UNIVERSITY OF MISSOURI

Annual Report 1982-83

UNIVERSITY OF MISSOURI RESEARCH REACTOR FACILITY
UNIV. RESEARCH EDUCATION SERVICE

RESEARCH REACTOR FACILITY

UNIVERSITY OF MISSOURI

RESEARCH REACTOR FACILITY

REACTOR OPERATIONS

ANNUAL REPORT

August 1983

Compiled by the Reactor Staff

Submitted by

J. C. McKibben
Reactor Manager

Reviewed and Approved

Robert M. Brugger
Director

TABLE OF CONTENTS

SECTION I

REACTOR OPERATIONS SUMMARY
Fiscal Year 1982-1983

The following table and discussion summarize reactor operations in the period July 1, 1982 to June 30, 1983.

Date	Full Power Hours	Megawatt Days	Full Power Percent* of Total Time	Full Power Percent* of Schedule
July 82	673.4	280.74	90.51	101.37
Aug. 82	678.8	283.06	91.24	102.19
Sep. 82	672.6	280.40	93.42	104.63
Oct. 82	691.0	288.23	92.88	104.02
Nov. 82	612.3	255.43	85.04	95.25
Dec. 82	693.2	288.20	93.17	104.35
Jan. 83	618.3	269.48	83.10	93.08
Feb. 83	590.1	245.12	87.81	98.35
Mar. 83	692.5	288.57	93.08	104.25
Apr. 83	656.1	273.49	91.12	102.06
May 83	695.1	289.58	93.43	104.64
June 83	647.0	269.89	89.86	100.64
Total for Year	7,920.4	3,312.19	90.39% of time for yr. at 10MW	101.24% of sched. time for yr. at 10MW

*MURR is scheduled to average at least 150 hours per week at 10MW. Total time is the number of hours in a month or year.

JULY 1982

The reactor operated continuously in July, with the following exceptions: ten shutdowns for flux trap sample changes; two shutdowns for maintenance; and six unscheduled shutdowns.

On July 7, the reactor was scrammed by shifting the WRM switch too far down scale during a power reduction. All systems were verified normal and the reactor returned to operation.

Two unscheduled shutdowns on July 13 were by manual scram to repair and then replace an airlock door gasket. The third unscheduled shutdown on July 13 was caused by the failure of the local pump control switch for P-501B, which caused a reactor loop low flow scram when P-501B stopped. The reactor was returned to operation after the pump control switch was replaced.

The reactor was shutdown on July 18 by a momentary dip in electrical power, verified by the UMC Power Plant.

On July 31, the reactor was shutdown by a loss of valve operating air pressure which resulted in V509 leaving its full open seat, scramming the reactor. The main air compressor had shutdown due to high temperature. Cooling water was increased to the compressor, all systems were verified normal and the reactor returned to normal operation.

Major maintenance items in July included the regeneration of DI-200 beds "O" and "P"; the repair and replacement of the outer airlock door gasket and repair of the wet fire main.

AUGUST 1982

The reactor operated continuously in August, with the following exceptions: ten shutdowns for flux trap sample changes; three shutdowns for maintenance; and three unscheduled shutdowns.

On August 15 and 26, the reactor was shutdown by a rod not in contact with magnet Rod Run-In. These Rod Run-Ins were both caused by control blade "D" falling off during startup with the reactor not critical. The reactor was returned to operation after checking the rod "D" alignment.

On August 31, the reactor was again shutdown by a rod not in contact with magnet Rod Run-In. Rod "D" disengaged from its magnet during a shimming evaluation at 10MW. The reactor returned to operation after the upper housing of Rod "D" was realigned.

Major maintenance items in August included the dumping of DI bed "O", the loading of new DI bed "R"; replacement of P-501A with a spare pump; and the installation of air sparge lines on the secondary side of the primary heat exchangers.

SEPTEMBER 1982

The reactor operated continuously in September, with the following exceptions: seven shutdowns for flux trap sample changes; two shutdowns for maintenance; and seven unscheduled shutdowns.

On September 5, the reactor was scrammed by a spurious reactor loop low flow signal. The primary flow detectors were inspected and found to be normal. The next three unscheduled shutdowns occurred during the subsequent restoration of reactor power. Blade "D" fell off its magnet during each of three startups. The reactor was returned to operation, after alignment of the blade "D" drive housing and the performance of a blade pull and drop test on blade "D".

On September 13, while the reactor was operating at low power for Physics testing, the reactor scrammed due to a static charge buildup in the WRM range switch. The switch was wiped and a reactor startup was commenced. A second scram was caused by an operator trainee shifting the WRM range switch improperly. The trainee was instructed in proper switch operation and a third startup was commenced. A third scram occurred, caused by a voltage dip due to an electrical storm. The reactor systems were checked and the reactor was returned to operation.

Major maintenance items in September included regeneration of DI bed "R" and the alignment of offset drive housing "D".

OCTOBER 1982

The reactor operated continuously in October with the following exceptions: nine shutdowns for flux trap sample changes; two shutdowns for maintenance and three unscheduled shutdowns.

The three unscheduled shutdowns on October 12 and 13 were caused by reactor loop low flow scrams. These scrams were caused by spurious electronic signals generated in the Primary and Pool Flow Scram Trip Unit. In each case, the reactor flow recorder showed no actual loss or reduction of flow.

After both the first and second scrams, the primary system was inspected and flow detectors were inspected and vented. After the third flow scram, the Primary Loop A and Pool Loop B Flow Scram Trip Unit was replaced by the electronics technician. The scram trip points for F. T. 912A (Primary Flow A) and F. T. 912F (Pool Flow B) were then checked, and the reactor was returned to operation.

Major maintenance items for October included: the replacement of the Primary and Pool Flow Scram Trip Unit, installation of new offset #8 in the "B" position; the regeneration of DI bed "P" and the performance of two reactivity measurement startups.

NOVEMBER 1982

The reactor operated continuously in November with the following exceptions: six shutdowns for flux trap sample changes; four shutdowns for maintenance and eight unscheduled shutdowns.

The unscheduled shutdowns on November 9 was due to a loss of site electrical power, verified by the UMC power plant.

One unscheduled shutdown on November 16 was caused by turning the Channel 4 Range switch incorrectly and the other by an electrical glitch in the annunciator. The reactor was returned to operation after each of the shutdowns.

On November 18, the reactor was shutdown by Manual Rod Run In to inspect and repair the regulating blade clutch mechanism. The reactor was refueled and returned to operation.

On November 22, the reactor was shutdown by Manual Rod Run In because the jog/stop switch had failed for the charging pump. The switch failed in the run mode causing an increase in pressurizer level. The reactor was returned to operation after the pump control switch was replaced.

On November 29, the reactor was scrammed while decreasing reactor power during a reactivity measurement when the Channel 4 Range switch was turned too far down scale.

