UNIVERSITY OF MISSOURI-ROLLA

Nuclear Reactor Facility

Nuclear Reactor
Rolla, MO 65401-0249
Telephone (314) 341-4236

April 29, 1992

Document Control Room
Attention: Director
Office of Nuclear Reactor Regulations
U.S. Nuclear Regulatory Commission
Mail Stop 10-D-21
Washington, D.C. 20555

Dear Sir:

Please find enclosed the Annual Progress Report 1990-91 for the University of Missouri-Rolla Reactor Facility (License R-79). This report is being filed under the reporting requirements of our Technical Specifications. A copy of this report is also being sent to our Regional Administrator and Project Manager.

Sincerely,

David W. Freeman
Reactor Manager

DWF/lp

Enclosure

xc: Marvin Mendonca, Project Manager (NRC)
A. Burt Davis, Region III Administrator (NRC)
Dr. A. E. Bolon, Reactor Director (UMR)
Dr. Don L. Warner, Dean, School of Mines & Metallurgy (UMR)
Mr. Ray Bono, Director, Envir. Health/Risk Management (UMR)
Dr. Robert L. Davis, Dean, School of Engineering (UMR)
Mr. Bruce Ernst, American Nuclear Insurers
Dr. Nord Gale, Chairman, Radiation Safety Committee (UMR)
Dr. John Fulton, Dean, College of Arts and Science (UMR)
Dr. John Park, Chancellor (UMR)
American Nuclear Insurers, c/o Librarian

PROGRESS REPORT

1991-92

UNIVERSITY OF MISSOURI-ROLLA

NUCLEAR REACTOR FACILITY

PROGRESS REPORT

FOR THE

UNIVERSITY OF MISSOURI-ROLLA

NUCLEAR REACTOR FACILITY

APRIL 1, 1991 TO MARCH 31, 1992

Submitted to
The U.S. Nuclear Regulatory Commission
and
The University of Missouri-Rolla

Albert E. Bolon, Director
David W. Freeman, Manager
Nuclear Reactor Facility
University of Missouri-Rolla
Rolla, Missouri
65401

SUMMARY

During the 1991-92 reporting period the University of Missouri-Rolla Reactor (UMRR) was in use for 420 hours. Use hours are up 8.5% over last year. The major part of this time, about 71%, was used for class instruction 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 26 UMR courses over the year for a total of 3,799 student-hours. The reactor was visited by about 3,000 visitors during the past year. There were 600 participants in the U.S. Department of Energy Reactor Sharing Program.

The reactor produced about 6,376 kilowatt hours of energy using approximately 0.33 grams of uranium. A total of 171 samples were irradiated at the reactor with most of them being analyzed in the Reactor Counting Laboratory.

Two one-week training programs for reactor operator trainees of a Midwest utility were conducted during this reporting period. The reimbursement helped to defray facility costs.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 Introduction

This progress report covers activities at the University of Missouri-Rolla Reactor (UMRR) Facility for the period April 1, 1991 to March 31, 1992.

The reactor is operated as a university facility, available to the faculty and students of the various departments of the university for their educational and research programs. Several other universities, colleges, and high schools have made use of the facility during this reporting period. The facility is also made available for the purpose of training reactor personnel of nuclear electric utilities. Trace element analysis using neutron activation is also provided at the facility.

1.1 Background Information

The University of Missouri-Rolla Reactor (UMRR) Facility was constructed in 1960-1961 and attained 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 initial licensed power was 10 kW. The licensed power was upgraded to 200 kW in 1966.

The reactor is a pool-type reactor cooled by natural convection flow. The fuel is MTR plate-type fuel. The standard fuel element consists of ten curved plates fueled with high-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 with gamma and alpha spectroscopy capabilities. The gamma spectroscopy system includes a high purity germanium, germanium-lithium, and two sodium-iodide detectors, associated electronics, and state-of-the-art spectrum analysis software. The alpha spectroscopy system consists of a surface barrier detector and data acquisition equipment.

1.2 Facility Status

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

Major progress has been made in the LEU conversion process. NRC concerns regarding our proposed LEU Safety Analysis Report and Technical Specifications have been addressed. On March 5, 1991 NRC issued the order modifying our license to convert to LEU, effective the date of receipt of the LEU fuel.

We received "dummy" (unfueled) elements for testing in September, 1991. We extensively tested the dummies to assure dimensional compatibility with our control rods and drives, gridplate, and experimental facilities. We expect to receive the new core in the summer of 1992. We plan to load the initial LEU core carefully, in accordance with written procedures. A detailed core loading and start-up testing plan is being prepared

for the new fuel.

We received a second grant award from DOE to aid in purchasing new nuclear instrumentation (NI) for the UMRR console. The cost of the upgrade is being shared directly from reactor funds. We plan to replace our existing five channel NI system with a three channel system. Gamma-Metrics has been selected as the supplier of our new console equipment.

During the months of December, 1991 and January, 1992, the reactor facility was the subject of an internal review. A UMR Task Force was assigned to evaluate costs and benefits of continued operation of the reactor facility. The Task Force recommended "no further degradation in the status of the UMR Nuclear Reactor" and stated that "to maintain a strong Nuclear Engineering Program, UMR must continue to have an operating nuclear reactor".

The Reactor Facility was audited in April of 1991 by an independent audit team from the University of Missouri-Columbia research reactor. The audit team stated "We didn't have any significant areas of concern. The Facility appeared in good order." Several minor suggestions and comments were made by the audit team.

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 was implemented this year 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. A number of special seminars were presented by Mr. Freeman. As a result, several classes went to the Reactor Facility for laboratories demonstrating various nuclear concepts such as neutron activation and radioactive decay.

The following sections of this report are intended to provide a brief description of the various aspects of facility operations including the reactor's utilization for education and research.

2.0 Reactor Staff and Personnel

2.1 Reactor Staff

Name	Title
Albert E. Bolon	Director
David Freeman	Reactor Manager
Carl Barton	Senior Electronic Technician
Juls Williams	Lab Mechanic
Francis Jones	Reactor Maintenance Engineer
Linda Pierce	Senior Secretary
Matt McLaughlin	Student Operator

2.2 Licensed Operators

Name	License
Albert E. Bolon	Senior Operator
Carl Barton	Senior Operator
David Freeman	Senior Operator
Francis Jones	Senior Operator
Matt McLaughlin	Reactor Operator

2.3 Radiation Safety Committee

The Radiation Safety Committee is required to meet quarterly. The committee met on 6/12/91, 9/17/91, 12/16/91 and 3/23/92 during the reporting period. The committee members are listed below:

Name	Department
Dr. Nord L. Gale (chairman)	Life Sciences
Mr. Ray Bono (secretary, ex-officio, non-voting)	Environmental Health and Risk Management
Dr. Ernst Bolter	Geology and Geophysics
Dr. Oliver K. Manuel	Chemistry
Dr. Albert E. Bolon	Reactor Director
Dr. Nick Tsoulfanidis	Radiation Safety Officer
Dr. Edward Hale	Physics
Dr. Arvind Kumar	Nuclear Engineering
Mr. David Freeman (ex-officio, non-voting)	Nuclear Reactor

2.4 Health Physics

Health Physics support is provided through the Environmental Health and Risk Management Department and is organizationally independent of the Reactor Facility operations group. Health Physics personnel are listed below:

Name	Title
Dr. Nick Tsoulfanidis	Radiation Safety Officer
Mr. Ray Bono	Director, Environmental Health and Risk Management and Reactor Health Physicist
Mr. Mark Sautman[1]	Student Assistant (HP)
Mr. Charles Hooper	Student Assistant (HP)
Mr. Cary Lieurance	Student Assistant (HP)
Miss Lisa Stiles[2]	Student Assistant (HP)

---

1) terminated effective May, 1991

2) employed effective February, 1992

3.0 Improvements

A continuous effort is made to enhance safety, availability and reliability of the facility. In that effort the following improvements have been made at the facility during the reporting period:

1) Three new nuclear instrumentation drawers have been ordered from Gamma-Metrics. The three channel Gamma-Metrics system will replace our present five channel system. This is possible due to advanced technology that will allow a fission chamber based "wide range" channel to both serve as a start-up channel and an Intermediate Log N and period channel. The other channel reduction is possible because advanced technology allows a linear high power scram trip to be set on each of the three channel drawers, thus the two existing Uncompensated Ion Chamber Safety Channels will not be needed.

