Armed Forces Radiobiology Research Institute
AFRRI TRIGA Reactor Facility

1 January 2003 - 31 December 2003

To satisfy the requirements of
U.S. Nuclear Regulatory Commission License No. R-84 (Docket No. 50-170),
Technical Specification 6.6.b.

Prepared by
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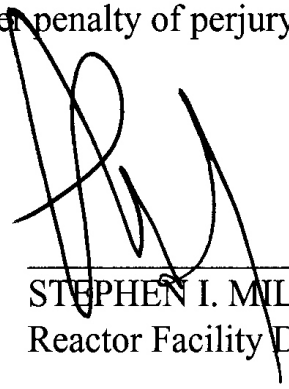
Submission of 2003 Annual Report

I declare under penalty of perjury that this report is true and correct.



MAR 2 6 2004

STEPHEN I. MILLER Date
Reactor Facility Director

2003 ANNUAL REPORT

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2003 ANNUAL REPORT

INTRODUCTION

The Armed Forces Radiobiology Research Institute (AFRRI) reactor facility was available for irradiation services throughout the year except for one nonoperational period of approximately one month during the annual reactor maintenance shutdown.

There were no major reactor modifications or projects during the year. Several minor facility modifications were made during 2003 in accordance with the provisions of 10 CFR 50.59. Summaries of modifications and procedure changes are found in Sections I and V.

The 2003 annual reactor audit required by the reactor technical specifications was conducted by Mr. Andrew Cook in December 2003. Mr. Cook is a senior reactor operator and Operations Manager at the North Carolina State University reactor facility. During the audit he verbally indicated that he had not found any major discrepancies in reactor operations and those conclusions are reflected in his written report.

There were several staff and RRFSC membership changes during the year. These are detailed in the following section.

Reactor staff members participated in an inspection of the military reactor facility at White Sands Missile Range, NM conducted by the U.S. Army Inspector General (DAIG) during June 2003. We expect to participate in a similar inspection during 2004 conducted by the U.S. Army Test and Evaluation Command.

In December 2003, the reactor implemented a new Reactor Emergency Plan following approval of the plan by the Reactor and Radiation Facility Safety Committee. The revised plan was forwarded to the NRC on 15 December 2003.

The remainder of this report is written in the format designated in the Technical Specifications for the AFRRI TRIGA Reactor Facility. Items not specifically required are presented in the General Information section. The following sections correspond to the required items listed in Section 6.6.b. of the specifications.

GENERAL INFORMATION

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

Key AFRRI personnel (as of 31 December 2003) are as follows:

1. Director - David Jarrett, COL, MC, USA (25 Jul)

   Radiation Sciences Department (RSD) Head - Stephen I. Miller (01 Aug)

   Radiation Protection Officer - David McKown (11 Mar)

2. Reactor Facility Director - Stephen I. Miller (SRO)

3. Reactor operations personnel:

   Reactor Operations Supervisor - Harry H. Spence (SRO)

   SRO Training Coordinator - John T. Nguyen (SRO)

   ERT Training Coordinator - Stephanie Vaughn, MAJ, CM, USA (21 Jul)

   Maintenance Specialist - John T. Nguyen (SRO)

   Records Administration Specialist - Harry H. Spence (SRO)

   Senior Staff Engineer - Stephanie Vaughn, MAJ, CM, USA (21 Jul)

4. Senior Reactor Operator - Christopher Whicker, SSG, USA (29 Aug)

5. Operator candidates:
   Walter D. Tomlinson
   Joneil Ribaya, SFC, USA (21 Jul)
   Stephanie Vaughn, MAJ, CM, USA (21 Jul)

6. Newly licensed operators:
   Christopher Whicker, SSG, USA (29 Aug)

7. Additions to staff during 2003:
   Joneil Ribaya, SFC, USA (21 Jul)
   Stephanie Vaughn, MAJ, CM, USA (21 Jul)

8. Departures during 2003:
   John L. Carter, MAJ, FA, USA (01 Oct)
   Guy Gammons, SFC, USA (23 Jun)

9. There were two changes to the Reactor and Radiation Facility Safety Committee (RRFSC) during 2003. Dr. David McKown replaced LT Gerald Burke as the Radiation Protection Officer on 11 March and Mr. Mark Gee replaced LCDR Marvin Earls as Chairman on 16 September.

