University of Missouri-Rolla
Nuclear Reactor Facility

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April 25, 2003

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulations
Attention: Director
Document Control Desk
Washington, D.C. 20555

Dear Sir:

Please find enclosed the Annual Progress Report 2002-2003 for the University of Missouri-Rolla Reactor Facility (License R-79, Docket No: 50-123). This report is being filed under the reporting requirements of our Technical Specifications. Copies of this report are also being sent to our Regional Administrator and Project Manager.

Sincerely,

Dr. Akira T. Tokuhiro
Reactor Director

mh

Enclosure

xc: Marvin Mendonca, Project Manager (NRC)
Chancellor Gary Thomas (UMR)
Dr. Lee W. Saperstein, Dean, School of Mines & Metallurgy (UMR)
Mr. Ray Bono, Radiation Safety Officer(UMR)
Dr. Robert Mitchell, Dean, School of Engineering (UMR)
Dr. Paula M.. Lutz, Dean, College of Arts and Science (UMR)
American Nuclear Insurers, c/o Librarian
Dr. Mark Fitch, Chairman, Radiation Safety Committee (UMR)
University of Missouri-Columbia Research Reactor (MURR)
Dr. Arvind Kumar, Chairman of Nuclear Engineering (UMR)
Dr. Arlan R. DeKock, Dean of School of Management & Information Systems

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PROGRESS REPORT

2002-2003

UNIVERSITY OF MISSOURI – ROLLA

NUCLEAR REACTOR FACILITY

PROGRESS REPORT

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PROGRESS REPORT

FOR THE

UNIVERSITY OF MISSOURI-ROLLA

NUCLEAR REACTOR FACILITY

April 1, 2002 to March 31, 2003

Submitted to

The U.S. Nuclear Regulatory Commission

and

The University of Missouri-Rolla

SUMMARY

During the 2002-2003 reporting period the University of Missouri-Rolla Reactor (UMRR) was in use for 416 hours. The major part of this time, about 95% was used for class instruction, research, and training purposes.

The UMRR operated safely and efficiently over the past year. No significant safety-related incidents or personnel exposures occurred.

The reactor facility supported several UMR courses over the year for a total of 2,550 student-hours. About 2,968 visitors visited the reactor during the past year. There were 394 participants, mostly high school students, in the U.S. Department of Energy Reactor Sharing Program.

The reactor produced 12,861.6 kilowatt-hours of thermal energy using approximately 0.66 grams of uranium. A total of 155 samples were neutron irradiated in the reactor with most of them being analyzed in the Reactor Counting Laboratory. An additional 320 samples were exposed to gamma radiation in the reactor without neutron irradiation.

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1.0 INTRODUCTION

This progress report covers activities at the University of Missouri-Rolla Reactor (UMRR) Facility for the period April 1, 2002 to March 31, 2003.

The reactor is operated as a university facility, available to the faculty and students from various departments of the university for their educational and research programs. Several other college and pre-college institutions have made use of the facility during the reporting period. The facility is also available for the training of reactor personnel from companies with nuclear power plants.

1.1 Background Information

The University of Missouri-Rolla Reactor Facility attained initial criticality on December 9th, 1961. The UMRR was the first operating nuclear reactor in the state of Missouri. The reactor design is based on the Bulk Shielding Reactor at Oak Ridge National Laboratory. The reactor is a light water, open pool reactor cooled by natural convective flow. The fuel is MTR plate-type fuel. The initial licensed power was 10 kW. The licensed power was upgraded to 200 kW in 1966. During the summer of 1992, the reactor fuel was converted from high-enriched uranium fuel to low-enriched uranium.

The facility is equipped with several experimental facilities including a beam port, thermal column, pneumatic rabbit system and several manual sample irradiation facilities. Additionally, the facility is equipped with a counting laboratory that has gamma and alpha spectroscopy capabilities. The gamma spectroscopy system includes germanium and sodium-iodide detectors, associated electronics, and state-of-the-art data acquisition and spectrum analysis software. The alpha spectroscopy system consists of a surface barrier detector and data acquisition equipment. The beamport experimental area is equipped with NE-213 and time-of-flight neutron spectroscopy systems.

1.2 General Facility Status

The UMRR operated safely and efficiently over the past year. No significant safety-related incidents or personnel exposures occurred.

The license for UMRR has been extended to January 14, 2005, Amendment No. 16 (August 6, 1999). We have been working on re-licensing during this period and will continue.

We are continuing efforts to upgrade our console using grant awards from DOE combined with money directly from reactor funds. We have received grant funds for Reactor Instrumentation upgrade in Spring 2002 and have received notice of an award for additional grant funds in Spring 2003.

The reactor has funded a graduate student to perform research in support of the relicensing effort. To date research on atmospheric dispersion modeling dose assessments associated with normal operations and accident conditions has been finished. An additional graduate student is now conducting computational analysis of severe accident scenario in support of the SAR.

An independent auditor from the University of Columbia audited the Reactor Facility on December 11, 2002. There were no significant areas of concern. We have entered into an agreement with the University of Missouri-Columbia to audit each other. This has been a very beneficial arrangement for both facilities involved.

The reactor staff has continued to review the operation of the Reactor Facility in an effort to improve the safety and efficiency of its operation and to provide conditions conducive to its utilization by students and faculty. An "outreach" program, implemented over the past years, has been continued in order to let both students and faculty in a number of departments across campus know how the reactor could be used to enhance course work and research. As a result, additional classes have been using the Reactor Facility to augment their programs, including:

Physics 4&5, 'Concepts in Physics'
Physics 7, 'Environnemental Physics'
Chemistry 8, 'Qualitative Analysis Laboratory'
Physics 107, 'Modern Physics'
Physics 207, 'Modern Physics II'
Physics 322, 'Advanced Physics'
Chemical Engineering 261, 'Introduction to Environmental Engineering'

Chemistry 2, 'General Chemistry Laboratory'
Mechanical Engineering 229, 'Energy Conversion'
Life Sciences 352, 'Biological Effects of Radiation'
Chemistry 251, 'Intermediate Quantitative Analysis'
Chemistry 355, 'Instrumental Methods Laboratory'
Civil Engineering 310, 'Senior Design Class'
Basic Engineering 50, 'Engineering Mechanics – Statics'
Engineering Management 386, 'Safety Engineering Management'

SOPs have been revised over the past year in order to improve our operations and efficiency. The following is a list of SOPs revised during the reporting period:

SOP 102	Pre-Startup Checklist Procedure (Pages 5,7,8)
SOP 102	Pre-Startup Checklist Procedure (Page 5)
SOP 501	Emergency Procedures For Reactor Building Evacuation (Page 7)
SOP 501	Emergency Procedures For Reactor Building Evacuation (Page 7)
SOP 501	Emergency Procedures For Reactor Building Evacuation (Page 7)
SOP 653	Sealed Source Leak (Page 1)
SOP 655	Radiation Area Monitor (RAM) Calibrations (Page 1,5)
SOP 800	Semi-Annual Checklist (Pages 5,6,7,8,9,&10)
SOP 804	Safety Amplifier System (Pages 1,2)
SOP 810	Weekly Checklist (Pages 5,10)
SOP 810	Weekly Checklist (Page 5)

The above listed SOP revisions are provided in Appendix A.

2.0 REACTOR STAFF AND PERSONNEL

2.1 Reactor Staff

Name	Title
Dr. Akira Tokuhiro	Director & Senior Operator
William Bonzer	Reactor Manager & Senior Operator
Mendy Kell[1]	Senior Secretary
Maureen Henry[2]	Senior Secretary
James Jackson[3]	Senior Operator & Senior Lab Mechanic
Brian Porter	Senior Electronics Technician
Dan Estel[4]	Interim Senior Lab Mechanic

[1]Departed Reactor 05/10/02

[2]Hired effective 07/22/02

[3]Departed Reactor 12/09/02

[4] Hired effective 12/23/02

2.2 Licensed Operators

Name	License
William Bonzer	Senior Operator
James Jackson	Senior Operator
Akira Tokuhiro	Senior Operator
Dan Estel	Reactor Operator
Jeremy Gorelick	Reactor Operator
Craig Heimericks	Reactor Operator
Michelle Minard[1]	Reactor Operator
Kurt Koch[1]	Reactor Operator
Hannah Yount[1]	Reactor Operator

[1]Effective in September 16, 2002

2.3 Radiation Safety Committee

The Radiation Safety Committee meets quarterly. The committee met on 4/17/02, 7/15/02, 11/14/02, and 3/10/03 during the reporting period. The committee members are listed below.

