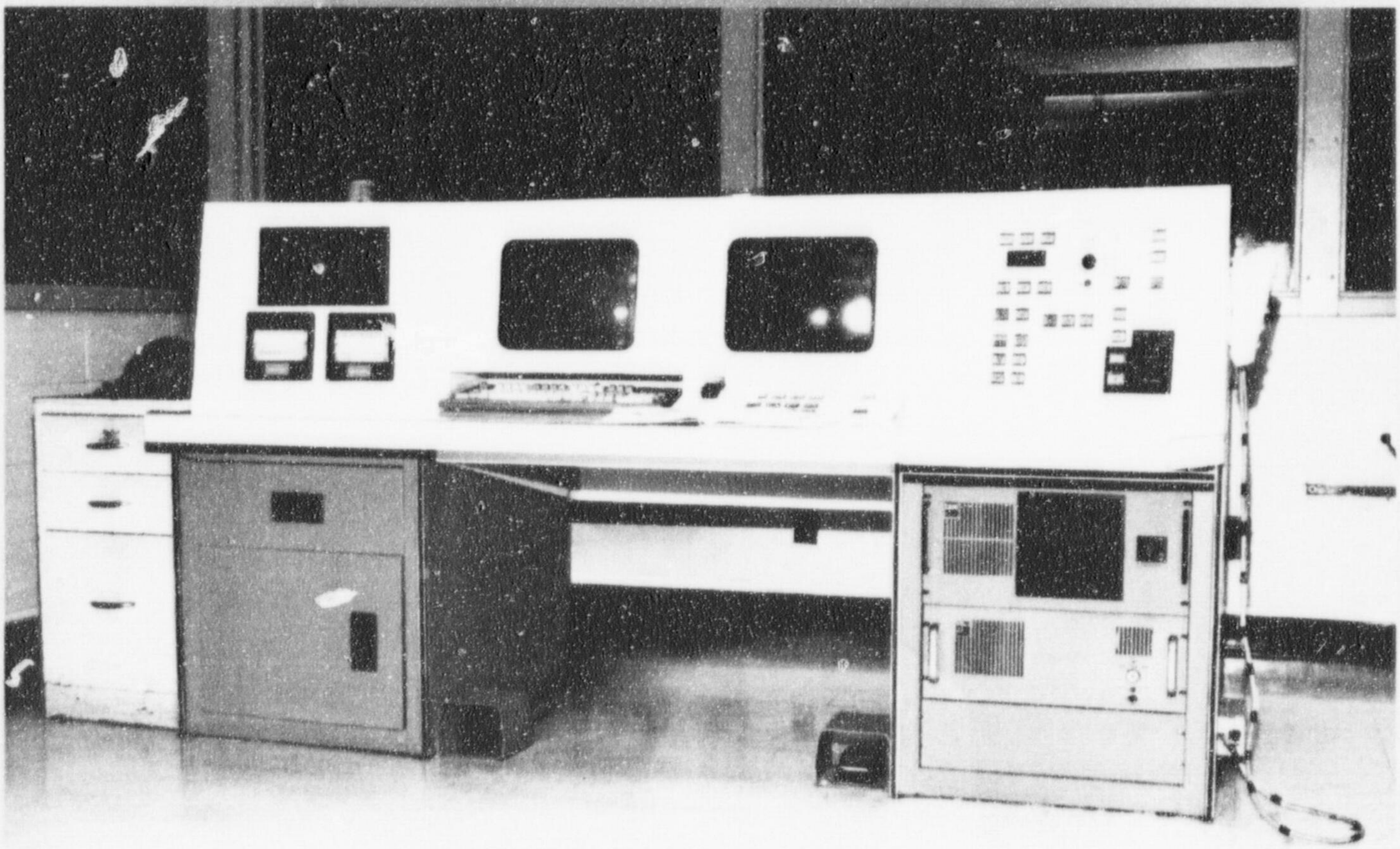
Staff time was utilized in numerous projects throughout 1998. Acquisition and installation of a multichannel analyzer was completed to enhance the reactor staff's ability to perform neutron activation analysis. Multiple experimental arrays were constructed to meet the rigid neutron energy spectrum requirements of one investigator. Reactor staff also participated in public relations projects in the Washington D.C. area.

Changes were made to various procedures and facilities during 1998 in accordance with the provisions of 10 CFR 50.59. Summaries of modifications are found in Sections I and V.

The reactor staff personnel were provided to conduct a peer review of the reactor facility at Cornell University in Ithaca, New York.

The remainder of this report is written in the format designated in AFRRI's TRIGA Reactor Technical Specifications. Items not specifically required are presented in the General Information section. The following sections correspond to the required items listed in Section 6.6.1.b of the specifications.

General Information



- Key Personnel
- Reactor and Radiation Facility Committee

GENERAL INFORMATION

All personnel held the listed positions throughout the year unless otherwise specified.

Key AFRRI administration personnel (as of 31 December 1998) are as follows:

1. Director: COL Robert R. Eng, MS, USA

   Chairman, Radiation Sciences Department: CAPT James Malinoski, MSC, USN

   Radiation Protection Officer: Maj Bruce White, USAF

2. Reactor Facility Director and Senior Reactor Operator (SRO): Stephen Miller

3. Reactor Operations Personnel:

   Reactor Operations Supervisor: Robert Marté (SRO)

   Training Coordinator: Robert Marté (SRO)

   Maintenance: John Nguyen (SRO)

   Records Administration: SFC Samuel Osborne, USA (SRO)

   Senior Staff Engineer: MAJ Kenneth L. Wrisley, CM, USA (SRO)

4.	Other Senior Reactor Operators:	CPT Michael Ortelli, FA, USA (3 September 1998) SFC William Baxter, USA (3 September 1998)
5.	Operator Candidates:	ET1 Steven Pierson, USN (24 August 1998) HM1 Deborah Gilchrist, USN (18 July 1997)
6.	Newly Licensed Operators:	MAJ Kenneth L. Wrisley, CM, USA (3 September 1998) SFC Samuel Osborne, USA (3 September 1998) CPT Michael Ortelli, FA, USA (3 September 1998) SFC William Baxter, USA (3 September 1998)
7.	Additions to staff during 1998:	ET1 Steven Pierson, USN (24 August 1998)
8.	Departures during 1998:	None

9. There was one staff change and one substitution to the Reactor and Radiation Facility Safety Committee (RRFSC) during 1998. Dr. Leslie Mckinney was removed as a nonvoting member from the committee. Mr. Marté acted as the recorder for the RRFSC for the December meeting. In accordance with the requirements set forth in section 6.2.1.1. of the AFRRI Reactor Technical Specifications, the 1998 RRFSC consisted of the following voting members as of 31 December 1998.

Regular Members:
Maj Bruce White (Radiation Protection Officer)
Stephen Miller (Reactor Facility Director)
Marcus Voth (Reactor Operations Specialist)
William Powers (Health Physics Specialist)

Chairman:
Col Curtis Pearson, USAF, MSC (Director's Representative)

Special Member:
CAPT James Malinoski, MSC, USN (Chairman, Radiation Sciences Department, AFRRI)

Additional Nonvoting Member:
Edward Herbert, Montgomery County Government (Environmental Protection Agency)

Recorder:
SFC Samuel Osborne, USA

As required by the Reactor Technical Specifications, four meetings of the RRFSC were held:

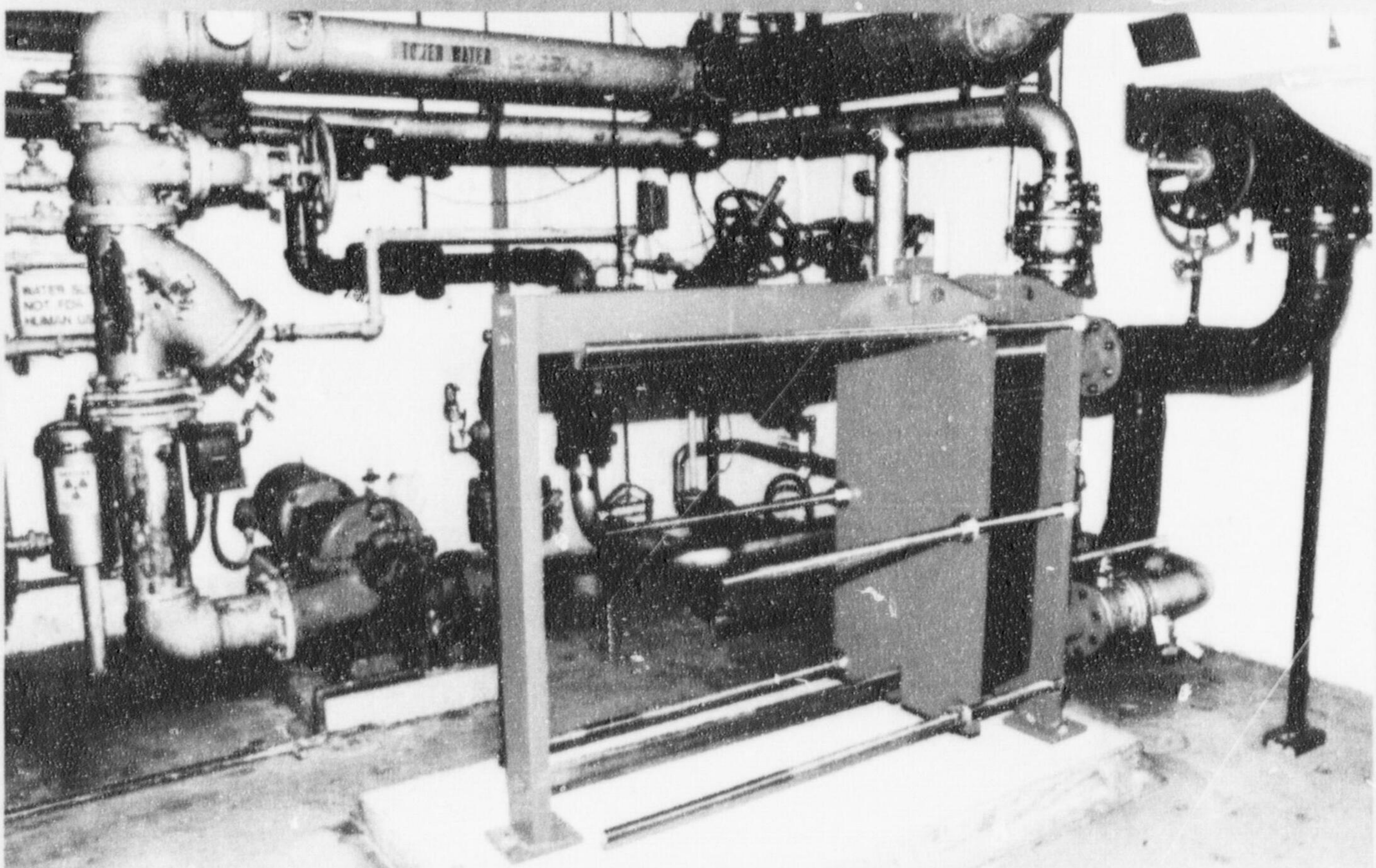
13 April 1998, Full Committee Meeting,

13 June 1998, Full Committee Meeting,

15 October 1998, Full Committee Meeting, and

4 December 1998, Subcommittee Meeting.

Section I



- Changes to the Facility Design, Performance Characteristics and Operational Procedures
- Results of Surveillance Tests and Inspections

SECTION I

Changes in the Facility Design, Performance Characteristics, Administrative Procedures, Operational Procedures, and Results of Surveillance Test and Inspections.

A summary of changes to the facility design, performance characteristics, administrative procedures, and operational procedures, and the results from surveillance testing are provided in this section. Revised reactor administrative and operational procedures are in attachment A, and the 10 CFR 50.59 reviews are in attachment B.

A. DESIGN CHANGES:

There were six design changes in the facility during 1998.

1. A voltmeter was added to the stack gas monitor (SGM) to continuously measure the high voltage to the SGM detector. This meter allows easier verification of the correct SGM operating voltage.

2. The reactor distillation unit was removed from the water makeup system and replaced with the AFRRI water purification system. The AFRRI system can provide a larger volume of water at a faster rate than the existing reactor distillation unit could provide. The water reservoir remains. This change improves the capabilities of the water makeup system.

3. Radiation Area Monitors (RAM) R1 and R5 were relocated from over the reactor tank to locations on the east wall of the reactor room. This change resulted from an inspector's comments regarding the adjustment of the RAM set points for high power reactor operations. The new locations were chosen based on the areas where people are most likely to be working in the reactor room.

4. A water spigot was added inside the reactor cooling tower to allow for a hose hookup. Cooling fins in the tower nearly reach the bottom of the tower, making it difficult to brush calcium deposits from under the fins. The hose allows deposits to be easily removed from under the fins.

5. Check valves were added to the air system for the lead shield door bearing. The check valves will prevent the backflow of water into the bearing cup should air pressure be lost. In addition, a pressure sensor was added to the reactor air system to notify the front desk in the event that air pressure is lost. These changes, in conjunction with the bearing cup design, will ensure that the air bearings are kept dry.

6. The reactor tube and shell heat exchanger was replaced with a plate and frame heat exchanger. The new heat exchanger was installed in room 2158. This location is above

the old unit and above the level of the core. The new exchanger provides the same thermal transfer capacities as the original unit but occupies a smaller area. Some of the aluminum piping in the primary system was replaced with stainless steel piping. Analysis of the stainless steel piping and stainless steel plates in the heat exchanger showed that the replacement would not create an activation problem from ions dissolving into the primary water. A bypass valve was added to the primary side of the exchanger to allow the primary and purification systems to continue operating while the heat exchanger is disassembled during maintenance. This upgrade to the facility will prevent future problems with the aging exchanger and allow for easier maintenance.

B. PERFORMANCE CHARACTERISTICS:

No changes to the core occurred during 1998. All fuel, chambers, and the core experiment tube (CET) remained in place for operations throughout the year. The performance characteristics of the core did not change.

C. ADMINISTRATIVE PROCEDURES:

Four modifications to the Safety Analysis Report (SAR) were made in 1998.

1. All references to the criticality monitor, RAM R5, were removed from the SAR. This change coincides with the movement of RAMs R1 and R5 as described in part A of this section. Discussions with the NRC inspector and research in Title 10 CFR showed that a criticality monitor is not required for an operating reactor facility.

2. A reference to a patch panel, which had been removed from the facility, was removed from the SAR. A panel for coax cables had been attached to a wall outside a reactor exposure room for connecting the dosimetry readout room with chambers inside the exposure rooms. The patch panel was removed when new cables were run directly from the readout room to each exposure room. The reference in the SAR was removed after the panel was removed.

3. The accidental criticality monitors were removed from the reactor facility as well as all references to them in the SAR. This type of criticality monitor is used to detect accidental criticality at fuel fabrication facilities and are not required in this type of facility.

4. The SAR was changed to reflect the plate and frame heat exchanger installation. The description of the tube and shell exchanger was removed, and a description of the plate and frame exchanger was added. Drawings of the coolant water system were also updated.

D. OPERATIONAL PROCEDURES:

1. Procedure C006, Stack Gas Monitor Calibration, was changed to add the calibration of the voltmeter that continuously measures the detector high voltage power supply.

2. The instructions on how to replace the resin beds in procedure M042, Change Resin Beds for Water Makeup System, were changed from the still resin beds to the resin beds for the water makeup system. The reactor now receives purified water from the AFRRI water system. The water then runs through two additional resin beds before being adding to the reactor holdup tank. Procedure M042 provides instructions on how to change the two additional resin beds.

3. Startup and safety checklists were revised twice during 1998. The alarm set points were changed to 10 mRem for RAMs R1 and R5 when the RAMs were relocated. The second revision involved the accepted pressure range at the output of the primary pump, because the new exchanger presents less resistance to the flow of water, the output pressure from the water pump dropped from 21 psi to 13 psi. Wording changes in the procedures involved modifying Section VI, Line 8(b) where "Alarm check" was changed to "SGM High Indicator Check", Section VI, Line 8(d) "High alarm set to" was changed to "High alarm point set to", and line 12 was clarified as "Demineralizer Inlet Temperature." The startup checklist had one additional change to line 15: "Time Delay Operative" was moved below line 17, "Prestart operability checks performed."

4. Two modifications were made to the Shutdown Checklist during 1998. The alarm set points were changed to 10 mRem for RAMs R1 and R5 when the RAMs were relocated. The second change involved the accepted pressure range at the output of the primary pump. Because the new heat exchanger presents less resistance to the flow of water, the output pressure from the water pump dropped from 21 psi to 13 psi.

5. The term "Criticality Monitor" and its set points were removed from procedure 8, Tab C, Nuclear Instrumentation Set Points, in response to moving the RAM as discussed in part A of this section.

6. Procedure 8 TAB G1 was changed to eliminate adjusting the RAM alarm points during high power operations. This change was part of the RAM movement as discussed in part A of this section.

7. Procedure 8, Tab G2 was modified twice in 1998. The first change was to eliminate adjusting the RAM alarm points due to the movement of the RAMs. The second was to clarify from what power level a subcritical pulse may be fired.

8. The word "criticality" was removed from Procedure 8, TAB H, Weekly Operational Instrumentation Checklist, as part of the elimination of the criticality monitor.

9. Procedure 8, Tab F1 (Subcritical Square Wave Operations) was modified to clarify the equation for calculating the transient rod position. The equation did not change. Only the format in which the equation appears was changed for clarification.

10. Fitness for Duty Procedure, A1, was updated to remove references to employee termination and to allow prescription medication usage as long as the medication does not impair the performance of the operator. The previous version stated that "drug" users would be

terminated. Reactor management may relieve an operator from licensed duties but does not have the authority to terminate an employee. The current version reflects this position.

11. A line in Procedure 6, Emergency Procedures, was expanded to notify both the Reactor Facility Director and Emergency Response Team commander of the emergency situation.

12. Reactor Operations Procedure 8A was updated to remove references and recording requirements for the Senior Reactor Operator (SRO) on call, Health Physicist (HP) on call, and Person In Charge (PIC). The positions and recording of personnel filling the positions were moved to Procedure 8, Tab A. This change was implemented due to the use of a new set of logbook stamps that record this information for each reactor operation.

13. Procedure 8, TAB A, Logbook Entry Checklist, was updated in several places. Many of the changes were due to new logbook stamps. The stamps were updated to include blanks for the four positions required by Technical Specifications. When filled in, the blanks prove compliance to the Technical Specifications. Changes to the procedure include how to use the new stamps when filling out the operational logbook, who can be designated in each of the four positions on the stamp, and sample usage of the stamps for a typical day's operations. Under the green entries section, reactor calibrations and data were added for any data that the operator wishes to enter into the operations logbook. The color blue-black was removed as an acceptable color for use in the operational logbook. Various redundant statements were removed from this procedure.

14. In Procedure 11, Air Particulate Monitor (also called Continuous Air Monitor, CAM), the specification that the secondary chart recorder will be turned on when the primary CAM is bypassed was removed because the secondary CAM chart recorder operates continuously.

E. RESULTS OF SURVEILLANCE TESTS AND INSPECTIONS

All required maintenance and surveillance tasks during 1998 were accomplished.

Malfunctions are detailed in section IV, Safety-Related Corrective Maintenance..

The Nuclear Regulatory Commission inspected the reactor facility during 1998. AFRRI's programs were found to be in compliance with NRC requirements. No safety concerns or violations were identified. No noncompliance or significant issues were identified.

The inspector commented that two of the four technical specification positions required for operations were explicitly noted in the logbook but the other two were not. The reactor administrative staff agreed to change logbook entries to include all four positions, which were always filled but had not been explicitly noted in the logbook. This change was implemented with the use of new logbook stamps and various procedural changes previously described in Parts A and D of this section.

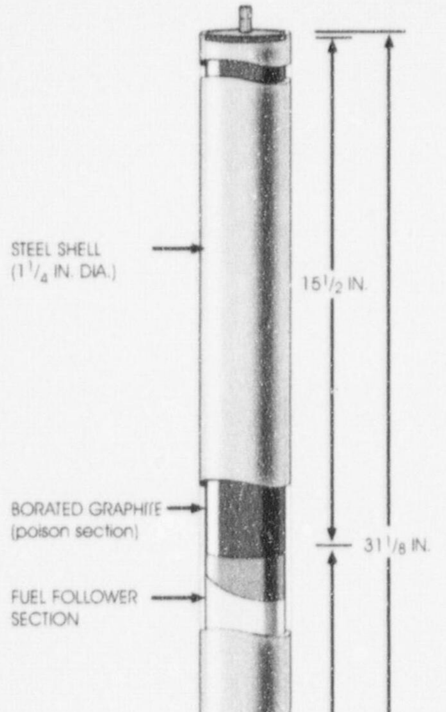
The inspector discussed year-2000 issues relating to the reactor console and other systems. The reactor facility is in the process of procuring an upgrade to the reactor console to make it fully year-2000 compliant. Tests have shown that the console will continue to operate properly when 1 January 2000 arrives.

The inspector noted reactor staff members adjusting the RAM set points several times a day to allow for various high-power reactor operations. The administration agreed to change the RAM system to eliminate the need to change set points. This change involved procedure and SAR changes as well as relocating the RAMs. These changes have been discussed in Parts A, C, and D of this section.

The inspector stated that facility changes were thorough and well documented, that the Radiation Protection Program was well maintained, that personnel in key positions were knowledgeable and had sufficient background to do their jobs, and that logs and records were maintained as required.

Section II

Standard Control Rod



- Energy Generated by Current Reactor Core and Number of Pulses $2.00 or Larger

SECTION II

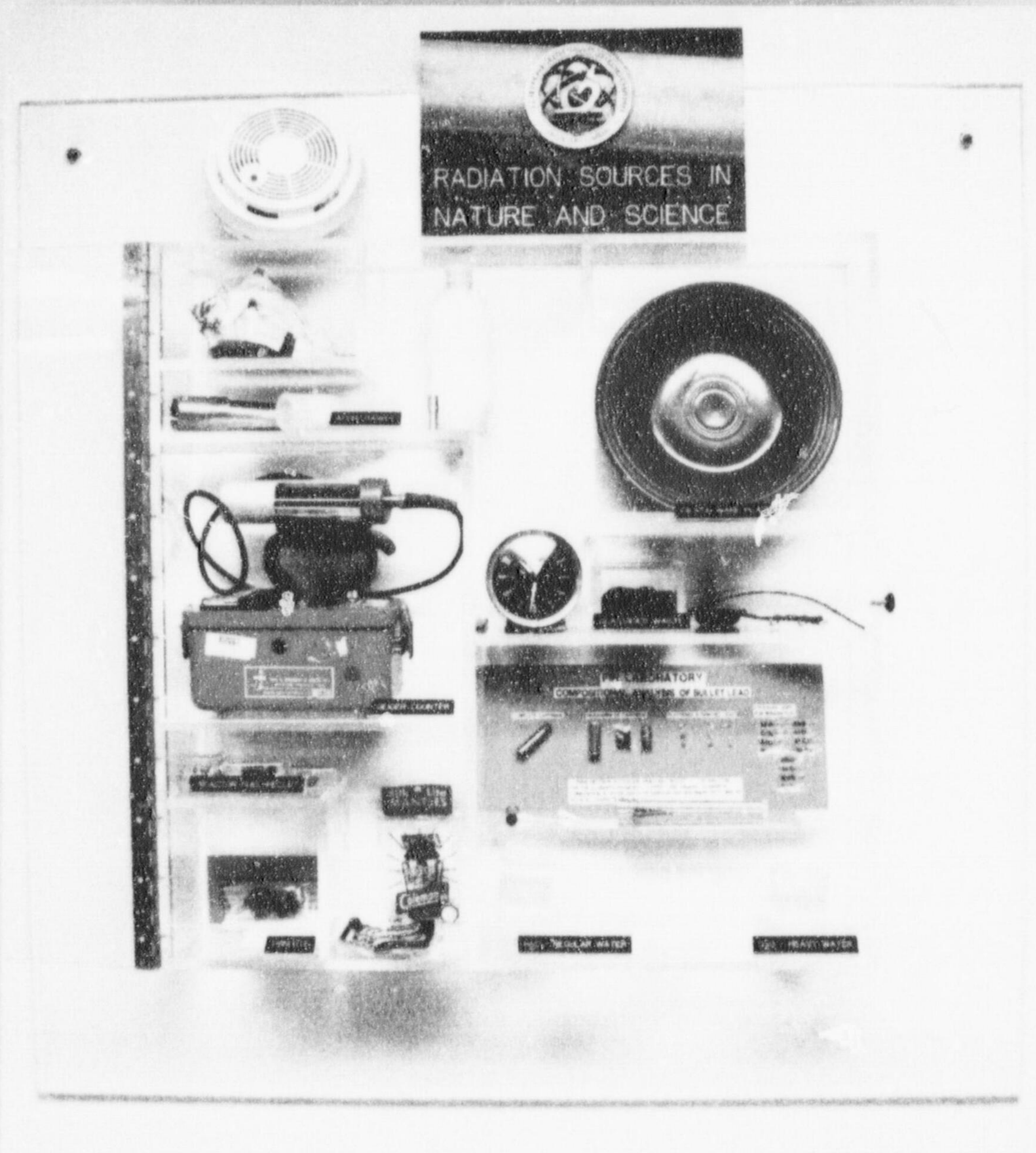
Energy Generated by the Reactor Core and the Number of Pulses $2.00 or Larger

Month	Kilowatt-hours
JAN	11,099.0
FEB	654.5
MAR	1,757.7
APR	647.6
MAY	1,293.9
JUN	2,436.9
JUL	35.4
AUG	81.9
SEP	1,538.3
OCT	3,565.3
NOV	275.8
DEC	4,775.1
TOTAL	28,161.4

Total energy generated in 1997:	28,161.4 kWhr
Total energy on fuel elements:	945,405.6 kWhr
Total energy on FFCRs*:	212,607.5 kWhr
Total pulses this year ≥ $2.00:	11
Total pulses on fuel elements ≥ $2.00:	4,206
Total pulses on FFCRs* ≥ $2.00:	94
Total pulses this year:	167
Total pulses on fuel elements:	11,451
Total pulses on FFCRs*:	1,686

*Fuel Following Control Rods

Section III



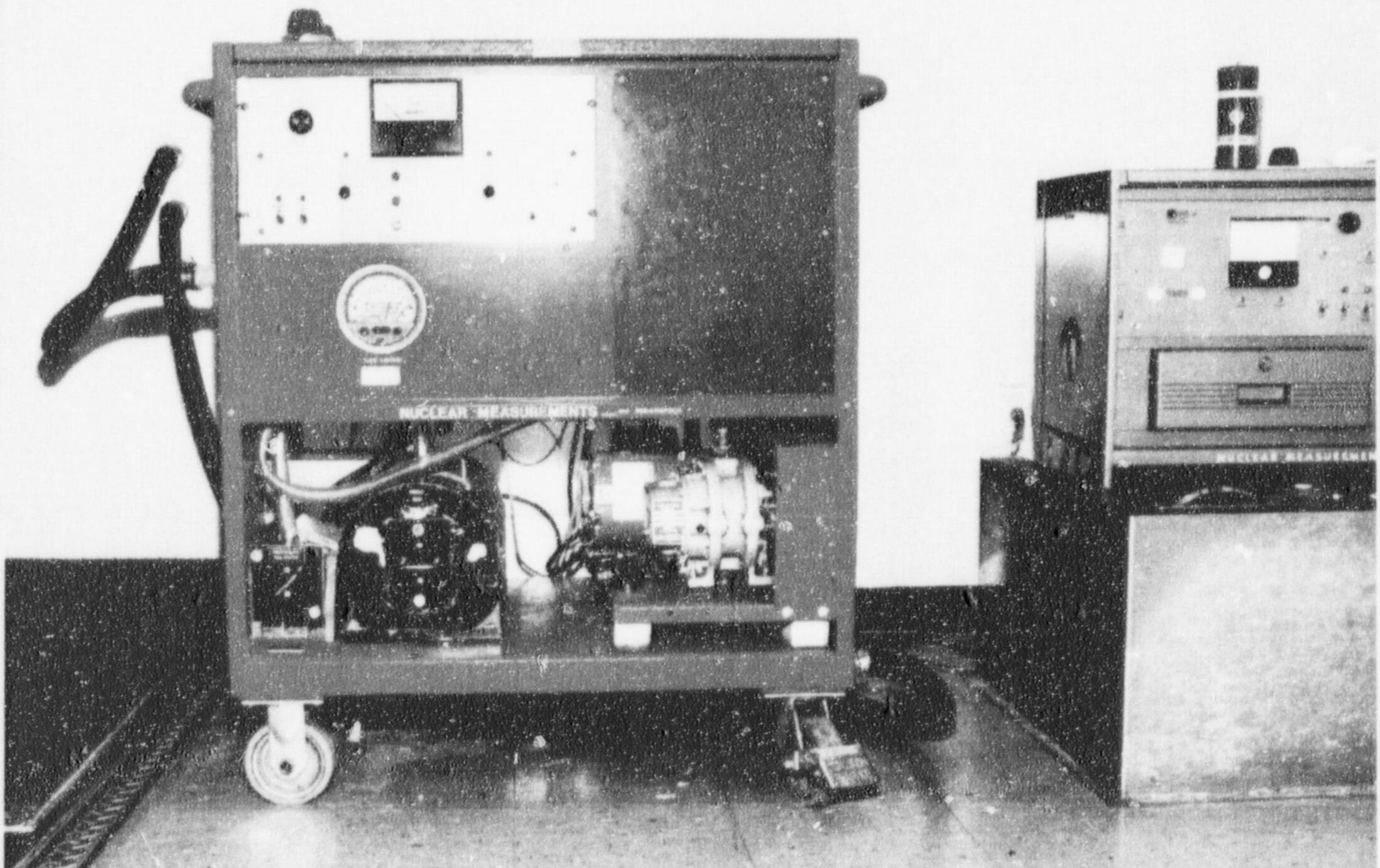
Unscheduled Shutdowns

SECTION III

Unscheduled Shutdowns

There were no unscheduled shutdowns in 1998.

Section IV



- Safety-Related Corrective Maintenance

SECTION IV

Safety-Related Corrective Maintenance

The following are excerpts from the malfunction logbook during the reporting period. The reason for the corrective action taken, in all cases, was to return the failed equipment to its proper operational status.

26 January 1998 — A daily test of the fuel temperature scram points showed a faster than normal ramp rate during the automated prestart tests. Manual tests of the fuel temperature scram circuits passed. During the automated scram test, a signal from the fuel temperature test action pack is ramped into the fuel temperature circuit to check the scram point of each fuel temperature channel. Because the fuel temperature test action pack supplies the ramp signal for both fuel temperature channels, the unit was replaced with a new calibrated unit. The new unit provided the proper ramp rate and allowed the prestart tests to pass.

05 February 1998 — The stack gas monitor air pump was found not operating during the daily instrumentation startup checklist. Diagnosis found the fuse holder for the pump motor had broken. A new fuse holder was installed, and the pump operated properly. The stack gas monitor passed the daily tests and was placed back on line.

27 May 1998 — The float in the cooling tower that controls the addition of makeup water into the cooling tower was found broken off its stem. This makeup water float works like a toilet bowl float. The broken float allowed a continuous stream of water to flow into the cooling tower sump. When the water added filled the cooling tower sump, the water flowed over a stand pipe and down the drain. The secondary system is isolated from the primary water system, and consists of normal tap water. A new float was ordered, and the make up water system was repaired. During the time the water in the cooling tower was shut off, the secondary system, which uses the cooling tower, was also shut off.