In accordance with the requirements set forth in Section 6.2.1.1. of the Technical Specifications for the AFRRI Triga Reactor Facility, the RRFSC consisted of the following members as of 31 December 2003.

Regular members are:
Radiation Protection Officer - David McKown
Reactor Facility Director - Stephen I. Miller
Reactor Operations Specialist - Seymour Weiss
Health Physics Specialist - Joe Pawlovich

Chairman and Director's Representative - Mark Gee

Special nonvoting member - David Rotolone, Montgomery County Government (Environmental Policy and Compliance Office)

Recorder - Harry H. Spence

Two meetings were held in 2003. All meetings are full committee meetings; subcommittees were eliminated in 2001:

24 July

11 December

SECTION I

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

A summary of changes to the facility design, performance characteristics, administrative procedures, and operational procedures as well as the results of surveillance testing are provided in this section. Design change documentation with their 10 CFR 50.59 reviews are in the Attachments.

A. DESIGN CHANGES

There were two design changes to the facility during 2003. First, an access point was installed between the DAC and the console chart recorder to allow remote readout of the recorder signal. An experiment performed during April 2003 required that the experimenter monitor reactor power level changes on his equipment in the prep area. This was necessary to compare power levels measured by the reactor instrumentation to power levels measured by the experimental detectors being tested. The modification allowed the experimenter to remotely read and record reactor power levels, but he could not affect the operational console. Even a direct shunt would not affect the reactor controls or displays (Attachment 1). Second, obsolete NMC Model AM-2D continuous air monitors (CAMs) were replaced with modern Ludlum Model 333-2 Air Monitoring Systems. The old CAMs had been in service over 20 years and could no longer be economically repaired. The new units perform the same functions with the same alarms as the old units (Attachment 2). Complete descriptions of these changes are included at Attachments 1-2.

B. PERFORMANCE CHARACTERISTICS

There were no changes to the performance characteristics of the core during 2003. All fuel, chambers, and the core experiment tube (CET) remained in place for operations throughout the year.

C. ADMINISTRATIVE PROCEDURES

Administrative Procedure A4 ,Special Nuclear Material Accountability, was revised to change SNM inventory reporting from twice per year to once per year. This change brings the procedure into compliance with the new 10 CFR 74 effective October 2003.

D. OPERATIONAL PROCEDURES

Operational Procedure 8, Tab I - Daily Operational Shutdown Checklist and Operational Procedure 11, Air Particulate Monitor (CAM) Procedure, were changed to revise the daily CAM function checks in conjunction with the design change discussed above.

E. RESULTS OF SURVEILLANCE TESTS AND INSPECTIONS

All maintenance and surveillance tasks during 2003 were accomplished on time.

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

The 2003 annual reactor audit required by the reactor technical specifications was conducted by Mr. Andrew Cook in December 2003. Mr. Cook is a senior reactor operator and Operations Manager at the North Carolina State University reactor facility. During the audit he verbally indicated that he had not found any major discrepancies in reactor operations and those conclusions are reflected in his written report.

SECTION II

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

Month	Kilowatt Hours
JAN	896.5
FEB	43.0
MAR	415.3
APR	307.9
MAY	663.8
JUN	122.9
JUL	16.6
AUG	41.0
SEP	27.9
OCT	418.6
NOV	572.2
DEC	27.1
TOTAL	3,552.8

Total energy generated in 2003: 3,552.8 kWh

Total energy on fuel elements: 992,853.9 kWh

Total energy on FFCRs*: 260,056.2 kWh

Total pulses this year $\geq$ $2.00: 1

Total pulses on fuel elements $\geq$ $2.00: 4,216

Total pulses on FFCRs* $\geq$ $2.00: 104

Total pulses this year: 69

Total pulses on fuel elements: 11,828

Total pulses on FFCRs*: 2,063

*Fuel-follower control rods

SECTION III

Unscheduled Shutdowns

There were no unscheduled shutdowns in 2003.