Name	Department
Dr. Mark Fitch, (Chairman)	Civil Engineering
Mr. Ray Bono (Secretary, ex-officio, non-voting)	Environmental Health and Safety Services
Mr. William Bonzer	Nuclear Reactor, Reactor Manager
Dr. Roger Brown	Biological Sciences
Dr. Robert DuBois	Physics
Dr. Arvind Kumar until 7/2/02	Nuclear Engineering
Dr. Heather Gepford effective 7/2/02	Nuclear Engineering
Dr. Ekkehard Sinn	Chemistry
Mr. Randy Stoll	Director, Business Services
Dr. Akira Tokuhiro	Director, Nuclear Reactor
Dr. Nick Tsoulfanidis	Nuclear Engineering

2.4 Health Physics

Health Physics support is provided through the Environmental Health and Safety Department, which is organizationally independent of the Reactor Facility operations group.

Health Physics personnel are listed below:

Name	Title
Mr. Ray Bono	Health Physicist & Radiation Safety Officer
Mr. Brian Smith	Industrial Hygienist
Allison Adams	HP Technician
Michelle Minard	HP Technician
LeAnn Splitter	HP Technician
Julie Tucker	HP Technician

3.0 REACTOR OPERATIONS

Core designation 101W is presently in use. The "W" mode core is completely water reflected and is used for normal reactor operations. The "T" mode (core positioned near graphite thermal column) may be used for various experiments, including beam port and thermal column experiments.

Table 3-1 presents pertinent core data and Figure 3-1 shows the core configuration of core 101W. The excess reactivity, shutdown margin, and rod worths were measured in cold, clean conditions.

Table 3-1. Core 101W Technical Data

Parameter	Value
Rod 1	2.73 %Δk/k
Rod 2	2.69 %Δk/k
Rod 3	3.22 %Δk/k
Reg Rod	0.371 %Δk/k
Excess Reactivity	0.496 %Δk/k
Shutdown Margin*	4.92 %Δk/k

* Assumes Rod 3 (highest worth rod) and Reg Rod are fully withdrawn.

Figure 3-1. UMRR Core 101W Configuration

	1	2	3	4	5	6	7	8	9
A									
B					S				
C				F-8	F-4	C-4			
D			F-13	C-1	F-3	F-2	F-12	F-15	
E			F-10	C-2	F-1	C-3	F-9	F-14	
F			CR	F-5	F-6	F-7	BR		

KEY TO PREFIXES

F - Standard Elements

C - Control Elements

BR - Bare Rabbit

CR - Cadmium Rabbit

S - Source Holder

Table 3-2 presents a listing of unscheduled shutdowns (scrams, rundowns, and unplanned normal shutdowns) along with their causes and corrective actions. There were four scrams (unscheduled shutdowns). Each was due to one rod dropping. One was due to the reactor bridge being bumped and the other three were caused by low magnet current settings, in which the electromagnet's magnetic flux did not support the weight of the control rod. None of the four scrams initiated a trip signal due to the nature of the scram.

Five of the 12 rundowns were 120% Full Power rundowns caused by electrical noise spikes to the Log and Linear Channel in which this trip originates. The noise spikes generally were created from the auto controller circuitry. The reactor was at a stable power during each of these trips. The 120% Demand rundowns occurred due to switching errors and noise spikes originating in the Linear Channel's meter switches. Operators were instructed to properly switch scales to avoid additional switching errors.

Maintenance activities are listed in Table 3-3. Table 3-4 shows reactor utilization and Table 3-5 shows other facility usage.

Table 3-2. Scrams, Rundowns, and Unplanned Shutdowns

05/03/02	120% Full Power Rundown. Cause was a noise spike from auto-controller. No corrective taken. SRO gave permission to restart reactor.
05/16/02	120% Demand Rundown.. Cause was operator inattention to Linear Channel. Corrective action; SRO instructs RO to observe Linear Channel while operating. SRO granted permission to restart the reactor.
05/31/02	120% Full Power Rundown. Noise spike caused rundown. No corrective action taken. SRO granted permission to restart reactor.
05/31/02	Scram (Unscheduled shutdown). Control rod 3 dropped due to low magnet current. Corrective action; magnet power supply replacement scheduled. Reactor was not restarted.
06/11/02	120% Full Power Rundown. Caused by noise spike from auto-controller. No corrective action taken. SRO granted permission to restart reactor.
06/11/02	120% Full Power Rundown. Cause was a noise spike from auto-controller. No corrective action taken. SRO granted permission to restart reactor.
07/23/02	Scram (unscheduled shutdown). Caused by jarring of the reactor bridge steps causing one rod to drop. No corrective action taken. SRO granted permission to restart reactor

02/01/03	120% Demand Rundown. Caused by trainee downscaling Linear Channel too soon. SRO instructed operator to downscale at 8%. SRO granted permission to restart reactor.
02/06/03	Scram (unscheduled shutdown). Caused by low magnet current to control rod 2. Corrective action taken was to increase magnet current an additional five milliamps. SRO granted permission to restart reactor.
02/07/03	Scram (unscheduled shutdown). Cause was control rod 2 dropping due to low magnet current. Corrective action taken was magnet current was increased five milliamps. SRO granted permission to restart reactor.
02/08/03	120% Full Power Rundown. Caused by noise spike from auto-controller. Reactor did not exceed 200kW. No corrective action was taken. SRO gave permission to restart reactor.
03/11/03	120% Demand Rundown. Caused by operator downscaling too many scales. Corrective action taken was instructing operator to only down scale one scale at a time. SRO granted permission to restart.
03/11/03	120% Demand Rundown. Caused by operator failing to upscale properly on the Linear Channel. Corrective action taken was to instruct operator to upscale at 60% on Linear Channel. SRO granted permission to restart reactor.
03/18/03	120% Demand Rundown. Caused by operator failing to upscale properly on the Linear Channel. Corrective action taken was SRO instructed operator to upscale at 60% and relieved operator at console. SRO permission granted to restart reactor.
03/18/03	120% Demand Rundown. Caused by operator downscaling improperly on the Linear Channel. Corrective action was the SRO instructed the operator to shut down reactor.
03/19/03	120% Demand Rundown. Caused by operator not downscaling properly on the Linear Channel. Corrective action taken was SRO instructed operator to upscale at 60%. SRO granted permission restart reactor.

Table 3-3. Maintenance for 2002-2003

Date	Problem/Event and Action Taken
04/05/02	Problem: Electrical wiring verification. Corrective Action: Turned off power to allow verification of wiring. Wiring verification completed. Restored power to control room.
05/20/02	Problem: Electrical upgrade to control room. Corrective Action: Removed power to the control room. Electrical upgrade completed. Restored power to control room.
06/04/02	Problem: Replacement of Safety Channel and Magnet Power Supply. Corrective Action: Installed and tested new Safety Channel and Magnet Power Supply.
06/12/02	Problem: Auto-controller not responding to drifts in reactor power. Corrective Action: Removed and cleaned all cable pins. Removed and cleaned pins on

C17- C20. Tested with source.

06/28/02 Problem: Semi-annual calibration started.
Corrective Action: Completed semi-annual calibration.

07/17/02 Problem: Startup channel would not show more than two counts per second.
Corrective Action: Replaced four transistors and one resistor on the pre-amp.

07/26/02 Problem: Spare Startup Channel pre-amp not operable.
Corrective Action: Replace four transistors, removed existing pre-amp, replaced with spare, and tested unit.

07/30/02 Problem: Beamport shutter will not close.
Corrective Action: Removed motor and tighten set screw on shaft.

08/09/02 Problem: Control rod visual surveillance.
Corrective Action: Performed annual control rod visual inspection. Performed rod drop time tests

12/23/02 Problem: Semi-annual calibration started.
Corrective Action: Completed semi-annual calibration.