Major maintenance items for November included: dumping pool bed "Q" on November 13; installing reflector elements K-2, K-3, and N-2 as per Modification Packages 82-1 and 82-4 on November 15; the loading and regeneration of new DI bed "S" on November 17, and one reactivity measurement startup. Three reactor operator licensing examination startups were conducted November 8.

DECEMBER 1982

The reactor operated continuously in December with the following exceptions: sixteen shutdowns for flux trap sample changes; two shutdowns for maintenance and three unscheduled shutdowns.

On December 11, the reactor was shutdown twice by spurious pool loop low flow scrams. The pool systems were inspected and the reactor returned to operation. On the next Maintenance Day, December 13, the pool loop B low flow scram set point was found to have drifted high causing low flow scrams when no low flow condition existed. The scram set point was adjusted to within the desired compliance check limits and Compliance Check CP-7B was performed.

The unscheduled shutdown on December 20 was caused by a rod not in contact with magnet rod run in when blade "D" was bumped while handling a laser experiment in the reflector region.

Major maintenance items for December included the regeneration of DI bed "R" and the performance of reactivity measurements for the Reactor Services group.

JANUARY 1983

The reactor operated continuously in January with the following exceptions: nine shutdowns for flux trap sample changes; four shutdowns for maintemance and ten unscheduled shutdowns.

On January 3, after maintenance day, two anti-siphon high level Rod Run-Ins occurred. The anti-siphon system was blown down after the first Rod Run-In but the second Rod Run-In occurred a short time later. The reactor was shut down and the anti-siphon system values were cycled to reseat the valves. The reactor was returned to operation after the valves reseated.

On January 13, the reactor scrammed for an unknown reason. The reactor instrumentation and systems were inspected and found normal and the reactor returned to operation.

Following maintenance day on January 17 and 18, six unscheduled shutdowns occurred due to rod not in contact with magnet Rod-Run-Ins. After continued trouble shooting and fault isolation, the Rod Run-In Trip Actuator Amplifier was replaced and the reactor returned to operation.

On January 31, the reactor was shut down by a Pool Loop Low Flow Scram caused by a glitch from the Demineralizer Flow Chart Recorder. The pool flow recorder indicated no actual reduction of flow.

Major maintenance activities for January included the repair and replacement of the air sparge lines in waste tanks one and two; the overhaul of valves 543 A/B and installation of modified pins in the valve actuator linkages (Modification 83-1), and the dumping of DI bed "P".

FEBRUARY 1983

The reactor operated continuously in February with the following exceptions: eight shutdowns for flux trap sample changes, three shutdowns for maintenance and seven unscheduled shutdowns.

On February 1, while performing a startup, the reactor was shut down by a Pool Loop Low Flow scram. The scram was caused by an intermittent ground in a switch in the primary clean up flow recorder. The pool flow recorder indicated no actual reduction of flow. The reactor was returned to operation after the recorder switch mounting screws were tightened, removing the intermittent ground condition. This is believed to have also been the cause of the unscheduled shutdown on January 31, 1983.

The reactor had two rod not in contact with magnet Rod Run-Ins during February 3 startups on blades "C" and "B". After blade "C" dropped, its power supply was switched with the blade "B" power supply in an attempt to isolate the cause of dropping blade "C". Blade "B" fell off on the subsequent start-up. The power supplies for blades "C" and "B" were then returned to normal. The power supply current meters for blade "C" and "D" were then switched in a further attempt to isolate the cause of the rod drops. Each time the entire power supply circuitry and connections were checked. The rod drops were being caused by an intermittent problem. The reactor was scrammed on the subsequent startup by a static charge on Channel #4 Range switch.

On February 6, a rod not in contact with magnet Rod Run-In occurred when blade "D" fell off during a startup. The magnet current meter for rod "D" was replaced and the reactor returned to operation. This current meter was the one that had been on rod "C". No further unexplained rod drops have occurred since the current meter was replaced.

After maintenance day on February 7, there was an unexplained reactor scram. The scram circuitry was inspected and no abnormalities were found. The white rat monitoring system was installed in the jumper boards and the reactor returned to operation. On February 8, a reflector High/Low Differential Pressure Scram was received on the annunciator and the white rat. The electronics technicians replaced the meter and relay unit for PT-917 and the reactor returned to operation after a compliance check on PT-917.

Major maintenance activities for February included one spent fuel shipment; the replacement of blade "C" magnet current meter; the replacement of PT-917 meter and relay units; the replacement of the inner airlock door gasket and a change out of offset mechanism "D".

MARCH 1983

The reactor operated continuously in March with the following exceptions: nine shutdowns for flux trap sample changes; two shutdowns for maintenance; and two unscheduled shutdowns.

On March 21, a high power rod-run-in was received from Channel 5. The cause of the rod-run-in was vibration of a loose solder joint in the DC amplifier portion of the Channel 4 drawer. The loose DC amplifier lead caused Channel 4 indicated power to drop, which in turn caused the regulating blade to withdraw, resulting in an increase in power. The reactor was shutdown by manual scram, the lead was repaired and the reactor returned to operation.

On March 25, a rod-run-in was received for no apparent reason. All systems were checked satisfactory and the reactor returned to operation.

Major maintenance activities included replacement of offset "D" with a new offset mechanism. This was done to replace an offset installed a week earlier, which had a problem with control blades falling off the magnet in the upper four inches of travel.

APRIL 1983

The reactor operated continuously in April with the following exceptions: nine shutdowns for flux trap sample changes; four shutdowns for maintenance, and four unscheduled shutdowns.

On April 3, a loss of site power caused the reactor to scram. The power loss was due to a ground in an electrical substation adjacent to the reactor facility cooling tower. The reactor was refueled and returned to operation after electrical power was restored to the facility.

The reactor scrammed on April 6 by an electrical glitch from the Channel 4 Range switch. The reactor was being restored to power after a brief maintenance shutdown for electrically switching the source of site power.

On April 11, after a maintenance shutdown, the reactor was scrammed by a Reactor Isolation. The isolation was initiated by the Area Radiation Bridge Monitor while handling a silicon sample. After evacuation of containment, the set point for the reactor bridge upscale meter was determined to have been set too low. The reactor returned to operation after setting the meter trip point properly.

A momentary dip in electrical power caused by a thunderstorm initiated a scram on April 27. The reactor returned to operation after systems were inspected.

Major maintenance in April included the repair of an in-pool leak in the primary vent system. A vent line was replaced from the pressure vessel to the in-pool heat exchange.

MAY 1983

The reactor operated continuously in May with the following exceptions: ten shutdowns for flux trap sample changes and three shutdowns for maintenance. There were no unscheduled shutdowns for the month.

Major maintenance activities in May included the completion of the annual containment leak test and the replacement of the pool system demineralizer bed. The containment leak rate was 11.1 scfm, which is less than the Technical Specification limit of 16.3 scfm.

JUNE 1983

The reactor operated continuously in June with the following exceptions: ten shutdowns for flux trap sample changes; two shutdowns for maintenance and three unscheduled shutdowns.