   We have purchased a Wide Range Logarithmic Drawer (fission chamber based), Wide Range Linear Drawer (CIC based), and a Log/Linear Drawer (CIC based).

   Table 3-1 presents characteristics of our existing NI system. Table 3-2 lists the characteristics of our new proposed NI system. It should be noted that some details of the new proposed system may be revised in response to internal review comments. No equipment

will be installed until proper reviews and approvals have been obtained.

2) A campus outreach program has been in progress over the past year. The program is designed to make UMR faculty and researchers outside of the Nuclear Engineering Department aware of reactor capabilities applicable to their specific disciplines. The program has been very successful and has resulted in significant increased reactor usage.

Table 3-1. Existing Nuclear Instrumentation System Characteristics

CHANNEL	TYPE OF DETECTOR	MONITORED PARAMETERS	RANGE	OUTPUT DISPLAYS	TRIP FUNCTION (SET POINT)
A. Startup	Fission Chamber	Log CR	1 to 10E4 CPS (Moveable to Cover Full Power Range)	1. Meter 2. Recorder	RWP (Recorder off) RWP (CR<2CPS)
B. Intermediate Log NP	CIC	1. Log N	0.2 W to 300 kW	1. Meter 2. Recorder	RWP (Recorder Off) Rundown (P>120%) Rundown (Low (80%) Detector HV) Scram (Not Operate Mode)
		2. Period	-30 to +3 Sec	1. Meter 2. Recorder	RWP (Recorder Off) RWP (Period <30 Sec) Rundown (Period <15 Sec) Scram (Period <5 Sec)
C. Linear	CIC	Linear Power	0 to 150% Scale w/Selectable Scales Over 0.2W to 300kW	1. Meter 2. Recorder	RWP (Recorder Off) Rundown (P>120% Scale) Rundown (Low (80%) Detector HV)
D. Safety #1	UIC	Power Range	0 to 150%	Meter	Scram (P>150%)
E. Safety #2	UIC	Power Range	0 to 150%	Meter	Scram (P>150%)

RWP = Rod Withdrawal Prohibit
CIC = Compensated Ion Chamber
UIC = Uncompensated Ion Chamber
CR = Count Rate
CPS = Counts Per Second
HV = High Voltage
P = Power

Table 3-2. Proposed Nuclear Instrumentation System Characteristics

CHANNEL	TYPE OF DETECTOR	MONITORED PARAMETERS	RANGE	OUTPUT DISPLAYS	TRIP FUNCTION (SET POINT)
A. Wide Range Log NP	Fission Chamber	1. Log CR 2. Log N	0.1 to 10^5cps 10E-8% to 200% Full Power	Meter 1. Meter 2. Recorder	RWP (CR<2cps) RWP (Recorder Off) Rundown (P>120%) Scram (Not Operate Mode)
		3. Power Range	0 to 125%	Meter	Rundown (Power >120%) Scram (Power >125)%
		4. Period	-30 to +3 Sec	1. Meter 2. Recorder	RWP (Recorder Off) RWP (Period <30 Sec) Rundown (Period <15 Sec) Scram (Period <5 Sec)
B. Wide Range Linear	CIC	Linear Power	0 to 125% Scale w/Selectable Scales over 0.01 W to 250 kW	1. Meter 2. Recorder	RWP (Recorder Off) Rundown (P>120% Scale) Scram (P>120% Full Power) Scram (Not Operate Mode) Rundown (Low CIC HV)
C. Log and Linear	CIC	1. Log N	1E-6 to 110%	Meter	Scram (Not Operate Mode) Rundown (Low CIC HV)
		2. Linear (Power Range)	0 to 125% Power	Meter	Scram (Power >125%)
		3. Period	-30 to +3 sec	Meter	Scram (Period <5 Sec)

RWP = Rod Withdrawal Prohibit
CR = Count Rate
HV = High Voltage

CIC = Compensated Ion Chamber
CPS = Counts Per Second

4.0 Reactor Operations

Core designation 74W 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 4-1 presents pertinent core data and Figure 4-1 shows the core configuration of core 74W. The excess reactivity, shutdown margin, and rod worths were measured in cold clean conditions.

Tables 4-2 and 4-3 present a listing of unscheduled shutdowns along with their causes and corrective actions.

Maintenance activities are listed in Table 4-4.

Table 4-5 shows facility use other than the reactor and Table 4-6 shows reactor utilization. Table 4-7 presents core loadings and unloadings over the past year.

Table 4-1. Core 74W Technical Data

Rod Worths:

Rod 1:	2.40%	$\Delta k/k$	(3/23/92)
Rod 2:	2.40%	$\Delta k/k$	(3/23/92)
Rod 3:	3.38%	$\Delta k/k$	(3/23/92)
Reg Rod:	0.35%	$\Delta k/k$	(3/23/92)

Excess Reactivity: 0.37% $\Delta k/k$

Shutdown Margin*: 4.43% $\Delta k/k$

---

*) Rod 3 and Reg Rod are assumed to be fully withdrawn.

Figure 4-1. UMRR Core Configuration and Rack Storage Form

DATE 23 March, 1992 LOADING NUMBER 74W

R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
										IP			F-22	

RACK STORAGE FACILITY

R16	R17	R18	R19	R20	R21	R22	R23	R24	R25	R26	R27	R28	R29	R30
							F-2	F-15	HR-1	F-19	F-16	F-3	F-18	F-21

	1	2	3	4	5	6	7	8	9
A									
B					S				
C			F-12	F-14	F-1	C-4			
D			F-8	C-1	F-5	F-9	F-13	F-20	
E			F-6	C-2	F-11	C-3	F-17	HF-1	
F			BRT	F-10	F-4	F-7	CRT		

BRIDGE SIDE UMRR CORE STATUS

KEY TO PREFIXES

F - Standard Elements
C - Control Elements
HF - Half Front Element
HR - Half Rear Element
S - Source Holder

Other BRT - Bare Rabbit Tube
CRT - Cadmium Rabbit Tube

Table 4-2. SCRAMS

Date	Cause
07/03/91	< 5 second Reactor Period Scram Cause: Received Scram during adjustment of Log N CIC detector. Reactor was at steady state power. Transient was indicated from detector movement - not from actual transient. Corrective Action: Cautioned staff involved in adjustments to move detector very slowly.
11/22/91	<5 second Period Scram Cause: Passed by Log N CIC too closely with a fuel element while loading the core. Core loading was subcritical. Corrective Action: Cautioned SRO handling fuel.
02/13/92	Lost power indication on Log N channel during reactor operations. Cause: Modulator board failed. Corrective Action: Failure was immediately identified. Reactor shut down immediately by operator via normal reactor shutdown. Repaired modulator board and realigned unit.
03/16/92	< 5 second Reactor Period Scram Cause: Movement of void tube during experiment. Void Tube moved too close to Log N detector causing an indicated (not actual) period transient. Reactor was subcritical. Corrective Action: Cautioned personnel on proper movement of void tube.
03/23/92	150% full power and < 5 second period Scram Cause: Spurious signal from safety amp. Rods were being inserted at the time of Scram and reactor was subcritical. Corrective Action: Checked connectors and safety amp.