01/10/03 Problem: Rod Drive #1 brake not holding.
Corrective Action: Remove Rod Drive #1 actuator from bridge, replaced solenoid, and brake band. Installed actuator and tested rod height indicator.

01/10/03 Problem: Rod #3 magnet current is fluctuating.
Corrective Action: Removed magnet #3 from the pool. Replaced magnet coil. Installed into pool and performed rod drop time test.

01/15/03 Problem: Rod Drive #3 actuator not holding.
Corrective Action: Removed Rod Drive #3 actuator from bridge, replaced solenoid, and brake band. Installed actuator and tested.

Table 3-4. Reactor Utilization

1.	Reactor use		416.0 hrs.
2.	Time at power		148.1 hrs.
3.	Energy generated		12861.6 kW/hrs
4.	Total number of samples	Neutron Irradiated	155
		Gamma Exposure	320
5.	U-235 Burned		0.6601 g
6.	U-235 Burned and Converted		0.6630 g

Table 3-5. Experimental Facility Use Other Than The Reactor

Facility	Hours
Bare Rabbit Tube	4.05 hr.
Cadmium Rabbit Tube	0.02 hr.
Beam Port	1.92 hr.
Other Core Positions	2,048 hr.
Total	2054 hr.

4.0 PUBLIC RELATIONS

The reactor staff continues to educate the public about applications of nuclear science. Over 2,968 persons visited the facility during this reporting period. Tour groups are typically given a brief orientation and/or demonstration by a member of the reactor staff.

Table 4-1 lists some of the major occasions or groups and number of visitors for each event.

Table 4-1. Public Relations Program 2002-2003

DATE	PARTICIPANTS	NUMBER
04/09/02	Omron Transaction Systems, facial identification	2
04/19/02	Tour, Representatives from the Republic of Georgia	8
04/13/02	Spring Open House	63
04/02/02	TJ South	22
04/17/02	UMR Family Tour	8
04/19/02	Pro Day	26
6/9/02-6/14/02	UMR Jackling Session I	44
6/17-6/17/02	UMR Jackling Session II	31
6/23-6/29/02	UMR Jackling Session III	34
6/23-6/25/02	UMR Introduction to Engineering, Admissions	46
7/8-7/12/02	UMR Introduction to Engineering, Admissions	75
07/19/02	UMR Tour for Prospective Students	8
7/21-7/26/02	UMR NE Summer Camp Session I	14
7/21-8/02/02	UMR NE Summer Camp Session II	33
7/21-8/2/02	UMR Jackling II	22
7/28-8/02/02	UMR NE Summer Session II	16
08/01/02	UMR NE Summer Camp half life	16
08/02/02	UMR Tours, 2 groups, half life / blue glow	41
09/29/02	ABET Tour	10
10/12/02	Tour, Mike Evans, President of INPO	2
11/09/02	Open House for UMR	23
12/06/02	International Affairs, group	7
12/06/02	UMR Blue Glow Tours	72
12/07/02	UMR Open House Blue Glow Tours	84
12/18/02	Cub Scouts	12
1/10/03	Highway Patrol	3
02/22/03	Cub Scouts	22
	TOTAL FOR 2002-2003	744

5.0 EDUCATIONAL UTILIZATION

The reactor facility supported several UMR courses in the past year for a total of 3,886 student-hours. The number of UMR students utilizing the facility was 544. This usage is a direct result of an aggressive and continuing campus wide "outreach" program. The reactor facility provided financial support for four students with hourly wages, and one Graduate Research Assistants. Additionally, students from several universities, colleges and high schools have used the facility.

Table 5-1 lists UMR classes taught at the facility along with associated reactor usage for this reporting period.

The University of Missouri-Columbia Nuclear Engineering Department again sent its NE 404 class, "Advanced Reactor Laboratory," to our facility (Spring, 2003) for a total of 7 hours to participate in a wide variety of reactor experiments that they are unable to perform with their reactor. The laboratory was held from mid-afternoon to the evening (2:00 pm until 9:00 pm) and conducted by the UMR reactor staff.

The Reactor Sharing Program, which is funded by the U.S. Department of Energy, was established for colleges, universities, and high schools which do not have a nuclear reactor. This past year, 408 students and instructors from 29 institutions participated in the program. Table 5-2 lists those schools and groups that were involved in this year's Reactor Sharing Program. The majority of our participants were high school students. We coordinate with the Admissions Office to schedule high school students to see other items of interest at UMR after they have visited our facility, such as the student group of American Nuclear Society, the Computer Integrated Manufacturing Lab, the Foundry, Ceramics Engineering, Mineral Museum, Computer Center, Experimental Mine, Solar Car, Electron Microscope, and Stonehenge. The Reactor Sharing Program serves as a strong campus-wide recruiting tool by getting high school students to the university and hopefully sparking some interest in nuclear engineering, science, and technology.

Table 5-1. UMR Classes at Reactor Facility 2002-2003 Reporting Period				
WS- Winter FS- Fall	CLASS NUMBER/TITLE	# OF STUDENTS	TIME AT REACTOR	STUDENT HOURS
WS02	NE 25	8	4	32
WS02	NE 306	4	30	120
WS02	NE 308	10	30	300
WS02	NE 300	2	30	60
SS02	NE 490	1	36	36
WS02/FS02	OURE (Ken Morrison, Will Atkins); Distance Learning & Remote Monitoring	2	45	90
FS02/WS03	Reactor Operator Trainees	15	24	360
FS02	OURE (Chris Byrum); Design of a robotic arm for control rod inspection	1	7.5	7.5
FS02	NE 304	6	30	180
FS02	NE 306	11	30	330
FS02	NE 300	2	30	60
FS02	NE 490	1	45	45
WS03	NE 308	6	30	180
WS03	NE 306	9	30	270
FS02	Chemistry Labs (half-life); Dr. Terry Bone	389	0.5	194.5
4/29/02	Physics 107; Dr. Pringle	24	1	24
FS02	NE 400; UMC Students	4	16	64
fs02	NE 25	13	5	65
FS02	NE 105	13	1	13
WS03	NE 204	15	1	15
02/03	Research Dr Bertino	1	62	2
12/06/03	Physics 107, Dr. Pringle	17	1	17
	TOTALS FOR 2002-2003	**554**	**489**	**2465**

DATE	Table 5-2. Reactor Sharing Program (2002-2003) PARTICIPANTS	Number
04/02/02	Thomas Jefferson High School	16
04/08/02	Lynn High School	14
04/08/02	World Youth in Science & Engineering	17
04/09/02	South Western Missouri State University	9
04/13/02	Spring Open House	16
04/16/02	Fort Leonard Wood Chemical School Trainees	10
04/17/02	Hazelwood East High School	20
04/17/02	NE 25	7
04/29/02	Physics 6	23
05/16/02	Fort Leonard Wood Tour	14
06/20/02	M.I.T.E. Michelle Schoenborn	41
08/02/02	Central High School	18
09/23/02	Fort Leonard Wood Chemical School Trainees	7
09/30/02	Fort Leonard Wood Chemical School Trainees	11
10/22/02	East Central College	23
10/29/02	Mansfield High School	5
11/06/02	Parkway West High School	16
11/12/02	Fairview K-8	50
	Rolla High School	25
12/03/02	Marshfield High School	5
12/18/02	Boy Scouts	12
02/07/03	Rolla Middle School Job Shadowing	3
02/10/03	Waynesville High School	14
03/17/03	Fort Leonard Wood Chemical School Trainees	14
03/24/03	Charles Beasley	1
03/28/03	Charles Beasley	1
03/31/03	NE 404	10
	High School Students	
2002-2003	Alfred Schovanez (Washington, MO) Neutron Exposure to Zener diodes	1
2002-2003	Justin Munson (Warsaw, MO) Neutron Exposure to Diodes	1
2002	Kevin Johnson, (West Plains, KS) Neutron Exposure to TTL & CMOS	1
2002	Keong Kam (Overland Park, KS) Gamma Exposure to Zener Diodes	1
2003	Matt Krantz (Loudon, TN) Gamma exposure to TTL Logic chips	1
2003	Matt McCreary (Arnold, MO) Gamma exposure to TTL & Logic chips	1
	TOTAL FOR 2002-2003	**408**

6.0 REACTOR HEALTH PHYSICS ACTIVITIES

The health physics activities at the UMR Reactor Facility consist primarily of radiation and contamination surveys, monitoring of personnel exposures, airborne activity, pool water activity and waste disposal. Releases of all by-product material to authorized, licensed recipients are surveyed and recorded. In addition, health physics activities include calibrations of portable and stationary radiation detection instruments, personnel training, special surveys and monitoring of non-routine procedures.