On June 8, the reactor was shutdown by a manual rod-run-in when the breakers supplying the secondary cooling pumps and fans tripped. The breaker for cooling tower fan #2 was found to have shorted, causing a power surge that tripped the supply breakers for the secondary pumps and fans. The reactor returned to operation after the #2 fan breaker was racked out and the cooling tower switch gear was inspected and tested.

On June 18, the reactor was scrammed due to a loss of site power, verified by the UMC Power Plant.

On June 21, the reactor was scrammed during a reactor startup by a static charge buildup on the Channel #4 Range switch. The switch was wiped and the reactor returned to operation.

Major maintenance items for June included electronic ground isolation on June 6 and the replacement of cooling tower fan #2 breaker on June 10.

SECTION II

OPERATING PROCEDURE CHANGES
TO
REVISED OCTOBER 1981 MANUAL

As required by the MURR Technical Specifications, the Reactor Manager reviewed and approved the Standard Operating and Emergency Procedures (SOP).

There have been six revisions (#7 through #12) made to the Revised October 1981 manual during the past year. The revisions are contained in this section with the part of each page that was revised marked on the right side of the page by a bracket (]).

REVISION NUMBER 7

TO REVISED OCTOBER 1981 MANUAL

SOP/I-15	Revised 12/7/82
SOP/I-16	Revised 12/7/82
SOP/I-17	Revised 12/7/82
SOP/I-18	Revised 12/7/82
SOP/VII-45	Revised 12/7/82
SOP/VII-53	Revised 12/7/82
SOP/A-1a	Revised 12/7/82
SOP/A-11	Revised 12/7/82

Table IV

Values of Trip Settings for Alarm, Run-In and Scram Conditions

		Scram	Run-In	Alarm	Units
1.	Short Period	≥8	≥10	--	sec
2.	Low Count Rate	--	--	<1.0	cps
3.	High Power	≤120	≤115	--	% full power
4.	RC Inlet Temp	150	--	148	°F
5.	RC Outlet Temp	170	--	165	°F
6.	RC System Low Flow 5 MW Operation	1725	--	1800	gpm
	RC System Low Flow 10 MW Operation	[2]1725	--	1800	gpm
7.	Heat Exchanger Low ΔP (DPS 928A/B)	[4]1675	--	--	gpm
8.	Rx System Low Press Switch PS 944A/B	[3]63	--	--	psig
9.	Core Low ΔP, 5 MW	[4]1650	--	--	gpm
	Core Low ΔP, 10 MW	[4]3300	--	--	gpm
10.	Low Pressurizer Level	13-14 below C	--	10-13 below C	inch
11.	High Pressurizer Water Level	--	--	12-15 above C	inch

[2] For 10 MW operation, Alarm and Scram received from either loop
[3] Pressurizer pressure with normal system flow
[4] ΔP Corresponding to this flow value

TABLE IV (continued)

		Scram	Run-In	Alarm	Units	
12.	Low Pressurizer Press	63	--	65	psig	]
13.	Hi Pressurizer Press	78	--	75	psig	]
14.	Pool Low Flow, 5 MW	490	--	530	gpm	]
	Pool Low Flow, 10 MW	490	--	530	gpm	]
15.	Pool Low Hi Temp	--	--	115	°F	
16.	Low Pri Demin Flow	--	--	<42.5	gpm	
17.	Low Pool Demin Flow	--	--	<42.5	gpm	
18.	Bldg Air Plenum Hi Activity	1.0	--	--	mr/hr	
19.	Reactor Bridge	50.0	--	--	mr/hr	
20.	RC Hi Conductivity	--	--	2.0	μmhos	
21.	PC Hi Conductivity	--	--	2.0	μmhos	
22.	Hi Refl ΔP, 5 MW	1.9	--	--	psi	
	Hi Refl ΔP, 10 MW	7.0	--	--	psi	]
23.	Low Refl ΔP, 5 MW	.75	--	--	psi	
	Low Refl ΔP, 10 MW	3.0	--	--	psi	]
24.	Low N_2 System Press	--	--	115	psig	
25.	Low Seal Trench Level	--	--	5.1	feet	
26.	Hi/Lo Level in T-300	--	--	6200/2500	gal	
27.	Hi/Lo Level in T-301	--	--	6000/<100	gal	

		Scram	Run-In	Alarm	Units
28.	Fission Product Monitor Hi Activity	--	--	40K	cps
29.	Off-Gas Hi Activity	--	--	[5]see below	cpm
30.	Secondary Coolant Hi Activity	--	--	10	cps
31.	Anti-Siphon Line Hi Level	--	>6 (above vlvs)	--	inches
32.	Pool Level Low	>23'	29'-1"	--	inches
33.	Reg Blade	--	<10% or bottomed	<20% or >60%	% withdrawn
34.	Vent Tank Low Level	--	7-11 (below C)	--	inches
35.	Secondary Coolant Low Flow	--	--	<1800	gpm
36.	Ch 4, 5, or 6 Downscale	--	--	<75	% full-scale
37.	Valve 546 A or B	--	--	off closed	
38.	Valve 509	off open	--	--	
39.	Valve 547	--	--	off open	
40.	Valves 507 A/B	off open	--	closed with P501 on	
41.	Valve S-1	--	--	90% open or 90% shut	--

[5]This setpoint is determined by the semiannual calibration.

TABLE IV (continued)

	Scram	Run-In	Alarm	Units
42. Nuclear Instrument	[6]inoperative	--	anomaly	--
43. Anti-Siphon System Pressure Low	--	--	30	psig
Anti-Siphon System Pressure High	--	--	44	psig
44. Thermal Column Door	--	--	open	--
45. Truck Entry	--	door seal deflated	--	--
46. Evacuation or Isolation	manual/auto	--	manual/auto	--
47. Rx System Low Pressure (PT-943)	63	--	--	psig

---

[3]Pressurizer Pressure with normal system flow
[6]Any channel will scram on NI Inoperative except SRM

sludge is dumped via a 3" drain line at the north end of WT1 or the south end of WT# into barrels. This sludge is dried and removed as dry active waste.

B. Cuno Filters

The waste water will normally be pumped through the two Cuno filters. When the ΔP is high across them, they are replaced with new filters, and the old ones are disposed of as dry active waste. See Section VII.8.11.

C. Chemical Precipitant Treatment

Radioactive particulates will attach themselves to carriers which can then be readily filtered out of the WT water. Without these carriers, even the most efficient filters could not remove this rsadioactive particulate. After filtering, the filters are shipped as dry radioactive waste (see Section VII.8.12).