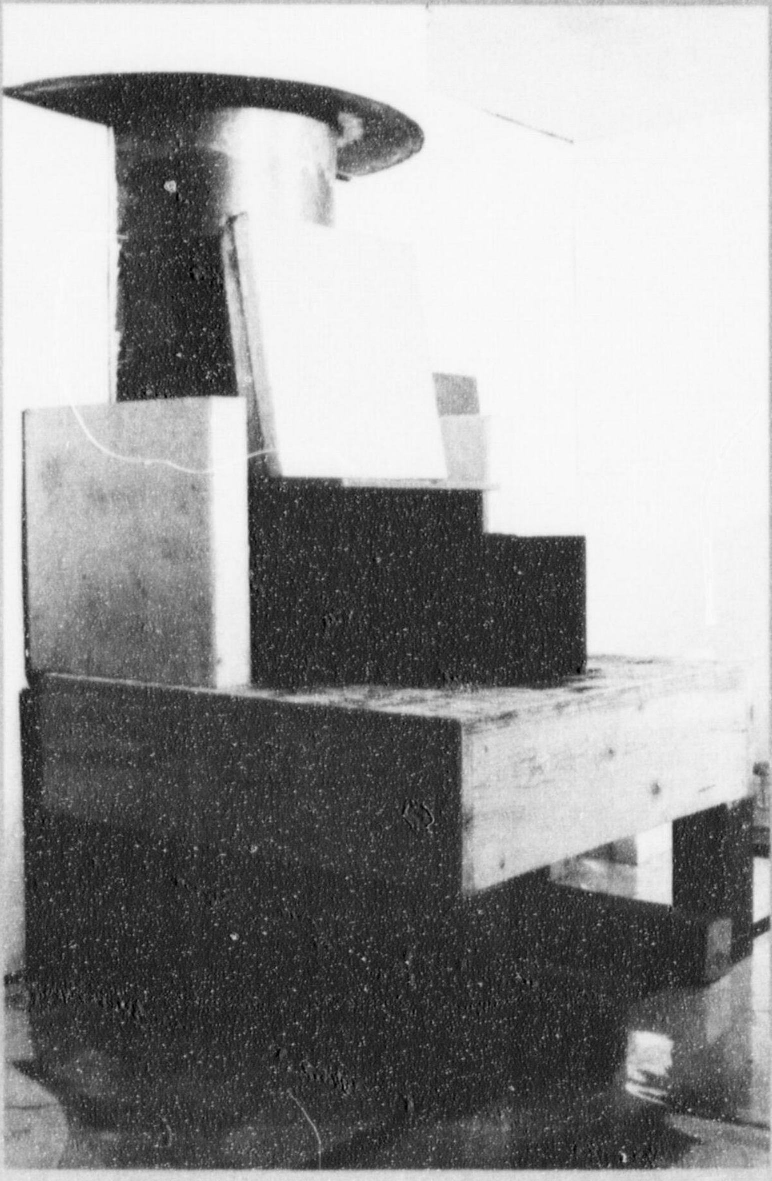
22 June 1998 — The water temperature at the core outlet was discovered reading -25°C during the morning instrumentation checkout. The Resistance Temperature Device (RTD) probe above the core that provides the temperature indication to the console had failed. A new probe was installed in its holder, tested, and calibrated. The holder with the probe was re-positioned above the reactor core, and the console indicated the correct pool temperature.

10 August 1998 — During the daily startup checklist, the water temperature at the inlet to the demineralizer was found reading -25°C. Investigation found that contractors working on the new heat exchanger had broken the RTD probe where it enters the water monitor box. A new probe was installed, tested, and

calibrated. The normal water temperature reading registered on the reactor console.

19 August 1998	The console was found locked up with the message "network looks dead." Diagnosis found the network board in the Data Acquisition and Control unit (DAC) had failed. A new network board was installed and tested. The console booted up properly, and all tests passed.
02 October 1998	The reactor core was moved into region 1, but the region 1 lamp did not illuminate, and the lead shield doors would not close. The lever arm on the switch that detects the core in region 1 was bent. The switch was replaced and adjusted to operate properly. All other switches were checked and found to be operational.
13 November 1998	Prior to an operation, the console showed 3% power on the NP channel (Safety Channel 1), and the NPP channel (Safety Channel 2) was less than 1% but greater than zero. Test signals inserted into the NP channel showed the entire span of the channel was 3% high. This error was a conservative error. A test of the system determined that the analog input board (AI016), which measures the signal from the NP and NPP units, was bleeding over from channel to channel. A new AI016 board was installed and calibrated. The new board passed all tests, and the bleed-over problem was corrected. The AI016 board was tested to verify the proper operation.

Section V



- Facility Changes and Changes to Procedures as Described in the Safety Analysis Report
- New Experiments or Tests During the Year

SECTION V

Facility Changes and Procedure Changes as Described in the Safety Analysis Report (SAR). New Experiments or Tests Performed During the Year

A. Changes to the SAR

1. All references to the criticality monitor, RAM R5, were removed from the SAR.
   Operating reactors are not required to have a criticality monitor.

2. The locations of RAMs R1 and R5 were changed.
   The RAMs were relocated from over the reactor pool to areas in the reactor deck where people are likely to be during normal reactor operations.

3. A reference to a patch panel was removed from the SAR.
   A panel for coaxial cables had been attached to the wall outside exposure room 2 for connecting the dosimetry readout room with chambers inside both exposure rooms. The patch panel was removed when new cables were run directly from the readout room to each exposure room.

4. The accidental criticality monitors were removed from the reactor facility.
   The criticality monitors in use at AFRRI were intended for use at fuel fabrication facilities. Since the reactor core is shielded, there is little value for this type of detector at AFRRI.

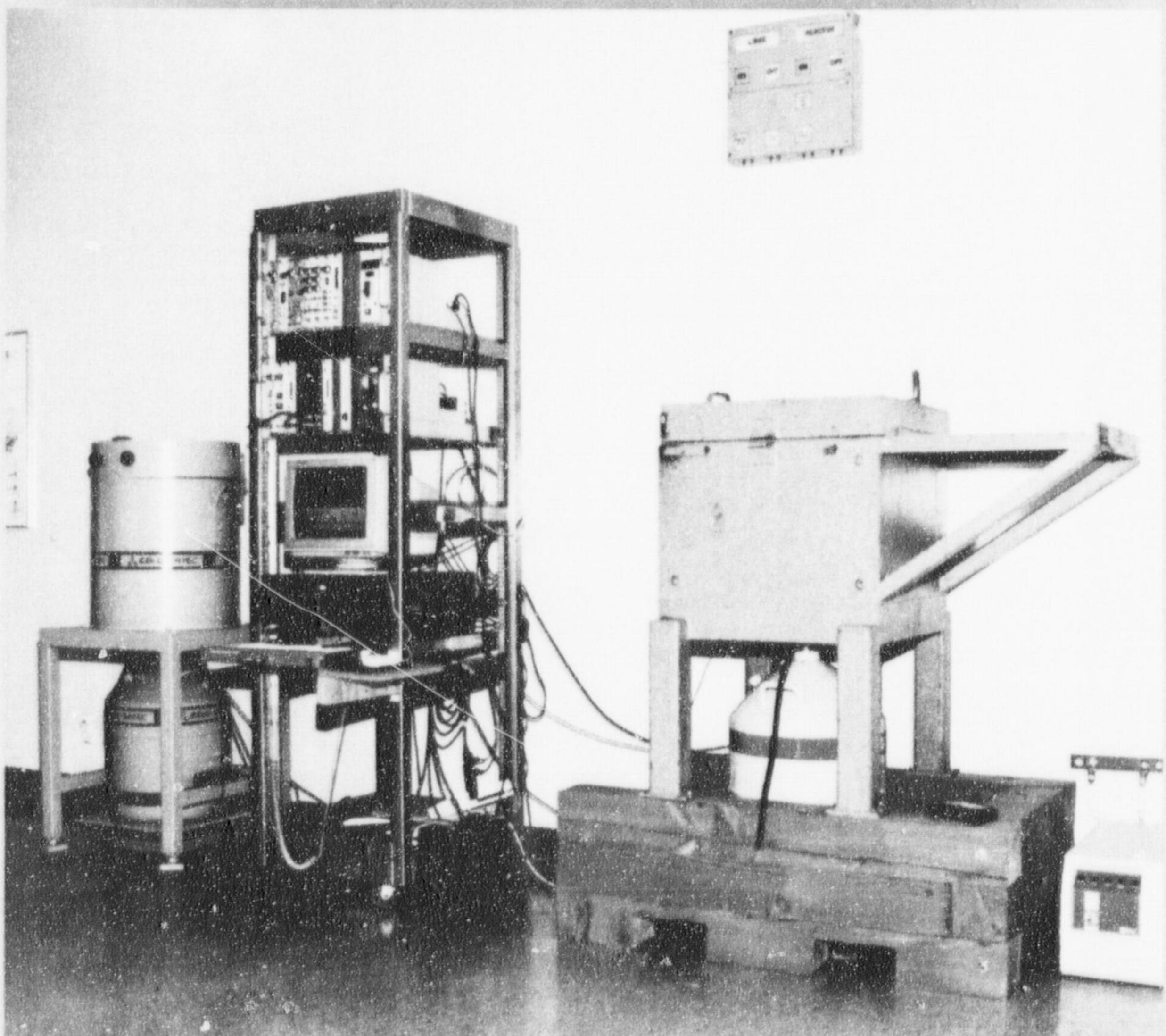
5. The SAR was changed to reflect use of a plate and frame heat exchanger.
   A description of the plate and frame heat exchanger replaced the description of the tube and shell unit. Drawings of the water-cooling system were also updated.

B. There were no changes to procedures described in the SAR. Changes to the operational procedures are covered in Section I.

C. There were no new experiments or tests performed during the reporting period that were not encompassed by the SAR.

Attachment B contains the safety evaluations made for changes not submitted to the NRC, pursuant to the provisions of 10 CFR 50.59. Each modification was described and qualified using Administrative Procedure A3, Facility Modification. This procedure utilizes a step-by-step process to document that there were no unreviewed safety questions, and no changes were required to the Technical Specifications.

Section VI through VIII



- Summary of Radioactive Effluent Released
- Environmental Radiological Surveys
- Exposures Greater than 10% of 10 CFR Limits

SECTION VI

Summary of Radioactive Effluent Released

A. Liquid Waste: The reactor produced no liquid waste during 1998.

B. Gaseous Waste: There were no particulate discharges in 1998.

The total activity of Ar-41 discharged in 1998 was 17.80 curies. The estimated activity from the release of Argon-41 was below the constraint limit for unrestricted areas (Table 2 of Appendix B to 10 CFR 20).

Quarterly:	Jan - Mar 1998	5.74 Ci
	Apr - Jun 1998	0.94 Ci
	Jul - Sep 1998	0.83 Ci
	Oct - Dec 1998	10.29 Ci

C. Solid Waste: All solid radioactive waste material was transferred to the AFRRI byproduct license; none was disposed of under the R-84 License.

SECTION VII

Environmental Radiological Surveys

A. Environmental sampling of soil and vegetation reported no radionuclide levels above the normal range. The radionuclides that were detected were those expected from natural background and from long-term fallout from nuclear weapons testing.

B. The calculated annual dose, due to Argon-41 release to the environment for 1998, was 0.6 mRem at the location of maximum exposure. The maximum exposure is calculated at a location 91 meters from the release point. Exposure to the general population at the boundary of the National Naval Medical Center is significantly less due to the diffusion of Argon-41 in the atmosphere. The constraint limit for exposure to the public is 10 millirem per year. The exposure dose was calculated using COMPLY code, level 2, which is the most conservative level of COMPLY. Emissions due to reactor operations were 6% of the 10 millirem constraint limit, or 0.6 millirem for the entire year.

C. The reactor in-plant surveys, specified in HPP 3-2, did not exceed any of the action levels specified in HPP 0-2.

SECTION VIII

Exposures Greater than 10% of 10 CFR 20 Limits

There were no doses to reactor staff personnel or reactor visitors greater than 10% of 10 CFR 20 occupational and public radiation dose limits.

ATTACHMENT A

Revised Reactor Administrative and Operational Procedures

Procedure C006, Stack Gas Monitor

Procedure M042, Change Resin Beds For Water Makeup System

Procedure A1, Fitness For Duty

Procedure 6, Emergency Procedures

Procedure 8, Reactor Operations

Procedure 8, Tab A, Logbook Entry Checklist

Procedure 8, Tab B, Daily Operational Startup Checklist

Procedure 8, Tab B1, Daily Safety Checklist

Procedure 8, Tab C, Nuclear Instrumentation Set Points

Procedure 8, Tab F1, Square Wave Operation (Subcritical)

Procedure 8, Tab G1, Pulse Operation (Critical)

Procedure 8, Tab G2, Pulse Operation (Subcritical)

Procedure 8, Tab H, Weekly Operational Instrumentation Checklist

Procedure 8, Tab I, Daily Operational Shutdown Checklist

Procedure 11, Air Particulate Monitor (CAM) Procedure

STACK GAS MONITOR CALIBRATION

I. General:

1. Reference: Tech Specs 4.5; HPP 7.3; NMC Stack Monitor Electronic Test and Calibration Procedure P/N 0001020-1.

2. Requirement: The air particulate monitoring system (SGM) shall be calibrated annually, not to exceed 15 months. (HPP 7.3)

3. Tools: Crescent wrench, screwdriver, special calibration connectors.

4. Equipment: Oscilloscope w/leads, voltmeter, pulse generator, pulse counter, plastic Ar-41 sample beaker w/tubing provided by SHD

5. Coordination: With SHD to set a date for isotopic calibration and with the ROS/RFD to arrange a date on operations schedule with no other reactor operations.

6. Estimated time: One day

7. Safety precautions: Use caution when working around high voltage sources and minimize exposure to Ar-41 or Na-22 calibration sources.

8. General:
   Turn off high voltage and main power before plugging or unplugging any of the circuit boards.

   The "unit" refers to the rack mountable electronics section of the SGM.

II. Procedural Sequence:

1. Schedule date for calibration with RFD/ROS and SHD.

2. Assemble required tools and equipment

3. Produce Argon-41 (for argon calibration) with reactor.
   Suggest: 2 syringes, 50-60 cc P-10 gas irradiated for 5 min at 100 Kw.

ELECTRONIC CALIBRATION

4. Turn off the power. Adjust the front panel meter to 10 cpm.

5. Remove the CRA-14B/91 card and ensure switches SW1, SW2, and SW3 are open.

6. Remove the IC-13 card and set the dip switches into the following configuration:

S1	Closed		S5	Open (10% Window)
S2	Open		S6	Closed (20% Window)
S3	Open		S7	N/C
S4	Open	(5% Window)	S8	N/C

{Gross counting mode S1 Closed, S2 Open, S3 Open.}
{Spectrometer mode S1 Open, S2 Open, S3 Closed.}

Replace the IC-13 Card.
Place the card extension card into the CRA-14B/91 slot and attach the CRA-14B/91 card to the extension card.

7. Disconnect the detector cable from the back of the SGM unit and attach the test cable to the SGM unit.

Power up the unit.

8. Verify 24 ± 4 VDC between pins 19 and 20 on the terminal block inside the back of the unit. If the voltage is outside this range, replace or repair the power supply.

9. Connect a pulse generator to the detector test cable.

10. Attach a test cable from the jack on the face of the AA-13A/91 plastic face mask to a volt meter. The access hole is just below the red high alarm button.

11 Set the pulse generator to create 16,666 cps ($1x10^6$ cpm).

12. Adjust R33 on the CRA-14B/91 card to give -5.00 ± 0.01 VDC.

13. Set the pulse generator to create 166.6 cps ($1x10^4$ cpm).

14. Adjust R32 such that the analog meter reads 10,000 cpm.

15. Set the pulse generator to create 16.66 cps (1000 cpm).

16. Verify 1000 cpm on the local analog meter.

17. Adjust the potentiometer on the 0-1 mA card such that the remote analog meter in the reactor control room reads 1000 cpm.

18. Adjust the potentiometer on the 0-10 VDC card to give 1000 cpm on the remote chart recorder in the control room.

19. Monitor the voltage through the AA-13A/91 mask test jack, step through the following inputs, and verify the following outputs.

Pulse Generator	Voltage @ AA-13A/91
10 cpm	0.00 ± 0.15 VDC
100 cpm	1.00 ± 0.15 VDC
1000 cpm	2.00 ± 0.15 VDC
10,000 cpm	3.00 ± 0.15 VDC
100,000 cpm	4.00 ± 0.15 VDC
1,000,000 cpm	5.00 ± 0.15 VDC

20. Adjust the potentiometer, located above the yellow fail button, while pressing the yellow fail button such that the analog meter reads about 12-15 cpm. Set the pulse generator to 10 cpm. Verify that the fail alarm lamp illuminates when the analog meter needle drops below 12-15 cpm.

21. Press the meter reset and alarm reset buttons.

22. Press the alert and high alarm buttons to note the settings. Increase the count output of the pulse generator to cross each of these alarm points and verify that the respective lamps on top of the stack gas monitor illuminate at their set points and that the sonalert alarms at the high alarm point.

23. Power off the unit. Remove the test cables from the front and back of the unit. Set toggle switches to the following configurations: SW1 - Closed, SW2 -Open, SW3 - Open. Replace the CRA-14B/91 card back into its slot. Attach the detector cable to the back of the unit.

24. Remove the IC-13 card and set the dip switches into the following configuration for spectrometer mode:

S1 Open S5 Open (10%
Window)
S2 Open S6 Closed (20%

Window)

S3	Closed		S7	N/C
S4	Open	(5% Window) S8	N/C	

Replace the IC-13 card.

25. Power the unit back on. Turn on the high voltage. Press the meter reset button.

26. Insert the Sodium-22 source slowly into the chamber and verify operability of the unit.

27. Determine the proper high voltage and adjust as necessary to find the peak counts for the argon/sodium peak.
   A. This is done with the sodium source or a sample of argon in the detector chamber
   B. Slowly adjust the voltage. Set the voltage such that the maximum counts are read from the analog meter. Be sure that the peak selected is the Argon 41 (1293 Kev) or the Sodium 22 ((1274 Kev) peak and not the sodium 22 (511 Kev) peak. graph the output vrs. voltage if necessary to find the proper peak.

28. Assist SHD, as needed, in the isotopic calibration using HPP 7-3.

29. After SHD provides the new alarm point numbers, adjust the alarm points.
   A. The high alarm point is adjusted by pressing the high alarm button and adjusting the potentiometer located directly above the button to give the proper alarm point reading on the analog meter.
   B. The alert alarm point is adjusted by pressing the alert alarm button and adjusting the potentiometer located directly above the button to give the proper alarm point reading on the analog meter.

30. See that a new calibration sticker is placed on the SGM. Change the written alarm points at the appropriate locations (At SGM and Control Room Meter).

31. Obtain and file isotopic calibration report required by HPP 7-3 from SHD.

32. Create decay curve for Sodium-22 source to be used for semiannual source test.

33. Update TRIGA Tracker.

MEMORANDUM TO FILES

Re: Calibration of SGM

The SGM was calibrated on ___________. The results are as follows.

Step	Point	Expected	As Left
8.	Voltage TB19--20	24 ± 4 VDC	_________
12.	AA-13A/91 Jack	-5.00 ± 0.01 VDC	_________
17.	Control Room Meter	1000	_________
18.	Control Room Chart	1000	_________

19. Inject Signals

Pulse Generator		Voltage AA-13A/91	Meter Reading
0 cpm	(0 cps)	__________V	_________ cpm
100 cpm	(1.666 cps)	__________V	_________ cpm
1000 cpm	(16.66 cps)	__________V	_________ cpm
10,000 cpm	(166.6 cps)	__________V	_________ cpm
100,000 cpm	(1,666 cps)	__________V	_________ cpm
1,00,000 cpm	(16,666 cps)	__________V	_________ cpm

Fail Lamp Operates YES / NO

Warning Lamp Operates YES / NO

High Lamp Operates YES / NO

Audible Alarm Operates YES / NO

High Voltage Set Point ________ VDC

Alert Alarm Set Point ________ cpm

High Alarm Set Point ________ cpm

Counts Generated From Sodium-22 Source ________ cpm

Change Resin Beds For Water Makeup System

I. General

1. Reference: Manufacturers Literature
2. Requirements: As needed
3. Tools: None
4. Equipment: None
5. Coordination: None
6. Estimated Time: 1 hour

II. Procedural Sequence:

1. Determine that a demineralizer needs to be changed. There is a lamp on top of the demineralizer which will go out when the resins need changing. The lamp may come on if there has been no flow of water through the unit. To ensure the resins have been exhausted, open sample port and run water through the resins beds for one to two minutes.
2. Close the water supply valve to the resin bed housings.
3. Unscrew the housing and lower carefully so as not to damage the distributor tube. Remove the o-ring, dump out the resin and clean out the housing. The exhausted resin can be disposed of into any waste container as there is no danger of any hazard.
4. Before loading, make sure the bottom strainer of the distributor tube is inserted into the socket at the bottom of the housing. Carefully pour in the resin from one jar of resin. After loading, clean the threads, o-ring groove and the top surface of the housing of all resin beads. Wipe the o-ring dry and place into the groove in the housing. Lightly lubricate the top surface of the o-ring.
5. Replace the housing, hand tighten, and reapply the water supply.

FITNESS FOR DUTY

REQUIREMENT:

To meet the specifications as defined in the AFRRI plan. 10 CFR does not require a fitness for duty procedure for training reactors.

GENERAL

The AFRRI Reactor Facility is a drug-free work-place. The use of illicit drugs by any RSDR staff member is prohibited. Personnel using over-the-counter or prescription drugs which cause drowsiness or otherwise alter one's state of consciousness will not be permitted to operate the AFRRI TRIGA reactor. In addition, reactor operators, operators-in-training, and management will be monitored for attitude and behavioral changes that may impact an individual's reliability.

SPECIFIC

1. RSDR staff members shall participate in drug-free awareness programs sponsored by AFRRI. Military and civilian staff members shall submit to drug screening programs conducted by their respective services. If a staff member's drug screening test yields an unexplained positive result, that staff member shall not be permitted to operate the reactor pending verification of the test. Acceptable positive results may occur following use of certain prescription drugs. The Reactor Facility Director (RFD) is required to ensure that the cutoff levels for alcohol or controlled substances as established in 10 CFR 26 are not exceeded by NRC licensed personnel. Any staff member determined to be a drug user will be temporarily assigned non operational duties pending administrative procedures.

2. Personnel are instructed to inform their physician of their job description and requirements prior to being issued a prescription medication. They are instructed to inquire about any medication side effects expected and the physician's opinion regarding interference with safe job performance. This information shall be relayed to RFD as soon as possible.

Personnel are encouraged to minimize their use of non-prescription over-the-counter drugs for self-medication purposes. Specifically, sedatives, cough and cold preparations, appetite suppressants, and pain relievers have central nervous system side effects. If these medications are used in any quantity, an operator must inform the RFD or ROS and be relieved from operating on that day or until any side effects have resolved once the medication has been discontinued.

Personnel are instructed to read the information in the Physician's Desk Reference (PDR) concerning medication they are taking. If the medication is unlisted in the PDR or the instructions are not understood, the staff physician will be consulted for information on how the drug may affect performance. If there are indications that the medication will adversely affect an operator's ability to safely perform his/her duties, he/she must inform the RFD or Reactor Operations Supervisor (ROS) that he/she must be relieved from operating on that day.

3. The RFD shall continuously monitor the reliability of individuals under his/her command by the following criteria:

- Any court-martial or civil conviction of a serious nature. Minor traffic violations are not a consideration.
- Negligence or delinquency in duty performance.
- Significant mental or character traits, or aberrant behavior, sustained by medical authority, that might affect the reliable performance of duties.
- Behavior patterns that show or suggest a contemptuous attitude toward

the law or regulations

- Drug abuse or alcohol misuse.
- Poor attitude, lack of motivation toward assigned duties, or financial irresponsibility.

The RFD will be observed by his superiors to ensure his/her adherence to reliability criteria. Individuals who exhibit any of the listed behaviors or actions will be removed from licensed activities.

EMERGENCY PROCEDURES

GENERAL

The reactor emergency organization, emergency classes, and emergency action levels are set forth in the AFRRI Reactor Facility Emergency Plan and its Implementing Procedures.

SPECIFIC

Perform the following, as appropriate (need not be done in order).

1. Reactor Emergency:
   a. SCRAM reactor.
   b. Check radiation monitors; use portable survey instruments to assess situation, if necessary.
   c. Notify the RFD/ERT Commander of the situation.
   d. Activate the emergency response team.
2. AFRRI Complex Emergency Evacuation:
   a. SCRAM reactor.
   b. Secure any exposure facilities which are in use so that personnel access to that facility is not possible.
   c. Remove logbook, emergency guide, radios, teletector, tool kit, and keys; report to ERT.
   d. Ensure reactor area doors are secured upon departure.
3 Proper classification of emergency situation: All SROs must review the referenced Emergency Plan documents and be able to properly classify the events as they occur. Below is a tabulation of emergency classification to be used as guidance.

EMERGENCY CLASS	Radiation Alarms (Unanticipated)	Activate AFRRI Complex Emergency Evacuation	Activate Emergency Response Team
Class 0			
	Fire Alarm (non-reactor)	Yes	Yes
Class 1			
	R1 >> 1 min.	*	Yes
	R2>> 1 min.	*	Yes
	R3	No	No
	R5 >> 1 min.	*	Yes
	R6	No	No
	E3 >> 1 min.	*	Yes
	E6 >>1 min.	*	Yes
	SGM>> 1 min.	*	Yes
	Reactor Stack Fan Monitor	No	No
	Fire Alarm (reactor)	Yes	Yes
Class 2			
	CAM>> 1 min. concurrent with R1, R2, R5, and/or SGM	*	Yes

NOTE: * A decision to evacuate the Institute will be made by the ECP Commander based on input from the ERT Commander.

REACTOR OPERATIONS

GENERAL

Logbook entries will be made in accordance with the Logbook Entry Checklist (Tab A).

SPECIFIC

1. The names of the individuals who supervised and performed the daily and weekly checklists will be shown at the top of the checklist. Check marks or numbers, as appropriate, will then be entered on each checklist line as that item is performed.

2. Perform reactor Daily Operational Startup Checklist (Tab B), utilizing appropriate nuclear instrumentation set points (Tab C). In the case of no planned operations, a Daily Safety Checklist (Tab B1) may be performed.

3. Perform K-excess measurement (Tab D) if the startup is not a safety startup.

4. Perform operations in accordance with the following:
   a. Steady state operation (Tab E).
   b. Square wave operation (Tab F).
   c. Pulse operation (Tab G).
   d. CET operations (Procedure 1, Tab B).
   e. Pneumatic Transfer System (Procedure 1, Tab D).
   f. In-pool/in-core experiment (Procedure 1, Tab E)

5. Perform Weekly Operational Instrument Checklist once during each calendar week (Tab H).

6. At the end of each day in which a Daily Operational Startup Checklist or Daily Safety Checklist has been completed, perform a Daily Operational Shutdown Checklist (Tab I).

7. Complete the monthly summary .

8. Respirator equipment will not be used on a routine basis. Respirator equipment is provided for use during emergency conditions only.

LOGBOOK ENTRY CHECKLIST

I. Operational Logbook

1. The reactor operations logbook is a "before-the-fact" record, that is, entries will be logged whenever possible before the operator actually performs the operation. Events, such as scrams, which may not be planned ahead of time, will be entered at the time of occurrence. Any late entries will be so noted. Entries about what you plan to do are not necessary, only actual events need to be logged in the logbook.

2. The operations logbook will have a hardbound cover and will be sequentially numbered by volume. The pages will be dated at the top of each page and each page will be sequentially numbered.

3. The Reactor Facility Director (RFD) will review each logbook upon its completion and he will make an appropriate entry in the back of the logbook and sign the entry. The operator who makes the final entry at the end of a logbook is responsible for ensuring that the ROS is notified that the logbook is ready for RFD review.

4. All items in GREEN (see below) that are not closed out during the working day will be carried in GREEN at the end of the day and again at the beginning of the next operational day.

5. Each of the logbook stamps has space for *SRO ON CALL*, *SRO IN CHARGE* (supervising) of the operation, the *HP ON CALL*, and a second person who is in AFRRI who could help in emergency situations. The individual at the console will enter data into the stamp to designate who is filling these 4 positions. The persons who are on console will have their names entered on the *CONSOLE UNLOCKED BY* line and will be considered as RO's for the operation. For subsequent stamps

when the console is already unlocked, lining out the time for the console unlocked entry is appropriate.

One SRO can fill the positions of *SRO ON CALL*, *SRO IN CHARGE* and RO on console in *CONSOLE UNLOCKED BY*.

The HP on call cannot be on call and on the console at the same time.

6. The entries will be made in ink and in accordance with the following designated color code:

a. BLACK: Most Operational Activities.

(1) Console Unlocked By stamp.

(2) Completion of the daily startup, shutdown, and weekly checklists.

(3) Mode of operations. Use appropriate stamp or entry to designate the operation:

(a) Steady State.

(b) Square Wave

(c) Pulse

(4) Subsequent power level changes.

(5) Operation of reactor associated facilities such as lead shield doors, pneumatic tube systems, etc., unless such operations cause a change of reactivity (see 5.b.(2) below).

(6) Change of personnel at the console stamp. If hand written, the persons name replacing the person on console should be entered first as "on console" before the person logging off of the console is entered as "off"

(7) All changes to logbook entries (including line outs, error corrections, changes to operations mode stamp lines, and end-of-page line outs) will be initialed or signed by the operator.

(8) Console locked

(9) Signature of reactor operator to close out the log for the day.

b. RED: For Items Which Change or Measure Reactivity

(1) K-excess measurements, to include experiment worth determinations.

(2) Actions which affect reactivity:

(a) Core movement.

(b) Fuel movement.

(c) Control rod physical removal for maintenance.

(d) Experiment loading and removal from the CET, PTS, pool, or core.

(e) Removal or insertion of CET into core.

c. GREEN: For Maintenance or Malfunctions

(1) Any reactor malfunctions noted upon discovery/occurrence with a second entry noting corrective action has been completed.

(2) Additional items entered at the discretion of the operator such as addition of make-up water to the reactor pool, etc.

(3) Any Technical Specification required equipment taken out of service for any reason. A second entry is made when the unit is returned to service.

(4) Movement of detectors or chambers from above core.

(5) Reactor calibrations and data.

6. When an operation requiring entry into the logbook falls under more than one color code, the color to be used will be determined via the following order of precedence: RED - GREEN - BLACK.

Sample Logbook Entries for a Typical Operational Day

Startup Checklist Begun BLACK

```
SRO ON CALL __________ SRO IN CHARGE __________________

HP ON CALL ___________ OTHER PERSON ONSITE ___________

______ CONSOLE UNLOCKED BY ______________________________

                                                (BLACK)
```

Startup Checklist #**** Complete BLACK

```
SRO ON CALL __________ SRO IN CHARGE __________________

HP ON CALL ___________ OTHER PERSON ONSITE ___________

______ CONSOLE UNLOCKED BY ______________________________

______ CRITICAL AT _______________ WATTS FOR K-EXCESS

TRANS___________$___________ SHIM___________$___________

SAFE____________$___________ REG____________$___________

______ SCRAM, CORE POSITION_______ K-EXCESS $_________

                                                  (RED)
```

Console locked by ******* BLACK

SGM out of service for maintenance. No operations GREEN

SGM Back in service GREEN

```
SRO ON CALL __________ SRO IN CHARGE __________________

HP ON CALL ___________ OTHER PERSON ONSITE ___________

______ CONSOLE UNLOCKED BY ______________________________

                                                (BLACK)
```

Opening Pb Doors	BLACK
Moving Core to ***	RED
Closing PB Doors	BLACK
Rabbit (containing ****) inserted into CET	RED

```
SRO ON CALL __________ SRO IN CHARGE __________________

HP ON CALL ___________ OTHER PERSON ONSITE ___________

______ CONSOLE UNLOCKED BY ______________________________

______ RAISING RODS TO GO CRITICAL

TRANS________ SHIM________ SAFE________ REG__________

T1 MAX________°C  T2 MAX________°C  RUR#______________

______ CRITICAL AT ___ _____ WATTS

______ SCRAM, TOTAL TIME ______' ______" KWHRS______

                                                 (BLACK)
```

Rabbit removed from CET	RED
Console locked by ********	BLACK
Shutdown Checklist Begun	BLACK
Shutdown Checklist #**** Complete	BLACK
Page lined out, Page signed by SRO	BLACK

II. Malfunction Logbook

All entries in the malfunction logbook should include the following information. For consistency, the bold words should be copied into the malfunction log prior to the information.

DATE, TIME, SIGNATURE OF PERSON DISCOVERING MALFUNCTION

SYMPTOM:

This section describes how the system is acting or malfunctioning, i.e., channel went full scale, pump failed, keyboard stopped responding to keystrokes etc.

