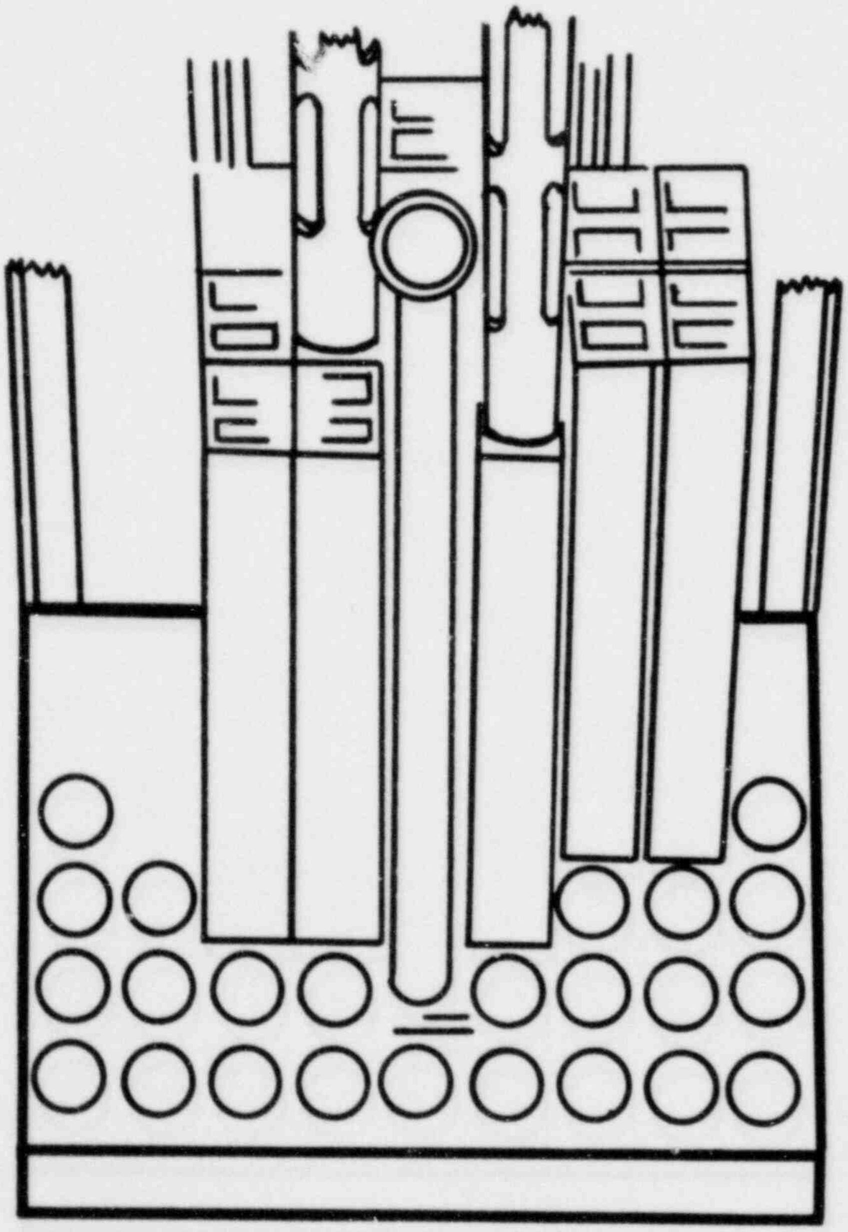
Progress Report
1981-1982
University of Missouri - Rolla
Nuclear Reactor Facility



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PROGRESS REPORT
FOR THE
UNIVERSITY OF MISSOURI - ROLLA
NUCLEAR REACTOR FACILITY

APRIL 1, 1981 to MARCH 31, 1982

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

By
Albert E. Bolon, Director
Nuclear Reactor Facility
University of Missouri - Rolla
Rolla, Missouri

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I. Introduction

This progress report is prepared in accordance with the requirements of the Nuclear Regulatory Commission 10 CFR 50.71 concerning the operation of the University of Missouri - Rolla Nuclear Reactor Facility (License R-79).

This reactor, a swimming pool type modified BSR, was first licensed as a 10 kW training and research facility with initial criticality on December 9, 1961. In January 1967 an amendment was granted by the Nuclear Regulatory Commission to upgrade the facility, allowing an increase in power level to 200 kW.

The Nuclear Reactor Facility 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 have made use of this facility during this reporting period. The facility is also made available for the purpose of training reactor personnel for the nuclear industry and electric utilities.

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 from this and other universities. The following sections of this report are intended to provide a brief description of the various aspects of the operation of this facility, including its utilization for education and research.

II. Reactor Staff and Personnel

A. Reactor Staff

Name	Title
D. Ray Edwards (1)	Director
Albert E. Bolon (2)	Director
Alva E. Elliott (3)	Reactor Manager
R.L. Jones (4)	Reactor Maintenance Engineer
Carl Barton	Electronic Technician
Karen Lane	Secretary
Juls William	Assistant Lab Mechanic
Mike Middleton	Reactor Operator
Charles Ruggeri	Student Research Assistant

B. Licensed Operators

Name	License
Alva E. Elliott (3)	Senior Operator
R.L. Jones (4)	Senior Operator
Carl Barton	Reactor Operator
Karen Lane	Reactor Operator
Michael Middleton	Reactor Operator

1) Served through June 5, 1981.
2) Served since June 6, 1981.
3) Retired effective March 19, 1982.
4) Resigned effective February 19, 1982.

C. Radiation Safety Committee

Name	Department
Nord L. Gale (chairman)	Life Sciences
Ray Bono (secretary) (ex officio)	Health Physicist
Ernst Bolter	Geology and Geophysics
O.K. Manuel	Chemistry
Albert E. Bolon	Reactor Director
N.T. Tsoulfanidis	Radiation Safety Officer
Ed Hale	Physics

This committee, which serves as the Reactor Advisory Committee, is required to meet at three month intervals. However, in practice the frequency of the meetings is usually greater.

D. Health Physics

Name	Title
Nick Tsoulfanidis	Radiation Safety Officer
Ray Bono	Campus Health Physicist
Dan Carter	Health Physics Technician

E. Independent Audit

Dr. Franklin Pauls, former Reactor Director, acts as the independent auditor of the Reactor Facility. He reviews all records, procedures, and operating methods of the facility on a semi-annual basis. Semi-annual audits were completed on May 1981 and October 1981 and are included in the Appendix of this report.

III. Supporting Facilities

Several supporting facilities are either operated or maintained by the reactor staff for users of the reactor. These greatly contribute to the efficiency of research and educational programs available to the faculty and students of the University of Missouri - Rolla, as well as other universities.

Analog Computer: This computer is currently available to faculty and students and is used in scheduled classes for both graduate and undergraduate students. Several units of auxiliary equipment are also available to widen the scope of its operation.

Slow Neutron Chopper: A slow neutron chopper is available for student use at the reactor facility. This chopper, was constructed as a Masters research project, and can be mounted on the face of the thermal column door.

Activation Analysis Laboratory: The activation analysis laboratory has proven to be the most-utilized supporting facility. The laboratory contains a 4096 channel analyzer, with NaI or GeLi selectable detector input. Included in the auxiliary equipment is a tape punch, multi-scaler programmer, a scope camera, and a teletype terminal. Three scalers are included in the laboratory equipment with the appropriate detectors for counting alpha, beta, and gamma radiation. A shielded detector with four ton low-background lead shield housing two "3X3" sodium iodide crystals, is also available for coincidence counting. These detectors are used in conjunction with the multi-channel analyzer. Several other units of equipment are available for the detection and evaluation of radioactive materials.

Pneumatic Tube Assembly: A dual tube pneumatic system is installed adjacent to the core of the reactor. One tube is cadmium lined, and the other is bare. This system is a positive pressure type and uses nitrogen as the propellant.

Dynamic Void: A method of introducing a contained void on the periphery of the core by use of nitrogen gas is available. This allows for a variation in void as a function of core height, total volume, or volume change.

IV. Improvements

The following items are considered improvements to the existing facilities during this reporting period.

(1) The power supplies of the MCA and SCA were changed from unregulated to regulated power.