Table 4-3. RUNDOWNS

Note: Most of the rundowns listed below were due to switching problems in the Linear instrument while manually changing scales. A new Linear instrument has been purchased from Gamma-Metrics that, when installed,will eliminate the spurious rundown trips.

Date	Cause
04/16/91	120% demand Cause: Button on Linear picoameter popped out. Corrective Action: Rundown terminated by Senior Operator on duty. Student Operator given additional instruction.
05/06/91	120% demand Cause: Student operator changed Linear picoameter down scale rather than upscale. Corrective Action: Rundown terminated by Seni[illegible] Operator on duty. Student operator cautioned [illegible]out operation of picoameter.
08/07/91	120% demand Cause: Auto controller withdrew reg rod instead of inserting and did not reverse. Reactor rundown occurred at 24 watts. Corrective Action: Rundown was terminated by Senior Operator and Reactor returned to power. Checked for insert action upon returning to auto position.
08/12/91	120% demand Cause: Operator did not change scales on Linear picoameter before increasing power. Corrective Action: Senior Operator terminated rundown. Operator cautioned.
09/11/91	120% demand Cause: Linear picoameter noise spike as range button was pressed. Corrective Action: Rundown terminated by Senior Operator on duty. Operator trainee cautioned.
09/11/91	120% demand Cause: Button on Linear pico[illegible]eter popped out after changing scales. Corrective Action: Senior Operator terminated rundown and cautioned operator trainee.

Table 4-3. RUNDOWNS (cont.)

Date	Cause
09/25/91	120% demand Cause: Button on Linear picoameter popped out. Corrective Action: Rundown terminated by SRO and operator cautioned.
10/07/91	120% demand Cause: Student operator pressed wrong button on Linear picoameter. Corrective Action: Rundown terminated by Senior Operator on duty. Student operator instructed on changing scales.
11/07/91	< 15 Second Period Cause: Moving void tube for experiment. Tube moved too close to Log N detector and caused indicated (not actual) period transient. Reactor was subcritical at the time. Corrective Action: Rundown terminated by Senior Operator on duty. Cautioned student moving void tube on proper movement of void tube.
11/25/91	120% demand Cause: Switch popped out on Linear picoameter while switching scales. Corrective Action: Rundown terminated by Senior Operator on duty. Cautioned Student Operator.
02/13/92	120% demand Cause: Switch on Linear picoameter not operating correctly. Corrective Action: Senior Operator terminated rundown.
03/16/92	120% demand Cause: Student operator did not switch scales on Linear picoameter. Corrective Action: Rundown terminated by Senior Operator and further instructions given to Student Operator.

Table 4-4. MAINTENANCE

Date	Cause
04/01/91	Problem: Need to measure dimension of control rod. Cause: None Corrective Action: Removed shroud and Control Rod No 1. Reassembled Control Rod No. 1, replaced shroud and performed Rod Drop tests on Rod No. 1.
06/04/91	Problem: Annual Control Rod inspection. Cause: Routine maintenance. Corrective Action: Control Rod Inspection completed and reassembled. Rod Drop Time test completed.
06/07/91	Problem: Routine Semi-Annuals. Cause: Routine maintenance. Corrective Action: Completed Semi-Annuals on 6/14/91.
06/24/91	Problem: Magnet currents not normal. Cause: Magnet tubes in Safety Amplifier bad. Corrective Action: Replaced V_3, V_4, V_5 and R-50 in Safety Amplifier.
06/27/91	Problem: 150% full power test not operating. Cause: Safety Amplifier power supply voltage low. Corrective Action: Replaced V-9, V-10, V-11 and V-12 in Safety Amplifier.
07/01/92	Problem: Magnet No. 1 not picking up Rod No. 1. Cause: Magnet current low. Corrective Action: Replaced V_3, V_4, and V_5 in Safety Amplifier.
08/12/91	Problem: Rod drive motor for Shim Rod No. 3 would not insert during normal shutdown. Cause: No voltage to rod drive motor. Failure of relay. Corrective Action: Reactor was shut down by normal rod insertion of Rods 1 and 2. Rod 3 was then inserted by dropping magnet current. Replaced relay K-13.
08/13/91	Problem: Fission chamber response not adequate. Cause: Fission chamber drive cable broken. Corrective Action: Reclamped drive cable to fission chamber extension tube.
08/30/91	Problem: Log Count Rate recorder not operating. Cause: Recorder not getting power. Switch bad. Corrective Action: Replaced power switch.

Table 4-4. MAINTENANCE (cont.)

Date	Cause
08/30/91	Problem: Testing dummy control rod element. Cause: Routine. Disassembled and removed rods for testing. Corrective Action: Rods reassembled, Rod Drop Time test completed and core reloaded.
09/30/91	Problem: Start-Up Channel not operating properly. Cause: No signal to Start-Up Channel equipment. Corrective Action: Replaced BNC connector on high voltage cable.
10/13/91	Problem: Temperature Recorder going full scale. Cause: Contact on switch broken. Corrective Action: Repaired switch.
10/2[illegible]/91	Problem: Testing dummy control element. Cause: Routine. Disassembled and removed each Control and Reg Rod for testing. Corrective Action: Reassembled rods and performed Rod Drop Time tests.
12/02/91	Problem: Linear Recorder indicating wrong power while Reactor was subcritical. Cause: Recorder inoperative due to bad capacitor. Corrective Action: Replaced capacitor unit.
01/06/92	Problem: Semi-Annual started. Cause: Routine. Corrective Action: Completed Semi-Annuals on 1/14/92.
01/15/92	Problem: Inspection and measurement of Control Rods 1, 2, and 3. Cause: Routine. Corrective Action: Completed measurements and reassembled units and completed Rod Drop Time test.
01/27/92	Problem: Magnet current not normal o Magnet No. 1. Cause: Magnet No. 1 bad. Corrective Action: Repaired and replaced Magnet No. 1 and performed Rod Drop Time test.
01/31/92	Problem: Start-Up Channel noisy. Cause: Preamplifier bad. Corrective Action: Repaired Pre-amplifier and reinstalled it.

Table 4. MAINTENANCE (cont.)

Date	Cause
02/14/92	Problem: Difficulty in aligning Log N amplifier. Cause: L_1 on modulator board defective. Corrective Action: Replaced L_1 on modulator board.
02/21/92	Problem: Start-Up Channel not operating correctly. Cause: Low high voltage. Corrective Action: Reset high voltage to proper value.
03/25/92	Problem: Start-Up Channel not operating properly. Cause: Pre-amplifier noisy. Corrective Action: Changed Pre-amplifiers.