VII.8.3 Dumping Criteria

A. The liquid waste is collected and held until an analysis is made to determine that the specific activity of all radioactive isotopes in the waste is less than the limit specified in the Code of Federal Regulations, Title 10, Part 20 (10 CFR 20) for dumping liquid waste to the sanitary sewer. If the 10 CFR 20 limits are not exceeded and the total activity of radionuclides does not exceed 4 mCi, the Shift Supervisor may authorize the water to be pumped to the sanitary sewer. Any tank containing water with an activity greater than 4 mCi will be discharged only with the approval of the Reactor Manager. In addition to the dumping limit on each isotope, 10 CFR 20 also limits the total activity which the University can dump to the sanitary sewer to 1 curie per year for carbon-14, 5 curies per year for H-3 (tritium) and 1 curie per year of other radioactive material, excluding C-14 and H-3. This latter limit and a general desire to minimize the activity dumped to our environment, dictates that the waste be retained as long as possible to permit the activity to decay off prior to discharge.]

5. Add sufficient acid (6 normal) to lower pH to between 5.0 amd 6.0.
6. Secure the acid pump and open the breaker.
7. Shut valves RE5, RE57, RE58 and RE70.
8. Drain and flush the acid mixing tank.
9. Close the acid mixing tank valves.

C. Sparge and recirculate, bypassing the filters, for 30 minutes.
D. Add a special carrier solution which will be provided by the Laboratory Group.
E. Sparge and recirculate, bypassing the filters, for one hour.
F. Raise the pH.
   1. Open the WT2 manhole cover.
   2. Add sufficient sodium hydroxide to raise the pH to 11.0-14.0.

      Caution: It is better to add too much than not enough.
   3. Replace the manhole cover.
G. Sparge and recirculate, bypassing the filter, for 30 minutes.
H. Secure W.T. recirculation and let tank settle for 24 to 48 hours. Then pump (without air sparge) through stand pipe, from WT2 to WT1.
I. WT1 should now be ready to sample.
J. Recirculate WT2 through filter until they no longer foul up.

VII.9 Nitrogen and Valve Operating Air Systems

VII.9.1 Purpose

The primary function of the nitrogen (N_2) system is to provide pressurized N_2 to the pressurizer. The secondary function of the N_2 system is to act as a backup to the air in the valve operating system.

REACTOR STARTUP CHECKSHEET
FULL POWER OPERATION
(or Low Power Forced Circulation)

DATE: ____________________
TIME (Started) ____________________

BUILDING AND MECHANICAL EQUIPMENT CHECKLIST

_____ 1. Run emergency generator for 30 minutes and check the governor oil level. (Required if shutdown for 24 hours or after each maintenance day.)
_____ 2. a. Check operation of fan failure buzzer and warning light. Shift fans. (Required if shutdown longer than 4 hours.)
_____ b. Test stack monitor per SOP wyhile in west tower.
_____ c. Test the stack monitor low flow alarm.
3. Visual check of room 114 equipment completed.
_____ a. P501A and P501B coolant water valves open.
_____ b. S1 and S2 hydraulic pumps on (oil level normal).
_____ c. Pump controllers unlocked to start (as required).
_____ d. Insure N_2 backup system on per SOP.
_____ e. Open air valve for valve operating header (VOP 31).
_____ f. N_2 backup valve open.
_____ g. Check valves 599A and 599B open.
_____ h. Pipe trench free of water (on Monday startups, check the four-pipe annulus drain valves for water leakage).
_____ i. Add DI water to beamport and pool overflow loop-seals.
_____ 4. Visual check of CT equipment completed.
_____ a. Oil level in CT fans normal (Monday start-ups).
5. Beamport Floor
_____ a. Beamport radiation shielding (as required).
_____ b. Unused beamports checked flooded (Monday).
_____ c. Seal trench low level alarm tested (Monday).
_____ 6. Emergency air compressor (load test for 30 minutes on Monday).
7. Reactor Pool
_____ a. Reflector experimental loadings verified and secured for start-up.
_____ b. Flux trap experimental loading verified and secured for start-up, or strainer in place.
_____ c. Check power on and reset, as necessary, silicon integrator, totalizer setting, silicon rotator and alarm system.

REACTOR CONTROL SYSTEM CHECKLIST

_____ 1. All chart drives on; charts timed and dated. IRM recorder to slow.
_____ 2. Fan failure warning system cleared.
_____ 3. Annunciator board energized; horn off.
_____ 4. Television receiver on.
_____ 5. Primary/pool drain collection system in service per SOP.
_____ 6. Secondary system on line per SOP (as needed).
7. Primary system on line per SOP.
_____ a. Primary cleanup system on line.
8. Pool system on line per SOP.
_____ a. Pool cleanup system on line.
_____ b. Pool skimmer system vented.
_____ c. Pool reflector ΔP trips set per SOP.
_____ 9. Valves S1 and S2 cycled in manual mode and positioned as required.
_____ 10. Nuclear Instrumentation check completed per SOP.
_____ a. The following trip values were obtained during the check:

IRM-2, run-in	_____	seconds	Scram	_____	seconds
IRM-3, run-in	_____	seconds	Scram	_____	seconds
WRM-4, run-in	_____	%	Scram	_____	%
PRM-5, run-in	_____	%	Scram	_____	%
PRM-6, run-in	_____	%	Scram	_____	%

_____ 11. Channel 4, 5, and 6 pots returned to last heat balance position.
_____ 12. SRM-1 detector response checked and set to indicate > 1 cps.

Rev. 12/7/82 App'd [signature]

RETURN ORIGINAL TO HEALTH PHYSICS OFFICE　　　　No. ____

WASTE TANK SAMPLE REPORT

TANK NO. ____　　　　TANK LEVEL ____ (Liters

Completed adding water to this tank.　　　　TIME ____ DATE ____

SAMPLER ____　　　　TIME ____ DATE ____

---

1. Analysis Results

Nuclide	Half Life	Physical Form	Concentration (μCi/ml)	MPC	Activity (μCi)
a. H-3	12.3Y				
b.					

pH ____　　　　TOTAL CONCENTRATION (b) ____

Analysis by ____　　　　TIME ____ DATE ____

	Concentration (μCi/m)		Total Volume (liters)		Activity (mci)
(a)		x		=	
(b)		x		=	

2. Approvals Required for:

Any Discharge . . . . ____
Shift Supervisor

Discharge of Total Activity >4 mci or to Secondary System ____
Reactor Manager

Discharge Limit Approved . . . . ____
Health Physics

3. Action Taken

Date Discharged ____ Time Discharged ____ Volume Discharged ____ (Liters)

Tank Discharged to (check one) ___ Sanitary Sewer ___ Secondary System ___ Not Dischar

REMARKS ____

Rev. 12/7/82 App'd J. C. Vha　　　　SOP/A-

REVISION NUMBER 8

TO REVISED OCTOBER 1981 MANUAL

SOP/VII-53	Revised 12/15/82*
SOP/A-11a	Revised 12/15/82**
SOP/A-11b	Revised 12/15/82**

*Brackets added.

**Only page number changed.

5. Add sufficient acid (6 normal) to lower pH to between 5.0 amd 6.0.
6. Secure the acid pump and open the breaker.
7. Shut valves RE5, RE57, RE58 and RE70.
8. Drain and flush the acid mixing tank.
9. Close the acid mixing tank valves.