6.1. Routine Surveys

Monthly radiation exposure surveys of the facility consist of direct gamma and neutron measurements. No unusual exposure rates were identified. Monthly surface contamination surveys consist of 20 to 40 swipes counted separately for alpha, and beta/gamma activity. No significant contamination outside of contained work areas was found.

6.2. By-Product Material Release Surveys

There were no shipments of by-product material released off-campus from the reactor facility. There were no shipments released on-campus.

6.3. Routine Monitoring

Fifty-two reactor facility personnel and students involved with the operations in the reactor facility are currently assigned Luxel, optically stimulated luminescence (OSL) dosimeters. Four (Reactor Staff) have beta, gamma, neutron dosimeters which are read twice a month. There are four area beta, gamma, neutron dosimeters and one TLD ring dosimeter, which are read monthly. The remaining dosimeters detect beta and gamma radiation only and are read monthly. There are 23 area dosimeters assigned on campus for beta and gamma monitoring and one for beta, gamma, and neutron monitoring. In addition, 5 digital, direct-reading dosimeters, 5 chirpers and 2 pocket ion chamber dosimeters are used for visitors and high radiation work. There have been no significant personnel exposures during this reporting period. Visitors are monitored with direct reading dosimeters. No visitors received any reportable nor significant exposure.

Airborne activity in the reactor bay is monitored by a fixed-filter, particulate continuous air monitor (CAM). Low levels of Argon-41 are routinely produced during

operations.

Pool water activity is monitored monthly to ensure that no gross pool contamination or fuel cladding rupture has occurred. Gross counts and spectra of long-lived gamma activity are compared to previous monthly counts. From April 2002 through March 2003 sample concentrations averaged 2.02×10^{-6} μCi/ml.

Release of gaseous Ar-41 activity through the building exhausts is determined by relating the operating times of the exhaust fans and reactor power during fan operation to previously measured air activity at maximum reactor power. During this period, an estimated 3.83 millicuries of Ar-41 were released into the air.

6.4. Waste Disposal

Solid waste, including used water filters, used resins and contaminated paper is stored and/or transferred to the campus waste storage area for later shipment to a commercial burial site. Water is analyzed for radioactive contamination and approval is required before the water is released. During this period no waste was transferred from the Reactor Facility.

6.5. Instrument Calibrations

During this period, portable instruments and area monitors were calibrated annually.

7.0 PLANS

The reactor staff will be heavily involved in four major projects during the next reporting period; 1) analysis for relicensing 2) implementation and revision of the new activities plan, 3) installing new reactor nuclear instrumentation, 4) continuation of the reactor operator training program.

7.1 Administrative Changes

UMRR is presently fully staffed. Mrs. Maureen Henry has filled the vacant Senior Secretary position as of July 22, 2002. Mr. Dan Estel, who served as Interim Senior Laboratory Mechanic from December 9th, 2002 has recently been appointed permanently as Senior Laboratory Mechanic.

7.2. Relicensing

Relicensing activities will continue during the upcoming reporting period. Our present license has been extended and is valid until January, 2005. Emphasis will be directed toward the SAR accident scenarios and Emergency Plan.

7.3. Strategic Plan

A strategic plan has been developed to help the facility achieve its vision "to become nationally recognized as the leading educational and training university reactor in the country and to become recognized as an active 200 kW facility in terms of research". The strategic plan identifies strategic goals and action items to enhance research, educational outreach and teaching. The action items will be initiated over the coming year and will guide the facility towards its vision.

7.4. Instrumentation Upgrade

The reactor console upgrade is well underway. Several pieces of new equipment have been installed under the provisions of 10 CFR Part 50.59. New Safety Channels and a magnet power supply were installed in Spring of 2002. The Linear drawer maybe replaced during the upcoming reporting period. Most of the changes will be made under the provisions of 50.59; however, some changes may require NRC approval.

7.5 Reactor Operator Training

The second annual group of reactor operator trainees took the NRC examination during the week of March 10, 2003. Twelve applicants tested for reactor operator licenses , with an additional three UMRR operators performing the SRO upgrade exams. Test results from NRC are expected during the month of April 2003. Six student ROs remain active at the reactor.

APPENDIX A.

STANDARD OPERATING PROCEDURES CHANGED DURING THE 2002-2003 REPORTING YEAR

21. **150% Power Scram Check:** control
    a. Withdraw the rods to 3 inches.
    b. Depress the scram test button on the Safety Amplifier
    c. Verify that a scram occurs before 150%.
    d. Verify that the 150% annunciator light and the audible alarm is activated.
    e. Depress the reset button on the Safety Amplifier 1
    f. Reset the annunciator panel and insert magnets
    g. Repeat steps a – f for Safety Amplifier 2.
    h. Record results

WB 10/4/02 -AT AT 10/14/02 Rev

22. **Log and Linear Drawer Non-Operative Scram and Rundown Test:**
    a. Withdraw the shim rods to 3 inches.
    b. Depress the **NON-OPER** keypad switch. Check for the Non-Operate Scram and Low CIC Voltage Rundown visual and audible alarms.
    c. Verify that the rods have dropped and rod drives are running down.
    d. Try to stop the rundown by lifting the shim joy stick.
    e. Stop the rundown with the rundown reset button.
    f. Reset the scram, rundown, and annunciator panel.

23. **Period Trip Test:**
    a. Withdraw the shim rods to 3 inches.
    b. Depress and hold the **PERIOD TEST** keypad switch. Verify that the 30 Second Rod Withdrawal Prohibit annunciator is activated, with a simulated period greater than or equal to 30 seconds.
    c. Continue depressing the **PERIOD TEST** keypad switch. Verify that the 15 Second Rundown is activated with a simulated period greater than or equal to 15 seconds.
    d. Continue depressing the **PERIOD TEST** keypad switch. Verify that the 5 Second Scram is activated with a simulated period greater than 5 seconds by observing a loss of magnet current and the annunciators.
    e. Release the switch.
    f. Reset the scram, rundown, and annunciator panel.

24. **Manual Scram:**
    a. Raise shim rods to 3 inches.
    b. Push the manual scram button. Verify that the rods have dropped by visually observing the video display and noting that the blue magnet contact lights are off.
    c. Push the scram reset button and reset the annunciator panel.

1. Date						Rev.
2. Initials of the Person Performing Checklist						
3. Time (Console Clock)						
4. Core Loading						
5. P.A., Intercom, Video Monitor On						
6. RAM System Check						
7. Radiation Level Normal						
8. Beam Port and Thermal Column Status (OPEN or SHUT)						
9. Linear Channel	Zero					
	Meter Reading					
	Scale					
10. Linear C.I.C. Voltages	HV (~540)					
	CV (~ 2 to 8)					
11. Recorders On, Dated, "RCD" Light On Temp. & CAM Recorders						
12. Core Check (Lights On)	Level Check					
	Inspect Core					
	Source Inserted					
13. Start-Up Channel Test						
14. Verify FC Response, FC Inserted, Count Rate > 2 CPS						
15. Log Count Rate HV Power Supply (+400 VDC)						
16. Log and Power Range Test						
17. Period Response Test						
18. Magnet Power On, Scram Reset, Board Reset						Rev.
19. Inlet Temperature (°F)						

Revised By: William Bonzer Approved By: Akira Tokuhiro

20. Magnet Currents (milliamps)	No. 1					Rev.
	No. 2					
	No. 3					
21. 150% Power Scram Test — Safety Amplifier 1	Raise Rods 3 in. Push "Test" Button					
21. 150% Power Scram Test — Safety Amplifier 2						
22. Log and Linear Drawer Non-Operative Scram Test	Raise Rods 3 in. Press NON-OPER switch.					
23. Period Trip Test						
24. Manual Scram Test	Raise Rods 3 in. Push Manual Scram					
25. Annunciator Test, All Lights On						
26. Magnets On, Rods on Insert Limit						
27. Prepare Hourly and Permanent Logs						
28. Detector Response Check	Inspect Core					
	Log Spike					
	Period Spike					
	Linear Spike					
	Startup Channel Response					
29. Raise Rods to 6 in., Record Time in **Both Logs**						
30. Nitrogen Diffuser Status (ON or OFF)	No. 1					
	No. 2					
31. Intended Power Level						
32. Announce Intention to Start						
33. Pre-Startup Check Properly Completed (Lic. Op. Initials)						
34. Senior Operator's Initials						
35. Date						Rev.