Table 4-5. Facility Use Other Than The Reactor

Facility	Hours
Bare Rabbit Tube	9
Beam Port	5.4
Total	14.4

Table 4-6. Reactor Utilization

1.	Reactor use	419 hr
	a. Research and irradiation runs	10.4 hr
	b. Instruction runs	231 hr
	c. Maintenance runs	35.5 hr
	d. Training	67.6 hr
2.	Time at power	197 hr
3.	Energy generated	6376 kw-hr
4.	Total number of samples	171
5.	Sample hours	21.5 hr
6.	U-235 burned	0.28 g
7.	U-235 burned and converted	0.33 g

Table 4-7. Core Loading and Unloading

Date	Action
06/04/91	Unload (67W to Subcrit) Annual Control Rod Inspection
06/06/91	Reload (Subcrit to 67W) Return to previous configuration
06/28/91	Unload different elements to fuel storage area for dose rate measurements
07/08/91	Unload different elements to fuel storage area for dose rate measurements
09/16/91	Unload (67W to Subcrit) Core for LEU dummy trial
09/17/91	Test fit of LEU dummy element
09/18/91	Reload to previous configuration
11/19/91	Unload (67W to subcrit) Core for LEU dummy trial
11/20/91	Test fit of dummy element
11/22/91	Reload to previous configuration
01/15/92	Unload (67W to subcrit) Core for Babcock and Wilcox measurement of control rods
01/17/92	Movement for Rod Drop test in dummy control element
01/21/92	Reload to previous configuration
03/12/92	Change core 67W to 73W
03/20/92	Unload 73W to subcrit
03/20/92	Load subcrit to core 74W

5.0 Public Relations

The reactor staff continues to educate the public about applications of nuclear science. Over 3,000 persons toured 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 5-1 lists some of the major occasions or groups and number of visitors for each event.

Table 5-1. Public Relations Program		
DATE	PARTICIPANTS	NUMBER
04/12/91	Rolla Middle School	57
04/23/91	Rolla High School Science Club	4
01/27/91	UMR Spring Open House	212
05/10/91	Salem 5 & 6 Grade	75
06/10/91	Jackling Institute, UMR	44
06/10/91	Fundamentals of Engineering, UMR	18
06/11/91	Fundamentals of Engineering, UMR	12
06/12/91	Fundamentals of Engineering, UMR	17
06/13/91	Fundamentals of Engineering, UMR	27
06/17/91	Jackling Institute, UMR	41
06/24/91	Jackling Institute, UMR	44
07/29/91	Minority Engineering, UMR	39
08/05-23/91	Jackling 2, UMR	3
08/05/91	Fundamentals of Engineering, UMR	17
08/06/91	Fundamentals of Engineering, UMR	30
	Fundamentals of Engineering, UMR	19

Table 5-1. Public Relations Program		
DATE	PARTICIPANTS	NUMBER
08/08/91	Fundamentals of Engineering, UMR	17
08/12/91	Fundamentals of Engineering, UMR	20
08/13/91	Fundamentals of Engineering, UMR	17
08/14/91	Fundamentals of Engineering, UMR	10
08/15/91	Fundamentals of Engineering, UMR	23
10/17/91	TJ 4 South, UMR	16
10/18/91	Rolla Review, Prospective Students, UMR	9
10/18/91	UM-Rolla Day	348
10/30/91	TJ 7 South, UMR	7
11/02/91	UMR Parents Day	123
11/04/91	Cub Scouts	5
11/25/91	TJ 4 North, UMR	11
12/06/91	TJ South, UMR	7
12/16/91	Nuclear Reactor Task Force, UMR	7
02/11/92	TEAMS Testing (Basic Engineering) UMR	33
02/25/92	St. Louis County 8th Grade	62
02/28/92	Rolla Emergency Services Training	7
03/10/92	Rolla Fire Department	6
03/11/92	Rolla Fire Department	5
03/12/92	Rolla Fire Department	5
03/17/92	Rolla Middle School	55
03/24/92	Freshman Engineering, UMR	18
03/25/92	Freshman Engineering, UMR	19
03/26/92	Freshman Engineering, UMR	4

6.0 Education Utilization

The reactor facility supported 26 UMR courses over the past year for a total of 3,799 student-hours. The reactor facility provided financial support for six students with hourly wages and one PhD candidate with a partial GRA. Additionally, students from several universities, colleges and high schools have used the facility.

Table 6-1 lists UMR classes taught at the facility along with associated reactor usage for this reporting period.

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. About 600 students and their instructors participated in this program. Table 6-2 lists those schools and groups that were involved in this year's Reactor Sharing program.

Table 6-1. UMR Classes at Reactor Facility 1991-92 Reporting Period				
DATE	CLASS NUMBER/TITLE	# OF STUDENTS	TIME AT REACTOR (hrs)	STUDENT HOURS
Fall 91 Winter 92	NE 300, Nuclear Special Problems	2	60	120
Fall 91	NE 304, Reactor Laboratory I	14	53	742
Fall 91 Winter 92	NE 306, Reactor Operations	14	153	2142
Winter 92	NE 308, Reactor Laboratory II	9	25	225
Winter 92	NE 404, UMC, Nuclear Laboratory (twice)	28	8	112
04/09/91	NE 204, Nuclear Radiation Measurement	8	1	8
04/11/91	NE 204, Nuclear Radiation Measurement	7	1	7
04/16/91	NE 204, Nuclear Radiation Measurement	9	1	9
04/18/91	NE 204, Nuclear Radiation Measurement	14	1	14
04/22/91	NE 204, Nuclear Radiation Measurement	8	1	8
04/25/91	NE 204, Nuclear Radiation Measurement	7	1	7
09/25/91	NE 205, Fundamentals of Nuclear Engineering	15	1	15
10/02/91	NE 105, Introduction to Nuclear Engineering	17	1	17
11/25/91	NE 205, Fundamentals of Nuclear Engineering	13	1	13
03/17/92	NE 204, Nuclear Radiation Measurement	7	2	14
04/09/91	Life Science 251, Ecology	17	1	17

Table 6 1. UMR Classes at Reactor Facility
1991-92 Reporting Period

DATE	CLASS NUMBER/TITLE	# OF STUDENTS	TIME AT REACTOR (hrs)	STUDENT HOURS
04/12/91	Eng. Mgmt. 334, Robotics	33	1	33
05/01/91	ME 229, Energy Conversion	13	1	13
05/03/91	Physics 107, Introduction to Physics	70	1	70
05/03/91	ME 229, Energy Conversion	11	1	11
10/01/91	Physics 107, Introduction to Physics	9	1	9
12/13/91	Physics 107, Introduction to Physics	101	1	101
01/23/92	Life Science 301, Biological Effects of Radiation	16	1	16
01/28/92	Life Science 301, Biological Effects of Radiation	17	3	51
03/04/92	ME 229, Energy Conversion	25	1	25
	TOTAL	484	378	3799