IMMEDIATE ACTION TAKEN:

This section is for denoting such things as Reactor Secured, SHD notified.

RFD NOTIFIED:

A remark should be made that the RFD or acting RFD was notified.

DIAGNOSIS : of problem

A narrative description of what was discovered to be causing the problem, i.e., Which system was malfunctioning or which component failed.

SOLUTION: / repair

A narrative description of what was done to correct the problem This could include both physical changes or administrative changes, i.e., a component was replaced and the unit was recalibrated, an additional backup system installed, an administrative prohibit on ... was initiated.

OPERATIONAL VERIFICATION AND/OR CALIBRATION:

A description of what actions were taken to verify that the new unit/repair would indeed perform the function for which it was intended, i.e., a calibration signal, system actuated multiple times, system tested, system calibrated with a source. Indicate whether the change will require staff training.

SIGNATURE RFD

DAILY OPERATIONAL STARTUP CHECKLIST

Checklist No. ___________ Date ___________________
Time Completed __________ Supervised by ____________
Assisted by ______________

I. EQUIPMENT ROOM (Room 3152)

1. Air compressor pressure (80 - 120 psig) .... _______*
2. Water drained from air compressor .... _______
3. Air dryer operating .... _______
4. Doors 231, 231A, and roof hatch SECURED .... _______

II. LOBBY AREA

Lobby alarm turned off .... _______

III. EQUIPMENT ROOM (Room 2158)

1. Prefilter differential pressure (< 8 psid) .... _______*
2. Primary discharge pressure (11 - 16 psig) .... _______*
3. Demineralizer flow rates set to 6 gpm (5.5 - 6.5 gpm) .... _______*
4. Stack roughing filter (notify supervisor if > 1.0" of water) .... _______*
5. Stack absolute filter (notify supervisor if > 1.35" of water) .... _______*
6. Visual inspection of area .... _______
7. Door 2158 SECURED .... _______

IV. PREPARATION AREA

Visual inspection of area .... _______

V. REACTOR ROOM (Room 3161)

1. Transient rod air pressure (78 - 82 psig) .... _______*
2. Shield door bearing air pressure (8.5 - 11 psig) .... _______*
3. Visual inspection of core and tank .... _______
4. Number of fuel elements and control rods in tank storage — Fuel elements _______* Control rods _______*
5. Air particulate monitor (CAM)
   - (a) Primary operating and tracing .... _______
   - (b) Backup operating .... _______
   - (c) Channel test completed, damper closure verified .... _______
6. Channel test completed on SGM .... _______
7. Door 3162 SECURED .... _______

*Numerical Entry

VI. REACTOR CONTROL ROOM (Room 3160)

1. Emergency air dampers reset .... _______
2. Console recorders dated .... _______
3. Stack flow and fuel temperature recorders dated .... _______
4. Logbook dated and reviewed .... _______
5. Water monitor box
   (a) Background activity (10 - 60 cpm) .... _______*
   (b) Water monitor box resistivity (> 0.2 Mohm-cm) .... _______*
   (c) DM1 resistivity (> 0.5 Mohm-cm) .... _______*
   (d) DM2 resistivity (> 0.5 Mohm-cm) .... _______*
6. Stack gas flow rate (15 - 35 Kcfm) .... _______*
7. Stack linear flow rate (1.0 - 2.0 Kft/min) .... _______*
8. Gas stack monitor
   (a) Background (2 - 20 cpm) .... _______*
   (b) SGM High Indicator Check .... _______
   (c) High alarm point set to 3.2 E-5 microCi/cc at stack top .... _______
   (d) SGM chart recorder operating and tracing .... _______
9. Radiation monitors

Monitor	Alarm Point Functional	Reading (mrem/hr)	Alarm Setting (mrem/hr)
(a) R-1	_______	(< 10) _______*	_______ 10
(b) R-2	_______	(< 10) _______*	_______ 10
(c) R-3	_______	(< 10) _______*	_______ 10
(d) R-5	_______	(< 10) _______*	_______ 10
(e) E-3	_______	(< 10) _______*	_______ 10
(f) E-6	_______	(< 10) _______*	_______ 10

10. TV monitors on .... _______
11. CAM high level audible alarm check .... _______
12. Demineralizer inlet temperature (5 - 35 °C) .... _______*
13. Water level log completed .... _______
14. Console lamp test completed .... _______
15. Source level power greater/equal to 0.5 cps .... _______
16. Prestart operability checks performed .... _______
17. Time delay operative .... _______
18. Interlock Tests
   (a) Rod raising, SS mode _______
   (b) Rod raising, Pulse mode _______
   (c) Source RWP _______
   (d) Period RWP _______
   (e) 1 kW/Pulse mode _______
   (f) NM-1000 HV _______
   (g) Inlet Temp _______
19. SCRAM checks (at least one per rod)
   (a) % Power 1 _______
   (b) % Power 2 _______
   (c) Fuel temp 1 _______
   (d) Fuel temp 2 _______
   (e) HV loss 1 _______
   (f) HV loss 2 _______
   (g) Pool level _______
   (h) Reactor key _______
   (i) Manual _______
   (j) Emergency Stop _______
   (k) Timer _______
   (l) CSC Watchdog _______
   (m) DAC Watchdog _______
20. Zero power pulse .... _______

*Numerical Entry

DAILY SAFETY CHECKLIST

Checklist No. ____________ Date ____________________
Time Completed __________ Supervised by ______________
Assisted by ______________

I. EQUIPMENT ROOM (Room 3152)

1. Air compressor pressure (80 - 120 psig) . . . . _______*
2. Water drained from air compressor . . . . _______
3. Air dryer operating . . . . _______
4. Doors 231, 231A, and roof hatch SECURED . . . . _______

II. EQUIPMENT ROOM (Room 2158)

1. Prefilter differential pressure (< 8 psid) . . . . _______*
2. Primary discharge pressure (11 - 16 psig) . . . . _______*
3. Demineralizer flow rates set to 6 gpm (5.5 - 6.5 gpm) . . . . _______*
4. Stack roughing filter (notify supervisor if > 1.0" of water) . . . . _______*
5. Stack absolute filter (notify supervisor if > 1.35" of water) . . . . _______*
6. Visual inspection of area . . . . _______
7. Door 2158 SECURED . . . . _______

III. PREPARATION AREA

Visual inspection of area . . . . _______

IV. REACTOR ROOM (Room 3161)

1. Transient rod air pressure (78 - 82 psig) . . . . _______*
2. Shield door bearing air pressure (8.5 - 11 psig) . . . . _______*
3. Visual inspection of core and tank . . . . _______
4. Number of fuel elements and control rods in tank storage — Fuel elements _______* Control rods _______*
5. Air particulate monitor (CAM)
   (a) Primary operating and tracing . . . . _______
   (b) Backup operating . . . . _______
   (c) Channel test completed, damper closure verified . . . . _______
6. Channel test completed on SGM . . . . _______
7. Door 3162 SECURED . . . . _______

*Numerical Entry

V. LOBBY AREA

Lobby audio alarm turned off .... ______

VI. REACTOR CONTROL ROOM (Room 3160)

1. Emergency air dampers reset .... ______
2. Console recorders dated .... ______
3. Stack flow and fuel temperature recorders dated .... ______
4. Logbook dated and reviewed .... ______
5. Water monitor box
   - (a) Background activity (10 - 60 cpm) .... ______*
   - (b) Water monitor box resistivity (> 0.2 Mohm-cm) .... ______*
   - (c) DM1 resistivity (> 0.5 Mohm-cm) .... ______*
   - (d) DM2 resistivity (> 0.5 Mohm-cm) .... ______*
6. Stack gas flow rate (15 - 35 Kcfm) .... ______*
7. Stack linear flow rate (1.0 - 2.0 Kft/min) .... ______*
8. Gas stack monitor
   - (a) Background (2 - 20 cpm) .... ______*
   - (b) SGM High Indicator Check .... ______
   - (c) High alarm point set to 3.2 E-5 microCi/cc at stack top .... ______
   - (d) SGM chart recorder operating and tracing .... ______
9. Radiation monitors

Monitor	Alarm Point Functional	Reading (mrem/hr)	Alarm Setting (mrem/hr)
(a) R-1	______	(< 10) ______*	______ 10
(b) R-2	______	(< 10) ______*	______ 10
(c) R-3	______	(< 10) ______*	______ 10
(d) R-5	______	(< 10) ______*	______ 10
(e) E-3	______	(< 10) ______*	______ 10
(f) E-6	______	(< 10) ______*	______ 10

10. TV monitors on .... ______
11. CAM high level audible alarm check .... ______
12. Demineralizer inlet temperature (5 - 35 °C) .... ______*
13. Water level log completed .... ______
14. Source level power greater/equal to 0.5 cps .... ______

*Numerical Entry

NUCLEAR INSTRUMENTATION SET POINTS

GENERAL:

These set points may be adjusted for a specific operation by of the RFD or ROS but in no case may they be set at a point non-conservative to the technical specifications.

SPECIFIC

The following are channel or monitor set points (alarm, scram, rod withdrawal prevent).

1. Scrams:
   a. Fuel Temperature 1 & 2: 575 C
   b. High Flux 1 & 2: 110% (1.1 MW)
   c. Safe Chambers 1 & 2 HV Loss: 20%
   d. Pulse Timer: Less than 15 seconds
   e. Steady State Timer: as necessary
2. Rod Withdrawal Prevents:
   a. Period: 3 seconds
   b. 1 KW (Pulse Mode): 1 KW
   c. Source: 0.5 CPS
   d. Water Inlet Temperature: 50 degrees C
   e. Fission Chamber HV Loss: 20%
3. Alarms:
   a. RAMS: As directed in procedures
   b. CAMS: 10,000 CPM
   c. Stack Gas: 3.2E-5 microCi/cc at stack top
   d. Water Monitor Box Gamma: 7000 CPM

SQUARE WAVE OPERATION (Subcritical)

GENERAL

The square wave mode will not be used above a demand power of 250 KW.

SPECIFIC

1. Determine the transient rod critical position using the core position, the final transient rod position, the rod curves and the equation below. Note that a square wave insertion can not exceed 75 cents.

	TOTAL WORTH TRANSIENT ROD ($) (to 100% or mechanical stop)
-	DESIRED INSERTION ($) *
=	TRANSIENT ROD INITIAL POSITION ($)

* For demand powers up to 25 KW, insert $0.70

* For demand powers greater than 25 KW, insert $0.75

2. Apply air to the transient rod and raise the anvil to the critical position that was calculated above.
3. Bring the reactor cold critical using the three standard control rods; use a rod configuration commensurate with the core position and experimental requirements. If Auto Mode is used, select the rods to be used. Ensure that these rods have been raised at least 5% before entering Auto Mode. Set the cold critical power level on the Power Demand thumb wheels and enter Auto Mode.
4. Stabilize the reactor in Manual Mode.
5. Set power demand thumb wheels to desired power level.
6. Select the standard control rods to be servoed. Make sure that all control rods to be servoed have been raised at least 5%.
7. Scram the transient rod.

8. Raise the anvil to the desired final position.
9. Allow the power level to fall below 1 watt.
10. Switch into Square Wave mode.
11. Depress Fire button.
12. As the power level approaches the power demand level, the console will switch into Auto Mode. If power can not reach the demand power, it will automatically change to manual mode. At this time, either switch to Auto Mode or bring the reactor to the desired power level manually.
13. Scram the reactor at the end of the run using the manual or timer scram.
14. Ensure all pertinent information has been entered in the reactor operations logbook.

PULSE OPERATION (CRITICAL)

GENERAL

Pulses above $2.00 must be verbally approved by the RFD (prior to pulse initiation) or specified on the RUR, signed by the RFD.

SPECIFIC

1. Bring the reactor critical at less than 1000 watts using the three standard control rods; use a rod configuration commensurate with core position and experimental requirements.
2. Stabilize in the manual mode.
3. Raise the transient rod anvil to the desired pulse position. (This position is obtained from the control rod worth curves for the appropriate core operating position)
4. Select the proper pulse detector according to the table below. **If the Cerenkov detector is selected, turn off the reactor room and tank lights**.

Detector 1 = Pulse Ion	(Maximum insertion = $2.00)
Detector 2 = Cerenkov	(Maximum insertion = $4.00)

5. Adjust Pulse Mode Scram Timer if necessary.
6. Enter Pulse Mode and select high or low resolution pulse display. High resolution displays 1200 MW full scale and should be used for pulses of $2.00 or smaller. Enter the pulse number at the next prompt. Remember, the power level must be below the 1 kW Technical Specification limit to enter Pulse Mode.
7. Fire the pulse by depressing the " Fire" button on the reactor console.
8. Record the appropriate data in the reactor operations logbook from the pulse display.

PULSE OPERATION (SUBCRITICAL)

GENERAL

Pulses above $2.00 must be verbally approved by the RFD (prior to pulse initiation) or specified on the RUR, signed by the RFD.

SPECIFIC

1. Given a core position, set the transient rod at a position corresponding to the dollar value determined by the following equation:

   $ Value = Total worth ($) Transient rod (to 100% or mechanical stop) - Desired pulse ($) Value

2. Bring the reactor cold critical using the three standard control rods; use a rod configuration commensurate with core position and experimental requirements.
   Do not use Automatic Mode until the three standard rods have been raised at least 5%
   Note: If a series of repetitive pulses are to be fired, it is not necessary to bring the reactor to cold critical for each pulse. Consecutive pulses may be fired using the same rod positions on the same day as long as the reactor power is not increasing and is less than 1 kW.
3. Stabilize in the manual mode.
4. Select the proper pulse detector according to the table below. **If the Cerenkov detector is selected, turn off the reactor room and tank lights**.

Detector 1 = Pulse Ion	(Maximum insertion = $2.00)
Detector 2 = Cerenkov	(Maximum insertion = $4.00)

5. Adjust Pulse Mode Scram Timer if necessary.
6. Scram the Transient rod.
7. Raise the Transient rod anvil to 100% or the mechanical stop if installed.
8. Let the power decay to approximately 1 watt or less unless otherwise dictated by

experimental constraints. Pulses may not be initiated above the Technical Specification 1kW limit.

9. Enter Pulse Mode and select high or low resolution pulse display. High resolution displays 1200 MW full scale and should be used for pulses of $2.00 or smaller. Enter the pulse number at the next prompt.
10. Fire the pulse by depressing the " Fire" button on the reactor console.
11. Record the appropriate data in the reactor operations logbook from the pulse display.

WEEKLY OPERATIONAL INSTRUMENT CHECKLIST

CHECKLIST # ________________ DATE ________________________
SUPERVISED BY ______________
ASSISTED BY ________________ REVIEWED BY __________ ______

I. WATER LEVEL INDICATOR

A. In pool, east side, depress float on water level indicator . . . . ______
B. Observe scram on console . . . . ______

II. WATER RESISTIVITY

List resistivity readings for previous calendar week from daily startup checklists. Determine the average at each point is >0.5 Mohm-cm.

	MON	TUE	WED	THU	FRI	AVG
Monitor Box	____	____	____	____	____	____
DM1	____	____	____	____	____	____
DM2	____	____	____	____	____	____

III. RADIATION ALARMS

A. Test alarm functions for high level and failure

Monitor	Failure alarm functional	HIGH Level alarm functional
R-1	______	______
R-2	______	______
R-5	______	______
E-3	______	______
E-6	______	______
Reactor Room CAM	______	______
Gas Stack Monitor	______	______

B. Reset alarms.. ______

IV. OTHER

A. Top lock key seals at Security Desk and at LOG verified intact . . . . . ______
B. Change Filter in the Stack Gas Monitor . . . . ______

DAILY OPERATIONAL SHUTDOWN CHECKLIST

Checklist No. ____________
Time Completed __________

Date ____________________
Supervised by ____________
Assisted by ______________
____

I. REACTOR ROOM (Room 3161)

1. All rod drives DOWN .... ______
2. Carriage lights OFF .... ______
3. Door 3162 SECURED .... ______
4. Channel test completed on both CAM's .... ______
5. Door 3161 locked with key .... ______

II. EQUIPMENT ROOM (Room 3152)

1. Distillation unit discharge valve CLOSED .... ______
2. Air dryer OPERATIONAL .... ______
3. Doors 231, 231A, and roof hatch SECURED .... ______

III. EQUIPMENT ROOM (Room 2158)

1. Primary discharge pressure (11 - 16 psig) .... ______*
2. Demineralizer flow rates set to (5.5 - 6.5 gpm) .... ______*
3. Visual inspection for leaks .... ______
4. Door 2158 and 2164 SECURED .... ______

IV. PREPARATION AREA

1. ER2 plug door CONTROL LOCKED .... ______
   Door closed; and handwheel PADLOCKED .... ______
2. ER2 lights ON and rheostat at 10% .... ______
3. ER1 plug door CONTROL LOCKED .... ______
   Door closed; and handwheel PADLOCKED .... ______
4. ER1 lights ON and rheostat at 10% .... ______
5. Visual inspection of area .... ______
6. Warm storage doors closed .... ______

V. LOBBY ALARM

Lobby alarm audio ON . . . . ______

VI. REACTOR CONTROL ROOM (Room 3160)

1. Reactor tank lights OFF . . . . ______
2. Console chart recorder pens raised . . . . ______
3. Steady-state timer OFF . . . . ______
4. Console LOCKED, and all required keys returned to lock box . . . . ______
5. Diffuser pumps OFF . . . . ______
6. Purification, secondary and primary pumps ON . . . . ______
7. Reactor monthly usage summary completed . . . . ______
8. Auxiliary chart recorders operating and tracing . . . . ______
9. Radiation monitors . . . . ______

MONITOR	READING	HIGH LEVEL ALARM SETTING (mrem/hr)
a. R-1	(<10) ______*	10 ______
b. R-2	(<10) ______*	10 ______
c. R-3	(<10) ______*	10 ______
d. R-5	(<10) ______*	10 ______
e. E-3	(<10) ______*	10 ______
f. E-6	(<10) ______*	10 ______
g. R-6	(<10) ______*	

* Numerical Entry

AIR PARTICULATE MONITOR(CAM) PROCEDURE

GENERAL

This procedure specifies how to test the CAM to ensure proper operation of this monitoring device. A channel test will be performed on both reactor room CAMs at the beginning and end of each day.

SPECIFIC

1. TEST FREQUENCY

   This entire procedure will be performed in conjunction with the daily startup or safety checklist. Items 2, 3a and 3d will be performed again as part of the daily shutdown checklist.

2. OPERATING and TRACING

   Check that the primary CAM is operating and tracing with the correct time indicated on the chart and check that the secondary CAM is operating. Ensure the flow rate is >6 cfm and not off scale.

3. CHANNEL TEST WITH SOURCE

   a. Place the switch on the front of the CAM to "test" and verify a reading of 1000 cpm +/-20%. Reset the switch.

   b. Open shield door and change the detector filter if the filter appears excessively dirty or the flow rate has dropped below 6 cfm (with the door closed). Place the used filter in the radioactive waste box in each CAM drawer.

   c. Slowly bring a radioactive source near the detector. Observe the meter on the front of the CAM. The yellow light will activate at approximately 4,000 counts per minute. The red light will activate at approximately 10,000 counts per minute; the alarm will sound and the dampers will close. Reset the alarm, close the chamber door and return the source to the CAM drawer.

   d. Annotate completion of the channel test on chart paper with initials, time, and date performed for primary CAM.

ATTACHMENT B

10 CFR 50.59 Safety Evaluations of Modifications, Changes, and Enhancements to Procedures or Facilities

Voltmeter Added To Stack Gas Monitor

Replacement Water Distillation Unit Replaced

References To Criticality Monitor R5 Removed From SAR

Sub-Critical Pulse Mode Operation Procedure Updated

The Word "Criticality" Removed From Weekly Checklist

Patch Panel Removed From SAR

Equation In Sub-Critical Square Wave Procedure Clarified

Accidental Criticality Monitors Removed From SAR

Water Spigot Added To Cooling Tower

Update of Procedures A1, 6, 8, 8 Tab A, and 11

Air Pressure Loss Switch For Compressor Tank & Check Valves in Air Lines

Replacement of Heat Exchanger With Stainless Steel Pipe

Startup Procedure Updated

Safety Procedure Updated

Shutdown Checklist Updated

FACILITY MODIFICATION SUMMARY SHEET
1998

NUM	INITIAL DATE	TYPE CHANGE	LOCATION	PROPOSED CHANGE	WS#	COMPLETE DATE	APPROVAL DATE (RFD)	APPROVAL DATE (RRFSC)
1	11 Feb 98	Procedure	Procedure C006	Add volt meter to SGM. Modify procedure C006: SGM calibration	2	11 Feb 98	11 Feb98	13 Apr 98
2	6 Mar 98	Facility	Procedure M042	Replacement of Reactor Distillation unit with AFRRI water purification system	1	6 Mar 98	23 Mar 98	13 Apr 98
3	13 Mar 98	Facility	SAR	Remove all references to Criticality Monitor R5 from SAR	1	12 Mar 98	30 Mar 98	13 Apr 98
4	30 Mar 98	Procedure	Procedure 8, Tab G2	Pulse Mode Operation (Sub-critical)	2	30 Mar 98	30 Mar 98	13 Apr 98
5	27 Apr 98	Procedure	Procedure 8, Tab H	Remove word "Criticality" from procedure	2	27 Apr 98	27 Apr 98	13 Jul 98
6	28 Apr 98	Facility	SAR	Remove non-existent patch panel from SAR	1	28 Apr 98	28 Apr 98	13 Jul 98
7	29 Apr 98	Procedure	Procedure 8, Tab F1	Change to equation in subcritical square wave procedure	2	29 Apr 98	29 Apr 98	13 Jul 98
8	4 Jun 98	Facility	SAR	Removal of accidental criticality monitors from SAR	1	4 Jun 98	4 Jun 98	13 Jul 98
9	5 Jun 98	Facility	Facility	Add water spigot to reactor cooling tower	2	5 Jun 98	9 Jun 98	13 Jul 98
10	4 Jun 98	Procedure	Various Procedures	Review and update of procedures A-1, 6, 8, 8 Tab A, and 11.	2	4 Jun 98	4 Jun 98	14 Oct 98
11	5 Oct 98	Facility	Facility	Installation of air line check valves and air pressure loss switch.	2	5 Oct 98	5 Oct 98	14 Oct 98
12	18 Aug 98	Facility	SAR	Replacement of reactor heat exchanger and the use of stainless steel pipe in primary water system.	1	18 Aug 98	Sep 98	14 Oct 98
13	27 Nov 98	Procedure	Procedure 8, Tab I	Discharge pressure changed to 11-16 psig	2	27 Nov 98	27 Nov 98	4 Dec 98
14	27 Nov 98	Procedure	Procedure 8, Tab B1	Discharge pressure change, various clarifications	2	27 Nov 98	27 Nov 98	4 Dec 98
15	27 Nov 98	Procedure	Procedure 8, Tab B	Discharge pressure change, various clarifications	2	27 Nov 98	27 Nov 98	4 Dec 98

Facility Modification Work Sheet 2

No 10 CFR 50.59 Analysis Required

Proposed Change: ADD VOLT METER TO STACK GAS MONITOR POWER SUPPLY

Modification to: Procedure ____ Facility XX Experiment ____

Submitted by: Osborne & George Date 11 Feb 1998

1. Description of change:
Add a volt meter to the stack gas monitor (SGM)high voltage power supply.

The addition of a panel volt meter allows for easier verification of the SGM operating voltage. Currently to check the SGM operating voltage the power supply must be turned off and a portable volt meter installed. The panel volt meter will provide us with a continous readout for calibration purposes.

The operating current for the detector and panel voltmeter was determined to be <10μA and 50μA respectively. This well below the 10mA provided by the H.V. power supply.

2. Verify that the proposed change does not involve a change to the Technical Specifications, the facility as described in the SAR, or procedures as described in the SAR, and does not produce an unresolved safety issue as defined in 10 CFR 50.59(a)(2).

NONE

3. If change involves a facility modification, attach a drawing if appropriate. If structural facility drawings need updating, forward a copy of changes necessary to Facilities.

NONE

4. Determine what other procedures, logs, or training material may be affected and record below.

Calibration Procedure C006, Stack Gas Monitor Calibration (attached)

5. List of associated drawings, procedures, logs, or other materials to be changed:

Manufacturer's drawings have been updated

6. Create an Action Sheet containing the list of associated work, specified above, attach a copy, and submit it to the RFD.

Action Sheet: Submitted ____ Not Required XX

Reviewed and approved by RFD [signature] Date [illegible]

RRFSC Notified SMD Date APR 13 1998

STACK GAS MONITOR CALIBRATION

I. General:

1. Reference: Tech Specs 4.5; HPP 7.3; NMC Stack Monitor Electronic Test and Calibration Procedure P/N 0001020-1.

2. Requirement: The air particulate monitoring system (SGM) shall be calibrated annually, not to exceed 15 months. (HPP 7.3)

3. Tools: Crescent wrench, screwdriver, special calibration connectors.

4. Equipment: Oscilloscope w/leads, voltmeter, pulse generator, pulse counter, plastic Ar-41 sample beaker w/tubing provided by SHD

5. Coordination: With SHD to set a date for isotopic calibration and with the ROS/RFD to arrange a date on operations schedule with no other reactor operations.

6. Estimated time: One day

7. Safety precautions: Use caution when working around high voltage sources and minimize exposure to Ar-41 or Na-22 calibration sources.

8. General:
   Turn off high voltage and main power before plugging or unplugging any of the circuit boards.

   The "unit" refers to the rack mountable electronics section of the SGM.

II. Procedural Sequence:

1. Schedule date for calibration with RFD/ROS and SHD.

2. Assemble required tools and equipment

3. Produce Argon-41 (for argon calibration) with reactor.

Suggest: 2 syringes, 50-60 cc P-10 gas irradiated for 5 min at 100 Kw.

ELECTRONIC CALIBRATION

4. Turn off the power. Adjust the front panel meter to 10 cpm.

5. Remove the CRA-14B/91 card and ensure switches SW1, SW2, and SW3 are open.

6. Remove the IC-13 card and set the dip switches into the following configuration:

S1 Closed		S5	Open	(10% Window)
S2 Open		S6	Closed	(20% Window)
S3 Open		S7	N/C	
S4 Open	(5% Window)	S8	N/C	

{Gross counting mode S1 Closed, S2 Open, S3 Open.}
{Spectrometer mode S1 Open, S2 Open, S3 Closed.}

Replace the IC-13 Card.
Place the card extension card into the CRA-14B/91 slot and attach the CRA-14B/91 card to the extension card.

7. Disconnect the detector cable from the back of the SGM unit and attach the test cable to the SGM unit.

Power up the unit.

8. Verify 24 ± 4 VDC between pins 19 and 20 on the terminal block inside the back of the unit. If the voltage is outside this range, replace or repair the power supply.

9. Connect a pulse generator to the detector test cable.

10. Attach a test cable from the jack on the face of the AA-13A/91 plastic face mask to a volt meter. The access hole is just below the red high alarm button.

11. Set the pulse generator to create 16,666 cps (1×10^6 cpm).

12. Adjust R33 on the CRA-14B/91 card to give -5.00 ± 0.01 VDC.

13. Set the pulse generator to create 166.6 cps (1×10^4 cpm).

14. Adjust R32 such that the analog meter reads 10,000 cpm.

15. Set the pulse generator to create 16.66 cps (1000 cpm).

16. Verify 1000 cpm on the local analog meter.

17. Adjust the potentiometer on the 0-1 mA card such that the remote analog meter in the reactor control room reads 1000 cpm.

18. Adjust the potentiometer on the 0-10 VDC card to give 1000 cpm on the remote chart recorder in the control room.

19. Monitor the voltage through the AA-13A/91 mask test jack, step through the following inputs, and verify the following outputs.

Pulse Generator	Voltage @ AA-13A/91
10 cpm	0.00 ± 0.15 VDC
100 cpm	1.00 ± 0.15 VDC
1000 cpm	2.00 ± 0.15 VDC
10,000 cpm	3.00 ± 0.15 VDC
100,000 cpm	4.00 ± 0.15 VDC
1,000,000 cpm	5.00 ± 0.15 VDC

20. Adjust the potentiometer, located above the yellow fail button, while pressing the yellow fail button such that the analog meter reads about 12-15 cpm. Set the pulse generator to 10 cpm. Verify that the fail alarm lamp illuminates when the analog meter needle drops below 12-15 cpm.

21. Press the meter reset and alarm reset buttons.

22. Press the alert and high alarm buttons to note the settings. Increase the count output of the pulse generator to cross each of these alarm points and verify that the respective lamps on top of the stack gas monitor illuminate at their set points and that the sonalert alarms at the high alarm point.

23. Power off the unit. Remove the test cables from the front and back of the unit. Set toggle switches to the following configurations: SW1 - Closed, SW2 -Open, SW3 - Open. Replace the CRA-14B/91 card back into its slot. Attach the detector cable to the back of the unit.

24. Remove the IC-13 card and set the dip switches into the following configuration for spectrometer mode:

S1 Open		S5	Open	(10% Window)
S2 Open		S6	Closed	(20% Window)
S3 Closed		S7	N/C	
S4 Open	(5% Window)	S8	N/C	

Replace the IC-13 card.

25. Power the unit back on. Turn on the high voltage. Press the meter reset button.

26. Insert the Sodium-22 source slowly into the chamber and verify operability of the unit.

27. Determine the proper high voltage and adjust as necessary to find the peak counts for the argon/sodium peak.
   A. This is done with the sodium source or a sample of argon in the detector chamber
   B. Slowly adjust the voltage. Set the voltage such that the maximum counts are read from the analog meter. Be sure that the peak selected is the Argon 41 (1293 Kev) or the Sodium 22 ((1274 Kev) peak and not the sodium 22 (511 Kev) peak. graph the output vrs. voltage if necessary to find the proper peak.

28. Verify that the panel voltmeter displays the high voltage set point ± 1 VDC. If the voltage falls outside this range follow these steps to calibrate the panel meter:
   A. Verify the 5 volt power supply voltage is within ± 0.1 volt. Adjust if necessary.
   B. Turn off the power and disconnect the SGM high voltage supply to the panel meter.
   C. Connect a precision DC power supply, turn on the unit, and allow the unit to warm up for 5 minutes.
   D. Apply 900 VDC with the precision power supply, adjust the potentiometer on the rear of the panel meter until the readout displays 900.
   E. Turn off power reconnect the SGM high voltage supply, turn on the unit and verify that the panel meter displays the high voltage setpoint ± 1 VDC.

29. Assist SHD, as needed, in the isotopic calibration using HPP 7-3.

30. After SHD provides the new alarm point numbers, adjust the alarm points.
   A. The high alarm point is adjusted by pressing the high alarm button and adjusting the potentiometer located directly above the button to give the proper alarm point reading on the analog meter.
   B. The alert alarm point is adjusted by pressing the alert alarm button and

adjusting the potentiometer located directly above the button to give the proper alarm point reading on the analog meter.

31. See that a new calibration sticker is placed on the SGM. Change the written alarm points at the appropriate locations (At SGM and Control Room Meter).

32. Obtain and file isotopic calibration report required by HPP 7-3 from SHD.

33. Create decay curve for Sodium-22 source to be used for semiannual source test.

34. Update TRIGA Tracker.

MEMORANDUM TO FILES

Re: Calibration of SGM

The SGM was calibrated on ____________. The results are as follows.