William Bonzer
Revised By: William Bonzer

Approved By: Akira Tokuhiro

UMR REACTOR EMERGENCY PHONE LIST

Reactor Staff	Cell	Pager	HOME	WORK	
Brian Porter, Sr. Electronics Tech.			368-3090	341-4291	
Jim Jackson, Sr. Lab Mechanic,SRO			(573)699-4897	341-4291	Rev.
William Bonzer, Manager, SRO	465-5544		368-3727	341-4384	
Akira Tokuhiro,Director,SRO	578-0542	428-6420	368-7121	341-4746	
Ray Bono, Health Physicist/Radiation Safety Officer	428-6469		364-5728	341-4240, 4305, 4403	
Maureen Henry, Sr. Secretary			364-7272	341-4236	Rev.
University Administrative Staff					
1. Director, UMR Police, William Bleckman			364-1294	341-4345	
2. Chancellor, Gary Thomas			368-3552	341-4114	
3. Vice Chancellor for Admin.Services, Steve Malott			364-7927	341-4122	
4. Director, Physical Plant, Marvin Patton			364-6278	341-4252	
5. Director, Health Service - Infirmary, Dwight Deardeuff, MD			364-0809	341-4284	
6. Dean, School of Mines and Metallurgy, Lee W. Saperstein	578-0602		368-3782	341-4153	
7. Radiation Safety Officer, Ray Bono	428-6469		364-5728	341-4240 4305,4403	

Local		
UMR University Police	341-4300	341-4111
Rolla City Police		**9-911**
Rolla Fire Department		**9-911**
Phelps County Hospital		**9-911**
Rolla Emergency Management Agency		**9-911**

State Agencies		
Missouri Highway Patrol		**368-2345**
Missouri State Emergency Mgt. Agency (24 hr.)		**(573) 751-2748**
Missouri Dept. of Natural Resources (24 hr.)		**(573) 634-2436**
Missouri Bureau of Environmental Health	**(573) 751-6160**	(573) 751-4674 (after hrs)

Federal Agencies			
NRC, Lisle, IL, Region III			**1-800-522-3025**
NRC Duty Officer (24 hour) (call first)	**(301) 816-5100**	(301) 951-0550	(301) 415-0550 (back up #)

Other		
American Nuclear Insurers		**(860) 561-3433**
Radiation Emergency Assistance Center	**(865) 576-3131**	(865) 576-1005 (24hrs)

Revised : July 29, 2002

Revised By: William Bonzer

Approved By: Akira Tokuhiro

UMR REACTOR EMERGENCY PHONE LIST

Reactor Staff	Cell	Pager	HOME	WORK	
Brian Porter, Sr. Electronics Tech.			368-3090	341-4291	
Jim Jackson, Sr. Lab Mechanic, RO			(573) 699-4897	341-4291	Rev.
William Bonzer, Manager, SRO	465-5544		368-3727	341-4384	
Akira Tokuhiro,Director	578-0542		364-1961	341-4746	
Ray Bono, Health Physicist		428-6469	364-5728	341-4240, 4305, 4403	
Maureen Henry, Sr. Sec.			364-7272	341-4236	

University Administrative Staff

1. Director, UMR Police, William Bleckman		364-1294	341-4345	
2. Chancellor, Gary Thomas	308-8240	368-3552	341-4116	
3. Vice Chancellor for Admin.Services, Steve Malott		364-7927	341-4122	Rev.
4. Director, Physical Plant, Marvin Patton		364-6278	341-4252	
5. Director, Health Service - Infirmary, Dwight Deardeuff, MD		364-0809	341-4284	
6. Dean, School of Mines and Metallurgy, Lee W. Saperstein	578-0602	368-3782	341-4153	
7. Radiation Safety Officer, Nick Tsoulfanidis		341-3595	341-4745	

Local

UMR University Police	341-4300	341-4111
Rolla City Police		**9-911**
Rolla Fire Department		**9-911**
Phelps County Hospital		**9-911**
Rolla Emergency Management Agency		**9-911**

State Agencies

Missouri Highway Patrol		**368-2345**	
Missouri State Emergency Mgt. Agency (24 hr.)		**(573) 751-2748**	**Rev.**
Missouri Dept. of Natural Resources (24 hr.)		**(573) 634-2436**	
Missouri Bureau of Enviromental Epidemiology	**(573) 751-6160**	(573) 751-4674 (24hrs)	

Federal Agencies

NRC, Lisle, IL, Region III			**1-800-522-3025**
NRC Duty Officer (24 hour)	**(301) 816-5100**	(301) 951-0550	(301) 415-0550

Other

American Nuclear Insurers		**(860) 561-3433**	
Radiation Emergency Assistance Center	**(423) 576-3131**	(865) 576-1005 (24hrs)	Rev

Revised 07/26/02

Revised By: William Bonzer *William E. Bonzer* Approved By: Akira Tokuhiro

UMR REACTOR EMERGENCY PHONE LIST

Reactor Staff	Cell	Pager	HOME	WORK	
Brian Porter, Sr. Electronics Tech.			368-3090	341-4291	
William Bonzer, Manager, SRO	578-9463		368-3727	341-4384	
Akira Tokuhiro, Director, SRO	578-0542		364-1961	341-4746	
Daniel Estel, RO			(573) 435-6820	341-4291	
Ray Bono, Radiation Safety Officer		428-6469	364-5728	341-4240,4305,4403	
Jim Jackson, SRO			(573) 699-4897	341-4258	Rev.
Maureen Henry, Sr. Sec.			364-7272	341-4236	

University Administrative Staff	Cell	Pager	HOME	WORK	
1. Director, UMR Police, William Bleckman			364-1294	341-4345	
2. Chancellor, Gary Thomas	308-8240		368-3552	341-4116	
3. Vice Chancellor for Admin.Services, Steve Malott			364-7927	341-4122	
4. Director, Physical Plant, Marvin Patton			364-6278	341-4252	
5. Director, Health Service - Infirmary, Dwight Deardeuff, MD			364-0809	341-4284	
6. Dean, School of Mines and Metallurgy, Lee W. Saperstein	578-0602		368-3782	341-4153	
7. Radiation Safety Officer, Ray Bono		428-6469	364-5728	341-4240,4305,4403	Rev.

Local		
UMR University Police	341-4300	Rev.
Rolla City Police	9-911	
Rolla Fire Department	9-911	
Phelps County Hospital	9-911	
Rolla Emergency Management Agency	9-911	

State Agencies		
Missouri Highway Patrol		(573) 368-2345
Missouri State Emergency Mgt. Agency (24 hr.)		(573) 751-2748
Missouri Dept. of Natural Resources (24 hr.)		(573) 634-2436
Missouri Bureau of Environmental Epidemiology	(573)751-6160	(573) 751-4674 (24hrs)

Federal Agencies		
NRC, Operations Center	(301) 816-5100	Rev.
NRC Duty Officer (24 hour)	(301) 816-5100	

Other		
American Nuclear Insurers		(860) 561-3433
Radiation Emergency Assistance Center	(423) 576-3131	(865) 576-1005 (24hrs)

Revised By: William Bonzer (signature)

Approved By: Akira Tokuhiro (signature)

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A. PURPOSE

To ensure the integrity and encapsulation of sealed sources and to guard against contamination of personnel.