(2) A separate intercom system was installed for use between the experimenters at the thermal column and the counting room.

(3) Programming is being done on our Apple II computer to provide us with a weekly update of the facility's operation and fuel usage.

(4) A remote T.V. monitor was installed in the Reactor Engineer's office to faciliate in identification of personnel who wish entry into secure area.

(5) The pneumatic transfer system was rebuilt, replacing hoses from the glove box to the bare and the cadmium lined rabbit tubes, valves, and wiring.

V. Reactor Operations

A. Facility Use

Table 1 depicts the current core loading which is designated as core 67. The number 67 denotes the sixty-seventh core configuration (assembly and location), that has been used at the reactor facility since the original operating license was issued in 1961. This core 67 has been in use since December of 1978 and is periodically checked for all parameters listed in Table 8 (core data). The core was unloaded for Control Rod Inspection during the month of September 1981. It was partially unloaded (4 or 5 assemblies) approximately 6 times for training exercises in fuel handling and 1/M plots during core loading during this reporting period. On March 19, 1982 the core was unloaded to less than half a critical mass in order that the reactor would be in a secured safe condition until another individual became licensed as a senior operator.

Tables 2 through 7 give additional pertinent information about the reactor for the reporting period.

Table 1. UMRR Core and Rack Storage Form

DATE December 19, 1978

LOADING NUMBER 67T*

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

RACK STORAGE FACILITY

R16	R17	R18	R19	R20	R21	R22	R23	R24	R25	R26	R27	R28	R29	R30
				F-13	F-20	HF-1	F-22	F-2	F-5	F-3			F-18	F-21

				S				
		HR-1	F-14	F-1	C-4			
		F-8	C-1	F-16	F-9	F-4	F-10	
		F-6	C-2	F-19	C-3	F-12	F-11	
		BRT	F-17	F-15	F-7	CRT		
1	2	3	4	5	6	7	8	9

BRIDGE SIDE

UMRR CORE STATUS

KEY TO PREFIXES

F - Standard Elements
C - Control Elements
HF - Half Front Element
HR - Half Rear Element
CA - Core Access Element
IP - Isotope Production Element
S - Source Holder
Other ______

Elem.	Pos.	Mass	Elem.	Pos.	Mass	Elem.	Pos.	Mass
HR-1	C3	84.912	F-16	D5	170.270	F-12	E7	168.774
F-8	D3	170.229	F-19	E5	170.264	F-10	D8	170.193
F-6	E3	169.160	F-15	F5	168.889	F-11	E8	168.969
F-14	C4	170.210	C-4	C6	102.112			
C-1	D4	102.112	F-9	D6	170.178			
C-2	E4	102.125	C-3	E6	101.978			
F-17	F4	169.111	F-7	F6	170.154			
F-1	C5	170.223	F-4	D7	170.206			

Bridge Position

Inches from T.C. 0.0

$\Delta K/K$ 0.905% @76°F (8-26-80 Total Mass Grams 2870.069

(measured value)

* T designates the thermal column-reflected mode. and W designates the water-reflected mode.

Table 2.

Facility Use of Core Grid Plate Locations around the Core

Number of Facility	Hours Used
A-4	0.167
A-7	0.250
B-3	0.167
B-4	0.15
B-5	0.6
B-6	0.167
B-7	0.283
B-8	0.167
C-2	0.067
C-3	1.117
C-4	0.35
C-7	1.484
C-8	0.25
D-2	0.167
D-5	0.55
D-6	0.167
D-7	0.167
D-8	0.9
D-9	0.3
F-3	11.683
Total	19.75

Table 3.

Facility Use Other Than the Grid Space around the Core

Facility	Hours
Neutron Chopper	
Bare Rabbit	11.68
Beam Port	
Reactor Console	556.76
Thermal Column	2.95
Total	571.39

Table 4.

Reactor Utilization

Hours in Use	1701.0
Hours available, But Not in Use	379.0
Hours at Power	170
Hours of Maintenance	824
kW Hours	5903.4
Hours for Research	23
Hours for Instruction	591.0
Experimenter Hours	1503.6
Sample Hours	85.7
Average Number of Experiments	1.04
Average Number of Samples	0.21
Total Number of Samples	219

Hours in Use is a total of Instruction, research and maintenance hours. With maintenance hours being only those hours when the reactor remained shutdown during the entire day.

Table 5.

Scrams and Rundowns

Date	Event
4-10-81	Scram, intentional (training).
4-13-81	Scram, intentional (training).
4-13-81	Scram, intentional (training).
4-13-81	Scram, intentional (training).
4-15-81	initiate <30 sec. period by pass (training).
4-20-81	Scram, intentional (training).
4-27-81	Scram, intentional (training).
4-30-81	Rundown, <15 sec. period (void tube by detector).
4-30-81	Rundown, hi-radiation spurious trip.
7-07-81	Scram, intentional (training).
8-04-81	<2cps by pass used for core loading.
8-04-81	<2cps by pass removed.
8-19-81	Scram, intentional (training).
8-21-81	Scram, intentional (training).
8-24-81	Scram, building evacuated (alarm due to sample escaping from rotor and surfacing). Radiation level on surface of pool under detector was 25 mr/hr.
8-31-81	Scram, intentional (training).
9-14-81	Scram, intentional (training).
10-29-81	Scram, (caused by failure of voltage regulator tube in safety amp).
11-03-81	Rundown, 120% demand, (void tube placed too close to detector).
11-03-81	Rundown, 120% demand, (void tube placed too close to detector).
11-04-81	Rundown, 120% demand, (void tube passed between detector and core).
11-04-81	Rundown, <15 sec. period (void tube passed between detector and core).
11-12-81	Rundown, hi-radiation, 15 mr/hr.
11-12-81	Rundown, hi-radiation, 7 mr/hr.

Date	Event
11-19-81	Scram, intentional (training).
11-20-81	Scram, intentional (training).
11-24-81	Rundown, <15 sec. period (caused by water filling the void).
11-24-81	Rundown, <15 sec. period (during void experiment).
11-24-81	Rundown, <15 sec. period (during void experiment).
11-24-81	Rundown, <15 sec. period (during void experiment).
11-24-81	Rundown, 120% demand (void tube passed between detector and core).
11-24-81	Rundown, 120% demand (void tube passed between detector and core).
11-24-81	Rundown, <15 sec. period (void tube passed between detector and core).
11-24-81	Rundown, <15 sec. period (void tube passed between detector and core).
12-09-81	Scram, intentional (training).
1-05-81	Scram, intentional (training).
1-13-82	Scram, intentional (training).
1-14-82	Scram, intentional (training).
1-28-82	Scram, intentional (training).
2-23-82	Due to running the reactor in the thermal mode without increasing the set point on the rundown limit.
2-26-82	Scram, intentional (training).
3-09-82	Rundown, 120% demand (student did not notice reactor was not on servo).
3-10-82	Scram, intentional (training).
3-10-82	Scram, intentional (training).
3-19-82	Scram, (fuel element too close to detector during fuel removal).

Table 6.

Maintenance

Date	Event and Corrective Action
4-25-81	Hi-radiation alarm on console - found no indication of Hi-radiation on RAMS. Checked building found no radiation level above normal.
	Replaced A4 (LM327) and A6 (7474) integrated circuits in log area monitor module.
8-20-81	Keithley 410, SN19683 micro-micro amp mike removed and SN19650 replaced for semi-annual.
8-24-81	Replaced all hoses on rabbit tube. Dose rate of 100 R@ 2 ft. below pool water surface on lower part of tubes.
9-28-81	Control rod inspection.
9-5-81	Placed source range detector cables in steel flex conduit. Placed linear and log n detector cables in aluminum flex conduit.
	Replaced blower hose on glove box and mounted blower on upper level.
9-6-81	Adjusted CIC (linear & log n) in accordance with power calibration dated 8-5-81.
9-11-81	Discharge hose on pool purification pump blew off due to high discharge pressure (60 lb). High pressure caused by clogged filters, 50 lb. differential pressure. Refilled pool with 1370 gallons and started.
9-25-81	No. 2 magnet bad - replaced no. 2 magnet.
10-22-81	No. 2 magnet bad - replaced no. 2 magnet.
11-05-81	No. 2 magnet current 120 ma. Found lead wire grounded to case. Repaired and returned to service.
11-12-81	Dropped all shim rods. Found voltage regulator tube in safety amp bad. Replaced voltage regulator tube.
11-12-81	Dropped #1 and #2 rods. Safety amp malfunction.
11-12-81	Dropped #2 rod. Safety amp malfunction.
11-12-81	Dropped #2 rod. Voltage fluctuation.
12-10-81	Keithley 410 micro-micro amp became erratic. Removed SN19650 and replaced with SN19683.