Step	Point	Expected	As Left	
8.	Voltage TB19--20	24 ± 4 VDC	_________	
12.	AA-13A/91 Jack	-5.00 ± 0.01 VDC	_________	
17.	Control Room Meter	1000	_________	
18.	Control Room Chart	1000	_________	
19.	Inject Signals			
	Pulse Generator		Voltage AA-13A/91	Meter Reading
	0 cpm	(0 cps)	__________V	_________ cpm
	100 cpm	(1.666 cps)	__________V	_________ cpm
	1000 cpm	(16.66 cps)	__________V	_________ cpm
	10,000 cpm	(166.6 cps)	__________V	_________ cpm
	100,000 cpm	(1,666 cps)	__________V	_________ cpm
	1,00,000 cpm	(16,666 cps)	__________V	_________ cpm
28.	Panel Voltmeter	H.V. Setpoint	_________	

Fail Lamp Operates	YES / NO
Warning Lamp Operates	YES / NO
High Lamp Operates	YES / NO
Audible Alarm Operates	YES / NO
High Voltage Set Point	________ VDC
Alert Alarm Set Point	________ cpm
High Alarm Set Point	________ cpm
Counts Generated From Sodium-22 Source	________ cpm

Facility Modification Work Sheet 1

10 CFR 50.59 Analysis

Proposed Change: ___ Replacement of Reactor Distillation Unit
___ with AFRRI water purification system. ____

Submitted by: ____ George __________ Date _6 March 98_

1. Description of change:

Removal of the reactor distillation unit as the primary source of make up wat_ and replace with the AFRRI water purification system.

The water will be run through two demineralizer beds before being added to the reactor water holdup tank to ensure purity. The UV lamp will remain in the hold up tank to sterilize the water in the tank.

2. Reason for change:

The aging reactor still needs to be repaired and replumbed. The reactor still makes about 6-8 gallons of water per hour where over 100 gallons of water can be drawn per hour from the AFRRI system. With the hold up tank from the still remaining in place, the system could supply 4 times the makeup capability of the current system.

3. Verify that the proposed change does not involve a change to the Technical Specifications or produce an unresolved safety issue as specified in 10 CFR 50.59(a)(2). Attach an analysis to show this.

Analysis attached? Yes _XX_

4. The proposed modification constitutes a changes in the facility or an operational procedure as described in the SAR. Describe which (check all that apply)

Procedure _XX_ Facility _XX_ Experiment ____

Facility Modification Work Sheet 1

5. Specify what sections of the SAR are applicable. In general terms describe the necessary updates to the SAR. Note that this description need not contain the final SAR wording.

In Section 3.3.4, the AFRRI water purification system will replace the reactor still.
Drawing 3-6 on page 3-44, change still water tank to water tank

See attached for SAR wording.

6. For facility modifications, specify what testing is to be performed to assure that the systems involved operate in accordance with their design intent.

Flow rate will be measured from the output of the demineralizer resins, upon installation, to verify that the flow rate of water added to the water tank is comparable to the current flow rate.

Facility Modification Work Sheet 1

7. Specify associated information.

New drawings are: Attached _XX_
Not required ____

Does a drawing need to be sent to Logistics? Yes _XX_ No ____
Are training materials effected? Yes _XX_ No ____
Will any Logs have to be changed? Yes ____ No _XX_
Are other procedures effected? Yes _XX_ No ____

List of items effected:

Annual maintenance procedure for the reactor still will be eliminated.

Question bank to be searched and updated for questions on the make up water system

The operations manual will be updated.

8. Create an Action Sheet containing a list of associated work specified in items #7, attach a copy, and submit another to the RFD.

Action Sheet: Submitted _XX_ Not Required ____

Reviewed and approved by RFD ____________________ Date 3/23/98

RRFSC Concurrence SDO ____________________ Date APR 13 1998

ACTION SHEET

✓ Remove procedure M027 (Still Cleaning and Inspection) from triga tracker and procedure book.

✓ Replace procedure M042 (Change Resin Beds for Water Makeup System) with procedure for new demineralizer beds.

✓ Verify Technical Specifications do not need changed.

✓ Verify that an unresolved safety issue is not created.

✓ Update section 3.3.4 of the SAR.

✓ Update drawing 3-6 in SAR.

✓ Install new water system.

✓ Verify flow rate of > 8 gallons per hour from new system.

✓ Remove existing still unit from service.

_____ Update as built drawings

✓ Update operations manual (training document).

✓ Search question bank for questions on still and remove. Add questions for the new system. (training document).

stillsmw.wp

Change Resin Beds For Water Makeup System

I. General

1. Reference: Manufacturers Literature
2. Requirements: As needed
3. Tools: None
4. Equipment: None
5. Coordination: None
6. Estimated Time: 1 hour

II. Procedural Sequence:

1. Determine that a demineralizer needs to be changed. There is a lamp on top of the demineralizer which will go out when the resins need changing. The lamp may come on if there has been no flow of water through the unit. To ensure the resins have been exhausted, open sample port and run water through the resins beds for one to two minutes.
2. Close the water supply valve to the resin bed housings.
3. Unscrew the housing and lower carefully so as not to damage the distributor tube. Remove the o-ring, dump out the resin and clean out the housing. The exhausted resin can be disposed of into any waste container as there is no danger of any hazard.
4. Before loading, make sure the bottom strainer of the distributor tube is inserted into the socket at the bottom of the housing. Carefully pour in the resin from one jar of resin. After loading, clean the threads, o-ring groove and the top surface of the housing of all resin beads. Wipe the o-ring dry and place into the groove in the housing. Lightly lubricate the top surface of the o-ring.
5. Replace the housing, hand tighten, and reapply the water supply.

Analysis for reactor water purification system replacement project:

Technical Specificaions:

- The pool water makeup system is not specifically mentioned in the Tech Specs. The requirement is that the conductivity of the bulk pool water be maintained at 200,000 ohms or greater.

Safety Analysis Report:

- The water purification system is designed to replace water due to normal evaporation. Water loss beyond the capability of the water purification system is addressed by other systems covered elsewhere in the SAR, and remains unchanged.

- The replacement system meets or exceeds the makeup system currently being used.

- A backup for the primary water purification exists, and remains unchanged.

Other Items Considered:

- Failure of the primary water makeup system does not affect the pool water level, or the ability to add water due to loss from normal operations.

- The limiting conditions for operations (conductivity of the bulk pool water) does not change as a result of the replacement

- The conductivity of the bulk pool water will be maintained at or above the Technical Specification requirement at all times.

EXISTING VERSION

3.3.4 <u>Primary Water Makeup System</u>

The primary water makeup system replaces any primary coolant water lost due to evaporation from the pool surface. The evaporation of 66 gallons of primary water results in an approximate one inch decrease in the pool water level. During normal operations, approximately 80 gallons of primary water are lost each week due to evaporation, depending on the season of the year. The primary water makeup system consists of a 100 gallon holding tank and distillation unit (still) connected via valving and piping to the primary water makeup line. This system is capable of using raw industrial water as feed water. In the event of a primary makeup water system failure, the replenishing of the evaporated reactor pool water is achieved via a straight-feed system (with valving and coupling) which contains a mixed-bed demineralizer and filter system. This system is also capable of using raw industrial water as feed water. The discharge line from the holdup tank is several feet above the reactor pool, which allows the makeup water to be gravity-fed to the reactor pool. This makeup water line is located along the east wall of the reactor pool and discharges the makeup water above the surface of the pool.

PROPOSED VERSION

3.3.4 <u>Primary Water Makeup System</u>

The primary water makeup system replaces any primary coolant water lost due to evaporation from the pool surface. The evaporation of 67 gallons of primary water results in an approximate one inch decrease in the pool water level. Depending on the season of the year, up to 80 gallons of primary water are lost each week due to evaporation. The primary water makeup system consists of a water feed line from the AFRRI water purification system and a 100 gallon holding tank connected via valving and piping to the primary water makeup line. In the event of a primary makeup water system failure, the replenishing of the evaporated reactor pool water is achieved via a straight-feed system (with valving and coupling) which contains a mixed-bed demineralizer and filter system. This system is also capable of using raw industrial water as feed water. The discharge line from the holdup tank is above the reactor pool, which allows the makeup water to be gravity-fed to the reactor pool. This makeup water line is located along the east wall of the reactor pool and discharges the makeup water above the surface of the pool.

EXISTING

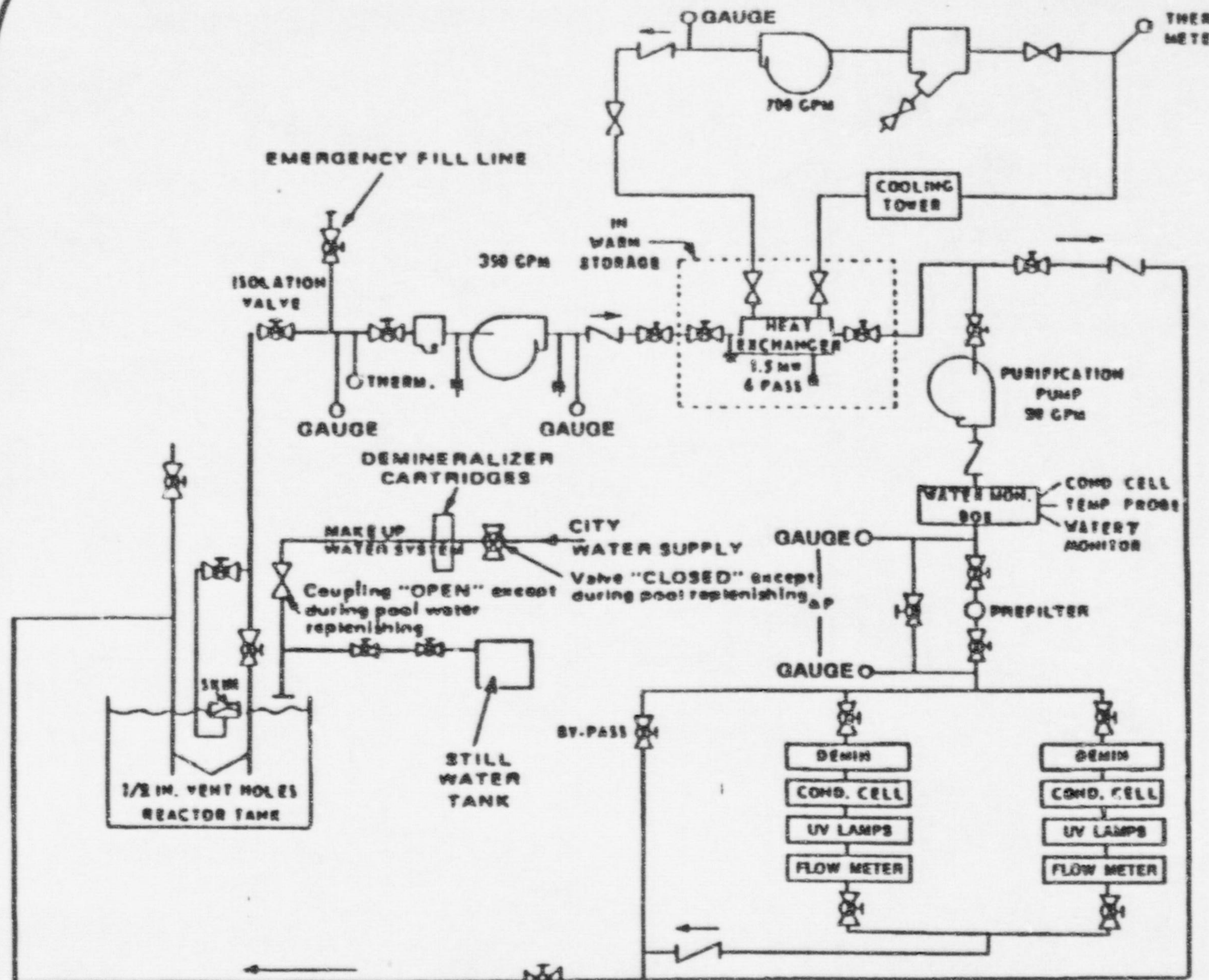


Figure 3-6.

WATER PURIFICATION AND COOLING SYSTEMS

PROPOSED

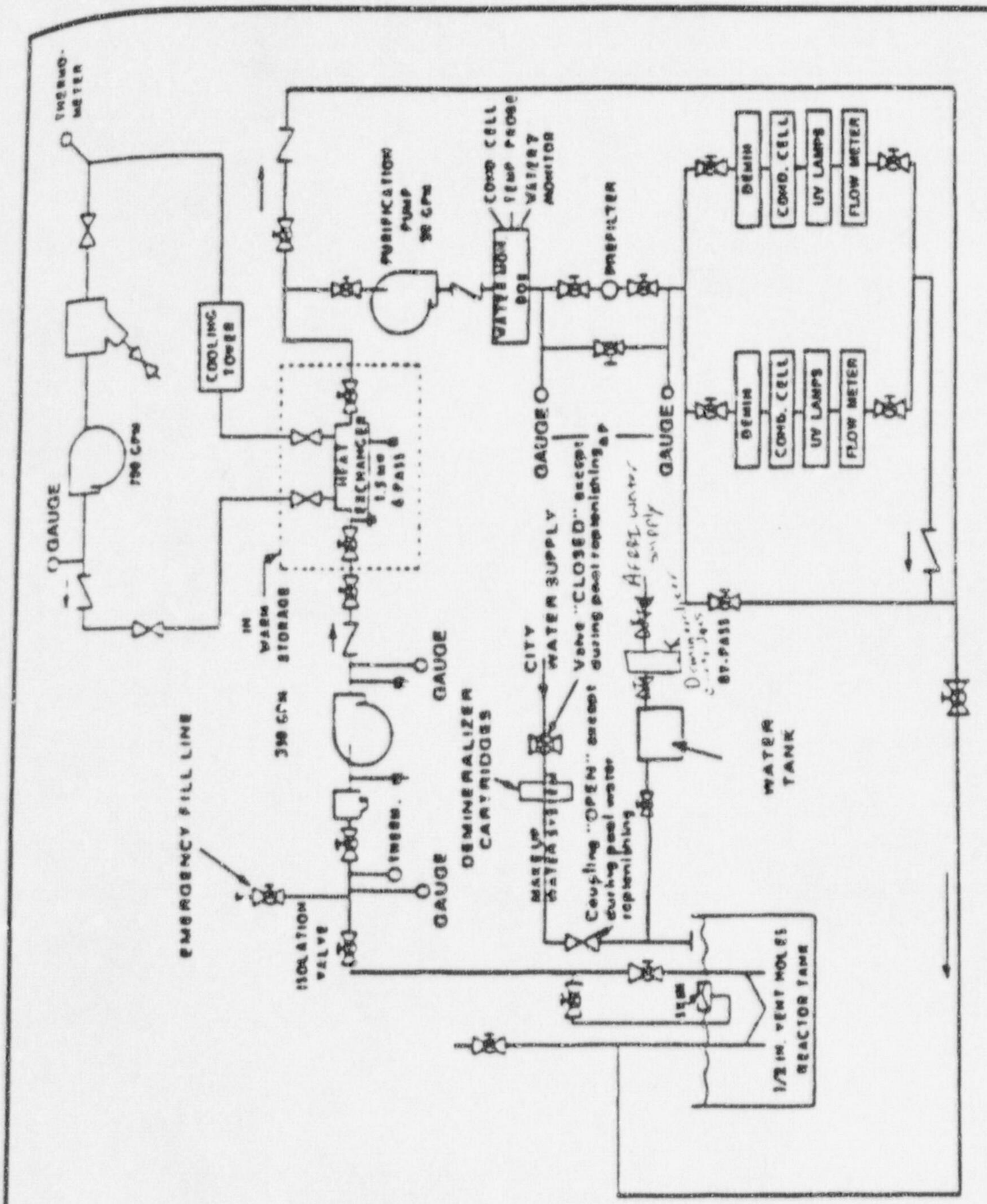


Figure 3-6.

WATER PURIFICATION AND COOLING SYSTEMS

Facility Modification Work Sheet 1

10 CFR 50.59 Analysis

Proposed Change: ___ Remove all References to Criticality _________ ___ Monitor R5 from SAR __________________

Submitted by: _____ George __________ Date 13 March 1998

1. Description of change:

This change is to remove all references to the Radiation Area Monitor (RAM) R5 from the SAR. RAM R1 will be moved from above the reactor pool to the east wall of the reactor room over the hot table, and RAM R5 will be moved to another location in the reactor room and be used as a spare RAM. Both RAMs will have a designated alarm point set to alert personnel of radiation in the area of the detector.

An additional radiation monitor will be added around the reactor dolly to inform operators working over the core when radiation levels are above some predetermined setpoint.

Various procedures (attached) will be updated to reflect this change.

2. Reason for change:

Radiation levels above the reactor pool for typical operations, are above the 20 millirem night time setpoint for RAMs R1 and R5. Typical operations require changing these set points to prevent alarms. An NRC inspector recommended changing the RAM locations so that alarm points would not have to be changed prior to high power runs or pulses.

10 CFR 70.24 specifies that an accident criticality monitor is required for storage of nuclear material. Because the nuclear material is in a reactor core and not in storage, an accidental criticality monitor is not applicable.

3. Verify that the proposed change does not involve a change to the Technical Specifications or produce an unresolved safety issue as specified in 10 CFR 50.59(a)(2). Attach an analysis to show this.

Analysis attached? Yes __XX__

4. The proposed modification constitutes a changes in the facility or an operational procedure as described in the SAR. Describe which (check all that apply).

Procedure _XX_ Facility _XX_ Experiment ____

Facility Modification Work Sheet 1

5. Specify what sections of the SAR are applicable. In general terms describe the necessary updates to the SAR. Note that this description need not contain the final SAR wording.

Section 3.6.5. Remove reference to R5 being criticality monitor.

Table 3-1. Change location of RAM R1

Figure 3-13 RAM locations and names.

6. For facility modifications, specify what testing is to be performed to assure that the systems involved operate in accordance with their design intent.

Channel test to be preformed. Unit will not be altered. Only the location of the detector head will be moved.

Facility Modification Work Sheet 1

7. Specify associated information.

New drawings are: Attached ____
Not required _XX_

Does a drawing need to be sent to Logistics? Yes ____ No _XX_
Are training materials effected? Yes _XX_ No ____
Will any Logs have to be changed? Yes ____ No _XX_
Are other procedures effected? Yes _XX_ No ____

List of items effected:

As built drawings, Location of RAMs

Startup Checklist
Shutdown Checklist
Pulse procedures (critical and subcritical)
Nuclear Instrumentation Setpoint Check sheet
SAR sections 3.6.5
SAR Table 3-1 (Page 3-26) Figure 3-13 (page 3-51)

8. Create an Action Sheet containing a list of associated work specified in items #7, attach a copy, and submit another to the RFD.

Action Sheet: Submitted _XX_ Not Required ____

Reviewed and approved by RFD ______________ Date 3/30/98

RRFSC Concurrence SMO Date APR 13 1998

c:wp\5059crit, attach: critana critsar, critsar2,critopg1/op8c/opb1/opbi/op8b, h:rdrive\op8g2ch2, ACTION SHEET: Criticality Monitor

- ✓ Change startup checklist to leave R1 and R5 set points unchanged
- ✓ Change shutdown checklist to leave R1 and R5 set points unchanged
- ✓ Change alarm points on safety checklist for RAM's R1 and R5
- ✓ Change Nuclear Instrumentation set point check sheet to reflect current set points for R1 and R5.
- ✓ Remove RAM adjustments from subcritical pulse procedure
- ✓ Remove RAM adjustments from critical pulse procedure
- ✓ Change SAR section 3.6.5 to remove reference about RAM R5 as criticality monitor
- ✓ Change SAR Table 3-1, location of RAM R1
- ✓ Change Figure 3-13
- ✓ Move RAM R1 and R5 to new location in reactor deck
- ✓ Search and update question bank for R1 and R5 questions
- ✓ Update Chapter 6 of operations training manual on RAM locations and alarms.
- ✓ Search training program for data on RAMs
- ✓ Replace procedures in procedure books
- ✓ Update procedure files on R: drive

critram.wp

Analysis for moving RAM R1 and R5

Technical Specifications: The Effect of Moving RAMs R1 and R5

The Technical Specifications does not specify where in the reactor room RAM R1 will be located. RAM R5 is not required by the Technical Specifications.

Safety Analysis Report: Effect on SAR for fuel cladding failure accident.

The SAR states that the maximum inventory of fission products released from a single TRIGA fuel element operating at full power would produce an exposure rate in the reactor room of about .2 Rem/hour from the noble gas mixture. The movement of the Radiation Area Monitor (RAM) detectors within the reactor room will not effect in the readings because the radioactive gas would distribute equally throughout the room

Safety Analysis Report: Effect on SAR loss of shielding water accident.

The SAR states that a loss of shielding water would produce a predicted gamma dose rate of approximately 300 mRem/hr 10 feet from the pool due to skyshine. Dose readings directly over the reactor core are expected to be approximately 3.2 Rem/r. The location of the detector would be moved from over the pool to a location on the wall approximately 10 feet from the edge of the pool. The alarm point for Ram R1 will be 10 millirem and would alarm in either location. The movement of the ram would not change its ability to alarm in a loss of shielding water accident.

Ability for RAM R1 to detect fuel being removed from the pool

A fuel element emitting a dose rate as little as 4 Rem at one foot, would alarm any RAM unit that is within 20 feet of the source. Each of the RAMs will be approximately 10 feet from the edge of the reactor pool. Fuel removed from the reactor deck would have to pass within 20 feet of one or more RAMs. Removal of fuel from the reactor pool would therefor be detected by the RAMs.

EXISTING VERSION

3.6.5 Criticality Monitors

Criticality monitors are used to detect and measure acute radiation dose levels, in excess of those measurable with personnel monitors, in the event of a criticality accident occurring in an inhabited work area. There are two types of criticality monitors used at AFRRI.

The reactor room criticality monitor is mounted at the end of the trail cable boom directly above the core carriage. There is only one of these units associated with the reactor. This unit monitors gamma radiation emitted by fuel elements stored in the reactor pool as well as the reactor core itself when the reactor is secured. The unit is attached to an uninterruptible power supply which can provide continuous power in the event of an electrical power outage at the facility. This criticality monitor consists of a scintillation detector and is capable of measuring gamma radiation with energies greater than 80 keV. The reactor room criticality monitor has a range of 1 mrem/hr to 10^5 mrem/hr, and a nominal accuracy of ± 15 percent at all levels. The unit is designed to activate a radiation alarm, both audible and visual, at an adjustable, preset level. The unit's readout meter and radiation alarms are located in the reactor control room. The reactor room criticality monitor also activates a visual alarm in the reactor control room when a loss of high voltage to the detector or a loss of signal occurs. The alarm setpoint is given in the appropriate AFRRI internal documents[4] and conforms to 10 CFR 70.24.

The second type of criticality monitor at AFRRI is the criticality accident dosimeter which contains various metal foils and other materials which are activated when exposed to large neutron and gamma radiation fields. In case of a criticality accident, the activated materials can be analyzed and the total integrated dose calculated. These dosimeters measure neutron exposures above 1 rem deep-dose equivalent (H_d) and gamma exposures above 50 rems H_d. The dosimeters are also capable of measuring exposures within discrete energy levels of the neutron spectrum. The foils and materials utilized in these dosimeters are contained in vials and the units are mounted on red plaques in the following locations:

- North wall of the reactor room
- East wall of the reactor room (2)
- South wall of the reactor room
- Ceiling of the reactor room
- East wall of the reactor control room
- West wall of Hallway 3106
- North wall of room 3152
- In room 1120 by the heat exchanger

PROPOSED VERSION

3.6.5 Criticality Monitors

The accidental criticality monitor is a dosimeter which contains various metal foils and other materials which are activated when exposed to large neutron and gamma radiation fields. In case of a criticality accident, the activated materials can be analyzed and the total integrated dose calculated. These dosimeters measure neutron exposures above 1 rem deep-dose equivalent (H_d) and gamma exposures above 50 rems H_d. The dosimeters are also capable of measuring exposures within discrete energy levels of the neutron spectrum. The foils and materials utilized in these dosimeters are contained in vials and the units are mounted on red plaques in the following locations:

- North wall of the reactor room
- East wall of the reactor room (2)
- South wall of the reactor room
- Ceiling of the reactor room
- East wall of the reactor control room
- West wall of Hallway 3106
- North wall of room 3152
- In room 1120

EXISTING VERSION

TABLE 3-1

REACTOR REMOTE AREA MONITORS

RAM	LOCATION	READOUT	RADIATION ALARM
R-1	Approximately 2 feet above the reactor pool surface on the east side of the reactor pool	Meter in reactor control room and Emergency Response Center (Room 3430)	Activates audible and visual alarm in the reactor room and in the reactor control room; activates visual alarm in the Emergency Response Center (Room 3430); activates visual and optional audible alarm on annunciator panel in Hallway 3101
R-2	Approximately 7 feet above the floor on the reactor room west wall	Same as R-1	Activates visual alarm in the reactor control room and in the Emergency Response Center (Room 3430)
E-3	6 feet above the floor on the west wall prep area opposite ER #1 plug door	Same as R-1	Same as R-2. In addition, a visual and audible local alarm exists in the prep area near ER #1 and a red light at the front desk
E-6	6 feet above the floor on the west wall prep area opposite ER #2 plug door ER #2	Same as R-1	Same as E-3 except the visual and audible local alarm exists in the prep area near ER #2

PROPOSED VERSION

TABLE 3-1

REACTOR REMOTE AREA MONITORS

RAM	LOCATION	READOUT	RADIATION ALARM
R-1	Approximately 7 feet above the floor on the reactor room east wall	Meter in reactor control room and Emergency Response Center (Room 3430)	Activates audible and visual alarm in the reactor room and in the reactor control room; activates visual alarm in the Emergency Response Center (Room 3430); activates visual and optional audible alarm on annunciator panel in Hallway 3101
R-2	Approximately 7 feet above the floor on the reactor room west wall	Same as R-1	Activates visual alarm in the reactor control room and in the Emergency Response Center (Room 3430)
E-3	6 feet above the floor on the west wall prep area opposite ER #1 plug door	Same as R-1	Same as R-2. In addition, a visual and audible local alarm exists in the prep area near ER #1 and a red light at the front desk
E-6	6 feet above the floor on the west wall prep area opposite ER #2 plug door ER #2	Same as R-1	Same as E-3 except the visual and audible local alarm exists in the prep area near ER #2

Existing

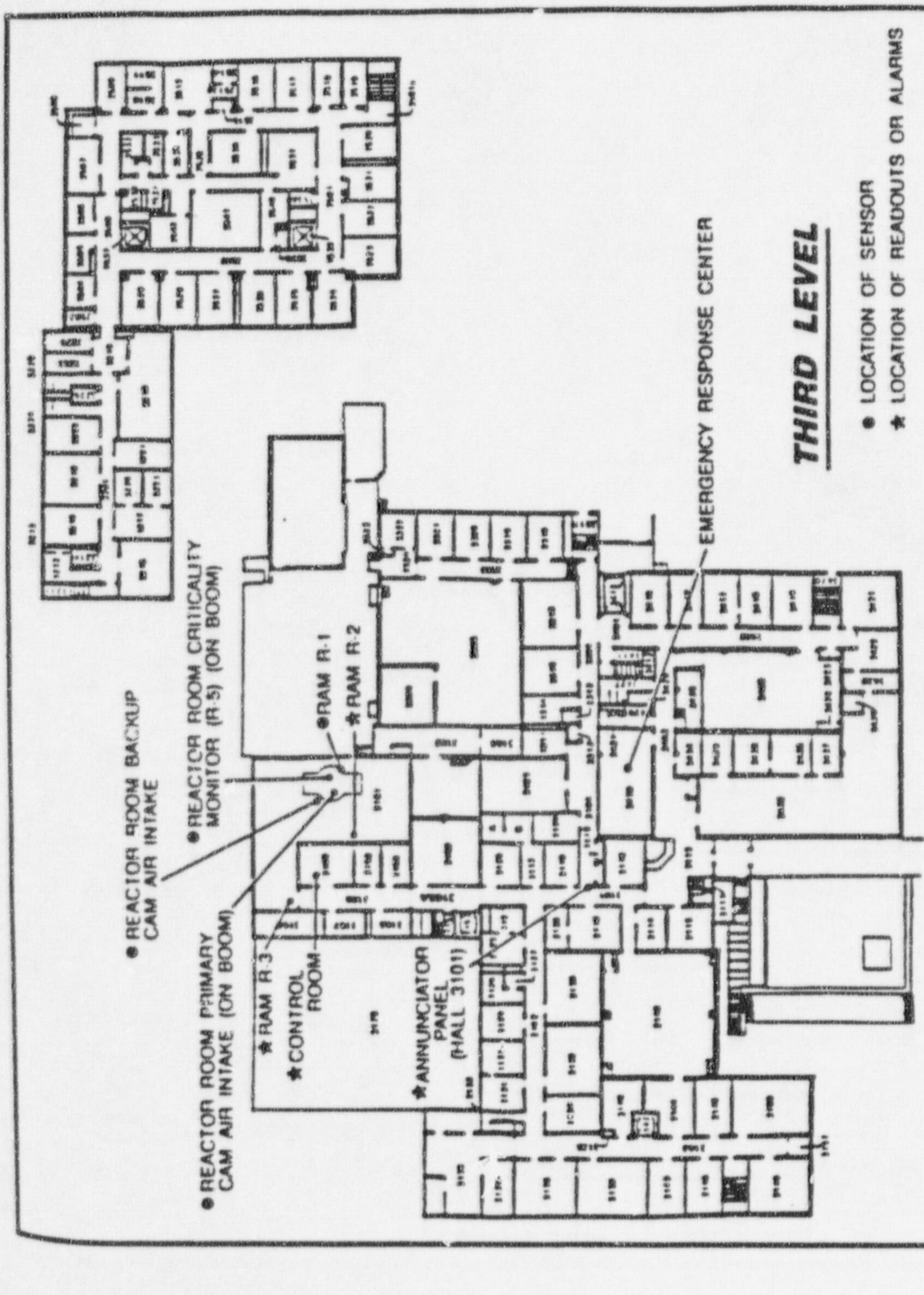


Figure 3-13.
AFRRI RADIATION MONITORS ASSOCIATED WITH AFRRI-TRIGA REACTOR THIRD LEVEL

Proposed

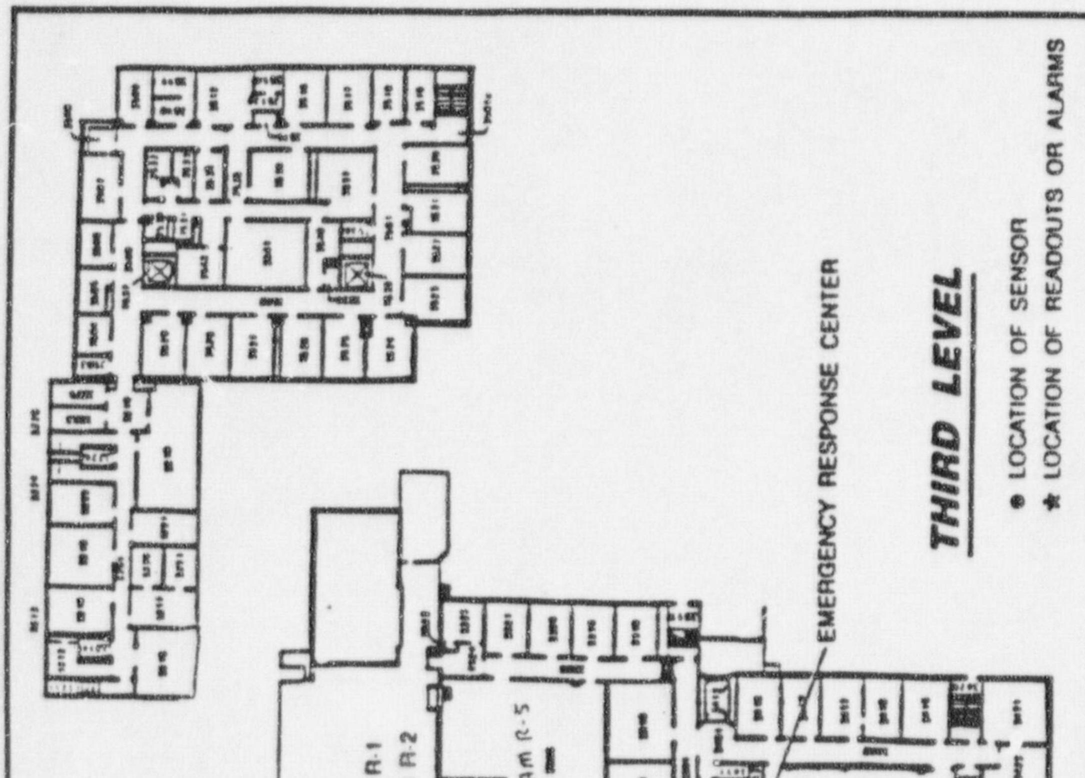


Figure 3-13.
AFRRI RADIATION MONITORS ASSOCIATED WITH AFRRI-TRIGA REACTOR
THIRD LEVEL

DAILY OPERATIONAL STARTUP CHECKLIST

Checklist No. ____________ Date ____________________
Time Completed __________ Supervised by _____________
Assisted by _______________