SECTION IV

Safety-Related Corrective Maintenance

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.

28 January 2003 - The CSC computer failed to acquire pulse data for several pulses. Data acquisition was correct for zero-power pulses with a signal input at the CSC computer, but not for real data input from either the pulse-ion or Cerenkov detectors. The RFD was notified and suspended pulse operations until the problem was corrected. One of the relays in the signal junction box at the rear of the NPP channel in the DAC cabinet was found to be loose. The relay was reseated in its socket. A bracket was installed around the relays to prevent reoccurrence. The system was tested and operated normally. Pulse operations were resumed.

17 October 2003 - While preparing to perform a thermal power calibration, whenever the "rod up" button was pressed on the console to raise the transient rod, the compressed air would be released and magnet power would be lost to the standard rods. The RFD was notified and annual calibration activities were suspended. Upon inspection, several loose wires were discovered in the magnet power supply scram loop after the magnet supply voltage action pack. The power supply and action pack were removed and tested and the wires were reconnected. The entire system was inspected for loose wires and tested before annual calibration activities resumed.

29 October 2003 - During annual transient rod calibration, a symmetrical integral rod worth curve could not be obtained. The slope of the lower half of the curve was much steeper than the upper half slope. The RFD was notified. Investigation determined that the physical movement of the rod did not track linearly with changes in the rod position indicator on the console. Extensive testing determined that the transient rod position 15v power supply was defective. The voltage was not constant as the rod was driven up and down. The variance was under the limits for a Technical Specification reportable occurrence. The power supply was replaced, linear rod travel was verified over the entire range, and the physical rod travel distance of 15.0 inches was verified. All components were tested and operated normally and satisfactory rod worth curves were obtained. A linearity check was added to the annual shutdown maintenance checklist.

SECTION V

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

A. FACILITY CHANGES AS DESCRIBED IN THE FSAR

There were two design changes to the facility during 2003. First, an access point was installed between the DAC and the console chart recorder to allow remote readout of the recorder signal. An experiment performed during April 2003 required that the experimenter monitor reactor power level changes on his equipment in the prep area. This was necessary to compare power levels measured by the reactor instrumentation to power levels measured by the detectors being tested. The experimenter could only read the signal being displayed on the console and could not remotely change reactor power levels (Attachment 1). The operation of the reactor log power channel is described in Section 4.11.2 of the FSAR. Second, obsolete NMC Model AM-2D continuous air monitors (CAMs) were replaced with modern Ludlum Model 333-2 Air Monitoring Systems. The old CAMs had been in service over 20 years and could no longer be economically repaired. The new units perform the same functions with the same alarms as the old units (Attachment 2). The operation of the CAMs is described in Section 3.6.2 of the FSAR. Complete descriptions of these changes are included at Attachments 1-2.

B. PROCEDURE CHANGES AS DESCRIBED IN THE FSAR

There were no changes to procedures as described in the FSAR. Changes to the administrative and operational procedures are covered in Section I.

C. NEW EXPERIMENTS OR TESTS

No new experiments or tests were performed during the reporting period that were not encompassed by the FSAR.

The Attachments contain the safety evaluations 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 uses a step-by-step process to document that the criteria in 10 CFR 50.59(c)(2) were not met and no technical specification changes were required prior to implementation.

SECTION VI

Summary of Radioactive Effluent Released

A. Liquid Waste: The reactor produced no liquid waste during 2003.

B. Gaseous Waste: There were no particulate discharges in 2003.

The total activity of Argon-41 discharged in 2003 was 1.22 curies. The estimated effluent concentration 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 2003	0.023 Ci
	Apr - Jun 2003	0.915 Ci
	Jul - Sep 2003	0.031 Ci
	Oct - Dec 2003	0.255 Ci

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

SECTION VII

Environmental Radiological Surveys

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.