B. PRECAUTIONS, PREREQUISITES, OR LIMITATIONS

1. This procedure is to be performed by Health Physics staff personnel.

2. The following sources located at the reactor facility are to be leak tested semi-annually: PuBe S/N M-1092 (Reactor Startup Source), PuBe S/N M-169 (RAM Calibration Source), Cs-137 S/N ~~5049~~ 74-150 (RAM Calibration Source). The Cs 137 source is located in the JL Shepherd Shield S/N 5409. WB 10/2/02 AT 10/14/02

3. Leak test requirements are listed in item 14 (A through F) of NRC Materials License number 24-00513-40.

C. PROCEDURE

1. The leak test should be performed with filter-paper discs or with cotton-tipped applicators depending upon the source activity, configuration, and containment.

2. The source, source holder, and immediately surrounding area should be rubbed firmly with the swipes held with tongs or forceps or with cotton-tipped applicators in order to remove any surface contamination that may be present. If access to the sealed source is prevented by the construction of the device, the swipes should be taken as near the source as possible.

3. Each swipe or applicator should be placed in a separate envelope appropriately labeled for identification.

4. Frisk the swipes with an open window G-M probe. If any detectable activity is observed above background, contact the Reactor Health Physicist for appropriate approvals before removing the swipe from the facility. If no detectable activity is identified, the swipes may be removed from the facility for counting at the Health Physics office.

Ray Bono

Revised By: Ray Bono

Albert Bolon

Approved By: Albert Bolon

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A. PURPOSE

To provide for the efficient calibration of the fixed Radiation Area Monitors and to minimize personnel exposure during the calibration.

B. PRECAUTIONS, PREREQUISITES, OR LIMITATIONS

1. The RAMs are to be calibrated annually. WB 10/2/02
2. The Cs-137 source (SN5409) shall be kept inside the shield. Only the plug will be removed from the shield when the detector is to be exposed to the Cs-137 source. Rev. AT 10/14/02
3. The person who handles the Cs-137 source must wear a minimum of a pocket dosimeter and a film badge.
4. The person who handles the neutron source shall wear a neutron dosimeter. Ring badges are optional but advisable.
5. The person who handles the source should minimize their exposure time in close proximity to the source.
6. The reactor must be shutdown and only authorized personnel allowed in the calibration area during the calibration to prevent accidental exposure while the sources are being handled. If a whole body dose > 100 mrem could be received, high radiation area control is required. Rev.
7. Notify the Reactor Manager prior to performing this procedure.

C. PROCEDURE - GAMMA RAM CALIBRATION

1. **Calculate Source to Detector Distances:** Calculate source to detector distances to provide target dose rates of 2 mrem/hr, 20 mrem/hr, and 200 mrem/hr. Use the inverse square law ($DR_1/DR_2 = d_2^2/d_1^2$) and the exponential decay law ($DR_1 = DR_0e^{-\lambda t}$). Rev. WB 10/2/02 AT 10/14/02

   The Cs-137 source (~~SN5049~~ SN24-156) was certified to read 114.4 mrem/hr at a distance of 1.64 ft (19.68 inches) on July 23, 1979. The half life of Cs-137 is 30.17 years.

Revised By: William Bonzer
William Bonzer

Approved By: David Freeman
[signature]

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Gamma RAM Calibration Form

A7 10/14/02 WB 10/14/02

SN 74-156
Source (~~SN 5049~~) Decay Time (since July, 1979): ____________________ (years)

Calculated Source to Detector Distance (inches)	Target Dose Rate (mrem/hr)	Measured Dose Rates		
		Reactor Bridge (mrem/hr)	Demin Level (mrem/hr)	Beam Room (mrem/hr)
	2 ± 0.4			
	20 ± 4			
	200 ± 40			

Rev.

Alarm setpoints reset verified ________________________ (Initials)

All readings are within ±20% of Target Dose Rates. ________________(Initials)

Calibration Performed By: __________________________ Date ___/___/___

Approved By: ___________________________________ Date ___/___/___
Reactor Manager

Approved By: ___________________________________ Date ___/___/___
Health Physicist

Revised By: William Bonzer
William Bonzer

Approved By: David Freeman
David Freeman

b. Fission Chamber Preamp — Initial — Date

(1) Cleaned chassis as needed ______ __________
(2) Additional Comments

c. Log Count Rate Channel Calibration
(Note: All readings should give 0.7 to 1.4 ratio of true-to-observed readings.)

Pulse Generator	Meter	Recorder	Initial	Date
10				
100				
1,000				
10,000				

d. High Voltage__________(350 VDC to 450 VDC) ______ __________

5. Reconnect all cables
Reconnection of cables verified ______ __________

4. Safety Amplifier System

a. •UIC 1 Signal __________MegOhms
•UIC 1 H.V. __________MegOhms
•UIC 2 Signal __________MegOhms
•UIC 2 H.V. __________MegOhms

Rev

b. Safety Amplifier 1 Current Tests

Applied Current Digital	Accepted Digital Display	Digital Display Reading	Accepted Bar Graph Display	Bar Graph Display
6.7nA	9-11%		7-13%	
13.2nA	19-21%		17-23%	
19.8nA	29-31%		27-33%	
26.4nA	39-41%		37-43%	
33.0nA	49-51%		47-53%	
39.6nA	59-61%		57-63%	
46.2nA	69-71%		67-73%	
52.8nA	79-81%		77-83%	
59.4nA	89-91%		87-93%	
66.0nA	99-101%		97-103%	
72.6nA	109-111%		107-113%	
79.2nA	119-121%		117-123%	
85.8nA	129-131%		127-133%	
92.4nA	139-141%		133-143%	
99.0nA	149-152%		147-153%	

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Safety Amplifier 1 Current Tests

Applied Current Digital	Accepted Digital Display	Digital Display Reading	Accepted Bar Graph Display	Bar Graph Display
6.7nA	9-11%		7-13%	
13.2nA	19-21%		17-23%	
19.8nA	29-31%		27-33%	
26.4nA	39-41%		37-43%	
33.0nA	49-51%		47-53%	
39.6nA	59-61%		57-63%	
46.2nA	69-71%		67-73%	
52.8nA	79-81%		77-83%	
59.4nA	89-91%		87-93%	
66.0nA	99-101%		97-103%	
72.6nA	109-111%		107-113%	
79.2nA	119-121%		117-123%	
85.8nA	129-131%		127-133%	
92.4nA	139-141%		133-143%	
99.0nA	149-152%		147-153%	

Rev

c. •H.V. 1 Output Voltage __________VDC
•Monitor H.V. 1/100 __________VDC
•H.V. 2 Output Voltage __________VDC
•Monitor H.V. 2/100 __________VDC

d. H.V. 1 Failure Test

•Trip Point Setting __________VDC
•150% Full Power Annunciator Light (y/n) __________
•Audible Alarm (y/n) __________
•Scram Occurred (y/n) __________
•Magnet Power Supply SCRAM Light Illuminated (y/n) __________
•Reset H.V. to 300VDC (y/n) __________

Revised By: William Bonzer Approved By: Akira Tokuhiro

William Bonzer

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e. H.V. 2 Failure Test

- Trip Point Setting ________VDC
- 150% Full Power Annunciator Light (y/n) ________
- Audible Alarm (y/n) ________
- Scram Occurred (y/n) ________
- Magnet Power Supply SCRAM Light Illuminated (y/n) ________
- Reset H.V. to 300VDC (y/n) ________

Rev

f.. NIM Bin Power Supply
Output Voltages

- +24VDC ________VDC
- -24VDC ________VDC
- +12VDC ________VDC
- -12VDC ________VDC
- +6VDC ________VDC
- -6VDC ________VDC

g. AC Power Off (y/n) ________

- 150% Full Power Annunciator (y/n) ________
- Audible Alarm (y/n) ________
- SCRAM Occurred (y/n) ________

Safety Amplifier System Tests Completed _____(Initials) _______(date)

5. PAT 60 Controller

	Initial	Date
a. PAT 60		
(1) Cleaned chassis as needed	_____	__________

b. Check dial settings and record the following	Setting	Initial	Date
(1) Approach	__________	_____	__________
(2) Proportional Bank	__________	_____	__________
(3) Rate Time	__________	_____	__________
(4) Reset	__________	_____	__________
(5) Gain (if applicable)	__________	_____	__________