Table 6-2. Reactor Sharing Program		
DATE	PARTICIPANTS	NUMBER
04/16/91	East Central College, Leroy Alt/Vera Luedde, Instructors	29
04/17/91	Potosi Gifted 8th Grade, Alan Ziegler, Instructor	12
04/22/91	John F. Hodge High School, Jim Jenkins, Instructor	19
04/02/91	Vienna High School, Ms. Fritchey, Instructor	16
04/24/91	Park College of Nursing, Christiane Dornhoefer, Instructor	14
04/25/91	Park College of Nursing, Christiane Dornhoefer, Instructor	13
05/02/91	Northwest High School, Paul Oldeg, Instructor	25
05/08/91	Vo-Tech Radiography, Rita Montgomery, Instructor	9
05/15/91	Sullivan High School, Marcene Abel, Instructor	11
05/22/91	Rolla High School, Gayle Lucien, Instructor	43
07/09-11/91	University of Arkansas, Dr. Leon West, Instructor	7
07/30/91	Eldon High School Science Club, Connie Wyrick, Instructor	11
10/17/91	Rolla High School, Gayle Lucien, Instructor	10
11/01/01	Park College of Nursing, Christiane Dornhoefer, Instructor	22
11/08/91	Rolla Vo-Tech School, Jeff Dalton, Instructor	13
11/13/91	Roxana High School, Gerald Uhe, Instructor	50
11/13/91	West Plains High School, Jack Dillard, Instructor	14
12/09/91	St. Dominic High School, Dorothea Bean, Instructor	26
12/10/91	Linn Technical College, Jack Light, Instructor	31
12/11/91	Benton County High School (Cole Camp), Todd Rusk, Instructor	26

Table 6-2. Reactor Sharing Program

DATE	PARTICIPANTS	NUMBER
01/24/92	Licking High School, Jonnie Kirkland, Instructor	9
02/06/92	Licking High School, Jonnie Kirkland, Instructor	9
02/10/92	Poplar Bluff High School, Bill Reeves, Instructor	17
02/17/92	UMC NE 404, Robert Thompson, Instructor	14
02/27/92	Cabool High School, Gary Maggard, Instructor	28
02/28/92	Westminster Christian Academy, Andrew Shaw, Instructor	18
03/03/92	Newburg Science Club, Peggy Brown, Instructor	16
03/09/92	St. Louis Community College, Delwin Johnson, Instructor	4
03/16/92	UMC NE 404, Robert Thompson, Instructor	14
03/19/92	Van Buren High School, Daniel Freeman, Instructor	31
03/20/92	John F. Hodge High School, Jim Jenkins, Instructor	7
03/24/92	Hazelwood West High School, Gail Haynes, Instructor	22
03/25/92	Viburnum High School, Judy McGee, Instructor	10
	TOTAL	600

7.0 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.

A. Routine Surveys

Monthly radiation exposure surveys of the facility consist of direct gamma and neutron measurements with the reactor at power. 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.

B. By-Product Material Release Surveys

There were no shipments of by-product material released off-campus from the reactor facility during this reporting period.

C. Routine Monitoring

Twenty-four reactor facility personnel and students involved with operations in the reactor facility are currently assigned film badges. Five are read twice per month and twenty-nine are read once per month. There are four area beta-gamma/neutron badges assigned. Eighteen campus personnel and students are assigned beta-gamma film badges, and frequently TLD ring badges for materials and X-ray work on campus. There are 22 monitor and spare badges assigned on campus. In addition, 4-7 direct-reading dosimeters are used for visitors and high radiation area work. There have been no significant personnel exposures during this reporting period.

Visitors are monitored with direct reading dosimeters. No visitor received in excess of an indicated 8 millirem.

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

Pool water activity is monitored monthly to ensure that no gross pool contamination nor fuel cladding rupture has occurred. Gross counts and spectra of long-lived gamma activity are compared to previous monthly counts. From April 1991 through March 1992 sample concentrations averaged 5.58×10^{-6} μCi/ml.

D. Waste Disposal

Release of gaseous and particulate 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 138.72 millicuries were released into the air. The released isotope was identified as Ar-41.

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. Radioactive waste released to the sanitary sewer is primarily from regeneration of the ion-exchange column. During this period four releases associated with resin regeneration were discharged to the sanitary sewer totaling approximately 10,598 gallons of water with a total gross activity of less than 257 microcuries.

E. Instrument Calibrations

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

8.0 Pl. ns

The reactor staff will be heavily involved in four major projects during the next reporting period; 1) preparing for receipt of the LEU fuel, 2) procuring, testing and bringing on-line the new reactor nuclear instrumentation, 3) preparing to ship HEU fuel offsite, and 4) managing staff turnover.

A. LEU Fuel Conversion

On March 5, 1991 we received the NRC order to modify our license to convert from HEU to LEU effective upon the date of receipt of the LEU fuel. We received "dummy" elements this past year for fit tests and will receive the LEU fuel sometime this summer.

The dummy elements have been received and were rigorously tested to assure dimensional compatibility with our gridplate, control rods, and experimental facilities.

A detailed start-up testing plan is being prepared to cover fuel receiving, inspection, loading and testing of the new LEU core.

B. Reactor Instrumentation Upgrade

We have recently contracted with Gamma-Metrics to provide three new NI channels which will replace our existing five channel system.

As instruments are procured, extensive review documentation

will be established and appropriate approvals will be obtained. NRC will be notified of our intended changes in a timely fashion.

Detailed testing will be performed and extensive operational data will be collected prior to actually replacing the equipment.

C. **Shipment of HEU Fuel Offsite**

Efforts will continue during the next reporting period to prepare for offsite shipment of our HEU fuel. We hope to maintain the HEU fuel for a period of about one year after discharge to allow for radioactive decay. Studies have been completed to help project the dose rates that will be associated with each element.

Additionally, we plan to submit a revised Security Plan for NRC review and approval to relax our current security requirements associated with the HEU fuel.

D. **Staff Turnover**

As of September 1, 1992, two staff personnel will retire and a third position will be eliminated. Carl Barton (Senior Electronics Technician and SRO) and Juls Williams (Reactor Lab Mechanic) plan to retire on September 1, 1992. Both employees are planning on working at the facility on a part-time basis (about 1/3 time each) over the next few years. The third technical position, the Reactor Maintenance Engineer (3/4 time) will be eliminated. Because the Reactor Maintenance Engineer is referred to in Chapter 6 of the Technical Specifications, we plan

to either apply for a Technical Specification change or to classify one of the new hires as "Reactor Facility Maintenance Engineer".

Presently, we plan to hire a replacement for the Senior Electronics Technician in September, 1992 and a replacement for the Reactor Lab Mechanic in September, 1993. Both new hires will be trained for SROs. Efforts are underway to begin training of additional personnel to serve as licensed operators. Both faculty and students are being considered as operator candidates.

The above staffing changes will not impair the facility's ability to operate safely and within compliance of procedures and regulations.

Rev.

and Health Physicist notified.

7. If an abnormal radiation level is detected in a restricted area. The Reactor Manager and the Health Physicist are to be immediately notified. The appropriate action, as determined by Health Physics shall be taken.

Written By: David Freeman

Approved By: Albert Bolon

Ray Bono

A. PURPOSE

To ensure the proper operation of the control and safety-related instruments of the reactor and to functionally test the Physical Security Alarm System.

B. PRECAUTIONS, PREREQUISITES, OR LIMITATIONS

1. The Weekly Check should be completed on the first working day of each week the reactor is to be operated. Rev.

2. The security system and pool conductivity must be checked weekly. The remaining portion of the checklist may be omitted if the reactor will not be operated that week.