The calculated annual dose, due to Argon-41 release to the environment for 2003, was 0.04 mRem at the location of maximum public 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 established under 10 CFR 20.1101(d) 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 calculated to be 0.4% of the 10 millirem constraint limit, or 0.04 millirem for the entire year.

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 25% of 10 CFR 20 Limits

There were no doses to reactor staff personnel or reactor visitors greater than 25% of 10 CFR 20 occupational and public radiation dose limits.

ATTACHMENT 1

Facility Modification Worksheet 2

No 10 CFR 50.59 Analysis Required

Proposed Change Install access point between DAC and console chart recorder to allow remote readout of console log power chart recorder sign

Modification to: Procedure _____ Facility XX

Submitted by: Tomlinson Date 14 April 03

1.Description of change:

See attached description & schematic.

2. Verify that the proposed change does not involve a change to the Technical Specifications, the facility as described in the FSAR, or procedures as described in the FSAR.

Does not apply - completed.

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 Logistics.

N/A

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 _____ Date APR 16 2003

RRFSC Notified _____ Date JUL 24 2003

Chart Recorder Modification

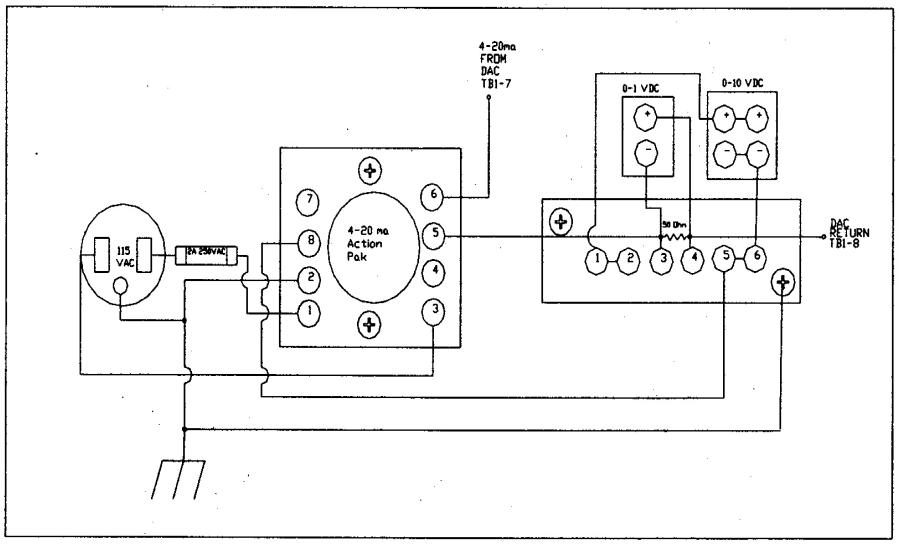
Propose installing an access point between the DAC and console chart recorder. Through theory and experimentation, the best source is the log power channel between TB1-7 and TB1-8 (console). Up to a 3K ohm load may be applied to this signal without changing the characteristics. By installing an Action Pak (model AP4382) in series, we can obtain 0-1VDC and 0-10VDC outputs. The action pak has typical 20-ohm impedance and will convert the 4-20ma input to VDC output.

This change does not affect the AFRRI TRIGA reactor Technical Specifications and is not connected to the SCRAM loop or other reactor safety circuits.

This change does not affect calibration curves and/or the accuracy of any log power readouts.

Periodic calibration of this device is not required.

The log power chart recorder continues to function as before.



ATTACHMENT 2

Facility Modification Worksheet 1

10 CFR 50.59 Analysis

Proposed Change Replacement of current air particulate monitors (CAMs) with new models.

Submitted by: Spence **Date** 07 Feb 2002

1. Description of change:

The current NMC Model AM-2D air monitors in both the reactor room and the prep area will be replaced with new Ludlum Model 333-2 Air Monitor Systems.