I. EQUIPMENT ROOM (Room 3152)

1. Air compressor pressure (80 - 120 psig) .... _______*
2. Water drained from air compressor .... _______
3. Air dryer operating .... _______
4. Doors 231, 231A, and roof hatch SECURED .... _______

II. LOBBY AREA

Lobby alarm turned off .... _______

III. EQUIPMENT ROOM (Room 2158)

1. Prefilter differential pressure (< 8 psid) .... _______*
2. Primary discharge pressure (15 - 25 psig) .... _______*
3. Demineralizer flow rates set to 6 gpm (5.5 - 6.5 gpm) .... _______*
4. Stack roughing filter (notify supervisor if > 1.0" of water) .... _______*
5. Stack absolute filter (notify supervisor if > 1.35" of water) .... _______*
6. Visual inspection of area .... _______
7. Door 2158 SECURED .... _______

IV. PREPARATION AREA

Visual inspection of area .... _______

V. REACTOR ROOM (Room 3161)

1. Transient rod air pressure (78 - 82 psig) .... _______*
2. Shield door bearing air pressure (8.5 - 11 psig) .... _______*
3. Visual inspection of core and tank .... _______
4. Number of fuel elements and control rods in tank storage — Fuel elements _______* Control rods _______*
5. Air particulate monitor (CAM)
   - (a) Primary operating and tracing .... _______
   - (b) Backup operating .... _______
   - (c) Channel test completed, damper closure verified .... _______
6. Channel test completed on SGM .... _______
7. Door 3162 SECURED .... _______

*Numerical Entry

VI. REACTOR CONTROL ROOM (Room 3160)

1. Emergency air dampers reset . . . . ________
2. Console recorders dated . . . . ________
3. Stack flow and fuel temperature recorders dated . . . . ________
4. Logbook dated and reviewed . . . . ________
5. Water monitor box
   - (a) Background activity (10 - 60 cpm) . . . . ________*
   - (b) Water monitor box resistivity (> 0.2 Mohm-cm) . . . . ________*
   - (c) DM1 resistivity (> 0.5 Mohm-cm) . . . . ________*
   - (d) DM2 resistivity (> 0.5 Mohm-cm) . . . . ________*
6. Stack gas flow rate (15 - 35 Kcfm) . . . . ________*
7. Stack linear flow rate (1.0 - 2.0 Kft/min) . . . . ________*
8. Gas stack monitor
   - (a) Background (2 - 20 cpm) . . . . ________*
   - (b) Alarm check . . . . ________
   - (c) High alarm set to 3.2 E-5 microCi/cc at stack top . . . . ________
   - (d) SGM chart recorder operating and tracing . . . . ________
9. Radiation monitors

Monitor	Alarm Point Functional	Reading (mrem/hr)	Alarm Setting (mrem/hr)
(a) R-1	________	(< 20) ________*	________ 500
(b) R-2	________	(< 10) ________*	________ 10
(c) R-3	________	(< 10) ________*	________ 10
(d) R-5	________	(< 20) ________*	________ 500
(e) E-3	________	(< 10) ________*	________ 10
(f) E-6	________	(< 10) ________*	________ 10

10. TV monitors on . . . . ________
11. CAM high level audible alarm check . . . . ________
12. Water temperature (inlet) (5 - 35 °C) . . . . ________*
13. Water level log completed . . . . ________
14. Console lamp test completed . . . . ________
15. Time delay operative . . . . ________
16. Source level power greater/equal to 0.5 cps . . . . ________
17. Prestart operabili' checks performed . . . . ________
18. Interlock Tests
   - (a) Rod raising, SS mode ________
   - (b) Rod raising, Pulse mode ________
   - (c) Source RWP ________
   - (d) Period RWP ________
   - (e) 1 kW/Pulse mode ________
   - (f) NM-1000 HV ________
   - (g) Inlet Temp ________
19. SCRAM checks (at least one per rod)
   - (a) % Power 1 ________
   - (b) % Power 2 ________
   - (c) Fuel temp 1 ________
   - (d) Fuel temp 2 ________
   - (e) HV loss 1 ________
   - (f) HV loss 2 ________
   - (g) Pool level ________
   - (h) Reactor key ________
   - (i) Manual ________
   - (j) Emergency Stop ________
   - (k) Timer ________
   - (l) CSC Watchdog ________
   - (m) DAC Watchdog ________
20. Zero power pulse . . . . ________

*Numerical Entry

DAILY OPERATIONAL STARTUP CHECKLIST

Checklist No. ____________ Date ____________________
Time Completed __________ Supervised by ____________
Assisted by ______________

I. EQUIPMENT ROOM (Room 3152)

1. Air compressor pressure (80 - 120 psig) .... _______*
2. Water drained from air compressor .... _______
3. Air dryer operating .... _______
4. Doors 231, 231A, and roof hatch SECURED .... _______

II LOBBY AREA

Lobby alarm turned off .... _______

III. EQUIPMENT ROOM (Room 2158)

1. Prefilter differential pressure (< 8 psid) .... _______*
2. Primary discharge pressure (15 - 25 psig) .... _______*
3. Demineralizer flow rates set to 6 gpm (5.5 - 6.5 gpm) .... _______*
4. Stack roughing filter (notify supervisor if > 1.0" of water) .... _______*
5. Stack absolute filter (notify supervisor if > 1.35" of water) .... _______*
6. Visual inspection of area .... _______
7. Door 2158 SECURED .... _______

IV. PREPARATION AREA

Visual inspection of area .... _______

V. REACTOR ROOM (Room 3161)

1. Transient rod air pressure (78 - 82 psig) .... _______*
2. Shield door bearing air pressure (8.5 - 11 psig) .... _______*
3. Visual inspection of core and tank .... _______
4. Number of fuel elements and control rods in tank storage — Fuel elements _______* Control rods _______*
5. Air particulate monitor (CAM)
   - (a) Primary operating and tracing .... _______
   - (b) Backup operating .... _______
   - (c) Channel test completed, damper closure verified .... _______
6. Channel test completed on SGM .... _______
7. Door 3162 SECURED .... _______

*Numerical Entry

VI. REACTOR CONTROL ROOM (Room 3160)

1. Emergency air dampers reset . . . . ________
2. Console recorders dated . . . . ________
3. Stack flow and fuel temperature recorders dated . . . . ________
4. Logbook dated and reviewed . . . . ________
5. Water monitor box
   - (a) Background activity (10 - 60 cpm) . . . . ________*
   - (b) Water monitor box resistivity (> 0.2 Mohm-cm) . . . . ________*
   - (c) DM1 resistivity (> 0.5 Mohm-cm) . . . . ________*
   - (d) DM2 resistivity (> 0.5 Mohm-cm) . . . . ________*
6. Stack gas flow rate (15 - 35 Kcfm) . . . . ________*
7. Stack linear flow rate (1.0 - 2.0 Kft/min) . . . . ________*
8. Gas stack monitor
   - (a) Background (2 - 20 cpm) . . . . ________*
   - (b) Alarm check . . . . ________
   - (c) High alarm set to 3.2 E-5 microCi/cc at stack top . . . . ________
   - (d) SGM chart recorder operating and tracing . . . . ________
9. Radiation monitors

Monitor	Alarm Point Functional	Reading (mrem/hr)	Alarm Setting (mrem/hr)
(a) R-1	________	(< 10) ________*	________ 10
(b) R-2	________	(< 10) ________*	________ 10
(c) R-3	________	(< 10) ________*	________ 10
(d) R-5	________	(< 10) ________*	________ 10
(e) E-3	________	(< 10) ________*	________ 10
(f) E-6	________	(< 10) ________*	________ 10

10. TV monitors on . . . . ________
11. CAM high level audible alarm check . . . . ________
12. Water temperature (inlet) (5 - 35 °C) . . . . ________*
13. Water level log completed . . . . ________
14. Console lamp test completed . . . . ________
15. Time delay operative . . . . ________
16. Source level power greater/equal to 0.5 cps . . . . ________
17. Prestart operability checks performed . . . . ________
18. Interlock Tests

(a) Rod raising, SS mode	________	(e) 1 kW/Pulse mode	________
(b) Rod raising, Pulse mode	________	(f) NM-1000 HV	________
(c) Source RWP	________	(g) Inlet Temp	________
(d) Period RWP	________		

19. SCRAM checks (at least one per rod)

(a) % Power 1	________	(h) Reactor key	________
(b) % Power 2	________	(i) Manual	________
(c) Fuel temp 1	________	(j) Emergency Stop	________
(d) Fuel temp 2	________	(k) Timer	________
(e) HV loss 1	________	(l) CSC Watchdog	________
(f) HV loss 2	________	(m) DAC Watchdog	________
(g) Pool level	________		

20. Zero power pulse . . . . ________

*Numerical Entry

DAILY OPERATIONAL SHUTDOWN CHECKLIST

Checklist No. ____________ Date ____________________

Time Completed __________ Supervised by _____________

Assisted by ______________

____

I. REACTOR ROOM (Room 3161)

1. All rod drives DOWN .... _______
2. Carriage lights OFF .... _______
3. Door 3162 SECURED .... _______
4. Channel test completed on both CAM's .... _______
5. Door 3161 locked with key .... _______

II. EQUIPMENT ROOM (Room 3152)

1. Distillation unit discharge valve CLOSED .... _______
2. Air dryer OPERATIONAL .... _______
3. Doors 231, 231A, and roof hatch SECURED .... _______

III. EQUIPMENT ROOM (Room 2158)

1. Primary discharge pressure (15 - 25 psig) .... ______*
2. Demineralizer flow rates set to (5.5 - 6.5 gpm) .... ______*
3. Visual inspection for leaks .... ______
4. Door 2158 and 2164 SECURED .... ______

IV. PREPARATION AREA

1. ER2 plug door CONTROL LOCKED .... _______
   Door closed, and handwheel PADLOCKED .... _______
2. ER2 lights ON and rheostat at 10% .... _______
3. ER1 plug door CONTROL LOCKED .... _______
   Door closed, and handwheel PADLOCKED .... _______
4. ER1 lights ON and rheostat at 10% .... _______
5. Visual inspection of area .... _______
6. Warm storage doors closed .... _______

V. LOBBY ALARM

Lobby alarm audio ON	_______

VI. REACTOR CONTROL ROOM (Room 3160)

1. Reactor tank lights OFF	_______
2. Console chart recorder pens raised	_______
3. Steady-state timer OFF	_______
4. Console LOCKED, and all required keys returned to lock box	_______
5. Diffuser pumps OFF	_______
6. Purification, secondary and primary pumps ON	_______
7. Reactor monthly usage summary completed	_______
8. Auxiliary chart recorders operating and tracing	_______
9. Radiation monitors	_______

MONITOR	READING	HIGH LEVEL ALARM SETTING (mrem/hr)
a. R-1	(<20) _______*	20 _______
b. R-2	(<10) _______*	10 _______
c. R-3	(<10) _______*	10 _______
d. R-5	(<20) _______*	20 _______
e. E-3	(<10) _______*	10 _______
f. E-6	(<10) _______*	10 _______
g. R-6	(<10) _______*	

* Numerical Entry

DAILY OPERATIONAL SHUTDOWN CHECKLIST

Checklist No. ___ ________ Date ____________________

Time Completed __________ Supervised by _____________

Assisted by _______________

____

I. REACTOR ROOM (Room 3161)

1. All rod drives DOWN . . . . ______
2. Carriage lights OFF . . . . ______
3. Door 3162 SECURED . . . . ______
4. Channel test completed on both CAM's . . . . ______
5. Door 3161 locked with key . . . . ______

II EQUIPMENT ROOM (Room 3152)

1. Distillation unit discharge valve CLOSED . . . . ______
2. Air dryer OPERATIONAL . . . . ______
3. Doors 231, 231A, and roof hatch SECURED . . . . ______

III EQUIPMENT ROOM (Room 2158)

1. Primary discharge pressure (15 - 25 psig) . . . . ______*
2. Demineralizer flow rates set to (5.5 - 6.5 gpm) . . . . ______*
3. Visual inspection for leaks . . . . ______
4. Door 2158 and 2164 SECURED . . . . ______

IV PREPARATION AREA

1. ER2 plug door CONTROL LOCKED . . . . ______
   Door closed, and handwheel PADLOCKED . . . . ______
2. ER2 lights ON and rheostat at 10% . . . . ______
3. ER1 plug door CONTROL LOCKED . . . . ______
   Door closed, and handwheel PADLOCKED . . . . ______
4. ER1 lights ON and rheostat at 10% . . . . ______
5. Visual inspection of area . . . . ______
6. Warm storage doors closed . . . . ______

V. LOBBY ALARM

Lobby alarm audio ON .... ______

VI. REACTOR CONTROL ROOM (Room 3160)

1. Reactor tank lights OFF .... ______
2. Console chart recorder pens raised .... ______
3. Steady-state timer OFF .... ______
4. Console LOCKED, and all required keys returned to lock box .... ______
5. Diffuser pumps OFF .... ______
6. Purification, secondary and primary pumps ON .... ______
7. Reactor monthly usage summary completed .... ______
8. Auxiliary chart recorders operating and tracing .... ______
9. Radiation monitors .... ______

MONITOR	READING	HIGH LEVEL ALARM SETTING (mrem/hr)
a. R-1	(<10) ______*	10 ______
b. R-2	(<10) ______*	10 ______
c. R-3	(<10) ______*	10 ______
d. R-5	(<10) ______*	10 ______
e. E-3	(<10) ______*	10 ______
f. E-6	(<10) ______*	10 ______
g. R-6	(<10) ______*	

* Numerical Entry

DAILY SAFETY CHECKLIST

Checklist No. ____________ Date ______________________

Time Completed ________ Supervised by ______________

Assisted by _______________

I. EQUIPMENT ROOM (Room 3152)

1. Air compressor pressure (80 - 120 psig) .... ________*
2. Water drained from air compressor .... ________
3. Air dryer operating .... ________
4. Doors 231, 231A, and roof hatch SECURED .... ________

II. EQUIPMENT ROOM (Room 2158)

1. Prefilter differential pressure (< 8 psid) .... ________*
2. Primary discharge pressure (15 - 25 psig) .... ________*
3. Demineralizer flow rates set to 6 gpm (5.5 - 6.5 gpm) .... ________*
4. Stack roughing filter (notify supervisor if > 1.0" of water) .... ________*
5. Stack absolute filter (notify supervisor if > 1.35" of water) .... ________*
6. Visual inspection of area .... ________
7. Door 2158 SECURED .... ________

III. PREPARATION AREA

Visual inspection of area .... ________

IV. REACTOR ROOM (Room 3161)

1. Transient rod air pressure (78 - 82 psig) .... ________*
2. Shield door bearing air pressure (8.5 - 11 psig) .... ________*
3. Visual inspection of core and tank .... ________
4. Number of fuel elements and control rods in tank storage — Fuel elements ________* Control rods ________*
5. Air particulate monitor (CAM)
   - (a) Primary operating and tracing .... ________
   - (b) Backup operating .... ________
   - (c) Channel test completed, damper closure verified .... ________
6. Channel test completed on SGM .... ________
7. Door 3162 SECURED .... ________

*Numerical Entry

V. LOBBY AREA

Lobby audio alarm turned off* .... ______

VI. REACTOR CONTROL ROOM (Room 3160)

1. Emergency air dampers reset .... ______
2. Console recorders dated .... ______
3. Stack flow and fuel temperature recorders dated .... ______
4. Logbook dated and reviewed .... ______
5. Water monitor box
   - (a) Background activity (10 - 60 cpm) .... ______*
   - (b) Water monitor box resistivity (> 0.2 Mohm-cm) .... ______*
   - (c) DM1 resistivity (> 0.5 Mohm-cm) .... ______*
   - (d) DM2 resistivity (> 0.5 Mohm-cm) .... ______*
6. Stack gas flow rate (15 - 35 Kcfm) .... ______*
7. Stack linear flow rate (1.0 - 2.0 Kft/min) .... ______*
8. Gas stack monitor
   - (a) Background (2 - 20 cpm) .... ______*
   - (b) Alarm check .... ______
   - (c) High alarm set to 3.2 E-5 microCi/cc at stack top .... ______
   - (d) SGM chart recorder operating and tracing .... ______
9. Radiation monitors

Monitor	Alarm Point Functional	Reading (mrem/hr)	Alarm Setting (mrem/hr)
(a) R-1	______	(< 20) ______*	______ 20
(b) R-2	______	(< 10) ______*	______ 10
(c) R-3	______	(< 10) ______*	______ 10
(d) R-5	______	(< 20) ______*	______ 20
(e) E-3	______	(< 10) ______*	______ 10
(f) E-6	______	(< 10) ______*	______ 10

10. TV monitors on .... ______
11. CAM high level audible alarm check .... ______
12. Water temperature (inlet) (5 - 35 °C) .... ______*
13. Water level log completed .... ______
14. Source level power greater/equal to 0.5 cps .... ______

*Numerical Entry

DAILY SAFETY CHECKLIST

Checklist No. ____________ Date ____________________

Time Completed __________ Supervised by _____________

Assisted by ______________

I. EQUIPMENT ROOM (Room 3152)

1. Air compressor pressure (80 - 120 psig) . . . . ________*
2. Water drained from air compressor . . . . ________
3. Air dryer operating . . . . ________
4. Doors 231, 231A, and roof hatch SECURED . . . . ________

II. EQUIPMENT ROOM (Room 2158)

1. Prefilter differential pressure (< 8 psid) . . . . ________*
2. Primary discharge pressure (15 - 25 psig) . . . . ________*
3. Demineralizer flow rates set to 6 gpm (5.5 - 6.5 gpm) . . . . ________*
4. Stack roughing filter (notify supervisor if > 1.0" of water) . . . . ________*
5. Stack absolute filter (notify supervisor if > 1.35" of water) . . . . ________*
6. Visual inspection of area . . . . ________
7. Door 2158 SECURED . . . . ________

III. PREPARATION AREA

Visual inspection of area . . . . ________

IV. REACTOR ROOM (Room 3161)

1. Transient rod air pressure (78 - 82 psig) . . . . ________*
2. Shield door bearing air pressure (8.5 - 11 psig) . . . . ________*
3. Visual inspection of core and tank . . . . ________
4. Number of fuel elements and control rods in tank storage — Fuel elements ________* Control rods ________*
5. Air particulate monitor (CAM)
   - (a) Primary operating and tracing . . . . ________
   - (b) Backup operating . . . . ________
   - (c) Channel test completed, damper closure verified . . . . ________
6. Channel test completed on SGM . . . . ________
7. Door 3162 SECURED . . . . ________

*Numerical Entry

V. LOBBY AREA

Lobby audio alarm turned off .... ________

VI. REACTOR CONTROL ROOM (Room 3160)

1. Emergency air dampers reset .... ________
2. Console recorders dated .... ________
3. Stack flow and fuel temperature recorders dated .... ________
4. Logbook dated and reviewed .... ________
5. Water monitor box
   - (a) Background activity (10 - 60 cpm) .... ________*
   - (b) Water monitor box resistivity (> 0.2 Mohm-cm) .... ________*
   - (c) DM1 resistivity (> 0.5 Mohm-cm) .... ________*
   - (d) DM2 resistivity (> 0.5 Mohm-cm) .... ________*
6. Stack gas flow rate (15 - 35 Kcfm) .... ________*
7. Stack linear flow rate (1.0 - 2.0 Kft/min) .... ________*
8. Gas stack monitor
   - (a) Background (2 - 20 cpm) .... ________*
   - (b) Alarm check .... ________
   - (c) High alarm set to 3.2 E-5 microCi/cc at stack top .... ________
   - (d) SGM chart recorder operating and tracing .... ________
9. Radiation monitors

Monitor	Alarm Point Functional	Reading (mrem/hr)	Alarm Setting (mrem/hr)
(a) R-1	________	(< 10) ________*	________ 10
(b) R-2	________	(< 10) ________*	________ 10
(c) R-3	________	(< 10) ________*	________ 10
(d) R-5	________	(< 10) ________*	________ 10
(e) E-3	________	(< 10) ________*	________ 10
(f) E-6	________	(< 10) ________*	________ 10

10. TV monitors on .... ________
11. CAM high level audible alarm check .... ________
12. Water temperature (inlet) (5 - 35 °C) .... ________*
13. Water level log completed .... ________
14. Source level power greater/equal to 0.5 cps .... ________

*Numerical Entry

NUCLEAR INSTRUMENTATION SET POINTS

GENERAL:

These set points may be adjusted for a specific operation by of the RFD or ROS but in no case may they be set at a point non-conservative to the technical specifications.

SPECIFIC

The following are channel or monitor set points (alarm, scram, rod withdrawal prevent).

1. Scrams:

a. Fuel Temperature 1 & 2:	575 C
b. High Flux 1 & 2:	110% (1.1 MW)
c. Safe Chambers 1 & 2 HV Loss:	20%
d. Pulse Timer:	Less than 15 seconds
e. Steady State Timer:	as necessary

2. Rod Withdrawal Prevents:

a. Period:	3 seconds
b. 1 KW (Pulse Mode):	1 KW
c. Source:	0.5 CPS
d. Water Inlet Temperature:	50 degrees C
e. Fission Chamber HV Loss:	20%

3. Alarms:

a. RAMS:	As directed in procedures
b. CAMS:	10,000 CPM
c. Stack Gas:	3.2E-5 microCi/cc at stack top
d. Water Monitor Box Gamma:	7000 CPM
e. Criticality Monitor (R5):	500 mrem day 20 mrem night

NUCLEAR INSTRUMENTATION SET POINTS

GENERAL:

These set points may be adjusted for a specific operation by of the RFD or ROS but in no case may they be set at a point non-conservative to the technical specifications.

SPECIFIC

The following are channel or monitor set points (alarm, scram, rod withdrawal prevent).

1. Scrams:
   a. Fuel Temperature 1 & 2: 575 C
   b. High Flux 1 & 2: 110% (1.1 MW)
   c. Safe Chambers 1 & 2 HV Loss: 20%
   d. Pulse Timer: Less than 15 seconds
   e. Steady State Timer: as necessary
2. Rod Withdrawal Prevents:
   a. Period: 3 seconds
   b. 1 KW (Pulse Mode): 1 KW
   c. Source: 0.5 CPS
   d. Water Inlet Temperature: 50 degrees C
   e. Fission Chamber HV Loss: 20%
3. Alarms:
   a. RAMS: As directed in procedures
   b. CAMS: 10,000 CPM
   c. Stack Gas: 3.2E-5 microCi/cc at stack top
   d. Water Monitor Box Gamma: 7000 CPM

PULSE OPERATION (SUBCRITICAL)

GENERAL

Pulses above \$2.00 must be approved by the RFD (prior to pulse initiation). Specification on the RUR may be used to meet this requirement.

SPECIFIC

1. Set the alarm points on R-1 and R-5 (criticality monitor) to full scale. Turn over the RAM indicator sign to denote that the RAMs are turned up.
2. Given a core position, set the transient rod at a position corresponding to the dollar value determined by the following equation:

\$ Value = Total worth (\$) Transient rod (to 100% or mechanical stop) - Desired pulse (\$) Value

3. Bring the reactor cold critical using the three standard control rods; use a rod configuration commensurate with core position and experimental requirements.
   Do not use Automatic Mode until the three standard rods have been raised at least 5%
   Note: A series of repetitive pulses may be fired using the same rod positions on the same day as long as the reactor power is not increasing and is less than 1 kW.
4. Stabilize in the manual mode.
5. Select the proper pulse detector according to the table below. **If the Cerenkov detector is selected, turn off the reactor room and tank lights**.

Detector 1 = Pulse Ion	(Maximum insertion = \$2.00)
Detector 2 = Cerenkov	(Maximum insertion = \$4.00)

6. Adjust Pulse Mode Scram Timer if necessary.
7. Scram the Transient rod.
8. Raise the Transient rod anvil to 100% or the mechanical stop if installed.

9. Let the power decay to approximately 1 watt or less.
10. Enter Pulse Mode and select high or low resolution pulse display. High resolution displays 1200 MW full scale and should be used for pulses of $2.00 or smaller. Enter the pulse number at the next prompt.
11. Fire the pulse by depressing the " Fire" button on the reactor console.
12. Record the appropriate data in the reactor operations logbook from the pulse display.
13. Reset R-1 and R-5 to their normal alarm points when pulsing operations are complete and turn over the RAM indicator sign to denote that the RAMs are set back to normal.

PULSE OPERATION (SUBCRITICAL)

GENERAL

Pulses above $2.00 must be verbally approved by the RFD (prior to pulse initiation) or specified on the RUR, signed by the RFD.

SPECIFIC

1. Given a core position, set the transient rod at a position corresponding to the dollar value determined by the following equation:

   $ Value = Total worth ($) Transient rod (to 100% or mechanical stop) - Desired pulse ($) Value

2. Bring the reactor cold critical using the three standard control rods; use a rod configuration commensurate with core position and experimental requirements.

   Do not use Automatic Mode until the three standard rods have been raised at least 5%

   Note: If a series of repetitive pulses are to be fired, it is not necessary to bring the reactor to cold critical for each pulse. Consecutive pulses may be fired using the same rod positions on the same day as long as the reactor power is not increasing and is less than 1 kW.

3. Stabilize in the manual mode.
4. Select the proper pulse detector according to the table below. **If the Cerenkov detector is selected, turn off the reactor room and tank lights.**

Detector 1 = Pulse Ion	(Maximum insertion = $2.00)
Detector 2 = Cerenkov	(Maximum insertion = $4.00)

5. Adjust Pulse Mode Scram Timer if necessary.
6. Scram the Transient rod.
7. Raise the Transient rod anvil to 100% or the mechanical stop if installed.

8. Let the power decay to approximately 1 watt or less unless otherwise dictated by experimental constraints. Pulses may not be initiated above the Technical Specification 1kW limit.
9. Enter Pulse Mode and select high or low resolution pulse display. High resolution displays 1200 MW full scale and should be used for pulses of $2.00 or smaller. Enter the pulse number at the next prompt.
10. Fire the pulse by depressing the " Fire" button on the reactor console.
11. Record the appropriate data in the reactor operations logbook from the pulse display.

PULSE OPERATION (CRITICAL)

GENERAL

Pulses above $2.00 must be approved by the RFD (prior to pulse initiation). Specification on the RUR may be used to meet this requirement.

SPECIFIC

1. Set the alarm points on R-1 and R-5 (criticality monitor) to full scale. Turn over the RAM indicator sign to denote that the RAMs are turned up.
2. Bring the reactor cold critical using the three standard control rods; use a rod configuration commensurate with core position and experimental requirements. Note: A series of repetitive pulses may be fired using the same rod positions on the same day as long as the reactor power is not increasing and is less than 1 kW.
3. Stabilize in the manual mode.
4. Raise the transient rod anvil to the desired pulse position. (This position is obtained from the control rod worth curves for the appropriate core operating position)
5. Select the proper pulse detector according to the table below. **If the Cerenkov detector is selected, turn off the reactor room and tank lights**.

Detector 1 = Pulse Ion (Maximum insertion = $2.00)
Detector 2 = Cerenkov (Maximum insertion = $4.00)

6. Adjust Pulse Mode Scram Timer if necessary.
7. Enter Pulse Mode and select high or low resolution pulse display. High resolution displays 1200 MW full scale and should be used for pulses of $2.00 or smaller. Enter the pulse number at the next prompt. Remember, the power level must be below 1 kW to enter Pulse Mode.
8. Fire the pulse by depressing the " Fire" button on the reactor console.
9. Record the appropriate data in the reactor operations logbook from the pulse display.
10. Reset R-1 and R-5 to their normal alarm points when pulsing operations are complete

and turn over the RAM indicator sign to denote that the RAMs are set normal.

PULSE OPERATION (CRITICAL)

GENERAL

Pulses above $2.00 must be verbally approved by the RFD (prior to pulse initiation) or specified on the RUR, signed by the RFD.

SPECIFIC

1. Bring the reactor critical at less than 1000 watts using the three standard control rods; use a rod configuration commensurate with core position and experimental requirements.
2. Stabilize in the manual mode.
3. Raise the transient rod anvil to the desired pulse position. (This position is obtained from the control rod worth curves for the appropriate core operating position)
4. Select the proper pulse detector according to the table below. **If the Cerenkov detector is selected, turn off the reactor room and tank lights**.

Detector 1 = Pulse Ion (Maximum insertion = $2.00)
Detector 2 = Cerenkov (Maximum insertion = $4.00)

5. Adjust Pulse Mode Scram Timer if necessary.
6. Enter Pulse Mode and select high or low resolution pulse display. High resolution displays 1200 MW full scale and should be used for pulses of $2.00 or smaller. Enter the pulse number at the next prompt. Remember, the power level must be below the 1 kW Technical Specification limit to enter Pulse Mode.
7. Fire the pulse by depressing the " Fire" button on the reactor console.
8. Record the appropriate data in the reactor operations logbook from the pulse display.

Facility Modification Work Sheet 2

No 10 CFR 50.59 Analysis Required

Proposed Change: Pulse Mode Operation (Sub-critical), RE: Redefining initial conditions for repetitive pulse firings

Modification to: Procedure _X__ Facility ____ Experiment ____

Submitted by: ________ORTELLI, GEORGE____________________ Date __________

1. Description of changes: The change in paragraph #3 redefines pre-requisite conditions for the firing of each pulse in a series of pulses. Previously, the procedure required that before firing a pulse, it was necessary to bring the reactor to cold critical, but did not define whether this was only an initial requirement, or was to be met in all conditions. It could potentially cause confusion with a following statement in the procedure that states that the reactor power must be less than 1 KW in order to fire a pulse (which is a tech spec requirement). It is now proposed that only the <1 KW requirement be required, and to state clearly that there is no requirement to attain a cold critical status subsequent to the firing of an initial pulse that is part of a repetitive series. The change in paragraph #9 gives latitude for meeting a 1 watt power level before entering pulse mode. Previously, the paragraph stated that the power must decay to less than 1 watt before entering pulse mode, regardless of any circumstances. It is now proposed that experimental constraints may dictate whether or not the 1 watt power level requirement be met.

2. Verify that the proposed change does not involve a change to the Technical Specifications, the facility as described in the SAR, or procedures as described in the SAR, and does not produce an unresolved safety issue as defined in 10 CFR 50.59(a)(2).

   The proposed change does not affect any of the above.

3. If change involves a facility modification, attach a drawing if appropriate. If structural facility drawings need updating, forward a copy of changes necessary to Facilities.

   Change does not involve facility modification

4. Determine what other procedures, logs, or training material may be affected and record below.

   None are affected

5. List of associated drawings, procedures, logs, or other materials to be changed:

   No other changes

6. Create an Action Sheet containing the list of associated work, specified above, attach a copy, and submit it to the RFD.

   Action Sheet: Submitted ___ Not Required __X__

Reviewed and approved by RFD ____________________ Date 3/30/98

RRFSC Notified SRO ____________________ Date APR 13 1998

PULSE OPERATION (SUBCRITICAL)

GENERAL

Pulses above \$2.00 must be verbally approved by the RFD (prior to pulse initiation) or specified on the RUR, signed by the RFD.

SPECIFIC

1. Set the alarm points on R-1 and R-5 (criticality monitor) to full scale. Turn over the RAM indicator sign to denote that the RAMs are turned up.
2. Given a core position, set the transient rod at a position corresponding to the dollar value determined by the following equation:

\$ Value = Total worth (\$) Transient rod (to 100% or mechanical stop) - Desired pulse (\$) Value

3. Bring the reactor cold critical using the three standard control rods; use a rod configuration commensurate with core position and experimental requirements.
   Do not use Automatic Mode until the three standard rods have been raised at least 5%
   Note: If a series of repetitive pulses are to be fired, it is not necessary to bring the reactor to cold critical for each pulse. Consecutive pulses may be fired using the same rod positions on the same day as long as the reactor power is not increasing and is less than 1 kW.
4. Stabilize in the manual mode.
5. Select the proper pulse detector according to the table below. **If the Cerenkov detector is selected, turn off the reactor room and tank lights**.