3. The weekly check should be performed by a licensed operator, or a student under the direct supervision of a licensed operator

4. Complete the Weekly Surveillance Checklist form (Form SOP 810), and forward it to the Reactor Manager (or Director) for review and signature. Any abnormalities, problems, or out of service equipment should be brought to the attention of the Reactor Manager (or Director).

C. PROCEDURE

Select the Reactor Bridge Station on the Building Intercom, check the PA system, install the neutron source, turn on all 5 primary recorders (date the recorders), turn on core camera and select core on the monitor selector. Obtain Magnet Power Key and turn on magnet power.

1. ROD WITHDRAW PROHIBIT (yellow lights):

   A. Recorders off ... the rods will not withdraw if any one of 5 primary recorders is turned off.

      1. Turn off LCR recorder.
      2. Attempt to withdraw rods.
      3. Turn on LCR recorder, reset alarm.
      4. Turn off linear level recorder.
      5. Attempt to withdraw rods.

Written By: Carl Barton Approved By: Albert Bolon

6. Turn on linear level recorder, reset alarm.
7. Turn off period recorder.
8. Attempt to withdraw rods.
9. Turn on period recorder, reset alarm.
10. Turn off log N recorder.
11. Attempt to withdraw rods.
12. Turn on Log N recorder, reset alarm
13. Turn off temperature recorder.
14. Attempt to withdraw rods.
15. Turn on temperature recorder, reset alarm.

B. Log Count Rate < 2 CPS.

1. Remove source from holder and/or withdraw fission chamber until LCR reads <2 CPS. Record value at which alarm occurs from recorder.
2. Attempt to withdraw rods.
3. Insert source and/or insert the fission chamber to the insert limit. Reset annunciator.

C. Period < 30 Seconds

1. Depress "Test Trip" switch on Log N & Period Amplifier and adjust for a period < 30 seconds. Record value at which alarm occurs on the recorder.
2. Attempt to withdraw rods.
3. Release test switch, reset alarm.

D. Inlet Temperature Above 135 Degrees

1. With recorder on, remove back cover and manually rotate potentiometer arm until alarm occurs, record trip point.
2. Acknowledge alarm and attempt to withdraw rods.
3. Reset alarm on temp. recorder, reset alarm on console.

E. Shim Rods Below Shim Range

Written By: Carl Barton   Approved By: Albert Bolon

1. With all Shim/Safety rods below shim range attempt to withdraw the regulating rod. Note that the regulating rod will withdraw just far enough to clear the insert limit light. Attempt to withdraw the Shim/Safety rods. Note that further withdrawal cannot be made. Insert all control rods to the insert limit and record these results.

2. RUNDOWN CHECK (blue lights):

A. Radiation Area Monitoring (RAM) System

1. Withdraw rods to 3 inches.
2. Announce "The Building Alarm will sound. This is a test do not evacuate the building." on the Building PA System.
3. Using RAM check source switch #1. Note the value at which alarm(s) occurs. Check the automatic reset of the RAM, reset the Building Alarm, (Scram Reset Button), acknowledge annunciator Rundown Reset and Annunciator Reset. Record value of alarms.
4. Repeat step 3 for RAMs #2 and #3.
5. All alarms values shall be ≤ 20 mr/hr.
6. Upon completion of testing announce "Test Complete. Acknowledge all further alarms," on the building PA system.

B. 120% Demand

1. Withdraw rods to 3 inches.
2. De-energize (Linear, Period or Log N) recorder. (Switch to off.)
3. Remove Linear Channel potentiometer cover and manually rotate potentiometer arm, note recorder reading when trip point is reached.
4. When inward motion of rods is verified, lower recorder below reset point, reset the rundown and all alarms, turn recorder on and replace cover, compare actual and specified trip points.
5. Record trip point value.

Written By: Carl Barton Approved By: Albert Bolon

C. Period < 15 Seconds

1. Repeat steps 1 through 5 of 2.B for the Period recorder.

D. 120% Full Power

1. Repeat steps 1 through 5 of 2.B for the Log N Recorder.

E. Low CIC Voltage Linear Power Supply

1. Withdraw rods to 3 inches.
2. Push and hold alarm test button on Linear CIC Power Supply. Observe High Voltage meter and record the value when the under voltage alarm light comes on. Release the test button.
3. Acknowledge the annunciator alarm and observe Low CIC voltage annunciator light. Check for insertion of control rods (rundown in progress).
4. When the High Voltage on the Linear CIC Power Supply has increased to approximately 500 volts push alarm reset. The under voltage alarm light will go off allowing the operator to reset the rundown (push rundown reset) and the annunciator.
5. Record value of the trip point.

F. Low CIC Voltage Log N Power Supply

1. Withdraw the rods to 3 inches.
2. Push and hold alarm test button on the Log N CIC power supply. Observe the high voltage meter and record the value when the under voltage alarm light comes on. Release the test button.
3. Acknowledge the annunciator alarm and observe the Low CIC Voltage annunciator light (also check for ≤ [illegible] sec. period, ≤ 15 sec. period, < 30 sec. period, and 150% full power). Reset the period trip light on the Log N & Period Amplifier. This allows for reset of all annunciator lights except low CIC

voltage.

4. When the High Voltage on the Log N CIC power supply has increased to approximately 500V, push alarm reset. The voltage alarm light will go off allowing the operator to reset the rundown (push rundown reset) and reset the annunciator.
5. Record value of trip point.

G. Regulating Rod on Insert Limit on Auto

1. Withdraw the Shim/Safety rods to 3 inches and Reg Rod to 0.5 inches (use the shim range bypass).
2. Adjust Linear recorder setpoint so that "auto permit" comes on.
3. With regulating rod at approximately 0.5 inches withdrawn, switch the Reg Rod control to "Auto" and reset the annunciator.
4. Adjust the red pointer (auto setpoint) to be slightly below black pointer (Linear signal) so that an insert on the Reg Rod will result.
5. When the Reg Rod reaches insert limit observe Manual Operation and "Reg Rod insert limit on Auto" annunciators.
6. Acknowledge and reset rundown and annunciators.
7. Record results.

3. <u>SCRAM (red lights)</u>:

A. Bridge Motion scram

1. Withdraw rods to 3 inches.
2. Release bridge lock and move the bridge a small distance.
3. Observe a Bridge Motion, Manual Scram and Magnet contact lights off. Acknowledge the annunciator alarm.
4. Return bridge to original position and reset all annunciators. Re-insert the magnets.
5. Record results.

B. Period < 5 Seconds

1. Withdraw rods to 3 inches.
2. Push in and turn trip switch on the Period Section of the Log N Amplifier.
3. Observe Period Meter for, ≤ 30 second and ≤ 15 second annunciators. Continue with trip test button operation until the period light is illuminated on the Log N Amplifier. Record the meter value when this occurs.
4. Acknowledge annunciator alarm and observe period < 5 second scram, 150% Full Power Scram and Loss of Magnet Contact Lights. Reset the period trip test light on the Log N Amplifier and push reset buttons for rundown. Insert magnets and reset annunciators.
5. Record value.

C. Log N & Period Non-Operative Scram

1. Withdraw rods to 3 inches.
2. Turn Log N test from the operate to high or low position.
3. Observe Log N Period Amp Non-Operative Scram, Manual Scram, and that the Magnet contact lights go out. Acknowledge annunciators. Reset Manual Scram and reset annunciator. Insert the magnets.
4. Record results.