Date	Event and Corrective Action
1-29-82	At shutdown shim rod #3 would not drive in. Gear loose on motor shaft. Put new pin in to drive rod in. Removed motor for repair of adapter.
2-03-82	Replaced motor on #3 shim rod drive checked rod withdrawal speed and found it to be 241.6 sec for 24 inches or full withdrawal.
2-04-82	During weekly check a problem was noted with #3 safety rod. Micro switch for insert limit was found to be broken. Replaced micro switch and returned to service.
3-18-82	RAMS no. 3 found inoperative. No reading on meter.

Table 7.

Core Loading and Unloading

Date	Fuel Handling Maneuver
7-21-81	unloaded core for purpose of replacing rabbit tube hoses.
8-04-81	reloaded core.
8-25-81	unloading core for training.
8-25-81	reloaded core for training.
8-26-81	unloaded core for training.
8-26-81	reloaded core for training.
9-07-81	unloaded core for training.
9-07-81	reloaded core for training.
9-09-81	loaded HR-1 for training.
9-24-81	unloaded core for training.
9-24-81	reloaded core.
1-14-82	unloaded core for training.
1-14-82	reloaded core for training.
1-26-82	unloaded core for training.
1-26-82	reloaded core for training.
1-26-82	loaded HR-1 for training.
3-19-82	started core unloading for SO exam.
3-19-82	started core loading for SO exam.

B. Core Data

During this reporting period only one core designation has been used to any extent. The "W" mode core was used for normal reactor operations, since students cannot operate the reactor when the excess reactivity is above 0.7%. The "T" mode is used for extended operation (>3 hrs), beam port or thermal column experiments. The excess reactivity was measured for cold, clean critical conditions. In day-to-day operation the excess reactivity is quite often lower due to the temperature increase of the pool.

Table 8. Core Technical Data

Average Thermal Flux	$1.6\text{X}10^{12}$ at 200 kW
Maximum Thermal Flux	$2.8\text{X}10^{12}$ at 200 kW
Average Epithermal	$1.6\text{X}10^{11}$ at 200 kW
Worth of Thermal Column	0.37% @ 76°F
Worth of Beam Port	Not detectable

Rod Worth

I 2.64% , II 2.65% , III 3.36%, Reg. 0.347%, Date 9-29-81

Excess Reactivity 0.48% Shutdown Margin 4.8%

Void Coefficient -4.0X10 -7 ρ/cm^3 Date 11-03-81 Limit -2.0X10 -7 ρ/cm^3

Temperature Coefficient -8.4X10 -5 ρ/°F Date 11-12-81 Limit-4.0X10 -5 ρ/°F

xenon-free temp. coeff. -2.25X10 -5 ρ/°F

Reactivity Addition Rate (max % ΔK/K/sec)

I 0.0177ΔK/K/sec, II 0.0183ΔK/K/sec, III 0.0227ΔK/K/sec, Reg. 0.0072ΔK/K/sec

Date 8-04-81

Rod Drop Time (24")

I 5C0 msec, II 320 msec , III 520 msec, Date 8-04-81

Magnet Separation Time

I 30 msec , II 40 msec , III 30 msec , Date 8-04-81

VI. Public Relations

The reactor staff continues to put forth considerable effort to help educate the public about the application of nuclear energy. Over 1878 persons have toured the facility during this report period. This includes groups representing social, military, civic, industrial, governmental and educational fields. These groups are usually given a brief orientation lecture by a member of the reactor staff. These lectures are augmented by visual aids such as slides and displays. Many high school, junior college and college groups have attended the various lectures and open houses. Some groups from other universities have spent an entire day at the facility becoming acquainted with the reactor and performing simple experiments. Usually these groups are from colleges which have no reactor facilities. A guided tour by the reactor staff includes a brief description of the basic nuclear reactions, components of a nuclear reactor, a few specific examples of how nuclear energy is used in the industrial and educational fields and how nuclear energy helps the environmental situation.

The Nuclear Engineering faculty are members of various social civic, professional, and governmental committees. The faculty and students also are involved in speaking engagements around Missouri concerning the reactor facility and in informational programs at high schools and colleges.

VII. Educational Utilization

Approximately 32 UMR students, graduates and undergraduates, have participated in classes at the facility, utilizing 49 student - semester hours of allocated time. Also students from several colleges, and high schools have used the facility.

The following is a list of scheduled classes at the facility along with the total hours of reactor use for this reporting period.

NE 2 Introduction to Nuclear Engr.	1.3
NE 204 Radiation Measurement	0.1
NE 304 Reactor Physics Laboratory I	58.8
NE 306 Reactor Operations	77.4
NE 308 Reactor Physics Laboratory II	33.2
Reactor Operator Training Program	379.3
Preliminary Research	45

The current enrollment in Nuclear Engineering is 75 students. During this reporting period the reactor was used 96% for instruction and 4% for research.

The use of the nuclear reactor by departments other than Nuclear Engineering on this campus has continued to decrease. This condition seems to be a common occurrence with campus reactors that have been in service for a considerable number of years. This is reflected in the amount of time the reactor was used for research during this (and previous) reporting periods. It should be noted, however, that the reactor use has remained very high in the area of training.

The Nuclear Reactor Facility was accepted, by the Union Electric Company of

St. Louis, Mo., to provide several two-week programs in operational training. This training augments Phase One of their commercial nuclear reactor operator training program, with actual hands-on experience in start-up, shutdown, fuel handling, etc. This training was provided during April, August, September of 1981 and January of 1982. Seven groups, consisting of 39 individuals, were involved.

VIII. 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.

Routine Surveys

Monthly radiation surveys of the facility consist of direct gamma and neutron measurements with the reactor at full power. No unusual exposure rates were found. Monthly surface contamination surveys consist of 20 to 30 swipes counted separately for alpha and beta-gamma activity. In 12 monthly surveys, no significant contamination outside of contained work areas was found.

By-Product Material Release Surveys

During the period, 9 shipments of by-product material were surveyed and released from the reactor facility. Total activity released was 5.283 mCi. Five of the shipments were off campus which accounted for 5.0 mCi of the total activity. The other 4 shipments were utilized on the UMR Campus.

Routine Monitoring

Thirtyeight reactor facility personnel and students frequently involved with operations in the reactor facility are currently assigned beta-gamma, neutron film badges which are read twice each month. There are four beta-gamma, neutron area badges assigned. Fourteen 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 beta-gamma area and spare badges assigned. In addition, 7 direct-reading dosimeters are used for visitors and high radiation area work. There have been no personnel over exposure during the period.

Airborne activity in the reactor facility is constantly monitored by a fixed-filter, particulate air monitor (CAM) located in the reactor bay. Rb-88 and Cs-138 are the particulate daughters of Kr-88 and Xe-138 which are monitored particulate activity above the natural background of radon daughter products.

Argon-41, Krypton-88 and Xenon-138 are the gaseous activity routinely detected during operations.

Pool water activity is monitored monthly to insure 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 through March sample concentrations averaged 5.27×10^{-6} μci/ml.

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 3.11 millicuries were released into the air. Released isotopes were identified as Kr-88, Rb-88, Xe-138, Cs-138 and 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 resin exchange column. During this period 7 releases to the sanitary sewer totaling approximately 4,100 gallons of concentrated resin regeneration solution and pool water were discharged with a total activity of 0.541 millicuries. Isotopes released were: Hydrogen-3, Sodium-24, Cr-51, Mn-54, Fe-59, Co-58, Co-60, La-140, and Ba-140. All isotopes released were below 10 CFR 20. Appendix B, Table I, Column 2 limits.