C. Sparge and recirculate, bypassing the filters, for 30 minutes.

D. Add a special carrier solution which will be provided by the Laboratory Group.

E. Sparge and recirculate, bypassing the filters, for one hour.

F. Raise the pH.
1. Open the WT2 manhole cover.
2. Add sufficient sodium hydroxide to raise the pH to 11.0-14.0.

   Caution: It is better to add too much than not enough.
3. Replace the manhole cover.

G. Sparge and recirculate, bypassing the filter, for 30 minutes.

H. Secure W.T. recirculation and let tank settle for 24 to 48 hours. Then pump (without air sparge) through stand pipe, from WT2 to WT1.]

I. WT1 should now be ready to sample.]

J. Recirculate WT2 through filter until they no longer foul up.]

VII.9 Nitrogen and Valve Operating Air Systems

VII.9.1 Purpose

The primary function of the nitrogen (N_2) system is to provide pressurized N_2 to the pressurizer. The secondary function of the N_2 system is to act as a backup to the air in the valve operating system.

RETURN ORIGINAL TO HEALTH PHYSICS OFFICE   No. ____________

WASTE TANK SAMPLE REPORT

TANK NO. ____________________   TANK LEVEL ______________ (Liter

Completed adding water to this tank.   TIME __________ DATE __________

SAMPLER ______________________   TIME __________ DATE __________

1. Analysis Results

Nuclide	Half Life	Physical Form	Concentration (μCi/ml)	MPC	Activit (μCi)
a. H-3	12.3Y				
b.					

pH __________   TOTAL CONCENTRATION (b) ____________________

Analysis by ______________   TIME __________ DATE __________

	Concentration (μCi/m)		Total Volume (liters)		Activity (mci)
(a)		x		=	
(b)		x		=	

2. Approvals Required for:

Any Discharge . . . . ____________________
Shift Supervisor

Discharge of Total Activity >4 mci or to Secondary System ____________________
Reactor Manager

Discharge Limit Approved . . . . ____________________
Health Physics

3. Action Taken

Date Discharged ______ Time Discharged ______ Volume Discharged ______ (Liters)

Tank Discharged to (check one) ___ Sanitary Sewer ___ Secondary System ___ Not Dischar

REMARKS ____

Rev. 12/15/82   App'd JCM

SOP/A-11a

NOTE: THIS PAGE INTENTIONALLY LEFT BLANK

REVISION NUMBER 9

TO REVISED OCTOBER 1981 MANUAL

SOP/A-4a Revised 1/3/83

UNIVERSITY OF MISSOURI RESEARCH REACTOR FACILITY

App'd ____

Date Rev. 1/3/83

REACTOR SHUTDOWN CHECKSHEET

DATE ____

____ 1. Time of reactor shutdown: ______________________.

____ 2. All blades bottomed and drive mechanism full in.

____ 3. Magnet current switch off.

____ 4. SRM set to required position (≈ 1000 counts if refueling).

____ 5. Reactor primary system shutdown per SOP IV.

____ 6. Pool system shutdown per SOP V.

____ 7. Secondary system shutdown per SOP VI.

____ 8. Cooling tower fans off.

____ 9. Digital readout switch off.

____ 10. Annunciator board on ____ off ____ .

____ 11. Reverse osmosis unit to standby.

____ 12. Sample inventory satisfactory and data sheets updated.

____ 13. Si integrators recorded.

____ 14. All bypass switches off and keys in key box.

____ 15. Master switch off ____ on ____ .

____ 16. DCT system secured.

17. Room 114 check:

____ a. Cooling flow to P501 A/B secured.

____ b. Valves S1 and S2 hydraulic motor off.

____ c. N_2 system and air to valve header secured.

____ d. Calgon units secured.

____ e. Room 114 pump controllers locked out.

____ 18. Completed and logged reactor shutdown checksheet.

____

Senior Reactor Operator

BUILDING SHUTDOWN CHECKSHEET

____ 1. Pool level normal.

____ 2. ARM trip levels set per SOP.

____ 3. Annunciator board off.

____ 4. TV unit secured.

____ 5. ARM and off-gas recorder paper supply okay, charts timed and dated.

____ 6. Primary/pool drain collection system secured per SOP.

____ 7. Routine patrol completed.

____ 8. SRM, IRM, WRM, PRM, ARM and process radiation monitors in operate mode.

____ 9. Master key switch off and in key box.

____ 10. Test of containment intrusion alarm completed. System energized.

____ 11. All keys accounted for.

____ 12. Building shutdown and reactor secured.

____ 13. Control room doors locked.

____ 14. Completed building shutdown checksheet.

____ 15. Logbook entries complete, crews signed out.

____

Senior Reactor Operator

REVISION NUMBER 10

TO REVISED OCTOBER 1981 MANUAL

SOP/A-1a	Revised 1/17/83
SOP/A-1b	Revised 1/17/83*

*Only page number changed.

REACTOR STARTUP CHECKSHEET
FULL POWER OPERATION
(or Low Power Forced Circulation)

DATE: ______________________
TIME (Started) ______________________

BUILDING AND MECHANICAL EQUIPMENT CHECKLIST

____ 1. Run emergency generator for 30 minutes and check the governor oil level. (Required if shutdown for 24 hours or after each maintenance day.)
____ 2. a. Check operation of fan failure buzzer and warning light. Shift fans. (Required if shutdown longer than 4 hours.)
____ b. Test stack monitor per SOP while in west tower.
____ c. Test the stack monitor low flow alarm.
3. Visual check of room 114 equipment completed.
____ a. P501A and P501B coolant water valves open.
____ b. S1 and S2 hydraulic pumps on (oil level normal).
____ c. Pump controllers unlocked to start (as required).
____ d. Insure N_2 backup system on per SOP.
____ e. Open air valve for valve operating header (VOP 31).
____ f. N_2 backup valve open.
____ g. Check valves 599A and 599B open.
____ h. Pipe trench free of water (on Monday startups, check the four-pipe annulus drain valves for water leakage).
____ i. Add DI water to beamport and pool overflow loop-seals.
____ 4. Visual check of CT equipment completed.
____ a. Oil level in CT fans normal (Monday start-ups).
5. Beamport Floor
____ a. Beamport radiation shielding (as required).
____ b. Unused beamports checked flooded (Monday).
____ c. Seal trench low level alarm tested (Monday).
____ 6. Emergency air compressor (load test for 30 minutes on Monday).
7. Reactor Pool
____ a. Reflector experimental loadings verified and secured for start-up.
____ b. Flux trap experimental loading verified and secured for start-up, or strainer in place.
____ c. Check power on and reset, as necessary, silicon integrator, totalizer setting, silicon rotator and alarm system.