Revised By: William Bonzer Approved By: Akira Tokuhiro

6. **Temperature Channel**
(Note: All readings should be ± 2°F.)

a. Verification of Temperature Readings Date________________

Temperature Range (take one reading from each temperature range)	Thermometer	Thermocouple #1	Initials	Thermometer	Thermocouple #2	Initials	Thermometer	Thermocouple #3	Initials
60°F-70°F									
70°F-80°F									
80°F-90°F									
90°F-125°F									
125°F-135°F									
135°F-145°F									

Rev

b. Temperature > 135□ Rod Withdrawal Prohibit Test

	Thermocouple #1	Thermocouple #3
>135°F Trip Temperature		
>135°F Annunciator		
Audible Alarm		
Rod Prohibit Withdrawal		
Initials		

7. **Regulated Power Supply** Initial Date
a. Cleaned chassis as needed _____ __________

b. Additional comments

8. **Conductivity Bridge**
a. Cleaned chassis as needed _____ __________

b. Additional comments

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9. **Rod Indicator Calibration**

Actual Height	Rod 1	Rod 2	Rod 3	Reg. Rod	Initial	Date
1"	______	______	______	______		
6"	______	______	______	______		
12"	______	______	______	______		
18"	______	______	______	______		
24"	______	______	______	______	______	______

10. **Fire Alarm Check** — Initial / Date
    a. Cleaned system containers as needed ____ ______
    b. Checked batteries ____ ______
    c. Checked pull stations ____ ______
    d. Checked heat detectors ____ ______
    e. Checked smoke detectors ____ ______
    f. All indicator lamps operate ____ ______

Rev

11. **Security System Check** — Initial / Date
    a. Door Sensors ____ ______
    b. Motion Detectors ____ ______
    c. Tamper Switch ____ ______
    d. Duress Alarm ____ ______
    e. Battery ____ ______
    f. High Radiation ____ ______
    g. Low Pool Water ____ ______
    h. Additional Comments:

12. **Public Address System**
    a. Cleaned chassis as needed ____ ______
    b. Additional Comments

13. **Hand and Foot Monitor**
    a. Cleaned chassis as needed ____ ______
    b. Perform Source Check ____ ______
    1. Additional Comments

14. **Portal Detector**
    a. Cleaned chassis as needed ____ ______
    b. Perform Source Check ____ ______
    c. Additional Comments

Revised By: William Bonzer Approved By: Akira Tokuhiro

15. **Constant Air Monitor**
    a. Cleaned chassis and recorder as needed _____ __________
    b. Perform Source Check _____ __________
    c. Additional Comments

16. **Rod Drop Test (SOP 813)** _____ __________

17. **Power Calibration (SOP 816)** _____ __________

18. **Thermal Column Open Alarms** - Verify that the control room audio and visual alarms, and the basement red flashing light comes on when the thermal column is opened by about 1 inch.

Verify that the alarms clear when the thermal column door is closed. _____ __________

Rev

19. **RAM Calibration** - RAM Calibration shall be performed annually. Record the latest date the RAM calibration was performed. _____ __________

I have reviewed the results of this Semi-Annual Check on this date and discussed any problems and/or errors with the operating staff.

____________________	______		____________________	______
Director	(Date)	or	Reactor Manager	(Date)

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A. **PURPOSE**

To ensure that the safety amplifier system is operational.

B. **PRECAUTIONS, PREREQUISITES AND LIMITATIONS**

1 In accordance with Technical Specification 4.2.2 all console instruments and safety system shall be calibrated twice each year, not to exceed 7-1/2 months.

2 After each item is completed, a second knowledgeable person will check connections (where connections have been broken and reconnected) to ensure that the equipment is connected and on line.

3 A licensed operator must be in the control room when using the magnet key.

4 Record values on semi-annual checklist SOP 800.

C. **PROCEDURE**

1 Disconnect the H.V. and signal cables from Safety Amplifiers 1 and 2.
2 Measure and record the cable resistance of each cable.
3 Discharge each cable with a DMM before reconnecting to the safety amplifiers.
4 Connect the pico-amp source to Safety Amplifier 1 signal input and apply currents as listed in the semi-annual checklist. Record the readings for the digital display and bar graph. If current readings do not meet listed tolerances adjust the safety amplifier as described per the technical manual. Repeat current tests until no further adjustments are necessary. Rev
5 Perform step 4 for Safety Amplifier 2.
6 Record the H.V. 1 output voltage and voltage read at MONITOR H.V. 1/100 and COM.
7 Record the H.V. 2 output voltage and voltage read at MONITOR H.V. 2/100 and COM.
8 Raise control rods to three inches. Lower H.V. 1 to the trip set point to activate the H.V. 1 FAILURE light.
9 Record the High Voltage output at which the trip occurs.

Revised by William Bonzer
William Bonzer

Approved by: Akira Tokuhiro

10 Verify and record that the 150% Full Power annunciator light is illuminated and the audible alarm is sounding.
11 Verify and record that the H.V. 1Failure light is illuminated.
12 Verify and record that a scram has occurred.
13 Verify and record that the Magnet Power Supply SCRAM light is illuminated.
14 Reset HV1 to 300 Volts.
15 Insert magnets.
16 Repeat steps 8 and 15 for H.V. 2.
17 Record each of the NIM Bin power supply voltages.
18 Raise the rods to three inches and turn off AC power to the Safety Amplifier's NIM Bin power supply.
19 Verify and record the 150% Full Power annunciator light is illuminated and that the audible alarm is sounding.
20 Verify and record that a scram has occurred.
21 Turn on AC power to the Safety Amplifier's NIM Bin.
22 Reset Safety Amplifiers 1 and 2.
23 Reconnect UIC cables to Safety Amplifiers.

William Bonzer

Revised by William Bonzer

Approved by: Akira Tokuhiro

3.2.A. Non-Operative Scram and Rundown Test

a. Withdraw rods to 3 inches.
b. Depress the "NON-OPERATE" switch.
c. Verify rods have dropped and control rod drives are inserting.
d. Release the "NON-OPERATE" switch.
e. Verify the "Log N Non-operate" and "Low CIC High Voltage" annunciators and audible alarms are activated.
f. Reset the Scram, Rundown, and Annunciator panel.
g. Depress and release the test switches listed below. For each verify that the "Log N Non-operate" and "Low CIC High Voltage" annunciators and audible alarms are activated. Reset the scram and annunciator panel after each switch is checked. The following switches are to be checked:
   - 1 mA switch,
   - 0.1μA switch,
   - 10 pA switch, and
   - 3 SEC switch.

3.3. 150% Full Power Scram control

a. Withdraw the rods to 3 inches.
b. Depress the scram test button on Safety Amplifier
c. Verify that a scram occurred before 150%.
d. Verify that the 150% annunciator light and audible alarm is activated.
e. Depress the reset button on Safety Amplifier 1
f. Reset the annunciator panel and insert magnets
g. Repeat steps a – f for Safety Amplifier 2.
h. Record results

WB 10/4/02
AT 10/14/02
Rev

3.4. Manual Scram

a. Withdraw rods to 3 inches.
b. Push Manual Scram button.
c. Acknowledge the annunciator, observe Manual Scram light and all magnet contact lights are off. Push Scram Reset, Annunciator Reset and insert the magnets.
d. Record results.