Detector 1 = Pulse Ion	(Maximum insertion = \$2.00)
Detector 2 = Cerenkov	(Maximum insertion = \$4.00)

6. Adjust Pulse Mode Scram Timer if necessary.

7. Scram the Transient rod.
8. Raise the Transient rod anvil to 100% or the mechanical stop if installed.
9. Let the power decay to approximately 1 watt or less unless otherwise dictated by experimental constraints. Pulses may not be initiated above the Technical Specification 1kW limit.
10. Enter Pulse Mode and select high or low resolution pulse display. High resolution displays 1200 MW full scale and should be used for pulses of $2.00 or smaller. Enter the pulse number at the next prompt.
11. Fire the pulse by depressing the " Fire" button on the reactor console.
12. Record the appropriate data in the reactor operations logbook from the pulse display.
13. Reset R-1 and R-5 to their normal alarm points when pulsing operations are complete and turn over the RAM indicator sign to denote that the RAMs are set back to normal.

5

Facility Modification Work Sheet 2

No 10 CFR 50.59 Analysis Required

Proposed Change: ____ Remove Word "Criticality" From Procedure 8, TAB H ______

Modification to: Procedure _XX_ Facility ____ Experiment ____

Submitted by: __________ George ______________ Date __ 27 April 1998 __

1. Description of change:

Remove the word "Criticality" from section 3 of the weekly operational instrumentation checklist. The Criticality monitor name was eliminated in the last RRFSC meeting and this name change was missed during the document search.

2. Verify that the proposed change does not involve a change to the Technical Specifications, the facility as described in the SAR, or procedures as described in the SAR, and does not produce an unresolved safety issue as defined in 10 CFR 50.59(a)(2).

NONE, SAR already changed

3. If change involves a facility modification, attach a drawing if appropriate. If structural facility drawings need updating, modification of drawings must be approved by RFD and forward a copy of changes necessary to Facilities.

No Facility change

4. Determine what other procedures, logs, or training material may be affected and record below.

None

5. List of associated drawings, procedures, logs, or other materials to be changed:

None,

6. Create an Action Sheet containing the list of associated work, specified above, attach a copy, and submit it to the RFD.

Action Sheet: Submitted ___ Not Required _XX_

Reviewed and approved by RFD [signature] Date 4/27/98

RRFSC Notified Spr? JUL 13 1998 Date JUL 13 1998

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WEEKLY OPERATIONAL INSTRUMENT CHECKLIST

CHECKLIST # ________________ DATE ________________________
SUPERVISED BY ______________
ASSISTED BY ________________ REVIEWED BY ________________

I. WATER LEVEL INDICATOR

A. In pool, east side, depress float on water level indicator . . . . ______
B. Observe scram on console . . . . ______

II. WATER RESISTIVITY

List resistivity readings for previous calendar week from daily startup checklists. Determine the average at each point is >0.5 Mohm-cm.

	MON	TUE	WED	THU	FRI	AVG
Monitor Box	_____	_____	_____	_____	_____	_______
DM1	_____	_____	_____	_____	_____	_______
DM2	_____	_____	_____	_____	_____	_______

III. RADIATION ALARMS

A. Test alarm functions for high level and failure

Monitor	Failure alarm functional	HIGH Level alarm functional
R-1	__________	__________
R-2	__________	__________
R-5	__________	__________
E-3	__________	__________
E-6	__________	__________
Reactor Room CAM	__________	__________
Gas Stack Monitor	__________	__________

B. Reset alarms.. __________

IV. OTHER

A. Top lock key seals at Security Desk and at LOG verified intact . . . . ______
B. Change Filter in the Stack Gas Monitor . . . . ______

Facility Modification Work Sheet 1

10 CFR 50.59 Analysis

Proposed Change: __ Remove Section 5.2.4 of SAR which describes __
__ a non-existent patch panel system. ________

Submitted by: _____ George _______ Date _ 28 April 1998_

1. Description of change:

Section 5.2.4 of the SAR describes a patch panel system for both exposure rooms. The system was removed from service when it was determined that the patch panel connections were affecting the readings in the dosimetry readout room. The wires were replaced with continuous uninterrupted cables that fed directly from the exposure rooms to the dosimetry readout room. The patch panel was then removed.

2. Reason for change:

System described no longer exists

3. Verify that the proposed change does not involve a change to the Technical Specifications or produce an unresolved safety issue as specified in 10 CFR 50.59(a)(2). Attach an analysis to show this.

Analysis attached? Yes __NO, Not appropriate _

Removal of the panel will decrease the signal noise in the lines due to bad connections in the patch panel.

4. The proposed modification constitutes a changes in the facility or an operational procedure as described in the SAR. Describe which (check all that apply).

Procedure ____ Facility _XX_ Experiment ___

5. Specify what sections of the SAR are applicable. In general terms describe the necessary updates to the SAR. Note that this description need not contain the final SAR wording.

Remove Section 5.2.4, Patch Panel System

Facility Modification Work Sheet 1

6. For facility modifications, specify what testing is to be performed to assure that the systems involved operate in accordance with their design intent.

The replacement wiring was tested and operated properly.

7. Specify associated information.

New drawings are: Attached ____
Not required _XX__

Does a drawing need to be sent Logistics?	Yes	____	No	_XX_
Are training materials effected?	Yes	____	No	_XX_
Will any Logs have to be changed?	Yes	____	No	_XX_
Are other procedures effected?	Yes	____	No	_XX_

List of items effected:

NONE identified

8. Create an Action Sheet containing a list of associated work specified in items #7, attach a copy, and submit another to the RFD.

Action Sheet: Submitted ____ Not Required _XX_

Reviewed and approved by RFD SAP Date 4/28/98

RRFSC Concurrence SDP Date JUL 13 1998

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SECTION TO BE REMOVED FROM SAR

5.2.4 Patch Panel System

A patch panel system exists within the AFRRI reactor building so that electrical signals from instruments in either exposure room can be transmitted to other areas inside AFRRI. The Patch Panel in ER #1 is connected to a Patch Panel in Hall 1106, and the patch panel in ER #2 is connected to a Patch Panel in the prep area near ER #2. From here, the signals may be routed to other patch panels, as desired.

Facility Modification Work Sheet 2

No 10 CFR 50.59 Analysis Required

Proposed Change: Better Define the Equation in the Subcritical Square Wave Procedure

Modification to: Procedure _XX_ Facility ____ Experiment ____

Submitted by: __ ______ George ____________ Date _29 April 1998_

1. Description of change:

The definition in the square wave procedure on how to set the rod position is not very clear. This change clarifies the equation.

2. Verify that the proposed change does not involve a change to the Technical Specifications, the facility as described in the SAR, or procedures as described in the SAR, and does not produce an unresolved safety issue as defined in 10 CFR 50.59(a)(2).

No Change to the SAR. Only a procedural change

3. If change involves a facility modification, attach a drawing if appropriate. If structural facility drawings need updating, modification of drawings must be approved by RFD and forward a copy of changes necessary to Facilities.

No Facility modification

4. Determine what other procedures, logs, or training material may be affected and record below.

None, Single procedure change only

5. List of associated drawings, procedures, logs, or other materials to be changed:

Only the subcritical square wave procedure needs changed.

6. Create an Action Sheet containing the list of associated work, specified above, attach a copy, and submit it to the RFD.

Action Sheet: Submitted ____ Not Required _XX_

Reviewed and approved by RFD ______________ Date 4/29/98

RRFSC Notified ______________ Date JUL 13 1998

SQUARE WAVE OPERATION (Subcritical)

GENERAL

The square wave mode will not be used above a demand power of 250 KW.

SPECIFIC

1. Determine the transient rod critical position using the core position, the final transient rod position, the rod curves and the equation below. Note that a square wave insertion can not exceed 75 cents.

	TOTAL WORTH TRANSIENT ROD ($) (to 100% or mechanical stop)
-	<u>DESIRED INSERTION ($) *</u>
=	TRANSIENT ROD INITIAL POSITION ($)

* For demand powers up to 25 KW, insert $0.70
* For demand powers greater than 25 KW, insert $0.75

2. Apply air to the transient rod and raise the anvil to the critical position that was calculated above.
3. Bring the reactor cold critical using the three standard control rods; use a rod configuration commensurate with the core position and experimental requirements. If Auto Mode is used, select the rods to be used. Ensure that these rods have been raised at least 5% before entering Auto Mode. Set the cold critical power level on the Power Demand thumb wheels and enter Auto Mode.
4. Stabilize the reactor in Manual Mode.
5. Set power demand thumb wheels to desired power level.
6. Select the standard control rods to be servoed. Make sure that all control rods to be servoed have been raised at least 5%.

7. Scram the transient rod.
8. Raise the anvil to the desired final position.
9. Allow the power level to fall below 1 watt.
10. Switch into Square Wave mode.
11. Depress Fire button.
12. As the power level approaches the power demand level, the console will switch into Auto Mode. If power can not reach the demand power, it will automatically change to manual mode. At this time, either switch to Auto Mode or bring the reactor to the desired power level manually.
13. Scram the reactor at the end of the run using the manual or timer scram.
14. Ensure all pertinent information has been entered in the reactor operations logbook.

SQUARE WAVE OPERATION (Subcritical)

GENERAL

The square wave mode will not be used above a demand power of 250 KW.

SPECIFIC

1. Determine the transient rod critical position using the core position, the final transient rod position, the rod curves and the equation below. Note that a square wave insertion can not exceed 75 cents.

CRITICAL POSITION($) = FINAL POSITION($) - INSERTION ($)

* For demand powers up to 25 KW, insert $0.70
* For demand powers greater than 25 KW, insert $0.75

2. Apply air to the transient rod and raise the anvil to the citical position that was calculated above.
3. Bring the reactor cold critical using the three standard control rods; use a rod configuration commensurate with the core position and experimental requirements. If Auto Mode is used, select the rods to be used. Ensure that these rods have been raised at least 5% before entering Auto Mode Set the cold critical power level on the Power Demand thumb wheels and enter Auto Mode.
4. Stabilize the reactor in Manual Mode.
5. Set power demand thumb wheels to desired power level.
6. Select the standard control rods to be servoed. Make sure that all control rods to be servoed have been raised at least 5%.
7. Scram the transient rod.
8. Raise the anvil to the desired final position.
9. Allow the power level to fall below 1 watt.

10. Switch into Square Wave mode.
11. Depress Fire button.
12. As the power level approaches the power demand level, the console will switch into Auto Mode. If power can not reach the demand power, it will automatically change to manual mode. At this time, either switch to Auto Mode or bring the reactor to the desired power level manually.
13. Scram the reactor at the end of the run using the manual or timer scram.
14. Ensure all pertinent information has been entered in the reactor operations logbook.

8

Facility Modification Work Sheet 1

10 CFR 50 59 Analysis

Proposed Change: Removal of Accidental Criticality Monitors from SAR

Submitted by: ____ George __________ Date _4 June 1998_

1. Description of change:

Removal of section 3.6.5, accidental criticality monitor, from the SAR. Section 3.6.5 specifies the location of the Accidental Criticality Monitors in the facility.

2. Reason for change:

Criticality monitors are not required by 10 CFR 70.24 to be in the facility, and criticality monitors which contain foils and powders such as the ones specified in section 3.6.5 of the SAR were designed and used in fuel fabrication and reprocessing plants. These criticality monitors have no purpose for the AFRRI reactor facility.

3. Verify that the proposed change does not involve a change to the Technical Specifications or produce an unresolved safety issue as specified in 10 CFR 50.59(a)(2). Attach an analysis to show this.

Analysis attached? Yes _XX_

4. The proposed modification constitutes a changes in the facility or an operational procedure as described in the SAR. Describe which (check all that apply).

Procedure ____ Facility ____ Experiment ____

NONE, Removal of monitors from facility.

Facility Modification Work Sheet 1

5. Specify what sections of the SAR are applicable. In general terms describe the necessary updates to the SAR. Note that this description need not contain the final SAR wording.

Removal of section 3.6.5 of the SAR

6. For facility modifications, specify what testing is to be performed to assure that the systems involved operate in accordance with their design intent.

No Facility Modification

Facility Modification Work Sheet 1

7. Specify associated information.

New drawings are: Attached ____
Not required _XX_

Does a drawing need to be sent Logistics?	Yes ____	No _XX_
Are training materials effected?	Yes ____	No _XX_
Will any Logs have to be changed?	Yes ____	No _XX_
Are other procedures effected?	Yes ____	No _XX_

List of items effected:

SAR change only

8. Create an Action Sheet containing a list of associated work specified in items #7, attach a copy, and submit another to the RFD.

Action Sheet: Submitted _XX_ Not Required ____

Reviewed and approved by RFD [signature] Date 4 June 98

RRFSC Concurrence SAO Date JUL 1 3 1998

5059a363.wp

ANALYSIS ON TECHNICAL SPECIFICATIONS FOR REMOVAL OF ACCIDENTAL CRITICALITY MONITORS

The technical specifications state nothing about criticality monitors and therefore no change is required.

ACTION SHEET
REMOVAL OF ACCIDENTAL CRITICALITY MONITORS

- [x] Remove section 3.6.5 of SAR from electronic copy.
- [x] Update file copy of SAR
- [x] Remove diamond plaques

Facility Modification Work Sheet 2

No 10 CFR 50.59 Analysis Required

Proposed Change: **ADD WATER SPIGOT TO REACTOR COOLING TOWER**

Modification to: Procedure ____ Facility XX Experiment ____

Submitted by: Osborne & George Date 5 June 1998

1. Description of change:
Add a water spigot to the reactor cooling tower.

The addition of a water spigot allows for easier monthly cleaning of the reactor cooling tower.

2. Verify that the proposed change does not involve a change to the Technical Specifications, the facility as described in the SAR, or procedures as described in the SAR, and does not produce an unresolved safety issue as defined in 10 CFR 50.59(a)(2).

NONE

3. If change involves a facility modification, attach a drawing if appropriate. If structural facility drawings need updating, forward a copy of changes necessary to Facilities.

NONE

4. Determine what other procedures, logs, or training material may be affected and record below.

NONE

5. List of associated drawings, procedures, logs, or other materials to be changed:

NONE

6. Create an Action Sheet containing the list of associated work, specified above, attach a copy, and submit it to the RFD.

Action Sheet: Submitted ____ Not Required XX

Reviewed and approved by RFD [signature] Date 6/9/98

RRFSC Notified SMO Date JUN 13 1998

Facility Modification Work Sheet 2

No 10 CFR 50.59 Analysis Required

Proposed Change: ___ Update of various operational procedures ________________

____

Modification to: Procedure _XX_ Facility ____ Experiment ____

Submitted by: __________ George ________________ Date _ 4 June 98 _

1. Description of change:

Review and update of various operational procedures. See attached for changes to the following procedures.

Fitness for Duty	Procedure A1
Emergency Procedures	Procedure 6
Reactor Operations	Procedure 8
Logbook Entry Checklist	Procedure 8,Tab A
Air Particulate Monitor (CAM)	Procedure 11

2. Verify that the proposed change does not involve a change to the Technical Specifications, the facility as described in the SAR, or procedures as described in the SAR, and does not produce an unresolved safety issue as defined in 10 CFR 50.59(a)(2).
   No change to T.S. or SAR

3. If change involves a facility modification, attach a drawing if appropriate. If structural facility drawings need updating, modification of drawings must be approved by RFD and forward a copy of changes necessary to Facilities.
   No drawing changes

4. Determine what other procedures, logs, or training material may be affected and record below.
   No other logs

5. List of associated drawings, procedures, logs, or other materials to be changed:
   Listed in #1 above

6. Create an Action Sheet containing the list of associated work, specified above, attach a copy, and submit it to the RFD.

Action Sheet: Submitted ___ Not Required _XX_

Reviewed and approved by RFD ____________________ Date 4JUNE98

RRFSC Notified _____SPC_____________ Date OCT 14 1998

5059vars.wp

Fitness for Duty Procedure A1

Slight changes were made to this procedure to account for positive drug test results due to prescription medications. The statement that drug users would be terminated was changed to "assigned non operational duties pending administrative procedures".

Emergency Procedures Procedure 6

The line "Notify ERT commander..." was changed to "Notify the RFD/ERT commander of the situation".

Reactor Operations Procedure 8

The new reactor logbook stamps now contain spaces for who is SRO on call, HP on call. and Operator in Charge, so the section in the procedure on entering that information at the top of each logbook page was removed from the procedure.

Logbook Entry Checklist Procedure 8,Tab A

Changes were made to this procedure to account for the new console stamps. Also several redundant items were removed from the procedure.

Specifications were added (new item #5) on how to fill out the new stamps

Under black entries, the stamps are specified as options for unlocking the console, and for change of operators during operations. Added to the list were the console locked and signature at end of day.

Under green entries, Reactor Calibrations and Data was added for any data that the operator wishes to enter into the operations logbook.

The color BLUE-BLACK was removed as no one ever uses it.

The sample logbook entries page was redone to show the new console stamps in an example of how they might appear in a logbook.

Air Particulate Monitor (CAM) Procedure 11

The specification that the secondary chart recorder will be turned on when the primary CAM is by-passed was removed because the secondary CAM chart recorder operates continuously.

FITNESS FOR DUTY

REQUIREMENT:

To meet the specifications as defined in the AFRRI plan. 10 CFR does not require a fitness for duty procedure for training reactors.

GENERAL

The AFRRI Reactor Facility is a drug-free work-place. The use of illicit drugs by any RSDR staff member is prohibited. Personnel using over-the-counter or prescription drugs which cause drowsiness or otherwise alter one's state of consciousness will not be permitted to operate the AFRRI TRIGA reactor. In addition, reactor operators, operators-in-training, and management will be monitored for attitude and behavioral changes that may impact an individual's reliability.

SPECIFIC

1. RSDR staff members shall participate in drug-free awareness programs sponsored by AFRRI. Military and civilian staff members shall submit to drug screening programs conducted by their respective services. If a staff member's drug screening test yields an unexplained positive result, that staff member shall not be permitted to operate the reactor pending verification of the test. Acceptable positive results may occur following use of certain prescription drugs. The Reactor Facility Director (RFD) is required to ensure that the cutoff levels for alcohol or controlled substances as established in 10 CFR 26 are not exceeded by NRC licensed personnel. Any staff member determined to be a drug user will be temporarily assigned non operational duties pending

administrative procedures.

2. Personnel are instructed to inform their physician of their job description and requirements prior to being issued a prescription medication. They are instructed to inquire about any medication side effects expected and the physician's opinion regarding interference with safe job performance. This information shall be relayed to RFD as soon as possible.

Personnel are encouraged to minimize their use of non-prescription over-the-counter drugs for self-medication purposes. Specifically, sedatives, cough and cold preparations, appetite suppressants, and pain relievers have central nervous system side effects. If these medications are used in any quantity, an operator must inform the RFD or ROS and be relieved from operating on that day or until any side effects have resolved once the medication has been discontinued.

Personnel are instructed to read the information in the
Physician's Desk Reference (PDR) concerning medication they are taking. If the PDR indicates that the medication will adversely affect an operator's ability to safely perform his/her duties, he/she must inform the RFD or Reactor Operations Supervisor (ROS) that he/she must be relieved from operating on that day.

3. The RFD shall continuously monitor the reliability of individuals under his/her command by the following criteria:

- Any court-martial or civil conviction of a serious nature. Minor traffic violations are not a consideration.
- Negligence or delinquency in duty performance.
- Significant mental or character traits, or aberrant behavior, sustained by medical authority, that might affect the reliable performance of duties.

- Behavior patterns that show or suggest a contemptuous attitude toward the law or regulations
- Drug abuse or alcohol misuse.
- Poor attitude, lack of motivation toward assigned duties, or financial irresponsibility.

The RFD will be observed by his superiors to ensure his/her adherence to reliability criteria. Individuals who exhibit any of the listed behaviors or actions will be removed from licensed activities.

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REQUIREMENT:

To meet the specifications as defined in the AFRRI plan. 10 CFR does not require a fitness for duty procedure for training reactors.

GENERAL

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Personnel are encouraged to minimize their use of non-prescription over-the-counter drugs for self-medication purposes. Specifically, sedatives, cough and cold preparations, appetite suppressants, and pain relievers have central nervous system side effects. If these medications are used in any quantity, an operator must inform the RFD or ROS and be relieved from operating on that day or until any side effects have resolved once the medication has been discontinued.

Personnel are instructed to read the information in the Physician's Desk Reference (PDR) concerning medication they are taking. If the medication is unlisted in the PDR or the instructions are not understood, see the staff physician for information on how the drug may affect performance. If there are indications that the medication will adversely affect an operator's ability to safely perform his/her duties, he/she must inform the RFD or Reactor Operations Supervisor (ROS) that he/she must be relieved from operating on that day.

3. The RFD shall continuously monitor the reliability of individuals under his/her command by the following criteria:

- Any court-martial or civil conviction of a serious nature. Minor traffic violations are not a consideration.
- Negligence or delinquency in duty performance.

- Significant mental or character traits, or aberrant behavior, sustained by medical authority, that might affect the reliable performance of duties.
- Behavior patterns that show or suggest a contemptuous attitude toward the law or regulations
- Drug abuse or alcohol misuse.
- Poor attitude, lack of motivation toward assigned duties, or financial irresponsibility.

The RFD will be observed by his superiors to ensure his/her adherence to reliability criteria. Individuals who exhibit any of the listed behaviors or actions will be removed from licensed activities.

EMERGENCY PROCEDURES

GENERAL

The reactor emergency organization, emergency classes, and emergency action levels are set forth in the AFRRI Reactor Facility Emergency Plan and its Implementing Procedures.

SPECIFIC

Perform the following, as appropriate (need not be done in order).

1. Reactor Emergency:
   a. SCRAM reactor.
   b. Check radiation monitors; use portable survey instruments to assess situation, if necessary.
   c. Notify the RFD/ERT Commander of the situation.
   d. Activate the emergency response team.
2. AFRRI Complex Emergency Evacuation:
   a. SCRAM reactor.
   b. Secure any exposure facilities which are in use so that personnel access to that facility is not possible.
   c. Remove logbook, emergency guide, radios, teletector, tool kit, and keys; report to ERT.
   d. Ensure reactor area doors are secured upon departure.
3. Proper classification of emergency situation: All SROs must review the referenced Emergency Plan documents and be able to properly classify the events as they occur. Below is a tabulation of emergency classification to be used as guidance.

EMERGENCY CLASS	Radiation Alarms (Unanticipated)	Activate AFRRI Complex Emergency Evacuation	Activate Emergency Response Team
Class 0			
	Fire Alarm (non-reactor)	Yes	Yes
Class 1			
	R1 >> 1 min.	*	Yes
	R2>> 1 min.	*	Yes
	R3	No	No
	R5 >> 1 min.	*	Yes
	R6	No	No
	E3 >> 1 min.	*	Yes
	E6 >>1 min.	*	Yes
	SGM>> 1 min.	*	Yes
	Reactor Stack Fan Monitor	No	No
	Fire Alarm (reactor)	Yes	Yes
Class 2			
	CAM>> 1 min. concurrent with R1, R2, R5, and/or SGM	*	Yes

NOTE: * A decision to evacuate the Institute will be made by the ECP Commander based on input from the ERT Commander.

EMERGENCY PROCEDURES

GENERAL

The reactor emergency organization, emergency classes, and emergency action levels are set forth in the AFRRI Reactor Facility Emergency Plan and its Implementing Procedures.

SPECIFIC

Perform the following, as appropriate (need not be done in order).

1. Reactor Emergency:
   a. SCRAM reactor.
   b. Check radiation monitors; use portable survey instruments to assess situation, if necessary.
   c. Notify ERT Commander of situation.
   d. Activate emergency organization.
2. AFRRI Complex Emergency Evacuation:
   a. SCRAM reactor.
   b. Secure any exposure facilities which are in use so that personnel access to that facility is not possible.
   c. Remove logbook, emergency guide, radios, teletector, tool kit, and keys; report to ERT.
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EMERGENCY CLASS	Radiation Alarms (Unanticipated)	Activate AFRRI Complex Emergency Evacuation	Activate Emergency Response Team
Class 0			
	Fire Alarm (non-reactor)	Yes	Yes
Class 1			
	R1 >> 1 min.	*	Yes
	R2>> 1 min.	*	Yes
	R3	No	No
	R5 >> 1 min.	*	Yes
	R6	No	No
	E3 >> 1 min.	*	Yes
	E6 >>1 min.	*	Yes
	SGM>> 1 min.	*	Yes
	Reactor Stack Fan Monitor	No	No
	Fire Alarm (reactor)	Yes	Yes
Class 2			
	CAM>> 1 min. concurrent with R1, R2, R5, and/or SGM	*	Yes

NOTE: * A decision to evacuate the Institute will be made by the ECP Commander based on input from the ERT Commander.

REACTOR OPERATIONS

GENERAL

Logbook entries will be made in accordance with the Logbook Entry Checklist (Tab A).

SPECIFIC

1. The names of the individuals who supervised and performed the daily and weekly checklists will be shown at the top of the checklist. Check marks or numbers, as appropriate, will then be entered on each checklist line as that item is performed.

2. Perform reactor Daily Operational Startup Checklist (Tab B), utilizing appropriate nuclear instrumentation set points (Tab C). In the case of no planned operations, a Daily Safety Checklist (Tab B1) may be performed.

3. Perform K-excess measurement (Tab D) if the startup is not a safety startup.

4. Perform operations in accordance with the following:
   a. Steady state operation (Tab E).
   b. Square wave operation (Tab F).
   c. Pulse operation (Tab G).
   d. CET operations (Procedure 1, Tab B).
   e. Pneumatic Transfer System (Procedure 1, Tab D).
   f. In-pool/in-core experiment (Procedure 1, Tab E)

5. Perform Weekly Operational Instrument Checklist once during each calendar week (Tab H).

6. At the end of each day in which a Daily Operational Startup Checklist or Daily Safety Checklist has been completed, perform a Daily Operational Shutdown Checklist (Tab I).

7. Complete the monthly summary .

8. Respirator equipment will not be used on a routine basis. Respirator equipment is provided for use during emergency conditions only.

REACTOR OPERATIONS

GENERAL

Logbook entries will be made in accordance with the Logbook Entry Checklist (Tab A).

SPECIFIC

1. The names of the individuals who supervised and performed the daily and weekly checklists will be shown at the top of the checklist. Checkmarks or numbers, as appropriate, will then be entered on each checklist line as that item is performed.

2. Perform reactor Daily Operational Startup Checklist (Tab B), utilizing appropriate nuclear instrumentation set points (Tab C). In the case of no planned operations, a Daily Safety Checklist (Tab B1) may be performed.

3. Record at the beginning of each day in the reactor operations logbook the SRO on-call for that date.

4. At the top of each logbook page also record the name of the senior person in charge, noted as physicist in charge (PIC), present in the reactor facility and the name of the HP on-call. If the PIC, SRO on-call, or HP on-call changes during the day, an updated entry will be made in the body of the logbook at the time of occurrence.

5. Perform K-excess measurement (Tab D).

6. Perform operations in accordance with the following:
   a. Steady state operation (Tab E).
   b. Square wave operation (Tab F).
   c. Pulse operation (Tab G).
   d. CET operations (Procedure 1, Tab B).
   e. Pneumatic Transfer System (Procedure 1, Tab D).
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8. At the end of each day in which a Daily Operational Startup Checklist or Daily Safety Checklist has been completed, perform a Daily Operational Shutdown Checklist (Tab I).

9. Complete the monthly summary .

10. Respirator equipment will not be used on a routine basis. Respirator equipment is provided for use during emergency conditions only.

LOGBOOK ENTRY CHECKLIST

I. Operational Logbook

1. The reactor operations logbook is a "before-the-fact" record, that is, entries will be logged whenever possible before the operator actually performs the operation. Events, such as scrams, which may not be planned ahead of time, will be entered at the time of occurrence. Any late entries will be so noted. Entries about what you plan to do are not necessary, only actual events need to be logged in the logbook.

2. The operations logbook will have a hardbound cover and will be sequentially numbered by volume. The pages will be dated at the top of each page and each page will be sequentially numbered.

3. The Reactor Facility Director (RFD) will review each logbook upon its completion; he will make an appropriate entry in the back of the logbook and sign the entry. The operator who makes the final entry at the end of a logbook is responsible for ensuring that the ROS is notified that the logbook is ready for RFD review.

4. All items in GREEN (see below) that are not closed out during the working day will be carried in GREEN at the end of the day and again at the beginning of the next operational day.

5. Each of the logbook stamps has space for *SRO ON CALL*, *SRO IN CHARGE* (supervising) of the operation, the *HP ON CALL*, and a second person who is in AFRRI who could help in emergency situations. The individual at the console will enter data into the stamp to designate who is filling these 4 positions. The persons who are on console will have their names entered on the *CONSOLE UNLOCKED*

BY line and will be considered as RO's for the operation. For subsequent stamps when the console is already unlocked, lining out the time for the console unlocked entry is appropriate.

One SRO can fill the positions of *SRO ON CALL*, *SRO IN CHARGE* and RO on console in *CONSOLE UNLOCKED BY*

The HP on call cannot be on call and on the console at the same time.

6. The entries will be made in ink and in accordance with the following designated color code:

a. BLACK: Most Operational Activities.

(1) Console Unlocked By stamp.

(2) Completion of the daily startup, shutdown, and weekly checklists.

(3) Mode of operations. Use appropriate stamp or entry to designate the operation:

(a) Steady State.

(b) Square Wave

(c) Pulse

(4) Subsequent power level changes.

(5) Operation of reactor associated facilities such as lead shield doors, pneumatic tube systems, etc., unless such operations cause a change of reactivity (see 5.b.(2) below).

(6) Change of personnel at the console stamp. If hand written, the persons name replacing the person on console should be entered first as "on console" before the person logging off of the console is entered as "off"

(7) All changes to logbook entries (including line outs, error corrections, changes to operations mode stamp lines, and end-of-page line outs) will be initialed or signed by the operator.

(8) Console locked

(9) Signature of reactor operator to close out the log for the day.

b. RED: For Items Which Change or Measure Reactivity

(1) K-excess measurements, to include experiment worth determinations.

(2) Actions which affect reactivity:

(a) Core movement.

(b) Fuel movement.

(c) Control rod physical removal for maintenance.

(d) Experiment loading and removal from the CET, PTS, pool, or core.

(e) Removal or insertion of CET into core.

c. GREEN: For Maintenance or Malfunctions

(1) Any reactor malfunctions noted upon discovery/occurrence with a second entry noting corrective action has been completed.

(2) Additional items entered at the discretion of the operator such as addition of make-up water to the reactor pool, etc.

(3) Any Technical Specification required equipment taken out of service for any reason. A second entry is made when the unit is returned to service.

(4) Movement of detectors or chambers from above core.

(5) Reactor calibrations and data.

6. When an operation requiring entry into the logbook falls under more than one color code, the color to be used will be determined via the following order of precedence: RED - GREEN - BLACK.

Sample Logbook Entries for a Typical Operational Day

Startup Checklist Begun BLACK

SRO ON CALL ________ SRO IN CHARGE ______________

HP ON CALL ___ _____ OTHER PERSON ONSITE _________

_____ CONSOLE UNLOCKED BY ________________________

(BLACK)

Startup Checklist #**** Complete BLACK

SRO ON CALL ________ SRO IN CHARGE ______________

HP ON CALL _________ OTHER PERSON ONSITE _________

_____ CONSOLE UNLOCKED BY ________________________

_____ CRITICAL AT ______________ WATTS FOR K- EXCESS

TRANS_________$_________ SHIM_________$_________

SAFE__________$_________ REG__________$_________

_____ SCRAM, CORE POSITION_______ K-EXCESS $_______

(RED)

Console locked by ******* BLACK

SGM out of service for maintenance No operations GREEN

SGM Back in service GREEN

SRO ON CALL ________ SRO IN CHARGE ______________

HP ON CALL _________ OTHER PERSON ONSITE _________

_____ CONSOLE UNLOCKED BY ________________________

(BLACK)

Opening Pb Doors	BLACK
Moving Core to ***	RED
Closing PB Doors	BLACK
Rabbit (containing ****) inserted into CET	RED

SRO ON CALL __________ SRO IN CHARGE __________________

HP ON CALL ___________ OTHER PERSON ONSITE __________

______ CONSOLE UNLOCKED BY ______________________________

______ RAISING RODS TO GO CRITICAL

TRANS_________ SHIM_________ SAFE_________ REG___ _____

T1 MAX_________°C T2 MAX_________°C RUR#______________

______ CRITICAL AT __________ WATTS

______ SCRAM, TOTAL TIME ______' ______" KWHRS______

(BLACK)

Rabbit removed from CET	RED
Console locked by ********	BLACK
Shutdown Checklist Begun	BLACK
Shutdown Checklist #**** Complete	BLACK
Page lined out, Page signed by SRO	BLACK

II. Malfunction Logbook

All entries in the malfunction logbook should include the following information. For consistency, the bold words should be copied into the malfunction log prior to the information.