Instrument Calibrations

During this period, portable instruments were calibrated four times. Remote area monitors were checked for calibration four times.

IX. Plans

During the future reporting period the reactor staff will complete replacement of all originally installed, control room instrumentation. The final items to be purchased consist of two compensated ion chamber power supplies for the linear and log-n intermediate range nuclear instruments. The source range, magnet power supply, and power range equipment has been previously purchased and needs only to be installed.

There will be one-ten day Reactor Operator Training program in September of 1982 for Union Electric Company of St. Louis, Missouri. With the completion of this program our service to U.E. will be completed for their initial operator licensing effort. Continued programs (of perhaps five-day classes) will be provided for replacement operators and new professional employees. There are plans to obtain another utility user whose initial licensing effort is just beginning.

The facility is still involved in a re-licensing effort that began in November of 1979. We have been informed by the NRC that their review of the initial facility documents will be completed and the resulting questions/answer series will begin shortly.

It is anticipated that the reactor staff will be expanded to include at least three licensed senior operators. Operator licensing exams for three SRO's and one RO were administered on March 18 and 19 of 1982. These individuals scheduled for licensing have been members of the staff for some time and will therefore, require only a change in job title/duties. This should allow the facility to expand its operation without (or with only minor) increase in operating cost to the University.

The positions of Reactor Manager and Reactor Maintenance Engineer will be filled as soon as is reasonably possible. The individuals who take each of those two positions will be expected to obtain their senior operators licenses as soon as they can.

(On April 12 word was received from the U.S. NRC that Dr. Albert Bolon and Mr. Michael Middleton had passed the Senior Operators examination and the effective date of their licenses was April 6, 1982. The results of the other two candidates were still pending).

X. Summary

The University of Missouri - Rolla Nuclear Reactor was in use approximately 0.7% of the time class was in session at the University (40 wks) or 8.2% of the total available time based on a 2080 hour work year. (These percentages utilize the established method for use rate and are some what misleading.) A more reasonable percentage of use would be 38% [1] and 30% [2], respectively. The total maintenance time of the facility was 824 hours (40%) which provided a total availability (reactor operational) of 1248 hours (60%).

It should be noted that during this reporting period approximately 250-hours of maintenance time was used for new equipment installation and that the facility was operating with only two licensed senior operators instead of the normal complement of three.

A total of 5.9 megawatt-hours of energy was produced using 0.304 grams of U-235. The percentage of usage was 96% for instruction and 4% for research. A total of 219 samples were irradiated during this reporting with most of the samples being used on a intra-campus basis.

The reactor was visited by 1878 people during the past year. At the same time there were 32 UMR students enrolled for courses at the Reactor Facility. The facility was thus commited to over 49 student-hours of classes involving about 20 hours per week during the fall and spring semesters. There were no classes at the reactor during the summer of 1981 to allow for an extended maintenance period.

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1 Hours of instruction plus hours of research = 1600 hours

2 Hours of instruction plus hours of research = 2080 hours

The facility continues to be utilized by electrical utilities for operator training. Seven-ten day non credit University Extension Programs were completed with approximately 379 hours of facility time being used for these programs. These programs provided $43,160 to the University with net revenue of $9096 to the facility. These funds went to salaries and wages for the staff involved in conducting the programs.

APPENDICES

APPENDIX A

Semi Annual Check List (1)

Date Commenced 12-16-81

Date Completed ~~9-14~~ [illegible]

Total Hours on Hour Meter 7942.6

1. Vacuum Tube Test and Clean Chassis — Initial

a. Log N Power Supply

(1) Cleaned chassis — [illegible] JAN 23 1982

(2) Tested all vacuum tubes — [illegible]

Replaced:

tube #	tube type
None	

(3) Additional Comments

None

b. Linear Power Supply

(1) Cleaned chassis — [illegible] JAN 23 1982

(2) Tested all vacuum tubes — [illegible]

Replaced:

tube #	tube type
V3	5651
V4	5651
V10	5651

(3) Additional Comments

1. Due to the reactor being inoperable from March 19-March 31, 1982, it was impossible to complete the Semi-Annual Check. It will be completed as soon as possible when the core has been reloaded.

c. Linear Pulse Amplifier CMB JAN 23 1982 / CMB

(1) Cleaned chassis

(2) Tested all vacuum tubes

Replaced:

tube #	tube type
None	

(3) Additional Comments

~~None~~ XFORMER LEAKING

d. Scaler Timer CMB JAN 23 1982 / CMB

(1) Cleaned chassis

(2) Tested all vacuum tubes

Replaced:

tube #	tube type
V1	6201

(3) Additional Comments

e. Safety Amplifier CMB JAN 23 1982 / CMB

(1) Cleaned chassis

(2) Tested all vacuum tubes

Replaced:

tube #	tube type
V10	OA2
V11	OA2

1982

c. Linear Pulse Amplifier

(1) Cleaned chassis

(2) Tested all vacuum tubes

Replaced:

tube #	tube type
None	

(3) Additional Comments

~~None~~ XFORMER LEAKING

d. Scaler Timer

(1) Cleaned chassis

(2) Tested all vacuum tubes

Replaced:

tube #	tube type
V1	6201

(3) Additional Comments

e. Safety Amplifier

(1) Cleaned chassis

(2) Tested all vacuum tubes

Replaced:

tube #	tube type
V10	CA2
V11	CA2

(3) Additional Comments

f. Area Radiation Monitor

(1) Cleaned chassis

(2) Tested all vacuum tubes

Replaced:

tube #	tube type

(3) Additional Comments

* Solid state.

g. Micro-Micro Ammeter

(1) Cleaned chassis

(2) Tested all vacuum tubes

Replaced:

tube #	tube type
None	

(3) Additional Comments

h. Fission Preamp

(1) Cleaned chassis and inspected

(2) Additional Comments

None

i. Public Address System

(1) Cleaned chassis

(2) Tested all vacuum tubes NA

Replaced: tube # tube type

(3) Additional Comments

SOLID STATE UNIT

j. Log Count Rate Recorder

JAN 23 1982

(1) Cleaned chassis

(2) Tested all vacuum tubes

Replaced: tube # tube type

None

(3) Additional Comments

k. Linear Recorder

JAN 23 1982

(1) Cleaned chassis

(2) Tested all vacuum tubes

Replaced: tube # tube type

None

(3) Additional Comments

l. Period Recorder

(1) Cleaned chassis

(2) Tested all vacuum tubes

Replaced:

tube #	tube type
None	

(3) Additional Comments

m. Log N Recorder

(1) Cleaned chassis

(2) Tested all vacuum tubes

Replaced:

tube #	tube type
None	

(3) Additional Comments

n. PAT 60

(1) Cleaned chassis

(2) Tested all vacuum tubes

Replaced:

tube #	tube type
None	

(3) Additional Comments

o. Regulated Power Supply
(1) Cleaned chassis CMB
(2) Tested all vacuum tubes N/A *
Replaced: tube # tube type

(3) Additional Comments
* Solid State Unit

p. Conductivity Brigge
(1) Cleaned chassis CMB
(2) Tested all vacuum tubes * Solid State * N/A
Replaced: tube # tube type

q. Safety Amp Preamp
(1) Cleaned chassis CMB
(2) Tested all vacuum tubes CMB
Replaced: tube # tube type
None

(3) Additional Comments

2. Relay Test

a. Console relays tested and replaced as per SOP 815 CMB

b. Additional Comments None

3. Detector Resistance

FEB 3 1982

a. Safety #1

	Value	
(1) Signal to ground	6.4x10^11	CMB
(2) Positive to ground	9.1 x10^11	CMB
(3) Additional Comments		

b. Safety #2

	Value	Initial
(1) Signal to ground	6.6 x10^11	CMB
(2) Positive to ground	8.0 x10^11	CMB
(3) Additional Comments		

c. Log N

(1) Signal to ground	1.5x10^11	CMB
(2) Positive to ground	5x10^11	CMB
(3) Negative to ground		
(4) Additional Comments		

d. Linear

(1) Signal to ground	1.2x10^11	CMB
(2) Positive to ground	2.0x10^11	CMB
(3) Negative to ground	2.4x10^11	CMB
(4) Additional Comments		

4. Calibration Checks

Note: Any instrument found to be out of calibration should be realigned in accordance with its technical manual.