Revised By: William Bonzer
William Bonzer

Approved By: Akira Tokuhiro

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WEEKLY SURVEILLANCE CHECKLIST

Date Performed ____________

1. **Rod Prohibits**

1.1. Recorder Off

	Alarms (✓)	Prohibit (✓)
• Source Range recorder		
• Linear recorder		
• Log/Period recorder		
• Temperature recorder		

	Set Point	Alarms (✓)	Prohibit (✓)
1.2. Source Range <2 cps	______ cps		
1.3. Inlet Temperature >135°F	______ °F		
1.4. Shim Rods below shim range	N/A	N/A	

2. **Rundowns**

2.1. RAM System

Station	Rundown Set Point	Bldg. Alarm Set Point	Alarms (✓)	Remote and Local Alarm (✓)
Bridge	______ mrem/hr	______ mrem/hr		
Demin	______ mrem/hr	N/A		
Basement	______ mrem/hr	N/A		

	Rundown Set Point	Alarms (✓)
2.2. 120% Demand rundown	______ %	
2.3. 120% Full Power Rundown	______ %	
2.4. Low CIC Linear P.S. (≥440VDC)	______ VDC	
2.5. Regulating Rod on Insert Limit on Auto	N/A	

3. **Scrams**

	Alarms (✓)	Scram (✓)
3.1. Bridge Motion Scram		
3.2. Log and Linear Non-Op. Scram		
• Non-operate switch (raise rods 3")		
• 1 mA switch		
• 0.1 μA switch		
• 10 pA switch		
• 3 sec switch		
3.3. 150% Full Power Scram		
Safety Amplifier 1		
Safety Amplifier 2		
3.4. Manual Scram		

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Revised By: William Bonzer

Approved By: Akira Tokuhiro

21. **150% Power Scram Check:** – control
    a. Withdraw the rods to 3 inches.
    b. Depress the scram test button on the Safety Amplifier
    c. Verify that a scram occurs before 150%.
    d. Verify that the 150% annunciator light and the audible alarm is activated.
    e. Depress the reset button on the Safety Amplifier 1
    f. Reset the annunciator panel and insert magnets
    g. Repeat steps a – f for Safety Amplifier 2.
    h. Record results

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22. **Log and Linear Drawer Non-Operative Scram and Rundown Test:**
    a. Withdraw the shim rods to 3 inches.
    b. Depress the **NON-OPER** keypad switch. Check for the Non-Operate Scram and Low CIC Voltage Rundown visual and audible alarms.
    c. Verify that the rods have dropped and rod drives are running down.
    d. Try to stop the rundown by lifting the shim joy stick.
    e. Stop the rundown with the rundown reset button.
    f. Reset the scram, rundown, and annunciator panel.

23. **Period Trip Test:**
    a. Withdraw the shim rods to 3 inches.
    b. Depress and hold the **PERIOD TEST** keypad switch. Verify that the 30 Second Rod Withdrawal Prohibit annunciator is activated, with a simulated period greater than or equal to 30 seconds.
    c. Continue depressing the **PERIOD TEST** keypad switch. Verify that the 15 Second Rundown is activated with a simulated period greater than or equal to 15 seconds.
    d. Continue depressing the **PERIOD TEST** keypad switch. Verify that the 5 Second Scram is activated with a simulated period greater than 5 seconds by observing a loss of magnet current and the annunciators.
    e. Release the switch.
    f. Reset the scram, rundown, and annunciator panel.

24. **Manual Scram:**
    a. Raise shim rods to 3 inches.
    b. Push the manual scram button. Verify that the rods have dropped by visually observing the video display and noting that the blue magnet contact lights are off.
    c. Push the scram reset button and reset the annunciator panel.

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1. Date					
2. Initials of the Person Performing Checklist					
3. Time (Console Clock)					
4. Core Loading					
5. P.A., Intercom, Video Monitor On					
6. RAM System Check					
7. Radiation Level Normal					
8. Beam Port and Thermal Column Status (OPEN or SHUT)					
9. Linear Channel	Zero				
	Meter Reading				
	Scale				
10. Linear C.I.C. Voltages	HV (~540)				
	CV (~ 2 to 8)				
11. Recorders On, Dated, "RCD" Light On Temp. & CAM Recorders					
12. Core Check (Lights On)	Level Check				
	Inspect Core				
	Source Inserted				
13. Start-Up Channel Test					
14. Verify FC Response, FC Inserted, Count Rate > 2 CPS					
15. Log Count Rate HV Power Supply (+400 VDC)					
16. Log and Power Range Test					
17. Period Response Test					
18. Magnet Power On, Scram Reset, Board Reset					
19. Inlet Temperature (°F)					

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APPENDIX B.REVISED SAR CHANGED DURING THE 2002-2003 REPORTING YEAR

3.5.6 Safety Channels

Two redundant safety channels are a part of the reactor protection system. They provide the mechanism for scramming the reactor when power exceeds 150% of licensed full power. Each safety channel consists of an uncompensated ion chamber and a sensing circuit within the safety amplifier. A current to operate the magnets, which hold the shim/safety rods, is supplied from the magnet power supply. A sensing circuit in each safety amplifier is capable of actuating a shut off of magnet current.

An indicator lamp located on the front of each safety amplifier becomes energized if reactor power should reach a predetermined limit. The safety amplifier scram circuit activates a shutting off of magnet current. An additional safety amplifier relay activates the 150% full power annunciator light and audible alarm. Magnet current will remain shut off until reactor power is below the predetermined set point and the safety amplifier reset switch is depressed. Rev

The safety amplifier scram circuit will activate shut off of magnet current. The safety amplifier scram circuit consists of relay connections providing a current from the negative to positive input of the magnet power supply scram input. If a relay is actuated the magnet current will shut off. The safety amplifier scram circuit consist of relays from two safety amplifiers, two high voltage power supplies, a five second period trip, and the scram logic series containing bridge motion Log and Linear non-operative and manual scram circuitry described in section 3.5.8. In this way, the reactor will be scrammed not only if the power level increases beyond a predetermined limit, but also if the reactor power level is increasing too rapidly. A test switch is mounted on the front of each safety amplifier to provide testing of the scram circuitry. The scram circuits are of a fail-safe design.

Safety amplifiers are contained in separate NIMs (Nuclear Instrumentation Module). High voltage power supplies for the ion chambers are contained in a single NIM. In the case of failure of either high voltage power supply, the scram circuit is actuated. An indicator light will illuminate on the high voltage NIM upon failure of the high voltage power supply. The magnet power supply is contained in a NIM. A SCRAM indicator lamp will illuminate on the magnet power supply when the safety channel scram circuit is initiated. The four NIMs are located in a NIM Bin power supply, which provides power to each NIM. Rev

3.5.7 Alarms, Prohibits, Rundowns, and Scrams

There are a number of built-in engineered protective action levels derived from the UMRR instrumentation. According to the degree of their severity, some of them require only the

be scrammed are summarized in Table IX.

3.5.8 Scram Logic

The scram logic circuitry for the 5 second period scram and the 150% full power scrams contained in the power safety amplifier are discussed in Section 3.5.6. In this section the logic and operation of the circuit processing bridge motion, Linear non-operative, Log and Linear non-operative, and manual scram signals will be described.

The scram circuit for the bridge motion, Linear non-operative, Log and Linear non-operative and manual scrams consists of a set of open-on-failure relay contacts wired in series with a scram relay. Therefore, any of these scram signals or component failure will result in de-energizing the scram relay. This in turn opens the regulated power circuitry to the magnet current relay, thereby cutting the current in the safety magnets and subsequently releasing the shim/safety rods. The scram relay can only be reset after the condition causing a scram has been removed and the reset relay energized by manually pushing the reset button. Rev

The bridge motion scram is controlled by a micro-switch on the reactor bridge. As long as this switch is closed, a relay in the circuit is energized. A slight change in the position of the bridge, approximately 0.25 cm (0.1 in), will open the contact, de-energizing the motion relay which opens its contacts in the scram circuit.

As discussed in Sections 3.5.2 and 3.5.3, the status of the Linear drawer and the Log and Linear drawer are monitored by a Non-Operative circuits. If the ±15 VDC power supplies, CIC HV power supplies, or certain test switches are activated, the Non-Operative circuits de-energize a relay which breaks the scram circuit by de-energizing the scram relay thus causing a reactor scram. Additionally, the Non-Operative relays also initiate a reactor rundown.

When the manual scram button is pressed two contacts are mechanically opened: one of them causes the scram relay to de-energize and another one interrupts regulated power to the magnet power supply. Hence, the ac power circuit to the magnet power amplifier is opened in two different and independent ways.

In addition, the scram circuit also contains contacts of the relay which monitors the unregulated ac power. In the case when electrical power is lost the scram circuit opens and initiates a reactor scram.