REACTOR CONTROL SYSTEM CHECKLIST

____ 1. All chart drives on; charts timed and dated. IRM recorder to slow.
____ 2. Fan failure warning system cleared.
____ 3. Annunciator board energized; horn off.
____ 4. Television receiver on.
____ 5. Primary/pool drain collection system in service per SOP.
____ 6. Secondary system on line per SOP (as needed).
____ 7. Primary system on line per SOP.
____ a. Primary cleanup system on line.
8. Pool system on line per SOP.
____ a. Pool cleanup system on line.
____ b. Pool skimmer system vented.
____ c. Pool reflector ΔP trips set per SOP.
____ 9. Valves S1 and S2 cycled in manual mode and positioned as required.
____ 10. Nuclear Instrumentation check completed per SOP.
____ a. The following trip values were obtained during the check:

IRM-2, run-in	______	seconds	Scram	______	seconds
IRM-3, run-in	______	seconds	Scram	______	seconds
WRM-4, run-in	______	%	Scram	______	%
PRM-5, run-in	______	%	Scram	______	%
PRM-6, run-in	______	%	Scram	______	%

____ 11. Channel 4, 5, and 6 pots returned to last heat balance position.
____ 12. SRM-1 detector response checked and set to indicate > 1 cps.

Rev. 1/17/83 App'd [signature]

13. Check of process radiation monitors (front panel checks).
    ____ a. Fission product monitor.
    ____ b. Secondary coolant monitor.

NOTE: Items 14 through 35 are to be completed in sequence immediately prior to pulling rods for a reactor startup.

____ 14. Annunciator tested.
____ 15. Annunciator alarm cleared or noted.
____ 16. Power selector switch 1S8 in position required.
____ 17. a. Bypass switches 2S40 and 2S41 in position required.
____ b. All keys removed from bypass switches.
____ 18. Master switch 1S1 in "on" position.
____ 19. Magnet current switch on, check "Reactor On" lights.
____ 20. Reactor isolation, facility evacuation and ARMS checks. (Monday start-up). These items are to be checked with scrams and rod run-ins reset, and when appropriate items are actuated, verify that the TAA's do trip.
____ a. Reactor isolation switch (leave valves and doors closed). (Monday start
____ b. Facility evacuation switch (check outer containment horns).(Monday start
____ c. ARMS trip setpoints checked and tripped, check buzzer operational locall for all channels and remotely for channels 1 through 4 and 9.
____ Channel 1 - Beam Room South Wall
____ Channel 2 - Beam Room West Wall
____ Channel 3 - Beam Room North Wall
____ Channel 6 - Cooling Equipment Room 114
____ Channel 7 - Building Exhaust Air Plenum (Monday start-up)
____ Channel 8 - Reactor Bridge (switch in "Normal") (Monday Start-up)
____ Channel 9 - Reactor Bridge backup (switch in "upscale") (Monday Start-up
____ d. Check HV readings: ____________ volts.
____ e. Check 150V reading: ____________ volts.
____ f. Selector switch on ARMS in position 5.
____ g. Trip backup monitor with attached source.
____ h. Reactor isolation horns switch in "Isolation Horns On" position. Valves doors open.
____ i. All ARMS trips set per SOP.
____ j. Check ventilation fans, containment and backup doors.
____ 21. Operate reg blade from full-out to full-in and set at 10" $\pm$ .05".
____ a. Check rod run-in function at 10% withdrawn and annunciator at rod bottom
____ 22. Raise blade A to 2" and manually scram.
____ 23. Raise blade B to 2" and trip manual rod run-in.
____ 24. Raise blade C to 2" and scram by WRM trip.
____ 25. Raise blade D to 2" and scram by IRM trip.
____ 26. Annunciator board energized; horn on.
____ 27. Jumper and tag log cleared or updated.
____ 28. IRM recorder in fast speed.
____ 29. Check magnet current for 90 ma on each magnet.
____ 30. Cycle WRM range switch.
____ 31. Predicted critical blade position (__________ inches).
____ 32. Pre-startup process data taken.
____ 33. Visually check room 114 and D.I. area after all systems are in operation.
____ a. Check oil reservoir for pump P501A, P501B, and P533 for adequate supply. Add if necessary. Vent the 6000 gallon pool hold up tank.
____ 34. Routine patrol completed.
____ 35. Reactor ready for startup.

Time (Completed) ____________

____
Senior Reactor Operator

REVISION NUMBER 11

TO REVISED OCTOBER 1981 MANUAL

SOP/VIII-7	Revised 4/7/83
SOP/VIII-11a	Revised 4/7/83
SOP/VIII-11b	Revised 4/7/83
SOP/VIII-12a	Revised 4/7/83*
SOP/VIII-12b	Revised 4/7/83*
SOP/VIII-43a	Revised 4/7/83
SOP/VIII-43b	Revised 4/7/83*
SOP/VIII-44a	Revised 4/7/83*
SOP/VIII-44b	Revised 4/7/83*
SOP/A-1b	Revised 2/8/82
SOP/A-6a	Revised 3/9/83
SOP/A-7a	Revised 3/25/83

*Page number changed only.

threaded) or a sealed quartz vial. The quartz vials have a very low rupture pressure so precautions must be taken to eliminate possible pressure build-up when quartz vials are used.

Sample cans will be weighted if necessary to insure that the sample has negative buoyancy.

VIII.2.3 Flux Trap Irradiations

Since the flux trap region has a positive temperature and void coefficient of reactivity, additional limitations are placed on all samples to be irradiated in the flux trap.

All flux trap samples will be seal-welded, leak checked and will have a negative buoyancy.

The flux trap sample holder will be loaded or removed from the reactor only when the reactor is shutdown. The flux trap sample holder must be securely latched in place while it is in the reactor. DO NOT under any circumstances unlatch the flux trap until the control blades are full in.

For verification that the flux trap is properly latched, an operator other than the operator inserting the flux trap will visually observe its proper latching.

All flux trap irradiations will be shown on a flux trap loading sheet (Appendix A) which must be signed by the Reactor Service Engineer. If the sample loading is unique the Reactor Physicist will check the Service Engineer's calculations of the total reactivity worth and will also sign the loading sheet.

If there are insufficient samples to fully load the flux trap sample holder, the holder will be loaded with aluminum spacers to insure that the samples cannot move during reactor operation. The sample hold-down rod must be securely pinned or wired to the sample holder to satisfy the Technical Specification requirement of a secured experiment. When the loading of each]
tube in the flux trap is completed, the operator shall verify]
that the proper sample height loading has been achieved by lift-]
ing the unloading rod to the mark and observing that the top of]
the highest sample is in line with the unloading door.]

F. 1. Natural uranium;
   2. Special nuclear materials as defined in Title 10, Part 70, Paragraph 70.4m of the Federal Code of Regulations (i.e., plutonium, uranium-233, or uranium enriched in isotope 233 or 235);
   3. Pure elements: Li, Na, K, Rb, Cs, Ca, Sr, Ba, Hg, Os, H, O, F, Ne, Ar, Kr, Xe, and P;
   4. Compounds: NH_4NO_3, CaC_2, CaO, perchlorates, permanganates, Na_2O, and Na_2O_2;
   5. Materials which chemically react with water to produce undesirable quantities of heat and pressure;
   6. Any explosive, flammable, combustible, or toxic materials.