D. 150% Full Power Scram

1. Withdraw rods to 3 inches.
2. Push Scram test button on Safety Amplifier. Hold button until both power range meters read full scale and 4 red test lights are on, and Magnet power light is off.
3. Push reset on the Safety Amp., acknowledge the annunciator and observe the 150% Full Power Scram annunciator and Magnet Contact lights are off.
4. Reset annunciator and insert the magnets.
5. Record results.

Written By: Carl Barton Approved By: Albert Bolon

E. Manual Scram

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

4. <u>ROD DROP CURRENTS</u>:

1. Withdraw rods to 3 inches.
2. Using a screwdriver slowly reduce magnet current using current adjustment #1, until the #1 magnet contact light goes out (you should also hear an audible "click" from the Reactor Bridge Intercom Station). Record this drop current value.
3. Repeat Steps 1 and 2 for Shim Rod No. 2 and No. 3.
4. Insert all Shim Rods to insert limit.
5. Set all Magnet Currents to "normal" (i.e. Drop Current plus 10 ma).

5. <u>TEST OF ANNUNCIATORS</u>:

A. Beam Room High Neutron Flux

1. Lower alarm set point by turning red needle on log rate meter to the left. Alarm occurs when black needle is hard against the red needle.
2. Check for local red alarm light and for white annunciator light on control panel. Return red needle to normal (10K) set point, reset alarm and annunciator.
3. Record results.

B. Interlock Bypass

1. Bypass each interlock one at a time to ensure that each individual bypass operates the annunciator and the bypass lights.

C. Servo Limits

1. Note linear level recorder reading.
2. Change the automatic set point for auto permit by adjusting the star wheel. Note linear level at which light comes on (<+2%). Continue to lower and note reading until the auto permit light goes off (> -2%).
3. Reset automatic set point to the 100% level.
4. Record results.

D. Pool Demineralizer Effluent Conductivity High

1. Record pool and demin effluent readings. Rev.
2. Check the alarm setpoint by dialing setpoint knob on the resistivity meter to match the needle reading. The local alarm (red alarm light) on the resistivity meter should come on and the console annunciator should alarm.
3. Reset the alarm to a setpoint of 0.5 MΩ-cm (2.5%) and switch the selector switch to display Demin effluent resistivity (Meas B").

6. <u>"REACTOR ON" LIGHTS:</u>

A. With magnet key inserted and all scrams reset check the "reactor on" lights (1) above console (2) at reactor entrance and (3) basement level.

7. <u>BUILDING EVACUATION ALARM</u>:

A. Announce over the PA, "The Building Alarm will sound. This is a test. Do not evacuate the building."

B. Push the Building Evacuation Alarm (center) of reactor console) and note the audible alarm.

C. Reset Building Evacuation Alarm by pushing Scram Reset.

D. Announce over building PA "Test alarms complete. Acknowledge all further alarms."

Written By: Carl Barton Approved By: Albert Bolon

8. NITROGEN DIFFUSERS:

A. With the bridge intercom station selected, start diffuser #1. The green operation light should illuminate. Note the sound level of the pump and any unusual noise.

B. Shutdown the #1 pump and repeat step 1 for the #2 nitrogen diffuser.

C. Record results on form SOP 810.

9. BEAM PORT AND THERMAL COLUMN WARNING LIGHTS:

A. Announce over the building PA. "Attention personnel, stand clear of the Beam Port".

B. Open the Beam Port by holding the beam port control switch in the open position until the "Red" (open) light comes on.

C. Acknowledge the annunciator alarm and check the Basement Level Warning Light (Flashing Red).

D. Close the Beam Port by holding the Beam Port Switch until the Green (closed) light comes on. Reset the annunciator and observe that the light goes out.

E. Announce over the Building PA "Beam Port secured". Complete SOP 810.

F. Dispatch a knowledgeable individual to the Thermal Column with the Thermal Column Key. Select the Basement Level Station on the Building Intercom.

G. Address the operator over the intercom to open the Thermal Column until the warning light comes on (approximately 1 inch)

H. The Control Room Operator should observe and acknowledge the annunciator alarm. Inform the Thermal Column Operator to shut the Thermal Column and ensure the warning light goes off.

Written By: Carl Barton Approved By: Albert Bolon

I. Reset the annunciator and have the Thermal Column Operator return the key to the locker. Complete form SOP 810.

10. SHUTDOWN CHECK:

A. Complete a Shutdown Check List form 103 to ensure that all console equipment is secured.

11. SECURITY SYSTEM:

Inform the campus police (4300) that the security system will be checked.

1. Security Door

a. Have police remain on line for the security checks.
b. Hold in or close dead bolt on the security door.
c. Reset the alarm system.
d. Open dead bolt switch by releasing or opening dead bolt and ensure alarm occurs in campus police dispatch station.

2. Ultrasonics

a. Hold or close dead bolt on security door. Reset alarm system.
b. While holding the dead bolt switch, move around or have someone walk toward one of the UT's. Have campus police notify you when the alarm occurs. A different ultra sonic detector should be tested each week.
c. Allow the ultrasonic to reset by moving clear of the detector or stand still.

3. Duress

a. Inform the campus police that the duress alarm will be tested.
b. Momentarily depress the alarm button.

The campus police should indicate the satisfactory operation of this alarm.

4. Doors

a. While holding the dead bolt switch closed, reset the alarm.
b. Open one of the exterior doors equipped with an intrusion alarm. A different door should be tested each week.
c. Have the campus police acknowledge the alarm when the door is opened.
d. Repeat steps a, b, and c for one of the interior doors equipped with an intrusion alarm. A different door should be tested each week.
e. When all intrusion channels have been tested, ask campus police to check the battery circuit. This completes the security check.
f. When all channels of the security system have been functionally tested and operate properly, initial the weekly checklist, Form SOP 810.

Written By: Carl Barton Approved By: Albert Bolon

WEEKLY SURVEILLANCE CHECKLIST

FORM SOP 810

Date Performed ____________

1. ROD PROHIBIT

		Annunciator	Prohibit	Initial
A. Recorder Off				
(1) Log count rate recorder		___	___	___
(2) Linear recorder		___	___	___
(3) Period recorder		___	___	___
(4) Log N recorder		___	___	___
(5) Temperature recorder		___	___	___

	Actual Trip Point	Annunciator	Prohibit	Initial
B. Log count rate <2CPS	___	___	___	___
C. Period <30 seconds	___	___	___	___
D. Inlet Temperature >135^{0}F	___	___	___	___
E. Shim Rods below shim range			___	___

2. RUNDOWN CHECK

A. RAM System

Station	Bldg. Alarm	Remote and Local Alarm	Annunciator	Rundown	Trip point	Initial
1.	___	___			___	___
1.		___	___	___	___	___
2.		___	___	___	___	___
3.		___	___	___	___	___

	Actual Trip Point	Annunciator	Rundown	Initial
B. 120% Demand rundown	___	___	___	___
C. Period 15 seconds rundown	___	___	___	___
D. 120% Full Power Rundown	___	___	___	___
E. Low CIC Linear P.S.	___	___	___	___
F. Low CIC Log N P.S.	___	___	___	___
G. Regulating Rod on Insert Limit on Auto		___	___	___

Rev.