A. Temperature Recorder

MAR 12 1982

1. Reading #

Reading #	Thermometer	Recorder
1	80°F	79
2	80°F	79
3	80°F	80
1	140°F	140
2	140°F	139
3	140°F	140

Note: All readings should be ± 1°F

2. 135°F Interlock	Trip Point	Initial
	135	CMB

B. Log Count Rate Channel

FEB 3 1982

1.

Pulse Generator*	Meter	Recorder	Initial
10	10	12	CMB
100	100	120	CMB
1000	1000	1200	CMB
10,000	10000	Full Scale	CMB

Note: All readings should give .7 to 1.4 ratio of true-to observed readings.

2. Additional Comments

C. Linear

12-10-81

1.

Keithley	Meter	Recorder	Initial
$6.66X10^{-5}$	6.66	99	[illegible]
$2.0X10^{-5}$	2.0	98	[illegible]
$6.66X10^{-6}$	6.8	100	[illegible]
$2.0X10^{-6}$	2.0	98	[illegible]
$6.66X10^{-7}$	6.8	100	[illegible]
$2.0X10^{-7}$	2.05	101	[illegible]
$6.66X10^{-8}$	6.65	98	[illegible]
$2.0X10^{-8}$	2.0	99	[illegible]
$6.66X10^{-9}$	6.66	99	[illegible]
$2.0X10^{-9}$	2.05	100	[illegible]
$6.66X10^{-10}$	6.6	98	[illegible]
$2.0X10^{-10}$	2.0	97	[illegible]

20

50

100

Note: From 10^{-3} to 10^{-8} the overall accuracy should be better than 2% of full scale.

From $3X10^{-9}$ to $3X10^{-13}$ the overall accuracy should be better than 4%.

2. Additional Comments

D. Log N

1.

Meter	Recorder	Keithley	Initial
100	120	5×10^{-5}	CMB
10	8	3.4×10^{-6}	CMB
1	0.9	3.6×10^{-7}	CMB
0.1	0.15	5×10^{-8}	CMB
.01	0.015	5.6×10^{-9}	CMB
.001	0.0018	6.0×10^{-10}	CMB
.0001	0.0002	5.0×10^{-11}	CMB

Note: The ratio of true-to-observed readings should be between 0.7 and 1.4.

2. Additional Comments

5. Verification of Rod Drop Times

a.

Rod #	Rod Height (inch)	Separation Time (< 50 msec)	Rod Drop Time (< 600 msec at 24'
1			
1			
1			
1			
2			
2			
2			
2			
3			
3			
3			
3			

b. Date performed ____________ Preformed by ____________

Director or Supervisor ____________

6. Void Coefficient Determination

a. Value of void coefficient ______________________ % ΔK/K/cm^3

b. Calculation performed by __________ ______________

c. Date performed ______________________

d. Director or Supervisor ______________________

7. Temperature Coefficient Determination

a. Value of temperature coefficient ______________________ % ΔK/K/°F

b. Calculations performed by ______________________

c. Date performed ______________________

d. Director or Supervisor ______________________

8. Rod Speeds

Time (Sec)	I.	II.	III.	Reg.
0-24"	241.1	240.6	239.5	62.1

FEB 4 1982
CMB

(3) Additional Comment

Date FEB 4 1982 Performed By CMB

9. Rod Indicator Calibration

Actual Height	I.	II.	III.	Reg.
	Indicator Reading			
1"	1	1	1	1
6"	6	6	6	6
12"	12	12	12	12
18"	18	18	18	18
24"	24	24	24	24

10. Results of Annual Control Rod Inspection

A. Control Rod Number 1

11.b Control Rod Number 2

11.c Control Rod Number 3

d. Date Performed ______________________________

e. Director or Supervisor ______________________

Date ________________19________

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 or Reactor Manager

____________________ ________________________

UNIVERSITY OF MISSOURI-ROLLA - NUCLEAR REACTOR

STANDARD OPERATING PROCEDURES

S.O.P.: 817	REVISED: 7-24-75	PAGE 1 OF 1

TITLE: Fire Alarm System

The UMR Nuclear Reactor building, fire alarm system consists of two type of detectors; four heat sensing units and two smoke detectors, plus two manual alarm station.
The system has a built in circuit failure warning system with an audible and visible alarm at the control box.
The alarm system is normally powered from building power, with batteries for a backup.
When a actual alarm is initiated an internal and an external building fire alarm is sounded and when the building security system is in operation a remote alarm is sounded at the campus police headquarters.

PROCEDURE:

1. Replace the emergency power supply batteries in the battery box.
2. Test emergency power by securing power to the alarm system (switch 32 in the power panel) and text system operational.
3. Check the four heat detectors by applying a heat blower on them and acknowledging alarm actuation, audible and visible and their resetting after the heat is removed.
4. Check the two smoke detectors by placing a burning cigarette on a long pole momentarily removing all power to the alarm control box.
5. Check the two manual alarm stations and acknowledge alarm actuation, audible and visible and reset.
6. Check all indication lights operational.

Jan 29 1982

WRITTEN BY: R.M. Luckett	APPROVED BY: D.R. Edwards DRE

REACTOR FACILITY INSPECTION -- Date(s) April 30 & May 7, '81
(Phone: 341-4236)

Date(s) of last NRC inspection April 16, 1981 (32 hr)

Date(s) of last "inhouse" inspection Nov 6 & 7, 1980

Log Book Inspection:

	Log Book Number	Page	Date
From entry:	4	468	Nov 7 1980
Through entry:	4-end; 5 —	83	May 5, 1981

Follow up items from previous inspection (item; follow-up):
Hot water in emergency shower — see "General Comments"
Rod inspection — check on condition of Rod #3 — will be done in August
Evacuation drill — OK

A. Technical specifications Appendix A -- Jan. 6, 1967	OK	Comments
	✓	Changes None. if so, list
1. (2.1) Ventilating fans	✓	
Automatic closure	✓	
2. (3.1) Pool water depth (16 ft. min above core)	✓	
3. (3.1) Inlet water temperature $60°F < t < 135°F$	✓	OK
4. (3.2) Radiation one meter above pool < 5 mr/hr	✓	
5. (3.2) Resistivity > 0.5 megohm-cm	✓	
6. Fuel	✓	Type of elements: MTR; Other Triga (stan); Present loading(s): 67 W
(4.1.3) $\rho_{ex} < 1.5\%$	X	
$1.5\% < \rho_{ex} < 3.5\%$ five consecutive days twice a year	X	Sr. Oper. Dates: (1) ____ (2) ____
7. Control rod: (9.5) condition	✓	Date inspected: In August
(4.2.3) Reactivity shutdown margin at least 8%	✓	
(4.2.4) Drop time < 600 msec	✓	(9.3) Dates: (1) — (2) —
(4.3.2) Limit lights; shim range lights; magnet contact lights	✓	
8. Neutron source (min. 10^6 n/sec)	✓	

	OK	Comments
9. Safety systems (annunciator) ------	✓	
(5.4) Start-up channel ------------	✓	
(5.4) Linear channel --------------	✓	
(5.4) Log N - Peroid channel ------	✓	
(5.4) Safety channel #1 -----------	✓	
(5.4) Safety channel #2 -----------	✓	
10. (5.5) Magnet release time < 50 msec	✓	
11. (5.7) Radiation levels < 0.1 mr/hr-		Location / Reading
		Pool surface above core ------------ OK ~~start~~ daily read
		Near demineralizer -
		Beam room ---------- OK
12. (5.8) Portable survey instruments -	✓	
List:		
Neutron		Alpha
Gamma See attached sheet		Beta
Other		
13. Experimental facilities -----------	✓	Give example as to how used.
Hung samples ----------------------	✓	
(6.1.1) Core access element -------	✓	
(6.1.1) Isotope prod. element -----	✓	
(6.1.2) Rabbit tube ---------------	—	in process of modification
(6.1.2) Thermal column ------------	✓	
(6.1.2) Beam port -----------------	✓	
(6.2.2) Documentation of exps. ----	✓	
(6.2.3) Single independent experiment: $\rho_{ex} < 0.7\%$ -------------	✓	
(6.2.4) Single movable experiment: $\rho_{ex} < 0.4\%$ -------------	✓	
0.6% all movable exp. ------	✓	
(6.2.5) Experiments having moving parts: $\rho_{ex} < 0.05\%$ --------------	✓	
(6.2.6) Position of any/all exp. -	✓	
14. General Operating Limitations		
(7.1) Startup: Sr.Oper. plus one (in the control room)	✓	
(7.1) Operation: S.O. plus one -- (in building)	✓	
(7.4) No fuel position vacancies in core; loading (wall chart) ----	✓	