E. Capsules may be run shielded with cadium or boron (as boron, BC, or BN) but weight and time are restricted due to the heat generated and their reactivity effect on the reactor. The experimenter shall take measures to insure the heat generated can be dissipated without causing damage to the rabbit or sample. The following limitations apply to shielded capsules in addition to the activity limits of Section VIII.3.2.A:
   1. The authorized p-tube user will inform the control room he is going to run shielded capsules and will insert the rabbit so that the cap is on top when the rabbit is in the reactor.
   2. Cadium shielded capsules:
      a. 5 or less grams of cadium may be run for up to 30 minutes.
      b. 50 or less grams of cadium may be run for up to 10 seconds in row 1 or 20 seconds in row 2.
   3. Boron shielded capsules:
      NOTE: The weight limit is only on the boron, i.e., the carbon weight in BC does count towards the weight limit.

a. 10 or less grams of boron may be run for up to]
10 seconds in row 1 or 20 seconds in row 2.]

b. Between 10 to 15 grams of boron may be run up to]
10 seconds in row 1 or 20 seconds in row 2, but]
must be approved by Director of NAP and Reactor]
Manager prior to running.]

F. Except for the boron or cadium shielded samples, the con-]
trolling factor for determining the weight and time limits
of a sample to be irradiated in the p-tube is the activity
limitation of Section A. If the activity limits do not]
further restrict a sample's size, the following weight
limits shall apply:

1. For irradiation times up to 30 minutes, the maximum weight of irradiated materials in one rabbit will be 2 grams with two exceptions:
   a. A maximum of 10 grams of water or dried feces;
   b. Only 1 mg of chemical compounds in solution.
2. For irradiation times of 30 minutes to 1 hour, the maximum weight of irradiated materials in one rabbit will be 1 gram with two exceptions:
   a. A maximum of 10 grams of water or dried feces;
   b. Only 500 µg of chemical compounds in solution.

The weight limits above do not include the weight of the rabbit, polyethylene vial, or packing, or the cadmium (or other metal) shields.

The maximum irradiation time for most samples will be one hour at power levels $\leq$ 5 MW and 30 minutes for power levels > 5 MW. Hair, fibers, paint, air filters and flux monitors may be irradiated for a maximum of 4 hours at power levels $\leq$ 5 MW and 2 hours at power levels > 5 MW. The following additional limitations shall apply for irradiations > 10 minutes:

1. Primary encapsulation will be heat-sealed high-density polyethylene vials (Folland vials).
2. Liquid samples may be irradiated for up to 30 minutes provided pin holes are punched in the top of the polyethylene vial to relieve pressure.

Deviations from the above weight and time limitations must be specifically authorized in the experimenter's RUR.

VIII.3.3 Rabbit Limitations

A. Two types of rabbits are presently authorized for use in the p-tube system. The most commonly used rabbit is the low density polyethylene rabbit. The minimal cost of this rabbit makes it ideally suited for short irradiations in which the sample is a solid and the weight is small. These rabbits are very susceptible to radiation damage and have led to rabbit failure when they were used a number of times. Low density rabbits will therefore be used only once in the p-tube system and will not be used for irradiations greater than 10 minutes.

B. The second type of rabbit which may be used in the p-tube system is the high density rabbit. This type of rabbit will be used for all irradiations greater than ten minutes and for most liquid and powder irradiations (see Section VIII.3.2.B). Each high density rabbit will be limited to six insertions or two hours of total irradiation, whichever occurs first. To account for the irradiation history of high density rabbits, the experimenter will place one mark with a marking pen on the high density rabbit for

NOTE: THIS PAGE INTENTIONALLY LEFT BLANK

VIII.6.7 Remove Irradiated Roll from Rewind Stand

To remove irradiated film from the shield box one of the following two conditions must be met:

1. Eight hours decay time from completion of irradiation, or
2. a. Two hours decay time from completion of irradiation.
   b. Roll heading <500 mR/hr.
   c. Health Physics Technician present.
   d. Roll storage to be in the shielded steel box.

If an irradiated roll is to be stored outside the shielded box the radiation reading at the roll must be <100 mR/hr.

General: Consider all items inside the shield box as contaminated. Experience has shown contamination to be smearable but fixed sufficiently so that it does not blow around. The contamination levels on the bowed roller (light colored rubber) and the lay-on roller (black roller) will be quite high. The pinch roll (black rubber) will also be contaminated but it is relatively inaccessible.

A. Make sure the splined shaft coupling is disconnected from the rewind roll shaft.
B. Raise LAY-ON.
C. Cut the film near the roll.
D. Secure the end of the film on the roll with scotch tape.
E. Wrap a layer of plastic around the roll and secure it with tape.
F. Open the bearing caps.
G. Depending on roll size, follow procedure below.
   1. Fifty pound roll
      a. Lift the roll off the unwind stand and lay the roll on a piece of sponge rubber.
      b. Deflate the unwind shaft and remove it and the adapter from the roll.
      c. Set the shaft and adapter on paper.
      d. Tuck the ends of the plastic roll wrap inside the core tube.

e. Lift the roll and place it in the box it came out of.

f. Inset core tube shipping adapter in the end of the core tube.

g. Close the box with duct tape.

h. Write roll I.D. number on box.

i. Have Health Physics survey the box and record appropriate radiation level on the box.

j. Move the box to storage.

2. Greater than fifty pound roll (up to 300 lbs)
   a. Have either a shipping container or a roll support stand available to hold the roll.
   b. Place the large sling around the roll and lift it off the unwind stand with the MURR crane.
   c. Deflate the unwind shaft and remove it and the core tube adapter from the roll. It is convenient to store the adapter and rewind shaft back on the rewind stand.
   d. Place the film roll on the cantilevered shaft of the shipping container or the roll support stand.
   e. Remove the sling.
   f. If the shipping container is used, place the retainer ring on the shaft to hold the core tube in place and install the shipping container cover.
   g. Mark the container or roll with the radiation level and move the roll or container to storage.

VIII.6.8 Install New Core Tube on Rewind Stand

A. Put core tube adapter and rewind shaft inside core tube.
   NOTE: Make sure core tube is wide enough for the next roll.
B. Center the adapter and shaft in the core tube.
C. Inflate the unwind shaft. -
D. Put the assembly on the bearings and close and latch the bearing caps.
E. Paint the north end of the core tube black.
F. With measuring tape, mark the center of the core tube.
G. Measure from inside of left bearing block to the center of the core tube. The center should be 12" ± 1/8" from the inside edge of the left bearing block.
H. If necessary, deflate the rewind shaft, relocate the core tube and re-inflate the shaft.
I. Pull the film end from the raised lay-on roll to the core tube and lay it smoothly over the core tube.