DATE, TIME, SIGNATURE OF PERSON DISCOVERING MALFUNCTION

SYMPTOM:

This section describes how the system is acting or malfunctioning, i.e., channel went full scale, pump failed, keyboard stopped responding to keystrokes etc.

IMMEDIATE ACTION TAKEN:

This section is for denoting such things as Reactor Secured, SHD notified.

RFD NOTIFIED:

A remark should be made that the RFD or acting RFD was notified.

DIAGNOSIS : of problem

A narrative description of what was discovered to be causing the problem, i.e., Which system was malfunctioning or which component failed.

SOLUTION: / repair

A narrative description of what was done to correct the problem This could include both physical changes or administrative changes, i.e., a component was replaced and the unit was recalibrated, an additional backup system installed, an administrative prohibit on ... was initiated.

OPERATIONAL VERIFICATION AND/OR CALIBRATION:

A description of what actions were taken to verify that the new unit/repair would indeed perform the function for which it was intended, i.e., a calibration signal, system actuated multiple times, system tested, system calibrated with a source. Indicate whether the change will require staff training.

SIGNATURE RFD

LOGBOOK ENTRY CHECKLIST

I. Operational Logbook

1. The reactor operations logbook is a "before-the-fact" record, that is, entries will be logged whenever possible before the operator actually performs the operation. Events, such as scrams, which may not be planned ahead of time, will be entered at the time of occurrence. Any late entries will be so noted. Entries about what you plan to do are not necessary, only actual events need to be logged in the logbook.

2. The operations logbook will have a hardbound cover and will be sequentially numbered by volume. The pages will be dated at the top of each page and each page will be sequentially numbered.

3. The Reactor Facility Director (RFD) will review each logbook upon its completion; he will make an appropriate entry in the back of the logbook and sign the entry. The operator who makes the final entry at the end of a logbook is responsible for ensuring that the ROS is notified that the logbook is ready for RFD review.

4. All items in GREEN (see below) that are not closed out during the working day will be carried in GREEN at the end of the day and again at the beginning of the next operational day.

5. The entries will be made in ink and in accordance with the following designated color code:
   a. BLACK and BLUE-BLACK: Most Operational Activities.
      (1) Console locked and unlocked. The individual at the console will enter his/her name and the supervisory licensed operator's name, if necessary.

(2) Checklist number and completion time.

(3) Power level at criticality and subsequent power level changes.

(4) Reactor SCRAM. This entry to be added when the operational stamp does not contain the SCRAM word in the last line. The K-Excess stamp does not specify SCRAM time. Also any time the operator deviates from normal stamps for multiple power changes for short periods of time, the final line should be SCRAM. *Console locked does not fulfill this requirement even though the reactor scrams.*

(5) Mode of operations. Use appropriate stamp or entry to designate the operation:

  (a) Steady State.

  (b) Square Wave

  (c) Pulse

(6) Operation of reactor associated facilities such as lead shield doors, pneumatic tube systems, etc., unless such operations cause a change of reactivity (see 5.b.(2) below).

(7) Change of personnel at the console. When a change of operator is noted in the logbook, the name of the person replacing the person on console should be entered first as "on console" before the person logging off of the console is entered as "off".

(8) The operator in charge will be designated in the logbook whenever multiple operators are signed on the console.

(9) Completion of the daily startup and shutdown checklists and weekly checklist.

(10) Signature of reactor operator to close out the log for the day.

(11) Designation of the SRO on-call and physicist in charge (PIC).

(12) Reactor calibrations and data.

(13) All changes to logbook entries (including line outs, error corrections, changes to operations mode stamp lines, and end-of-page line outs) will

be initialed or signed by the operator.

b. RED: For Items Which Change or Measure Reactivity

(1) K-excess measurements, to include experiment worth determinations.

(2) Actions which affect reactivity:

(a) Core movement.

(b) Fuel movement.

(c) Control rod physical removal for maintenance.

(d) Experiment loading and removal from the CET, PTS, pool, or core.

(e) Removal or insertion of CET into core.

c. GREEN: For Maintenance or Malfunctions

(1) Any reactor malfunctions noted upon discovery/occurrence with a second entry noting corrective action has been completed.

(2) Additional items entered at the discretion of the operator such as addition of make-up water to the reactor pool, etc.

(3) Any Technical Specification required equipment taken out of service for any reason. A second entry is made when the unit is returned to service.

(4) Movement of detectors or chambers from above core.

6. When an operation requiring entry into the logbook falls under more than one color code, the color to be used will be determined via the following order of precedence: RED - GREEN - BLACK/BLUE-BLACK.

Sample Logbook Entries for a Typical Operational Day

SRO/PIC/HP Stamp, Date Stamp	BLACK
Startup Checklist Begun	BLACK
Console unlocked by ******	BLACK
Startup Checklist #**** Complete	BLACK

RAISING RODS TO GO CRITICAL CRITICAL AT __________WATTS FOR K-EXCESS TRANS______$_______ SHIM_______$_______ SAFE _______$________ REG _______$_______ CORE POSITION________ K-EXCESS $_______	RED

Manual Scram	BLACK
Console locked by *******	BLACK
SGM out of service for maintenance No operations	GREEN
SGM Back in service	GREEN
Console unlocked by ********	BLACK
Opening Pb Doors	BLACK
Moving Core to ***	RED
Closing PB Doors	BLACK
Rabbit (containing ****) inserted into CET	RED

RAISING RODS TO GO CRITICAL TRANS ____________ T1 MAX ____________ °C SHIM ______________ T2 MAX _____________ °C SAFE ______________ RUR# ________________ REG _______________ TOTAL KWHRS ________ CRITICAL AT ______________ WATTS SCRAM, TOTAL TIME _______ MIN ______ SEC	BLACK

Rabbit removed from CET	RED
Console locked by ********	BLACK
Shutdown Checklist Begun	BLACK
Shutdown Checklist #**** Complete	BLACK
Page lined out, Page signed by SRO	BLACK

II. Malfunction Logbook

All entries in the malfunction logbook should include the following information. For consistency, the bold words should be copied into the malfunction log prior to the information.

DATE, TIME, SIGNATURE OF PERSON DISCOVERING MALFUNCTION

SYMPTOM:

This section describes how the system is acting or malfunctioning,i.e., channel went full scale, pump failed, keyboard stopped responding to keystrokes etc.

IMMEDIATE ACTION TAKEN:

This section is for denoting such things as Reactor Secured, SHD notified.

RFD NOTIFIED:

A remark should be made that the RFD or acting RFD was notified.

DIAGNOSIS : of problem

A narrative description of what was discovered to be causing the problem, i.e., Which system was malfunctioning or which component failed.

SOLUTION: / repair

A narrative description of what was done to correct the problem This could include both physical changes or administrative changes, i.e., a component was replaced and the unit was recalibrated, an additional backup system installed, an administrative prohibit on ... was initiated.

OPERATIONAL VERIFICATION AND/OR CALIBRATION:

A description of what actions were taken to verify that the new unit/repair would indeed perform the function for which it was intended, i.e., a calibration signal, system actuated multiple times, system tested, system calibrated with a source. Indicate whether the change will require staff training.

SIGNATURE RFD

AIR PARTICULATE MONITOR(CAM) PROCEDURE

GENERAL

This procedure specifies how to test the CAM to ensure proper operation of this monitoring device. A channel test will be performed on both reactor room CAMs at the beginning and end of each day.

SPECIFIC

1. TEST FREQUENCY

   This entire procedure will be performed in conjunction with the daily startup or safety checklist. Items 2, 3a and 3d will be performed again as part of the daily shutdown checklist.

2. OPERATING and TRACING

   Check that the primary CAM is operating and tracing with the correct time indicated on the chart and check that the secondary CAM is operating. Ensure the flow rate is >6 cfm and not off scale.

3. CHANNEL TEST WITH SOURCE

   a. Place the switch on the front of the CAM to "test" and verify a reading of 1000 cpm +/-20%. Reset the switch.

   b. Open shield door and change the detector filter if the filter appears excessively dirty or the flow rate has dropped below 6 cfm (with the door closed). Place the used filter in the radioactive waste box in each CAM drawer.

   c. Slowly bring a radioactive source near the detector. Observe the meter on the front of the CAM. The yellow light will activate at approximately 4,000 counts per minute. The red light will activate at approximately 10,000 counts per minute; the alarm will sound and the dampers will close. Reset the alarm, close the chamber door and return the source to the CAM drawer.

   d. Annotate completion of the channel test on chart paper with initials, time, and date performed for primary CAM.

AIR PARTICULATE MONITOR(CAM) PROCEDURE

GENERAL

This procedure specifies how to test the CAM to ensure proper operation of this monitoring device. A channel test will be performed on both reactor room CAMs at the beginning and end of each day.

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1. TEST FREQUENCY

   This entire procedure will be performed in conjunction with the daily startup or safety checklist. Items 2, 3a and 3d will be performed again as part of the daily shutdown checklist.

2. OPERATING and TRACING

   Check that the primary CAM is operating and tracing with the correct time indicated on the chart and check that the secondary CAM is operating. Ensure the flow rate is >6 cfm and not off scale.

3. CHANNEL TEST WITH SOURCE

   a. Place the switch on the front of the CAM to "test" and verify a reading of 1000 cpm +/-20%. Reset the switch.

   b. Open shield door and change the detector filter if the filter appears excessively dirty or the flow rate has dropped below 6 cfm (with the door closed). Place the used filter in the radioactive waste box in each CAM drawer.

   c. Slowly bring a radioactive source near the detector. Observe the meter on the front of the CAM. The yellow light will activate at approximately 4,000 counts per minute. The red light will activate at approximately 10,000 counts per minute; the alarm will sound and the dampers will close. Reset the alarm, close the chamber door and return the source to the CAM drawer.

   d. Annotate completion of the channel test on chart paper with initials, time, and date performed for primary CAM. Annotate completion of the channel test on secondary CAM chart paper only when primary CAM is bypassed.

4. BY-PASS of PRIMARY CAM

When the primary CAM is by-passed, the secondary CAM chart recorder needs to be activated, then perform items 2, 3a, and 3d.

Facility Modification Work Sheet 2

No 10 CFR 50.59 Analysis Required

Proposed Change: Air Line Check Valves and Air Pressure Loss Switch Installation

Modification to: Procedure ____ Facility XX Experiment ____

Submitted by: George, Ortelli Date _ 5 October 1998 __

1. Description of change:

Installation of air line check valves preventing backflow of water into the lead shield door bearings in the event of loss of air pressure to the bearing compartment. Additionally, a switch will be installed on the reactor facility air compressor to provide a light signal alerting the security guards in the event of a pressure loss to the reactor air system.

2. Verify that the proposed change does not involve a change to the Technical Specifications, the facility as described in the SAR, or procedures as described in the SAR, and does not produce an unresolved safety issue as defined in 10 CFR 50.59(a)(2).

The installation of the new components to the pressurized air system does not require changes to be made to either the Technical Specifications or the SAR.

3. If change involves a facility modification, attach a drawing if appropriate. If structural facility drawings need updating, modification of drawings must be approved by RFD and forward a copy of changes necessary to Facilities.

Not required

4. Determine what other procedures, logs, or training material may be affected and record below.

A pressure loss warning light check will be added as a step in the air compressor maintenance and will be performed during annual shutdown.

5. List of associated drawings, procedures, logs, or other materials to be changed:

Figure M-14 of the Reactor as-built drawings will be amended to include the new components.

6. Create an Action Sheet containing the list of associated work, specified above, attach a copy, and submit it to the RFD.

Action Sheet: Submitted XX Not Required __

Reviewed and approved by RFD ____________ Date 5 Oct 98

RRFSC Notified SPC Date OCT 14 1998

50.59 ACTION SHEET
CHECK VALVE AND SAFETY SWITCH INSTALLATION

Items Needing Attention	Date Complete
Add Maintenance Step to Annual Shutdown Procedures	____________
Add new components into As-built drawing M-14	____________

Facility Modification Work Sheet 1

10 CFR 50.59 Analysis

Proposed Change: Replacement of Reactor Heat Exchanger and the Use of Stainless Steel Pipe in Primary Water System

Submitted by: George, Wrisley Date: 18 August 1998

1. Description of change:

Replacement of the tube in shell heat exchanger and the aluminum primary piping (from the isolation valve on the discharge side of the primary pump to the input of the new exchanger) with a new plate and frame exchanger and stainless steel primary piping. The old heat exchanger will be disconnected and the new unit will be installed in room 2158.

2. Reason for change:

Preventive maintenance. The current heat exchanger is 30 years old. Replacement will prevent future problems caused by leaks.

3. Verify that the proposed change does not involve a change to the Technical Specifications or produce an unresolved safety issue as specified in 10 CFR 50.59(a)(2). Attach an analysis to show this.

Analysis attached? Yes XXX

4. The proposed modification constitutes a changes in the facility or an operational procedure as described in the SAR. Describe which (check all that apply).

Procedure ____ Facility XXX Experiment ____

5. Specify what sections of the SAR are applicable. In general terms describe the necessary updates to the SAR. Note that this description need not contain the final SAR wording.

3.3.1 The primary cooling system is described an consisting "of the reactor tank, the primary pump, the tube side of the shell-and-tube heat exchanger". The shell-and-tube will be changed to plate and frame. The primary water is later described as passing "through the tube side of the heat exchanger".

Section 3.3.1 will have to have the wording "tube side of the shell-and-tube heat exchanger" and "tube side of the heat exchanger" changed to "the primary side of the plate and frame heat exchanger"

3.3.2 The secondary cooling system is described as consisting "of an enclosed forced-airflow wet tower with sump, a secondary pump, the shell side of the six pass heat exchanger, and associated piping, valves, and fittings. The secondary pump draws raw industrial water from the sump of the cooling tower, passes the water through the shell side of the heat exchanger at a rate of about 700 gpm, and returns the water ...."

Section 3.3.2 will have to have the wording "the shell side of the six pass heat exchanger" and "the shell side of the heat exchanger" changed to " the secondary side of the plate and frame heat exchanger".

Fig 3-6 will need slight modification. the diagram of the water purification and cooling systems currently specifies that the heat exchanger is a 1.5 Mw 6 PASS heat exchanger located IN WARM STORAGE. this will have to be changed to reflect a PLATE AND FRAME heat exchanger in room 2158.

6. For facility modifications, specify what testing is to be performed to assure that the systems involved operate in accordance with their design intent.

Pressure testing will be performed to verify that there are no leaks from either the primary or secondary sides of the exchanger.

Facility Modification Work Sheet 1

7. Specify associated information.

New drawings are: Attached ____ Not required ____ Other XX Drawings to be provided with new heat exchanger.

Does a drawing need to be sent Logistics?	Yes	XX	No	
Are training materials effected?	Yes	XX	No	
Will any Logs have to be changed?	Yes		No	XX
Are other procedures effected?	Yes		No	XX

List of items effected:

SAR 3.3.1
SAR 3.3.2
SAR Figure 3-6
Operations Manual (Under revision)
Facility Training Plan
As-built Drawings
Question Bank

8. Create an Action Sheet containing a list of associated work specified in items #7, attach a copy, and submit another to the RFD.

Action Sheet: Submitted XXX Not Required ____

Reviewed and approved by RFD ________ Date ________

RRFSC Concurrence ________ Date OCT 14 1998

50.59 ANALYSIS
TECHNICAL SPECIFICATION CHANGE NOT REQUIRED FOR HEAT EXCHANGER REPLACEMENT

The Technical Specifications for the AFRRI Triga Reactor Facility does not specify the type of heat exchanger installed in the facility. The specifications for the original heat exchanger has been provided to the contractor for a system will match the current cooling capacity of the current exchanger.

The new plate and frame exchanger is designed such that any leaks which could occur around gaskets would cause the exchanger to leak into the hot drain in room 2158 thus preventing cross contamination between the primary and secondary systems.

The new heat exchanger is composed of stainless steel plates. This is the same material as the tubes of the current heat exchanger. If any leaks were to occur through a plate in the new plate and frame heat exchanger, the heat exchanger can be easily disassembled, cleaned and new plates installed to replace bad plates. This is a great advantage over the current heat exchanger which has only 3 tubes.

The heat exchanger can later be expanded with additional plates if additional cooling is desired.

This change does not increase the consequences of, nor change the types of accidents previously evaluated in the Safety Analysis Report. This change does not reduce the margin of safety as defined in the basis for any Technical Specifications.

CURRENT WORDING IN THE SAR

3.3.1 Primary Cooling System

The primary cooling system consists of the reactor tank, the primary pump, the tube side of the shell-and-tube heat exchanger, and associated piping, valves, and fittings, all situated at elevations above the top of the core. The primary pump draws water from the reactor pool through the suction line, located in the reactor pool approximately 4 feet beneath the pool surface. The primary pump passes the water through the tube side of the heat exchanger at a rate of approximately 350 gallons per minute (gpm). The water is then returned to the reactor pool through the return line, located in the reactor pool approximately 8 feet beneath the pool surface. Small holes drilled in the suction and return lines about 4 inches beneath the pool surface prevent water from being syphoned out of the reactor pool and uncovering the core in the event of a primary coolant line leak or rupture. In the event of significant coolant depletion (below core height), due to a reactor tank leak or rupture, an emergency fill line will be connected from an outside, adjacent fire hydrant to the primary coolant loop in order to maintain the reactor tank coolant level above the reactor core.

3.3.2 Secondary Cooling System

The secondary cooling system consists of an enclosed forced-airflow wet tower with sump, a secondary pump, the shell side of the six-pass heat exchanger, and associated piping, valves, and fittings. The secondary pump draws raw industrial water from the sump of the cooling tower, passes the water through the shell side of the heat exchanger at a rate of about 700 gpm, and returns the water to the top of the cooling tower, providing the heat sink to cool the primary water. The water cascades down through the tower, where it is cooled by direct contact with the outside air, and returns to the sump at the base of the cooling tower. The cooling tower is heated in winter only enough to prevent freezing.

PROPOSED WORDING FOR THE SAR

3.3.1 Primary Cooling System

The primary cooling system consists of the reactor tank, the primary pump, *the primary side of the plate and frame heat exchanger,* and associated piping, valves, and fittings, all situated at elevations above the top of the core. The primary pump draws water from the reactor pool through the suction line, located in the reactor pool approximately 4 feet beneath the pool surface. The primary pump passes the water through the *primary side* of the heat exchanger at a rate of approximately 350 gallons per minute (gpm). The water is then returned to the reactor pool through the return line, located in the reactor pool approximately 8 feet beneath the pool surface. Small holes drilled in the suction and return lines about 4 inches beneath the pool surface prevent water from being syphoned out of the reactor pool and uncovering the core in the event of a primary coolant line leak or rupture. In the event of significant coolant depletion (below core height), due to a reactor tank leak or rupture, an emergency fill line will be connected from an outside, adjacent fire hydrant to the primary coolant loop in order to maintain the reactor tank coolant level above the reactor core.

3.3.2 Secondary Cooling System

The secondary cooling system consists of an enclosed forced-airflow wet tower with sump, a secondary pump, *the secondary side of the plate and frame heat exchanger*, and associated piping, valves, and fittings. The secondary pump draws raw industrial water from the sump of the cooling tower, passes the water through the *secondary* side of the heat exchanger at a rate of about 700 gpm, and returns the water to the top of the cooling tower, providing the heat sink to cool the primary water. The water cascades down through the tower, where it is cooled by direct contact with the outside air, and returns to the sump at the base of the cooling tower. The cooling tower is heated in winter only enough to prevent freezing.

CURRENT VERSION

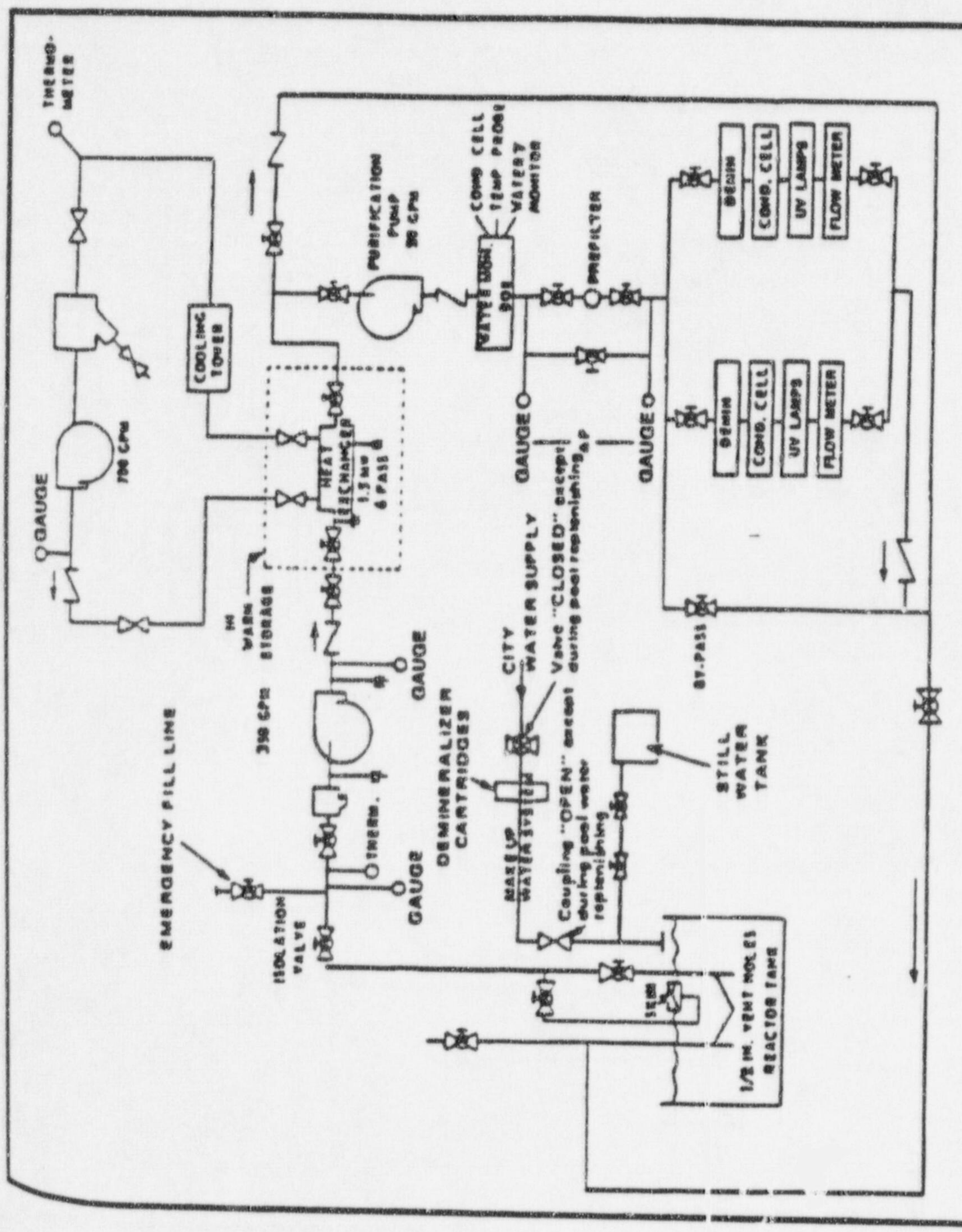


Figure 3-6.
WATER PURIFICATION AND COOLING SYSTEMS

PROPOSED VERSION

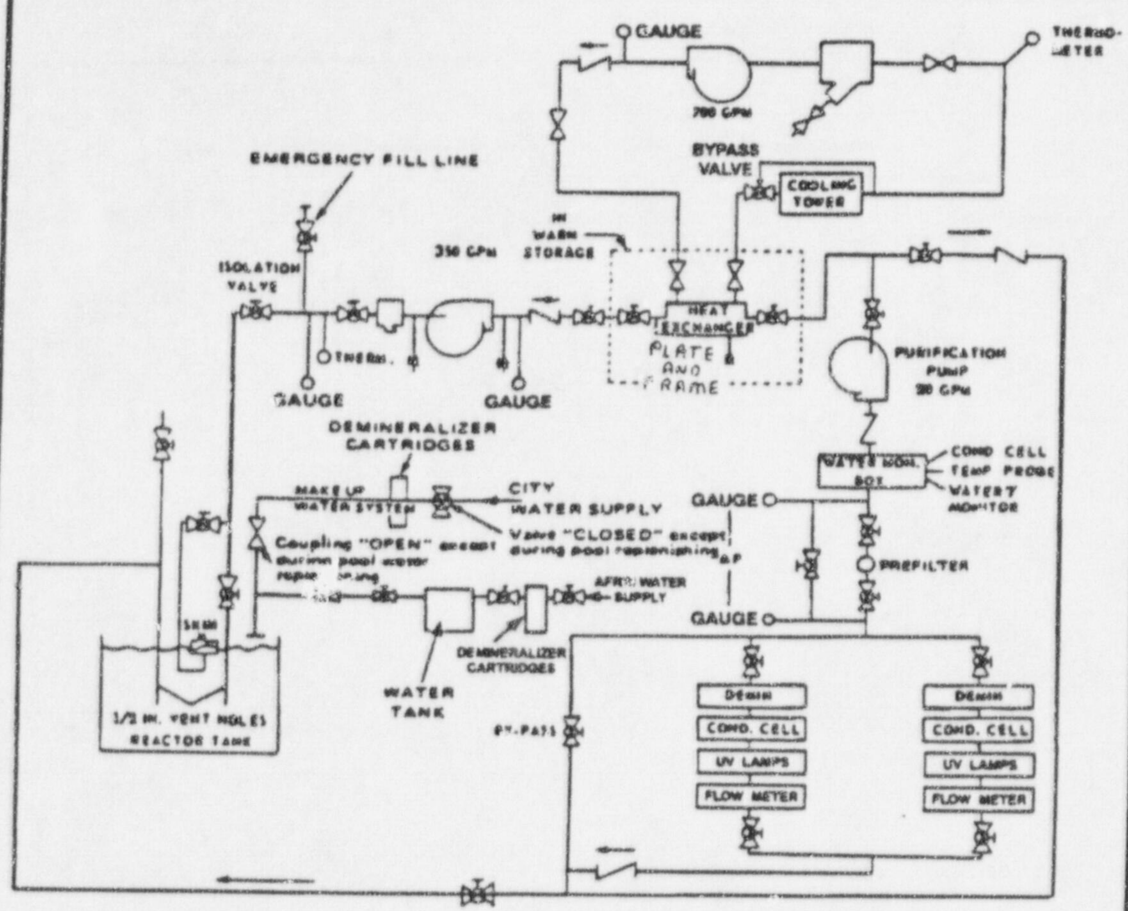


Figure 3-6.
WATER PURIFICATION AND COOLING SYSTEMS

50.59 ACTION SHEET
HEAT EXCHANGER REPLACEMENT

Item Needing Attention	Date Complete
Change Section 3.3.1 of the SAR	27 NOV 98
Change Section 3.3.2 of the SAR	27 NOV 98
Change Figure 3-3 of the SAR	27 NOV 98
Change Operations Manual (under revision)	27 NOV 98
Change Facility Training Plan	27 NOV 98
File new manufacturers literature	OCT 98
Install new heat exchanger and test	Aug 98
Change Asbuilt Drawings A1, A2, A6, A8, M1, M2, M3, M4,	IN Process
Search Question Bank for Piping and Heat Exchanger questions	27 NOV 98

HEATACTN WP

G.F. MORIN COMPANY

— Manufacturers Representatives —

8667 CHERRY LANE
LAUREL, MARYLAND 20707

FAX #: (301) 498-4870
WASHINGTON: (301) 953-7770
BALTIMORE: (410) 792-46[illegible]

TO: AFFRI

DATE: 11-14-94

ATTN: Robert George

TOTAL PAGES: 2

REFERENCE: 1½ MEG PLATE + FRAME HEAT EXCHANGER

(INCLUDING COVER SHEET)

Robert;

Attached is a sketch of the proposed plate + frame replacement heat exchanger. This unit will match the performance of the existing shell + tube.

UNIT WEIGHT = 1,221 pounds

AND is approx 2' WIDE, 4½' TALL AND 4' DEEP which should fit the proposed space well.

Please call me at your convenience to discuss replacement.

Sincerely
Jim Pegg
301-953-7770

SPECIFICATION SHEET

DATE: 11/10/94

CUSTOMER: APPRI

PROPOSAL NO. SC 072258-07A R00
ITEM NUMBER A
SALES TECH. PTG

ASME

MODEL NO: UFX-26

NO. OF UNITS IN PARALLEL: 1

RUN NUMBER: 277874

* PERFORMANCE	** HOT SIDE ****	COLD SIDE **	
FLUID CIRCULATED	WATER	WATER	
TOTAL FLOW RATE	350.00	700.00	GPM
UNIT FLOW RATE	350.00	700.00	GPM
SPECIFIC HEAT	1.00	1.00	BTU/LB °F
SPECIFIC GRAVITY	.99	1.00	
THERMAL CONDUCTIVITY	.36	.35	BTU/HR FT °F
VISCOSITY	.68	.81	CP AT AVG TEMP
INLET TEMPERATURE	110.00	80.00	°F
OUTLET TEMPERATURE	90.00	89.97	°F
PRESSURE DROP	5.57	10.00	PSI
OPERATING PRESSURE	UNKNOWN	UNKNOWN	PSIG
HEAT EXCHANGED	********* 3474378.0 *********		BTU/HR UNIT

* CONSTRUCTION

DESIGN PRESSURE	100	PSIG
TEST PRESSURE	150	PSIG
DESIGN TEMPERATURE	150	°F
UNIT NET WEIGHT	1221	POUNDS

* PASS ARRANGEMENTS

1 X 1

* UNIT DIMENSIONS

B	41.31"
C	46.94"
T	.88"

* NOZZLE SPECIFICATIONS
LOCATION 1 H/I- 4"-STR
LOCATION 2 C/I- 4"-STR
LOCATION 3 H/O- 4"-STR
LOCATION 4 C/O- 4"-STR 316SS

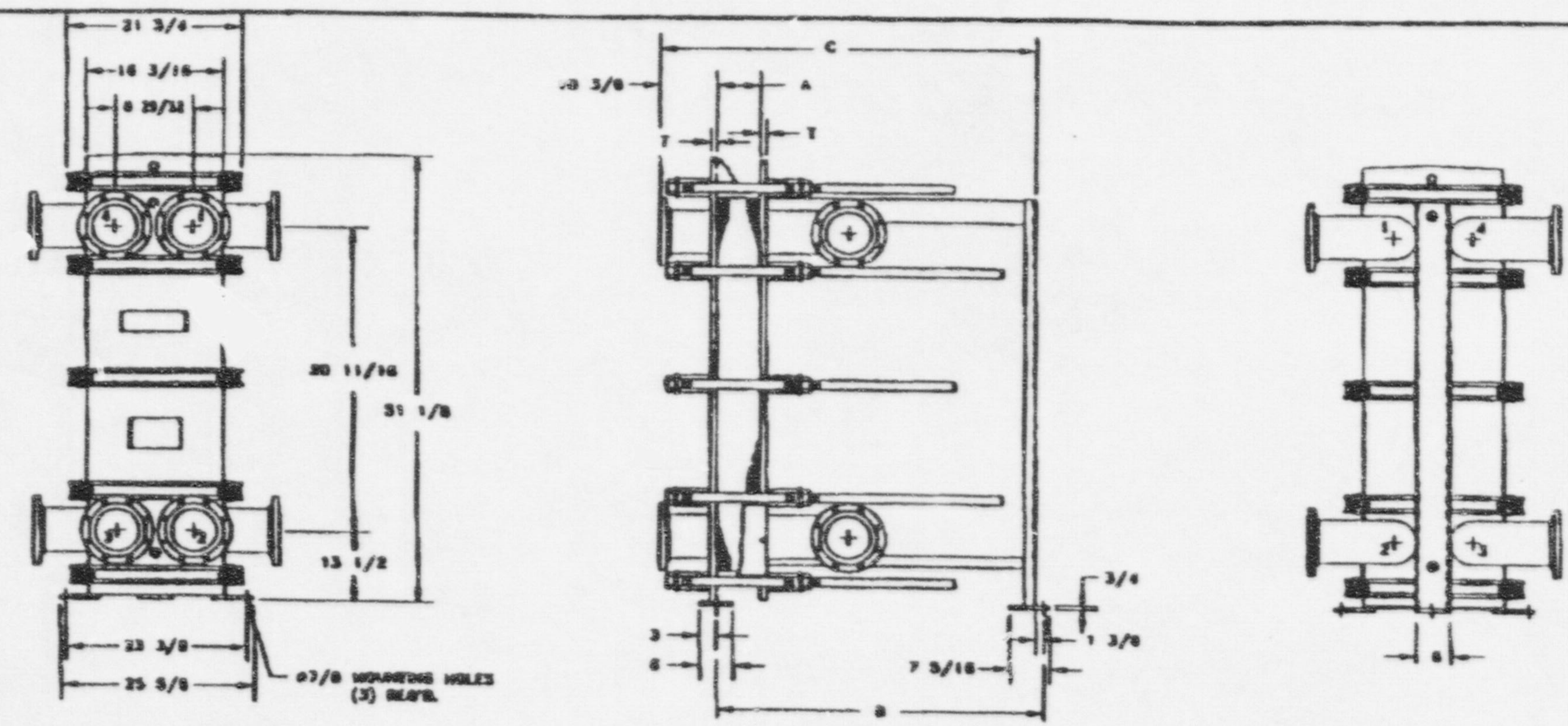
* MATERIALS

PLATES	304 SS
GASKETS	NBR
NOZZLES	HOT SA-53B COLD SA-53B (FLANGED)
FRAME	CS EPOXY PAINTED
BARS	CS (WITH UPPER STAINLESS STEEL CLAD)
BOLTS	CD/ZN PLATED CS

* REMARKS:

"The SUPERCHANGER performance guarantee is based on the accuracy of the data presented above, and the customers ability to supply product and operating conditions in conformance with the above."

tranter®



NOTES:
(1) ALL DIMENSIONS ARE APPROXIMATE. NOT TO BE USED FOR CONSTRUCTION PURPOSES.
(2) REFER TO THE ATTACHED COMPUTER SPECIFICATION SHEET FOR MATERIALS OF CONSTRUCTION AND SURFACE AREA.
(3) NOZZLES: ANSI C.S. LOOSE FLANGE WITH LAP JOINT STUB END.