	OK	Comments
15. Fuel Storage & Transfer		
wall chart ----------------------	✓	
(8.3) Fuel handling tools locked --	✓	
(8.4) Fuel transfer--three men		
(Sr. Oper.; Lic. Oper.; plus one --	✓	OK
16. (10.1) New loading: approach to		
critical exp. (reason & date)------	✓	none
(10.2) Core configuration change:		
one grid position. (Reason & date)-	✓	See 1/27/81 during training
(10.3) Loading change of more than		
one grid position-unload 50% ------	✓	
17. Instruments functioning (Table I)--		(On weekly check list - *)
Scram: Manual -------------------	✓	startup — pm of 4/30/81
Period < 5 sec. -----------	✓	*
150% full power -----------	✓	startup
Bridge motion -------------	✓	*
Log N - Period non-op -----	✓	*startup
Rundown: 120% power (linear) -----	✓	*
Period < 15 sec -----------	✓	*
Reg Rod (insert limit-auto		
rundown) -----------------	✓	*
120% full power (log N) ---	✓	*
Low CIC voltage -----------	✓	startup
High radiation ------------	✓	startup
Rod prohibit: Period < 30 sec. --	✓	*
Any recorder off ---------	✓	*
Low count rate -----------	✓	*
Reg Rod prohibit (rods		
below shim range) ---------	✓	*
Inlet temp. > 135°F -------	✓	*
Servo-prohibit on reg. rod --------	✓	*
18. Check Lists and records		
Log book checked -----------------	✓	Dating — see Bk 5 p. 2, ?, 16, 17, 38, 60
(9.1) Daily facility check list --	✓	Errors p65 - top of page
(9.3) Instrument channels & area monitors-calibrated at 90 day intervals -----------------------	OK	Dates: (1) 3/20/81 (2) 12/18/80 (3) ______ (4) ______
UMRR startup check list ----------	✓	
Hourly records-note variations ---	✓	
Shut-down check list -------------	✓	
Weekly check list ----------------	✓	
Work load log -------------------	✓	
Six month systems check ----------	✓	Dates: (1) Dec 1980 (2) ______

	OK	Comments
B. Records		
1. Log books	✓	Current book number 5 Other 4 Stored in control room
2. Recorder charts	✓	Stored: where and for how long
Log N (permanent)	✓	Located: head of stairs
3. Evacuation alarms: number and cause	✓	1. Drill Feb 6, 1981 2.
4. Evacuation procedures, drills	✓	
5. Use of by-pass keys	✓	1. 5p10 — 30 sec period 5p48 — " " "
6. Key security	✓	
General security	✓	
Night use of building	✓	
7. SOP'S - Note any revisions none	✓	
8. Film badge, dosimeter	✓	
9. Night watchman record	✓	
C. Reactor Bay		
1. General condition of pool	✓	
2. General condition of storage	✓	
3. Use of cable trench	✓	
4. Nitrogen diffuser	✓	
5. Miscellaneous (List)	✓	none
D. Control Room	✓	
List of current operators	✓	Senior operators: R. L. Jones - 1979 A. E. Elliott — 1980 Operators: C. M Barton - 1980 (Karen Lane)
E. Office (film badge rack, etc.)	✓	
F. Counting Room	✓	
G. Rooms & Storage upstairs	✓	

	OK	Comments
H. Stairwell & pump area	✓	
1. Demineralizer system	✓	
2. Outside air filters	✓	
I. Stairs and beam room	✓	
1. Thermal column	✓	
2. Beam tube	✓	
3. Fuel storage	✓	
4. Liquid & solid waste storage	✓	
J. Health Physics		
1. Sample removal	✓	
2. SOP'S (list)	✓	
3. Excursion or incident monitor	✓	
a. Film badge placement	✓	
b. Other	✓	
4. Film badge, dosimeter records	✓	
a. Staff	✓	
b. Students	✓	
c. Guests	✓	
d. Night watchman	✓	
5. Possible detection of fuel element rupture	✓	
6. Radiation survey	✓	Dates:
a. Periodic swipe tests	✓	2nd Tues
b. Pool water	✓	1st & 4th Tues
c. Inside air	✓	3rd Tues
d. Outside air	✓	OK
e. Neutron level (sub-critical	✓	
f. Misc. items (list)	✓	
7. Emergency box (Physics Bldg.)	✓	

General comments: Two items:
(1) Day dates are missing--see page 3, item 18, right-hand column, of this report for pages. One can tell the transition from one day to the next by noting when the times chang, for example, 1500 hrs to 0800 hrs.
(2) Hot water in the emergency shower: The lack of hot water in the emergency shower has been noted in the last two inspections (May 1980 & Nov. 1980). I understand that the campus committee on safety says that hot water is not necessary in emergency showers, I disagree on two counts. (a) It seems to me that the combination of radiactive contamination and subsequent bath in a cold shower could lead to shock and shock can not be ignored. (b) Whatever time it takes to shower in cold water could lead to hypothermia and that too can not be ignored.

I don't understand why the delay. Years ago the physics building had hot water in all appropriate faucets. During the emphasis on energy conservation hot water faucets in the rest rooms were turned off. The one in my office was not and I had hot water. What has changed? Why can't we again have hot

UNIVERSITY OF MISSOURI-ROLLA

Radiation Safety Office
Building C
Rolla, Missouri 65401
Telephone: (314) 341-4240

March 31, 1980

MEMORANDUM TO: D.R. Edwards
A. Elliott

From: Ray Bono

Subject: UMR Monthly Reactor Health Physics Audit

1. Sealed Sources. Due in May.

2. RAM Calibration. Remote area monitors were calibrated on March 12, 1980 and will be due again no later than June 30, 1980.

3. Health Physics Instrument Calibration. All β,γ and Neutron Health Physics instruments were calibrated on March 12, 1980 and are due again by no later than June 30, 1980.

   H.P. Reactor Instruments calibrated on 3-12-80:

   1.) Eberline Frisker s/n 2066

   2.) Eberline G.M. E-120 s/n 3194

   3.) Victoreen Thyac-389 s/n 1202

   4.) Eberline Pic-6A s/n 1405

   5.) Eberline Pic-6A s/n 1799

   6.) Eberline Pic-6A s/n 1851

   7.) Victoreen Radector III 2035 s/n 897
   (Reactor Emergency Box, Physics Bldg)

   8.) Victoreen 488A s/n 243 (Neutron Instrument).

4. Swipe Tests of the Reactor Building. Were performed on 3-18-80.

5. Air Releases. Complete through February, March has not been typed yet.

6. Water Releases. One water release was recorded on March 3, 1980, with no detectable activity.

REACTOR FACILITY INSPECTION -- Date(s) Oct 21, 22, 26, 1981
(Phone: 341-4236)

Date(s) of last NRC inspection None

Date(s) of last "inhouse" inspection Apr 30, May 7, 11 — 1981

Log Book Inspection:

	Log Book Number	Page	Date
From entry:	5	83	May 5, 1981
Through entry:	5	142	Bottom of page (Oct 21, 1981) {9:30 / 9:55}

Follow up items from previous inspection (item; follow-up):
Hot water in shower (Physics Bldg) — There is hot water!!