2. Reason for change:

The current CAMs have been in service over 20 years and can no longer be economically repaired.

3. Verify that the proposed change does not involve a change to the Technical Specifications or meet any of the criteria in 10 CFR 50.59(c)(2). Attach an analysis to show this.

Analysis attached? Yes X

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

Procedure ____ Facility XX

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

Section 3.6.2 will be changed to reflect that the flow rate will be 2.0-2.5 CFM rather than 6-8 CFM, the sensitivity range will be 10 to 1E5 CPM rather than 50 to 50E3 CPM, and the recording chart recorder specifications will also be updated. Section 5.2.3, describing CAM exposure room monitoring, will not require any changes.

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

Both old and new CAMs will be run side-by-side for one month to ensure identical response to operational conditions under all normal reactor modes (steady-state and pulse) and power levels. Operation of all audible and visual alarms will be verified as well as chart recorder operation and accuracy. Calibration of the new units will be performed at the beginning of the month and verified at the end of the month to check operational stability. The normal calibration interval is expected to remain 12 months.

Facility Modification Worksheet 1 (cont.)

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 ____	No XX
Will any Logs have to be changed?	Yes ____	No XX
Are other procedures effected?	Yes XX	No ____

List of items affected:

Operational Procedure 11
Daily Operational Shutdown Checklist

8. Create an Action Sheet containing a list of associated work specified in item # 7, attach a copy, and submit another to the RFD (modification of drawings must be approved by the RFD).

Action Sheet: Submitted XX Not Required ____

Reviewed and approved by RFD _____ Date 3/5/02

RRFSC Concurrence _____ Date JUN 05 2002

50.59 Analysis for CAM Replacement

1. TECHNICAL SPECIFICATIONS: The CAMs are referenced in several sections –

a. Sections 3.4 and 3.5.1 require that the reactor room air dampers close on an alarm signal from the reactor deck CAM. The new CAMs will send the same closure signal as the old CAMs at the same setpoint.

b. Section 3.5.1 also describes the location of alarms and readouts. These will remain the same for the new units.

c. Section 4.5 specifies the intervals for channel checks, channel tests, and calibrations. These will not change with the new units.

Therefore, no changes are required to the Technical Specifications.

2. 10 CFR 50.59(c)(2) CRITERIA: The new CAMs perform the same basic function as the old units. The new units utilize the same type of G-M tube mounted in a lead shield with the same ~36% 2π efficiency. The new units have increased sensitivity with a range of 10 to 1E5 CPM rather than 50 to 50E3 CPM. The new units will utilize the same alarms, readouts, and setpoints as the old CAMs.

The only significant difference is the air flow rate through the detector. The new units have a flow rate of 2.0 – 2.5 CFM while the old units operated at 6 - 8 CFM, a factor of ~3 smaller through the new units. However, the 1¼" ID collection hose of the old CAMs will be replaced by ¾" ID hose on the new units, resulting in a corresponding 3x increase in flow velocity. Thus, a radioactive particle entering the collection hose at the reactor core will arrive at the counting chamber at approximately the same time for both old and new units.

a. Because the new CAM performed the same functions and results in the same alarms at the same setpoints as the old CAM, there is no increase in either the frequency or consequences of an accident evaluated in the FSAR. The new system will not allow the design basis limit for the reactor room fission product barrier to be exceeded or altered since the CAMs will continue to alarm and close the dampers at the same setpoints. Finally, any malfunction of the new CAM could give only the same result as previously described in the FSAR (reactor room damper closure).

b. Since old equipment is being replaced with equivalent newer equipment, there is no increase in either the likelihood or consequences of a malfunction of an SSC previously evaluated in the FSAR.

c. The installation does not create the possibility for any accident not previously evaluated in the FSAR.

d. Lastly, there is no departure from, or even reference to, any method of evaluation described in the FSAR.

The proposed CAM replacement does not meet any of the criteria in 10 CFR 50.59(c)(2).