3. SCRAM CHECK

	Actual Trip Point	Annunciator	Scram	Initial
A. Bridge Motion Scram		___	___	___
B. Period <5 Seconds Scram	___	___	___	___
C. Log N Period Non-operative Scram		___	___	___

Written By: Carl Barton (signed) Approved By: Albert Bolon (signed)

Date ______________

		Actual Trip Point	Annunciator	Scram	Initial
D.	150% Full Power Scram		______	______	______
E.	Manual Scram		______	______	______

4.	ROD DROP CURRENTS	Drop Current	Contact Light Off	Initial
A.	Rod #1	______	______	______
B.	Rod #2	______	______	______
C.	Rod #3	______	______	______

5. TEST OF ANNUNCIATORS

A. Beam Room High Neutron Flux

Local Alarm Light	Annunciator	Initial
______	______	______

B.	Interlock Bypass	Annunciator	Initial
(1)	Shim range	______	______
(2)	30 second period	______	______
(3)	Radiation area high	______	______
(4)	<2 CPS	______	______

C. Servo Limits

Lin. Rec. Reading	Permit on at	Permit off at	Initial
______ %	______ %	______ %	______

FWJ 27APR92

D. Pool/Demineralizer Resistivity

Pool	Demin	Local Alarm	Annunciator	Initial
______ MΩ-cm	______ MΩ-cm	______	______	______

6.	"REACTOR ON" LIGHTS	Operational	Initial
A.	Main Entrance	______	______
B.	Control Room	______	______
C.	Beam Room	______	______

7	BUILDING EVACUATION	Alarm Operational	Initial
		______	______

8.	NITROGEN DIFFUSER	Pump Operational	Indicator Light On	Initial
A.	#1	______	______	______
B.	#2	______	______	______

9. BEAM PORT AND THERMAL COLUMN WARNING LIGHT

		Annunciator	Flashing Light	Initial
A.	Beam Port	______	______	______
B.	Thermal Column	______	______	______

			Completed	Initial
10.	SHUT DOWN CHECK LIST	Battery Check	______	______
11.	SECURITY SYSTEM	______	______	______

12. APPROVED AND REVIEWED ______________________
Manager or Director (Rev. 4/23/92)

Written By: Carl Barton Approved By: Albert Bolon

Rev.

A. PURPOSE

To check ventilation fans and closure equipment (bay door, ventilation inlet and exhaust duct louvers, and the personnel security door).

B. PRECAUTIONS, PREREQUISITES, OR LIMITATIONS

1. Ventilation fans and closure equipment shall be checked monthly.
2. Two people are needed - one to operate fans and the other to observe the fans and louvers.
3. One stopwatch is needed.

C. PROCEDURE

1. Fans and Louvers

   a. Start one fan.
   b. Observer will position himself to get a view of the fan to be turned off with stopwatch in hand.
   c. Inform operator to turn fan off.
   d. When the fan is turned off, a click will be heard. Start stopwatch at this point
   e. Record the time it takes for louver to close completely.
   f. Compare this time to previous readings. A major change could indicate a malfunctioning of the louvers.
   g. Visually check physical condition of fans and louvers.
   h. Log observations on Confinement and Ventilation System Check Form.
   i. Repeat a. through h. for each exhaust and intake louver.

2. Confinement

   a. Check operation of doors and louvers to ensure the ability to maintain confinement.
   b. Log observations on Confinement and Ventilation System Check Form.

Francis Jones
Written By: Francis Jones

Albert Bolon
Approved By: Albert Bolon

A. PURPOSE

To provide instructions for determining accurate and consistent control rod drop times.

B. PRECAUTIONS, PREREQUISITES, OR LIMITATIONS

1. Complete a Pre-Startup Checklist prior to withdrawing rods unless the core loading is below 50% of critical mass.

2. Rods shall only be withdrawn one at a time for the purpose of these tests.

3. The drop time for each rod must be less than 600 msec. If rod drop times exceed 600 msec, the rods shall be visually inspected for pitting and cracking. (Tech. Spec. 3.2.3.)

4. Rod drop times must be measured a) semiannually, b) when a control assembly is moved to a new core position, c) when a magnet assembly has been removed, and d) after rod visual inspections. (Tech. Spec. 4.2.1.)

C. PROCEDURE

Equipment Needed:

1. Tektronix Model 2221 (or equivalent) oscilloscope
2. Microphone
3. Auxiliary scram test trigger
4. Duct tape
5. Interconnecting wiring

Steps:

1. Tape microphone onto one of the rod shrouds.

Written By: Carl Barton Approved By: Albert Bolon

2. Connect microphone to Channel 1 input jack of the scope.

3. Remove the auxiliary scram circuit jumper wire connecting TB5-31 and TB5-32 (located on back panel of console).

4. Connect the auxiliary scram test trigger between TB5-31, TB5-32 and the external trigger jack of the scope.

5. Perform reactor Pre-Startup Checklist as required.

6. Determine the drop current for each rod by slowing reducing magnet current until rod drops. Record the drop currents on the Rod Drop Measurement Form.

Insert all rod drives to 0.0 inches.

8. Set the magnet current for each magnet about 20 mamps above drop current (not to exceed 80 mamps).

9. Recommended scope control settings are as follows:

a. Store Display Controls:
   (1) Press "STORE/NON-STORE" button in to put scope in store mode. Make sure "SAVE" is <u>not</u> displayed on upper right hand corner of screen. If it is, push SAVE/COUNT button.
   (2) Press the SGLSWP to activate the green "ready" light.
b. Input Controls:
   (1) Volts/Div to 50 mV
   (2) DC-GND-AC Switch to DC
   (4) Ch 1/BOTH/Ch 2 switch to Ch 1 position
c. SEC/DIV Settings:
   (1) X 10/CAL inner knob in and fully clockwise
   (2) Time/Div (outer knob) to 50 ms
d. Trigger Level Operation: Press button on auxiliary scram test unit. Single shot should fire and cause a trace across oscilloscope.

Written By: Carl Barton Approved By: Albert Bolon

10. Measure the rod drop times as follows:

    a. Fully withdraw (24 inches) one rod. Verify that the oscilloscope is in the store mode (STORE/NON-STORE button depressed and green "ready" light is on).
    b. Firmly press the auxiliary scram switch. (Sweep should start and the sound of rod hitting bottom should be heard.
    c. Press "Save" button on oscilloscope.
    d. Adjust curser to beginning of sweep (left hand side) and high point of blip on trace.
    e. Record the drop time displayed in upper right hand corner of screen.
    f. Clear data by depressing the "SAVE" button on the oscilloscope.

11. Repeat step 10 for other rods as necessary.

12. Shut down or secure the reactor and remove all rod drop equipment.

13. Complete a Reactor Secured Checklist, if appropriate.

14. Reconnect the jumper wire between TB5-31 and TB5-32.

15. List all data on the Rod Time Measurement Form and forward to the Reactor Manager for review.

Written By: Carl Barton   Approved By: Albert Bolon

ROD DROP TIME MEASUREMENT FORM

DESCRIPTION	ROD 1	ROD 2	ROD 3
1. Drop Current			
2. Current Used for Drop Time Measurement			
3. Rod Drop Time			

Performed By: ______________________ Date: ______________

Comments: ____

____

____

Reactor Manager Review: ______________________________

Written By: Carl Barton Approved By: Albert Bolon