	OK	Comments
A. Technical specifications ------------ Appendix A -- Jan. 6, 1967	✓	Changes None, if so, list. Reactor is operating under a temporary license (NRC has not acted)
1. (2.1) Ventilating fans ------------	✓	– see weekly check
Automatic closure ------------	✓	
2. (3.1) Pool water depth (16 ft. min above core) ------------	✓	
3. (3.1) Inlet water temperature $60^oF < t < 135^oF$ ------------	✓	
4. (3.2) Radiation one meter above pool < 5 mr/hr ------------	✓	– Hourly check or start-up
5. (3.2) Resistivity > 0.5 megohm-cm --	✓	
6. Fuel ------------	x	Type of elements: MTR; Other Triga {Stored in basement Reactor Bld}; Present loading(s): (*)
(4.1.3) $\rho_{ex} < 1.5\%$ ------------	✓	Sr. Oper.
$1.5\% < \rho_{ex} < 3.5\%$ five consecutive days twice a year ------------	x	Dates: (1) — (2) —
7. Control rod: (9.5) condition -----	✓	Date inspected: July 28, 1981
(4.2.3) Reactivity shutdown margin at least 8% ------------	✓	
(4.2.4) Drop time < 600 msec ------	✓	(9.3) Dates: (1) ______ (2) ______
(4.3.2) Limit lights; shim range lights; magnet contact lights -----	✓	
8. Neutron source (min. 10^6 n/sec) ---	✓	

(*) 69W — Aug 5, 1981
70W — Aug 27, 1981
71W — Sept 8, 1981
72T — Sept 9, 1981
73W — Sept 24, 1981

	OK	Comments
9. Safety systems (annunciator) ------	✓	
(5.4) Start-up channel ------------	✓	
(5.4) Linear channel --------------	✓	
(5.4) Log N - Peroid channel ------	✓	
(5.4) Safety channel #1 -----------	✓	
(5.4) Safety channel #2 -----------	✓	
10. (5.5) Magnet release time < 50 msec	✓	
11. (5.7) Radiation levels < 0.1 mr/hr -	✓	Location — Reading Pool surface above core ------------ OK Near demineralizer - checked Beam room ---------- during start-up
12. (5.8) Portable survey instruments -	✓	
List: Neutron Gamma Other See attached sheet p. 6		Alpha Beta
13. Experimental facilities -----------	✓	Give example as to how used.
Hung samples ----------------------	✓	
(6.1.1) Core access element -------	✓	storage
(6.1.1) Isotope prod. element -----	✓	storage V.T. — void tube, in storage
(6.1.2) Rabbit tube ---------------	✓	
(6.1.2) Thermal column ------------	✓	
(6.1.2) Beam port -----------------	✓	
(6.2.2) Documentation of exps. ----	OK	
(6.2.3) Single independent experiment: $\rho_{ex} < 0.7\%$ -------------	✓	
(6.2.4) Single movable experiment: $\rho_{ex} < 0.4\%$ -------------	✓	
0.6% all movable exp. ------	✓	
(6.2.5) Experiments having moving parts: $\rho_{ex} < 0.05\%$ --------------	✓	
(6.2.6) Position of any/all exp. --	OK	
14. General Operating Limitations		
(7.1) Startup: Sr.Oper. plus one (in the control room) -	✓	
(7.1) Operation: S.O. plus one (in building) --	✓	
(7.4) No fuel position vacancies in core; loading (wall chart) ----	✓	

	OK	Comments
15. Fuel Storage & Transfer wall chart ----------------------	✓	
(8.3) Fuel handling tools locked --	✓	
(8.4) Fuel transfer--three men (Sr. Oper.; Lic. Oper.; plus one --	OK	
16. (10.1) New loading: approach to critical exp. (reason & date)-------	✓	
8/25/81 Training U.E.		
(10.2) Core configuration change: one grid position. (Reason & date)-	✓	Sept 8, 1981 to go from 71 to 72 loadin
(10.3) Loading change of more than one grid position-unload 50% ------	✓	See core loadings p 1 item 6
17. Instruments functioning (Table I)--	✓	(On weekly check list - *)
Scram: Manual ----------------------	✓	startup
Period < 5 sec. -----------	✓	*
150% full power -----------	✓	startup
Bridge motion -------------	✓	*
Log N - Period non-op -----	✓	*startup
Rundown: 120% power (linear) -----	✓	*
Period < 15 sec -----------	✓	*
Reg Rod (insert limit-auto rundown) -----------------	✓	*
120% full power (log N) ---	✓	*
Low CIC voltage -----------	✓	startup
High radiation ------------	✓	startup
Rod prohibit: Period < 30 sec. --	✓	*
Any recorder off ----------	✓	*
Low count rate ------------	✓	*
Reg Rod prohibit (rods below shim range) ---------	✓	
Inlet temp. > 135°F -------	✓	*
Servo prohibit on reg. rod --------	✓	
18. Check Lists and records		
Log book checked -------------------	✓	— see notes
(9.1) Daily facility check list --	✓	
(9.3) Instrument channels & area monitors-calibrated at 90 day intervals ------------------------	✓	Dates: (1) 3/20/81 (2) 9/28/81 (3) ____ (4) ____
UMRR startup check list -----------	✓	
Hourly records-note variations ---	✓	
Shut-down check list --------------	✓	
Weekly check list -----------------	✓	
Work load log ---------------------	–	Using schedule board in control room
Six month systems check -----------	✓	Dates: (1) Dec 1980 (2) July (20) 1981

	OK	Comments
B. Records		
1. Log books	✓	Current book number 5 Other 1-4 Stored In central room
2. Recorder charts	✓	Stored: where and for how long
Log N (permanent)	✓	Located: Stairs
3. Evacuation alarms: number and cause	✓	1. Aug 24, 1981 - sample came to surface 2.
4. Evacuation procedures, drills	✓	
5. Use of by-pass keys	✓	1. 2 cps - Aug 4, 1981
6. Key security	✓	
General security	✓	
Night use of building	✓	- tours only
7. SOP'S - Note any revisions	✓	
8. Film badge, dosimeter	✓	
9. Night watchman record	✓	
C. Reactor Bay		
1. General condition of pool	✓	- paint needs watching
2. General condition of storage	✓	- Good
3. Use of cable trench	✓	
4. Nitrogen diffuser	✓	
5. Miscellaneous (List)	OK	
D. Control Room	✓	
List of current operators	✓	Senior operators: A. E. Elliott - 1980 R. L. Jones - 1981 Operators: C. M. Barton - 1980 K. J. Lane - 1981 M. R. Middleton - 1981
E. Office (film badge rack, etc.)	✓	
F. Counting Room	✓	
G. Rooms & Storage upstairs	✓	

	OK	Comments
H. Stairwell & pump area	✓	
1. Demineralizer system	✓	
2. Outside air filters	✓	
I. Stairs and beam room	✓	
1. Thermal column	✓	
2. Beam tube	✓	
3. Fuel storage	✓	
4. Liquid & solid waste storage	✓	
J. Health Physics		
1. Sample removal	✓	
2. SOP'S (list)	✓	
3. Excursion or incident monitor	✓	
a. Film badge placement	✓	
b. Other	✓	
4. Film badge, dosimeter records	✓	
a. Staff	✓	
b. Students	✓	
c. Guests	✓	
d. Night watchman	✓	
5. Possible detection of fuel element rupture	X	
6. Radiation survey	✓	Dates: See attached sheet p.9
a. Periodic swipe tests	✓	
b. Pool water	✓	
c. Inside air	✓	
d. Outside air	✓	
e. Neutron level (sub-critical	✓	
f. Misc. items (list)	✓	
7. Emergency box (Physics Bldg.)	✓	

General comments: (1) The overall operation of the reactor is very good. The housekeeping is superb. It is not easy to keep a facility clean where a portion must be used as a classroom, and a portion as an electronic shop. (2) There is now hot water in the emergency shower. (3) The pool wall paint seems to be holding its own. It, however, needs to be watched. (4) Greater care should be taken to have the entries in the log book be correct and complete. For example: (a) On June 9, according to the log book it took only one minute to check out the reactor. (b) On Aug 24 the reactor was evidently taken from 69W to 69T but this was not recorded. (c) On Sept 9 there is a discrepancy between the log book and the UIRR Start-up check list. Log says to core #72 and mentions 72T; the check list mentions 72W but not 72T.