TRANTER, Inc. - TEXAS DIVISION

Wichita Falls, Texas, U.S.A.

UFX-26

Corrosion and Activation Analysis of a Stainless Steel (type 304 or equivalent) Primary Pipe and Heat Exchanger Replacement for the AFRRI TRIGA Reactor

Assumptions:

1. The corrosion rate for austenitic stainless steels in neutral water is 1e-7 g/cm^2 day. This is reported as the lowest measurable value by H.H. Uhlig, Corrosion Handbook, 1948, p.154
2. Yearly average reactor usage is 26.3 MWh which yields a yearly thermal neutron fluence of 1e18 n/cm^2 and a fast neutron fluence of 0.5e18 n/cm^2.
3. The volume of water that receives neutrons is approximately 9.25 cubic feet, which is 0.45 % of the total water volume in the core and primary coolant system.
4. The composition of the austenitic stainless steel is 18 wt% Cr and 8 wt% Ni.
5. Decay of the activation daughter products can be neglected.
6. Activation Reactions of interest are:

Reaction	Isotope Abundance	Cross Section (thermal/fast)	$T_{½}$
Fe54(n,p)Mn54	5.85%	Σ_a (Fe) = 0/0.082 barns	312.5 d
Fe54(n,γ)Fe55	5.85%	Σ_a (Fe) = 2.25/1.2 barns	2.7 y
Ni58(n,γ)Ni59	68.08%	Σ_a (Ni) = 4.6/2.2 barns	75000 y
Ni58(n,p)Co58	68.08%	Σ_a (Ni) = 0/0.113 barns	70.8 d
Cr50(n,γ)Cr51	4.35%	Σ_a (Cr) = 15.9/7.7 barns	27.7 d

Constants:

1. Surface area of primary side of heat exchanger = 300 ft^2
2. Surface area of primary piping = 25 ft^2.

Calculated Values:

1. Surface Area of Primary Coolant System = 3E5 cm^2
2. Corrosion Rate = 11 g/yr
3. Radioactive materials produced:

Isotope	$T_{½}$	Number of atoms produced per year	Activity (mCi/yr)	Max Dose (mR/hr) after 1 year storage
Mn54	312.5 d	9.47E11	8.16E-4	1.8E-3
Fe55	2.7 y	6.58E13	0.018	8.0E-7
Ni59	75000 y	1.57E14	1.56E-6	1.0E-5
Co58	70.8 d	1.56E12	0.005	6.0E-4
Cr51	27.7 d	8.87E13	0.856	1.8E-4
			Total	2.6E-3

Conclusion: The conversion of the primary piping and heat exchanger to stainless steel will not pose an increased radiation hazard to personnel or increase our waste disposal requirements.

Facility Modification Work Sheet 2

No 10 CFR 50.59 Analysis Required

Proposed Change: _____ Daily Shutdown Checklist _____________

____

Modification to: Procedure _XX_ Facility ____ Experiment ____

Submitted by: _______ Marte' ___________________ Date __ 27 Nov 1998__

1. Description of change:

Section III, Line 2, Discharge pressure changed to 11-16 psig. New heat exchanger provides less resistance to primary pump.

2. Verify that the proposed change does not involve a change to the Technical Specifications, the facility as described in the SAR, or procedures as described in the SAR, and does not produce an unresolved safety issue as defined in 10 CFR 50.59(a)(2).

None, Items changed are administrative changes.

3. If change involves a facility modification, attach a drawing if appropriate. If structural facility drawings need updating, modification of drawings must be approved by RFD and forward a copy of changes necessary to Facilities.

No change to drawings

4. Determine what other procedures, logs, or training material may be affected and record below.

None, Staff to sign off on new procedure

5. List of associated drawings, procedures, logs, or other materials to be changed:

None

6. Create an Action Sheet containing the list of associated work, specified above, attach a copy, and submit it to the RFD.

Action Sheet: Submitted ___ Not Required _XX_

Reviewed and approved by RFD ____________ Date 27 Nov 98

RRFSC Notified SPD ____________ Date DEC 4 1998

50.59 wp2

DAILY OPERATIONAL SHUTDOWN CHECKLIST

Checklist No. ____________
Time Completed __________

Date ____________________
Supervised by _____________
Assisted by _______________
____

I. REACTOR ROOM (Room 3161)

1. All rod drives DOWN .... ______
2. Carriage lights OFF .... ______
3. Door 3162 SECURED .... ______
4. Channel test completed on both CAM's .... ______
5. Door 3161 locked with key .... ______

II. EQUIPMENT ROOM (Room 3152)

1. Distillation unit discharge valve CLOSED .... ______
2. Air dryer OPERATIONAL .... ______
3. Doors 231, 231A, and roof hatch SECURED .... ______

III. EQUIPMENT ROOM (Room 2158)

1. Primary discharge pressure (11 - 16 psig) .... ______*
2. Demineralizer flow rates set to (5.5 - 6.5 gpm) .... ______*
3. Visual inspection for leaks .... ______
4. Door 2158 and 2164 SECURED .... ______

IV. PREPARATION AREA

1. ER2 plug door CONTROL LOCKED .... ______
   Door closed, and handwheel PADLOCKED .... ______
2. ER2 lights ON and rheostat at 10% .... ______
3. ER1 plug door CONTROL LOCKED .... ______
   Door closed, and handwheel PADLOCKED .... ______
4. ER1 lights ON and rheostat at 10% .... ______
5. Visual inspection of area .... ______
6. Warm storage doors closed .... ______

V. LOBBY ALARM

Lobby alarm audio ON	_______

VI. REACTOR CONTROL ROOM (Room 3160)

1. Reactor tank lights OFF . . . . _______
2. Console chart recorder pens raised . . . . _______
3. Steady-state timer OFF . . . . _______
4. Console LOCKED, and all required keys returned to lock box . . . . _______
5. Diffuser pumps OFF . . . . _______
6. Purification, secondary and primary pumps ON . . . . _______
7. Reactor monthly usage summary completed . . . . _______
8. Auxiliary chart recorders operating and tracing . . . . _______
9. Radiation monitors . . . . _______

MONITOR	READING	HIGH LEVEL ALARM SETTING (mrem/hr)
a. R-1	(<10) _______*	10 _______
b. R-2	(<10) _______*	10 _______
c. R-3	(<10) _______*	10 _______
d. R-5	(<10) _______*	10 _______
e. E-3	(<10) _______*	10 _______
f. E-6	(<10) _______*	10 _______
g. R-6	(<10) _______*	

* Numerical Entry

DAILY OPERATIONAL SHUTDOWN CHECKLIST

Checklist No. ____________ Date ____________________

Time Completed __________ Supervised by ____________

Assisted by ______________

____

I. REACTOR ROOM (Room 3161)

1. All rod drives DOWN .... ______
2. Carriage lights OFF .... ______
3. Door 3162 SECURED .... ______
4. Channel test completed on both CAM's .... ______
5. Door 3161 locked with key .... ______

II. EQUIPMENT ROOM (Room 3152)

1. Distillation unit discharge valve CLOSED .... ______
2. Air dryer OPERATIONAL .... ______
3. Doors 231, 231A, and roof hatch SECURED .... ______

III. EQUIPMENT ROOM (Room 2158)

1. Primary discharge pressure (15 - 25 psig) .... ______*
2. Demineralizer flow rates set to (5.5 - 6.5 gpm) .... ______*
3. Visual inspection for leaks .... ______
4. Door 2158 and 2164 SECURED .... ______

IV. PREPARATION AREA

1. ER2 plug door CONTROL LOCKED .... ______
   Door closed, and handwheel PADLOCKED .... ______
2. ER2 lights ON and rheostat at 10% .... ______
3. ER1 plug door CONTROL LOCKED .... ______
   Door closed, and handwheel PADLOCKED .... ______
4. ER1 lights ON and rheostat at 10% .... ______
5. Visual inspection of area .... ______
6. Warm storage doors closed .... ______

V. LOBBY ALARM

Lobby alarm audio ON	_______

VI. REACTOR CONTROL ROOM (Room 3160)

1. Reactor tank lights OFF	_______
2. Console chart recorder pens raised	_______
3. Steady-state timer OFF	_______
4. Console LOCKED, and all required keys returned to lock box	_______
5. Diffuser pumps OFF	_______
6. Purification, secondary and primary pumps ON	_______
7. Reactor monthly usage summary completed	_______
8. Auxiliary chart recorders operating and tracing	_______
9. Radiation monitors	_______

MONITOR	READING	HIGH LEVEL ALARM SETTING (mrem/hr)
a R-1	(<10) _______*	10 _______
b R-2	(<10) _______*	10 _______
c R-3	(<10) _______*	10 _______
d R-5	(<10) _______*	10 _______
e E-3	(<10) _______*	10 _______
f E-6	(<10) _______*	10 _______
g R-6	(<10) _______*	

* Numerical Entry

14

Facility Modification Work Sheet 2

No 10 CFR 50.59 Analysis Required

Proposed Change: _____ Change of Daily Safety Checklist. _______

Modification to: Procedure _XX_ Facility ____ Experiment ____

Submitted by: _____________ Marte'_____________ Date __27 Nov 98 ___

1. Description of change:

Section III, Line 2, Discharge pressure changed to 11-16 psig. New heat exchanger provides less resistance to primary pump.

Section VI, Line 8.(b), "Alarm check" changed to "SGM High Indicator Check". The alert device for this point is a lamp, not an audible warning as may have been inferred from the word "Alarm".

Section VI, Line 8.(c), "High alarm set to" changed to "High alarm point set to". This is the point where the lamp on line 8.(b) illuminates.

Section VI, Line 12 was clarified as "Demineralizer Inlet Temperature"

2. Verify that the proposed change does not involve a change to the Technical Specifications, the facility as described in the SAR, or procedures as described in the SAR, and does not produce an unresolved safety issue as defined in 10 CFR 50.59(a)(2).

None, Items changed are administrative changes.

3. If change involves a facility modification, attach a drawing if appropriate. If structural facility drawings need updating, modification of drawings must be approved by RFD and forward a copy of changes necessary to Facilities.

No change to drawings.

4. Determine what other procedures, logs, or training material may be affected and record below.

None. Staff to sign off on new procedure

5. List of associated drawings, procedures, logs, or other materials to be changed:

None

6. Create an Action Sheet containing the list of associated work, specified above, attach a copy, and submit it to the RFD.

Action Sheet: Submitted ____ Not Required _XX_

Reviewed and approved by RFD ____________ Date 11/27/98

RRFSC Notified SMA____________ Date DEC 4 ____

50598b1 wp2

DAILY SAFETY CHECKLIST

Checklist No. ____________
Time Completed __________

Date ____________________
Supervised by _____________
Assisted by _______________

I. EQUIPMENT ROOM (Room 3152)

1. Air compressor pressure (80 - 120 psig) .... _______*
2. Water drained from air compressor .... _______
3. Air dryer operating .... _______
4. Doors 231, 231A, and roof hatch SECURED .... _______

II. EQUIPMENT ROOM (Room 2158)

1. Prefilter differential pressure (< 8 psid) .... _______*
2. Primary discharge pressure (11 - 16 psig) .... _______*
3. Demineralizer flow rates set to 6 gpm (5.5 - 6.5 gpm) .... _______*
4. Stack roughing filter (notify supervisor if > 1.0" of water) .... _______*
5. Stack absolute filter (notify supervisor if > 1.35" of water) .... _______*
6. Visual inspection of area .... _______
7. Door 2158 SECURED .... _______

III. PREPARATION AREA

Visual inspection of area .... _______

IV. REACTOR ROOM (Room 3161)

1. Transient rod air pressure (78 - 82 psig) .... _______*
2. Shield door bearing air pressure (8.5 - 11 psig) .... _______*
3. Visual inspection of core and tank .... _______
4. Number of fuel elements and control rods in tank storage
   Fuel elements _______*
   Control rods _______*
5. Air particulate monitor (CAM)
   (a) Primary operating and tracing .... _______
   (b) Backup operating .... _______
   (c) Channel test completed, damper closure verified .... _______
6. Channel test completed on SGM .... _______
7. Door 3162 SECURED .... _______

*Numerical Entry

V. LOBBY AREA

Lobby audio alarm turned off .... _______

VI. REACTOR CONTROL ROOM (Room 3160)

1. Emergency air dampers reset .... _______
2. Console recorders dated .... _______
3. Stack flow and fuel temperature recorders dated .... _______
4. Logbook dated and reviewed .... _______
5. Water monitor box
   - (a) Background activity (10 - 60 cpm) .... _______*
   - (b) Water monitor box resistivity (> 0.2 Mohm-cm) .... _______*
   - (c) DM1 resistivity (> 0.5 Mohm-cm) .... _______*
   - (d) DM2 resistivity (> 0.5 Mohm-cm) .... _______*
6. Stack gas flow rate (15 - 35 Kcfm) .... _______*
7. Stack linear flow rate (1.0 - 2.0 Kft/min) .... _______*
8. Gas stack monitor
   - (a) Background (2 - 20 cpm) .... _______*
   - (b) SGM High Indicator Check .... _______
   - (c) High alarm point set to 3.2 E-5 microCi/cc at stack top .... _______
   - (d) SGM chart recorder operating and tracing .... _______
9. Radiation monitors

Monitor	Alarm Point Functional	Reading (mrem/hr)	Alarm Setting (mrem/hr)
(a) R-1	_______	(< 10) _______*	_______ 10
(b) R-2	_______	(< 10) _______*	_______ 10
(c) R-3	_______	(< 10) _______*	_______ 10
(d) R-5	_______	(< 10) _______*	_______ 10
(e) E-3	_______	(< 10) _______*	_______ 10
(f) E-6	_______	(< 10) _______*	_______ 10

10. TV monitors on .... _______
11. CAM high level audible alarm check .... _______
12. Demineralizer inlet temperature (5 - 35 °C) .... _______*
13. Water level log completed .... _______
14. Source level power greater/equal to 0.5 cps .... _______

*Numerical Entry

DAILY SAFETY CHECKLIST

Checklist No. ____________
Time Completed __________

Date ____________________
Supervised by _____________
Assisted by _______________

I. EQUIPMENT ROOM (Room 3152)

1. Air compressor pressure (80 - 120 psig) .... _______*
2. Water drained from air compressor .... _______
3. Air dryer operating .... _______
4. Doors 231, 231A, and roof hatch SECURED .... _______

II. EQUIPMENT ROOM (Room 2158)

1. Prefilter differential pressure (< 8 psid) .... _______*
2. Primary discharge pressure (15 - 25 psig) .... _______*
3. Demineralizer flow rates set to 6 gpm (5.5 - 6.5 gpm) .... _______*
4. Stack roughing filter (notify supervisor if > 1.0" of water) .... _______*
5. Stack absolute filter (notify supervisor if > 1.35" of water) .... _______*
6. Visual inspection of area .... _______
7. Door 2158 SECURED .... _______

III. PREPARATION AREA

Visual inspection of area .... _______

IV. REACTOR ROOM (Room 3161)

1. Transient rod air pressure (78 - 82 psig) .... _______*
2. Shield door bearing air pressure (8.5 - 11 psig) .... _______*
3. Visual inspection of core and tank .... _______
4. Number of fuel elements and control rods in tank storage — Fuel elements _______* Control rods _______*
5. Air particulate monitor (CAM)
   - (a) Primary operating and tracing .... _______
   - (b) Backup operating .... _______
   - (c) Channel test completed, damper closure verified .... _______
6. Channel test completed on SGM .... _______
7. Door 3162 SECURED .... _______

*Numerical Entry

V. LOBBY AREA

Lobby audio alarm turned off .... _______

VI. REACTOR CONTROL ROOM (Room 3160)

1. Emergency air dampers reset .... _______
2. Console recorders dated .... _______
3. Stack flow and fuel temperature recorders dated .... _______
4. Logbook dated and reviewed .... _______
5. Water monitor box
   - (a) Background activity (10 - 60 cpm) .... _______*
   - (b) Water monitor box resistivity (> 0.2 Mohm-cm) .... _______*
   - (c) DM1 resistivity (> 0.5 Mohm-cm) .... _______*
   - (d) DM2 resistivity (> 0.5 Mohm-cm) .... _______*
6. Stack gas flow rate (15 - 35 Kcfm) .... _______*
7. Stack linear flow rate (1.0 - 2.0 Kft/min) .... _______*
8. Gas stack monitor
   - (a) Background (2 - 20 cpm) .... _______*
   - (b) Alarm check .... _______
   - (c) High alarm set to 3.2 E-5 microCi/cc at stack top .... _______
   - (d) SGM chart recorder operating and tracing .... _______
9. Radiation monitors

Monitor	Alarm Point Functional	Reading (mrem/hr)	Alarm Setting (mrem/hr)
(a) R-1	_______	(< 10) _______*	_______ 10
(b) R-2	_______	(< 10) _______*	_______ 10
(c) R-3	_______	(< 10) _______*	_______ 10
(d) R-5	_______	(< 10) _______*	_______ 10
(e) E-3	_______	(< 10) _______*	_______ 10
(f) E-6	_______	(< 10) _______*	_______ 10

10. TV monitors on .... _______
11. CAM high level audible alarm check .... _______
12. Water temperature (inlet) (5 - 35 °C) .... _______*
13. Water level log completed .... _______
14. Source level power greater/equal to 0.5 cps .... _______

*Numerical Entry

15

Facility Modification Work Sheet 2

No 10 CFR 50.59 Analysis Required

Proposed Change: _____ Change of Operational Startup Checklist. _______

Modification to: Procedure _XX_ Facility ____ Experiment ____

Submitted by: _____________ Marte'_____________ Date __27 Nov 98 ___

1. Description of change:

Section III, Line 2, Discharge pressure changed to 11-16 psig. New heat exchanger provides less resistance to primary pump.

Section VI, Line 8.(b), "Alarm check" changed to "SGM High Indicator Check". The alert device for this point is a lamp, not an audible warning as may have been inferred from the word "Alarm".

Section VI, Line 8.(c), "High alarm set to" changed to "High alarm point set to". This is the point where the lamp on line 8.(b) illuminates.

Line 15, Time Delay Operative, Moved to below line 17, Prestart operability checks performed. The prestart checks can be run without the key in the console.

Line 12, Was clarified as "Demineralizer Inlet Temperature"

2. Verify that the proposed change does not involve a change to the Technical Specifications, the facility as described in the SAR, or procedures as described in the SAR, and does not produce an unresolved safety issue as defined in 10 CFR 50.59(a)(2).

None, Items changed are administrative changes.

3. If change involves a facility modification, attach a drawing if appropriate. If structural facility drawings need updating, modification of drawings must be approved by RFD and forward a copy of changes necessary to Facilities.

No change to drawings.

4. Determine what other procedures, logs, or training material may be affected and record below.

None, Staff to sign off on new procedure

5. List of associated drawings, procedures, logs, or other materials to be changed:

None

6. Create an Action Sheet containing the list of associated work, specified above, attach a copy, and submit it to the RFD.

Action Sheet: Submitted ____ Not Required _XX_

Reviewed and approved by RFD ________________ Date 11/27/98

RRFSC Notified ________________ Date DEC 4 1998

505986 wp2

DAILY OPERATIONAL STARTUP CHECKLIST

Checklist No. ____________
Time Completed __________

Date ____________________
Supervised by ____________
Assisted by ______________

I. EQUIPMENT ROOM (Room 3152)

1. Air compressor pressure (80 - 120 psig) .... _______*
2. Water drained from air compressor .... _______
3. Air dryer operating .... _______
4. Doors 231, 231A, and roof hatch SECURED .... _______

II. LOBBY AREA

Lobby alarm turned off .... _______

III. EQUIPMENT ROOM (Room 2158)

1. Prefilter differential pressure (< 8 psid) .... _______*
2. Primary discharge pressure (11 - 16 psig) .... _______*
3. Demineralizer flow rates set to 6 gpm (5.5 - 6.5 gpm) .... _______*
4. Stack roughing filter (notify supervisor if > 1.0" of water) .... _______*
5. Stack absolute filter (notify supervisor if > 1.35" of water) .... _______*
6. Visual inspection of area .... _______
7. Door 2158 SECURED .... _______

IV. PREPARATION AREA

Visual inspection of area .... _______

V. REACTOR ROOM (Room 3161)

1. Transient rod air pressure (78 - 82 psig) .... _______*
2. Shield door bearing air pressure (8.5 - 11 psig) .... _______*
3. Visual inspection of core and tank .... _______
4. Number of fuel elements and control rods in tank storage — Fuel elements _______* Control rods _______*
5. Air particulate monitor (CAM)
   - (a) Primary operating and tracing .... _______
   - (b) Backup operating .... _______
   - (c) Channel test completed, damper closure verified .... _______
6. Channel test completed on SGM .... _______
7. Door 3162 SECURED .... _______

*Numerical Entry

VI. REACTOR CONTROL ROOM (Room 3160)

1. Emergency air dampers reset ________
2. Console recorders dated ________
3. Stack flow and fuel temperature recorders dated ________
4. Logbook dated and reviewed ________
5. Water monitor box
   - (a) Background activity (10 - 60 cpm) ________*
   - (b) Water monitor box resistivity (> 0.2 Mohm-cm) ________*
   - (c) DM1 resistivity (> 0.5 Mohm-cm) ________*
   - (d) DM2 resistivity (> 0.5 Mohm-cm) ________*
6. Stack gas flow rate (15 - 35 Kcfm) ________*
7. Stack linear flow rate (1.0 - 2.0 Kft/min) ________*
8. Gas stack monitor
   - (a) Background (2 - 20 cpm) ________*
   - (b) SGM High Indicator Check ________
   - (c) High alarm point set to 3.2 E-5 microCi/cc at stack top ________
   - (d) SGM chart recorder operating and tracing ________
9. Radiation monitors

Monitor	Alarm Point Functional	Reading (mrem/hr)	Alarm Setting (mrem/hr)
(a) R-1	________	(< 10) ________*	________ 10
(b) R-2	________	(< 10) ________*	________ 10
(c) R-3	________	(< 10) ________*	________ 10
(d) R-5	________	(< 10) ________*	________ 10
(e) E-3	________	(< 10) ________*	________ 10
(f) E-6	________	(< 10) ________*	________ 10

10. TV monitors on ________
11. CAM high level audible alarm check ________
12. Demineralizer inlet temperature (5 - 35 °C) ________*
13. Water level log completed ________
14. Console lamp test completed ________
15. Source level power greater/equal to 0.5 cps ________
16. Prestart operability checks performed ________
17. Time delay operative ________
18. Interlock Tests
   - (a) Rod raising, SS mode ________
   - (b) Rod raising, Pulse mode ________
   - (c) Source RWP ________
   - (d) Period RWP ________
   - (e) 1 kW/Pulse mode ________
   - (f) NM-1000 HV ________
   - (g) Inlet Temp ________
19. SCRAM checks (at least one per rod)
   - (a) % Power 1 ________
   - (b) % Power 2 ________
   - (c) Fuel temp 1 ________
   - (d) Fuel temp 2 ________
   - (e) HV loss 1 ________
   - (f) HV loss 2 ________
   - (g) Pool level ________
   - (h) Reactor key ________
   - (i) Manual ________
   - (j) Emergency Stop ________
   - (k) Timer ________
   - (l) CSC Watchdog ________
   - (m) DAC Watchdog ________
20. Zero power pulse ________

*Numerical Entry

DAILY OPERATIONAL STARTUP CHECKLIST

Checklist No. ____________ Date ____________________
Time Completed __________ Supervised by ____________
Assisted by ______________

I. EQUIPMENT ROOM (Room 3152)

1. Air compressor pressure (80 - 120 psig) .... _______*
2. Water drained from air compressor .... _______
3. Air dryer operating .... _______
4. Doors 231, 231A, and roof hatch SECURED .... _______

II. LOBBY AREA

Lobby alarm turned off .... _______

III. EQUIPMENT ROOM (Room 2158)

1. Prefilter differential pressure (< 8 psid) .... _______*
2. Primary discharge pressure (15 - 25 psig) .... _______*
3. Demineralizer flow rates set to 6 gpm (5.5 - 6.5 gpm) .... _______*
4. Stack roughing filter (notify supervisor if > 1.0" of water) .... _______*
5. Stack absolute filter (notify supervisor if > 1.35" of water) .... _______*
6. Visual inspection of area .... _______
7. Door 2158 SECURED .... _______

IV. PREPARATION AREA

Visual inspection of area .... _______

V. REACTOR ROOM (Room 3161)

1. Transient rod air pressure (78 - 82 psig) .... _______*
2. Shield door bearing air pressure (8.5 - 11 psig) .... _______*
3. Visual inspection of core and tank .... _______
4. Number of fuel elements and control rods in tank storage — Fuel elements _______* Control rods _______*
5. Air particulate monitor (CAM)
   - (a) Primary operating and tracing .... _______
   - (b) Backup operating .... _______
   - (c) Channel test completed, damper closure verified .... _______
6. Channel test completed on SGM .... _______
7. Door 3162 SECURED .... _______

*Numerical Entry

VI. REACTOR CONTROL ROOM (Room 3160)

1. Emergency air dampers reset . . . . ______
2. Console recorders dated . . . . ______
3. Stack flow and fuel temperature recorders dated . . . . ______
4. Logbook dated and reviewed . . . . ______
5. Water monitor box
    (a) Background activity (10 - 60 cpm) . . . . ______*
    (b) Water monitor box resistivity (> 0.2 Mohm-cm) . . . . ______*
    (c) DM1 resistivity (> 0.5 Mohm-cm) . . . . ______*
    (d) DM2 resistivity (> 0.5 Mohm-cm) . . . . ______*
6. Stack gas flow rate (15 - 35 Kcfm) . . . . ______*
7. Stack linear flow rate (1.0 - 2.0 Kft/min) . . . . ______*
8. Gas stack monitor
    (a) Background (2 - 20 cpm) . . . . ______*
    (b) Alarm check . . . . ______
    (c) High alarm set to 3.2 E-5 microCi/cc at stack top . . . . ______
    (d) SGM chart recorder operating and tracing . . . . ______
9. Radiation monitors

Monitor	Alarm Point Functional	Reading (mrem/hr)		Alarm Setting (mrem/hr)	
(a) R-1	______	(< 10)	______*	______	10
(b) R-2	______	(< 10)	______*	______	10
(c) R-3	______	(< 10)	______*	______	10
(d) R-5	______	(< 10)	______*	______	10
(e) E-3	______	(< 10)	______*	______	10
(f) E-6	______	(< 10)	______*	______	10

10. TV monitors on . . . . ______
11. CAM high level audible alarm check . . . . ______
12. Water temperature (inlet) (5 - 35 °C) . . . . ______*
13. Water level log completed . . . . ______
14. Console lamp test completed . . . . ______
15. Time delay operative . . . . ______
16. Source level power greater/equal to 0.5 cps . . . . ______
17. Prestart operability checks performed . . . . ______
18. Interlock Tests

(a) Rod raising, SS mode	______	(e) 1 kW/Pulse mode	______
(b) Rod raising, Pulse mode	______	(f) NM-1000 HV	______
(c) Source RWP	______	(g) Inlet Temp	______
(d) Period RWP	______		

19. SCRAM checks (at least one per rod)

(a) % Power 1	______	(h) Reactor key	______
(b) % Power 2	______	(i) Manual	______
(c) Fuel temp 1	______	(j) Emergency Stop	______
(d) Fuel temp 2	______	(k) Timer	______
(e) HV loss 1	______	(l) CSC Watchdog	______
(f) HV loss 2	______	(m) DAC Watchdog	______
(g) Pool level	______		

20. Zero power pulse . . . . ______

*Numerical Entry

ATTACHMENT C

Appointment Letters for Current Reactor and Radiation Facility Safety Committee Changes

ARMED FORCES RADIOBIOLOGY RESEARCH INSTITUTE
8901 WISCONSIN AVENUE
BETHESDA, MARYLAND 20889-5603

AFRRI/RSD

6055
31 December 1998

MEMORANDUM FOR REACTOR DEPARTMENT FILES

SUBJECT: Reactor and Radiation Facility Safety Committee Membership

Effective this date, the following individuals are members of the Armed Forces Radiobiology Research Institute (AFRRI) Reactor and Radiation Facility Safety Committee (RRFSC). Memberships are in accordance with the Technical Specifications of Nuclear Regulatory Commission license R-84.

PERMANENT MEMBERS

Stephen I. Miller, AFRRI, Reactor Facility Director	Voting Member
Bruce A. White, MAJ, USAF, AFRRI, Radiation Safety Officer	Voting Member

APPOINTED MEMBERS

Curtis W. Pearson, COL, USAF, MSC, Chairman	Voting Member
Dr. Marcus Voth, Monticello Nuclear Generating Plant, Licensing Project Manager	Voting Member
Bill Powers, Naval Research Laboratories, Radiation Safety Officer	Voting Member

SPECIAL MEMBERS

J.W. Malinoski, CAPT, MSC, USN, AFRRI, Head, Radiation Sciences Department	Special Voting Member
Edward R. Herbert, Montgomery County Government, Environmental Protection Department	Special Non-Voting Member

RECORDER

Samuel D. Osborne, SFC, USA, AFRRI

Robert R Eng

ROBERT R. ENG
COL, MS, USA
Director

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