Copies to:
Dr. A. E. Bolon
Mr. A. E. Elliott

Signed: Franklin B. Pauls

UMR Reactor

Health Physicists Survey Instruments

Calibrated & In-use

Date: October 18, 1977

Instrument/Model	Manufacturer	Serial Number
Cutie Pie Survey Meter/CP-3	Technical Associates	602
Cutie Pie Survey Meter/CP-3A	Technical Associates	477
Cutie Pie Survey Meter/CP-3A	Technical Associates	478
Cutie Pie Survey Meter/CP-3A	Technical Associates	479
G.M. Survey Meter/E-120	Eberline	3194
Radiation Monitor/RM-14	Eberline	2247
High Range Survey Meter/RadectorIII	Victoreen	897
High Range Survey Meter ----	Eberline PIC-6A ------	1405
GM Survey Meter/Thyac 3850	Victoreen	1202
Neutron Survey Meter/488A	Victoreen	243
Neutron Dosimeter/D-300C	Kaman	163
High Range Survey Meter ---	Eberline PIC-6A ----	1799
High Range Survey Meter ---	Eberline PI--6A ------	1851

10/26/81 no new instruments

Operator Requalification During License Period

A. Examination Review Sheet (Annual exam -- usually in summer)

Name of Operator	License number and date	~~Exam~~ dates Effective "	Comments	5-year record
1. A.E. Elliott	SOP 434-8	Aug 3, 1980 ~~July 15, 1981~~		
2. R.L. Jones	SOP 2964-2	Apr 18, 1981		
3. Karen G Lane	OP 5473	May 4, 1981		
4. C.M. Barton	OP 5236	June 11, 1980		
5. M.R. Middleton	OP 5578	July 15, 1981		

B. Performance Evaluation (Semi-annual)

Name of Operator	Evaluation Date	Comments
1. A.E. Elliott	8/3/80 to 8/3/81 8/3/81 to ⟹	Reactivity changes — OK 7/23/80; 10/3/80; 8/? Nuclear instr check - OK - 8/24/81 Fuel handling - OK 9/16/80; 8/4/81 Radiation instr - OK 9/17/80; 10/22/81 Emergency procedures - OK 11/5/80 —
2. R.L. Jones	4/18/81 → 4/18/82	Reactivity changes - OK 6/17/81; 8/5/81; 10/7/81 Nuclear Instrument - OK 6/17/81; 10/7/81 Fuel handling - OK 7/21/81 Radiation instr. - OK 8/24/81 Emergency procedures - OK 10/12/81
3. Karen G. Lane	5/4/81 → 82	Reactivity change - OK 8/4/81; 9/15/81; 9/17/81 Nuclear instr check - OK 9/15/81 Fuel handling - OK - 7/21/81 Radiation Monitors - OK 9/1/81 Emergency - none
4. C.M. Barton	6/11/81 → 82	OK In progress
5. M.R. Middleton	7/15/81 → 82	OK In progress

C. On the Job Training: Progress Report (Annual Summary)
(Notebook kept by the operator.)

Name of Operator	Annual Summary Date	Comments
1. A.E. Elliott		
2. R.L. Jones	Performance evaluation 10/7/81	— partially completed
3. K.G. Lane	~~Performance evaluation~~ — ~~11/2/80~~	
4. C.M. Barton	Performance evaluation 11/4/80	

Special Nuclear Materials (SNM)

Position	Name
Reactor Director --------------	Dr. A. E. Bolon
Reactor ~~Supervisor~~ Manager ------------	Alva Elliott
SNM Custodian -----------------	Alva Elliott

1. (See p. 2) Procedures reviewed annually by the Reactor ~~Supervisor~~ Manager:
   Date   Name Check by noting whether records have been kept

2. SNM Records: Where kept?

   (1) Position and/or change of position of non-irradiated fuel: Inga

   (2) Position and/or change of position of irradiated fuel: In pool

   (3) SNM receipts: none

   (4) SNM shipments: none

   (5) Semi-annual Material Status Report: Mar
   Most recent previous report: Date ~~Oct~~ 1981
   Current report:
   Date Oct 1981

   (6) Annual Physical Inventory (SNM status log): OK
   Previous report: Date Fuel inventory form
   Current report:

   (7) SNM loss, theft or sabotage reported: No
   Date   To whom reported (Director Region III NRC)

   (8) (See p. 5) Violations of Written Procedures:

   (9) SNM Internal Control Areas:

   Dry storage area (basement): OK

   Reactor: OK

   Containment building: OK

See Security (p 3): Identification of SNM

SNM license renewed. Notice received 10/26/81

Radiation Safety Office
Building C
Rolla, Missouri 65401
Telephone: (314) 341-4240

UNIVERSITY OF MISSOURI-ROLLA

January 17, 1980

Page 9

MEMO TO: D.R. Edwards and A. Elliott

FROM: Ray Bono and N. Tsoulfanidis

RE: UMR Monthly Reactor Health Physics Audit

On January 4, 1980, we performed an audit of Reactor Health Physics activities. We checked the frequency as well as the method used in carrying out the following activities:

Function	Frequency	Dates
✓1. Swipe test of sealed sources	6 months	5-15-81
✓2. Radiation area monitor (RAM) calibration	quarterly	9-28-81
✓3. Health Physics instrument calibration	quarterly	OK
✓4. Swipe test of reactor building	monthly	9-17-81
✓5. Air releases	monthly	9-24-81
✓6. Water releases	regeneration	8-12-81
✓7. Building survey	monthly	9-17-81
✓8. Routine pool water analysis	monthly	9-8, 24-81
✓9. By-product material released	monthly	8-31-81
✓10. Pool water tritium ana.	6 months	6-30-81

1. Sealed Sources. There are eight sealed sources requiring a leak test every six months. The last leak check was performed by Ray Bono in November 1979. All eight sealed sources are due to be leak tested again in May 1980.

2. RAM Calibration. The records show that the calibrations have been performed on schedule but in one case, there is a five month gap between the first and second quarter of 1979. The activity recorded for the source used for calibration should be the activity at the time of calibration.

3. Health Physics instrument calibration. This is done on a quarterly basis at the Reactor. Copies of all surveys and instrument calibrations should be forwarded to the Health Physics office upon completion. Meter calibrations are in order but a few calibration sheets do not indicate the scale used. Scale used should be recorded.

(Don't just say mr/hr, be sure to give the upper limit of the scale for all meters.)

Enclosed is a copy of the U.S. NRC Regulatory Guide Revision 1, October 1979, which should be followed when calibration are performed. The G.M.

UNIVERSITY OF MISSOURI-ROLLA

Nuclear Reactor Facility
Nuclear Reactor
Rolla, Missouri 65401
Telephone: (314) 341-4236

Feb. 19, 1982

Memo. to: Alva Elliott, Reactor Manager OK
From: Albert Bolon, Reactor Director
Re: Corrections and additions to SOP's

Alva,

I believe the following corrections and/or additions are sufficiently substantive that they should be made immediately to the SOP's and the Tech. Specs. (if we can change them too).

SOP	§	line	
(Preamble	3	3	change "by the SO's" to "by either the RO's, SO's, RM or RD"
101	2	5&6	change "possession of the Senior Operator on duty" to "cognizance of the Reactor Manager"
101	4	4	change "0.6%" to "0.5%"
102	p.2	1	delete sent. "Always keep one hand on the rod drive switch."
107	B.1	3&4	delete "while maintaining direct contact with the rod control switches." period after "system"
109	C.1	3	period after 600 W. then (This is n_0)
109		graphs	add reference title & no.
110		footnote	(see my book)
112	1	5	ERDA to DOE
112	4	2	ERDA to DOE
115	4	4&5	delete sentence(?) "When an element is removed from the display and stored in a safe place."
115		Fig. 2	change "POOL" to "FUEL"
207	16	2	change "SRO" to "Reactor Manager"
301	E	3	change "5 megohms" to "0.5 megaohm-cm"
303	A	last	"-2×10^{-5}%" to "$-2\times10^{-7}\ \frac{\Delta k}{k}$"
305		first	change "Atomic Energy" to "Nuclear Regulatory"

SOP	S	line	
306		title	add "for Experiments" change Table of Contents too.
306		throughout	$\varepsilon \rightarrow \xi, \eta \rightarrow m$ ~ (mass)
601	3	1	change "tritium" to "titanium"
807	2	f.	20K cpm, not 20R cpm