NOTE: THIS PAGE INTENTIONALLY LEFT BLANK

REACTOR STARTUP CHECKSHEET, FULL POWER OPERATION (Cont'd)

13. Check of process radiation monitors (front panel checks).
   ______ a. Fission product monitor.
   ______ b. Secondary coolant monitor.

NOTE: Items 14 through 35 are to be completed in sequence immediately prior to pulling rods for a reactor startup.

______ 14. Annunciator tested.
______ 15. Annunciator alarm cleared or noted.
______ 16. Power selector switch 1S8 in position required.
______ 17. a. Bypass switches 2S40 and 2S41 in position required.
______ b. All keys removed from bypass switches.
______ 18. Master switch 1S1 in "on" position.
______ 19. Magnet current switch on, check "Reactor On" lights.
______ 20. Reactor isolation, facility evacuation and ARMS checks. (Monday start-up). These items are to be checked with scrams and rod run-ins reset, and when appropriate items are actuated, verify that the TAA's do trip.
______ a. Reactor isolation switch (leave valves and doors closed). (Monday start
______ b. Facility evacuation switch (check outer containment horns).(Monday start
______ c. ARMS trip setpoints checked and tripped, check buzzer operational locally for all channels and remotely for channels 1 through 4 and 9.
______ Channel 1 - Beam Room South Wall
______ Channel 2 - Beam Room West Wall
______ Channel 3 - Beam Room North Wall
______ Channel 4 - Fuel Storage Vault
______ Channel 6 - Cooling Equipment Room 114
______ Channel 7 - Building Exhaust Air Plenum (Monday start-up)
______ Channel 8 - Reactor Bridge (switch in "Normal") (Monday Start-up)
______ Channel 9 - Reactor Bridge backup (switch in "upscale") (Monday Start-up
______ d. Check HV readings: ______________ volts.
______ e. Check 150V reading: ______________ volts.
______ f. Selector switch on ARMS in position 5.
______ g. Trip backup monitor with attached source.
______ h. Reactor isolation horns switch in "Isolation Horns On" position. Valves doors open.
______ i. All ARMS trips set per SOP.
______ j. Check ventilation fans, containment and backup doors.
______ 21. Operate reg blade from full-out to full-in and set at 10" $\pm$ .05".
______ a. Check rod run-in function at 10% withdrawn and annunciator at rod bottom
______ 22. Raise blade A to 2" and manually scram.
______ 23. Raise blade B to 2" and trip manual rod run-in.
______ 24. Raise blade C to 2" and scram by WRM trip.
______ 25. Raise blade D to 2" and scram by IRM trip.
______ 26. Annunciator board energized; horn on.
______ 27. Jumper and tag log cleared or updated.
______ 28. IRM recorder in fast speed.
______ 29. Check magnet current for 90 ma on each magnet.
______ 30. Cycle WRM range switch.
______ 31. Predicted critical blade position (__________ inches).
______ 32. Pre-startup process data taken.
______ 33. Visually check room 114 and D.I. area after all systems are in operation.
______ a. Check oil reservoir for pump P501A, P501B, and P533 for adequate supply. Add if necessary. Vent the 6000 gallon pool hold up tank.
______ 34. Routine patrol completed.
______ 35. Reactor ready for startup.

Time (Completed) ______________

____
Senior Reactor Operator

CORE: ____________ STARTUP NUCLEAR DATA Date: ________

TIME	APP. BANK POS.	RR POS.	SRM POS.	SRM-1	IRM-2	IRM-3	WRM-4	PROCEEDINGS

Critical Rod Position A ______ B ______ C ______ D ______ RR ______ ECP ______
Power at Critical Position ______ Pri. Temp ______/______ Pool Temp. ______/______

Operator/Remarks: ____________

CORE: ____________ Date: ________

TIME	APP. BANK POS.	RR POS.	SRM POS.	SRM-1	IRM-2	IRM-3	WRM-4	PROCEEDINGS

Critical Rod Position A ______ B ______ C ______ D ______ RR ______ ECP ______
Power at Critical Position ______ Pri. Temp. ______/______ Pool Temp. ______/______

Operator/Remarks: ____________

CORE: ____________ Date: ________

TIME	APP. BANK POS.	RR POS.	SRM POS.	SRM-1	IRM-2	IRM-3	WRM-4	PROCEEDINGS

Critical Rod Position A ______ B ______ C ______ D ______ RR ______ ECP ______
Power at Critical Position ______ Pri. Temp. ______/______ Pool Temp. ______/______

Operator/Remarks: ____________

Rev. 3/9/83 App'd ____________

Sheet No: ___________ Date: ___________

PNEUMATIC TUBE IRRADIATIONS

Run No.	Clock Time In	Clock Time Out	Name	Project No.	Room No.	Irradiation Min.	Irradiation Sec.	File No
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								

Rev. 3/25/83 App'd [illegible]

REVISION NUMBER 12

TO REVISED OCTOBER 1981 MANUAL

SOP/VIII-51	Revised 5/23/83
SOP/VIII-52	Revised 5/23/83

D. Turn on drive motor.

NOTE: Ensure take-up reel is turning. If not, immediately stop machine.

E. Run film approximately five (5) meters at four (4) to five (5) meters per minute.

F. Turn off drive motor. Leave speed set at running speed.

G. Turn off lamp.

H. Log entry.

VIII.7 Thermal Column Door Operations]

VIII.7.1 Opening The Thermal Column Door]

NOTE: Do not open thermal column door with the reactor critical.]

1. Clear all obstructions from behind thermal column door.]
2. Verify air off to Radiograph with Control Room.]
3. Disconnect air supply line on thermal column door at the snap fitting.]
4. Preparation of Nuclepore Case:]
   A. Decouple Nuclepore take-up shaft.]
   B. Remove alignment pins from shield box door.]
   C. Roll shield box cover as far back along track as possible. (NOTE: If thermal column door must be backed out further than this, attach shield box door lifting rig and move to south side of the platform using the building crane.)]
   D. Decouple Nuclepore drive shaft.]
   E. Decouple Nuclepore rabbit drive. (NOTE: Remove rubber grommet and store.)]
   F. Secure air to the Nuclepore equipment.]
   G. Disconnect PVC air lines to the drive roll.]
5. Unstack shielding as necessary to allow free movement of the door.]
6. Plug in thermal column door drive motors (2).]

7. Back out thermal column door approximately six (6) inches.
8. Disconnect four (4) PVC lines connected to the top of the Nuclepore Irradiator Case.
9. With Health Physics coverage, open the thermal column door to the desired position.

VIII.7.2 Shutting The Thermal Column Door

1. Shut the thermal column door far enough to allow the four (4) PVC lines to be reconnected to the Nuclepore Irradiator Case.
2. Reconnect the four (4) PVC lines.
3. Completely shut the thermal column door while monitoring to insure that the four (4) PVC lines do not become pinched off.
4. Verify the thermal column door open limit switch has cleared in the Control Room.
5. Unplug the thermal column door drive motors.
6. Restack shielding on the top of the thermal column.
7. Connect the Radiograph air supply line to the regulator assembly.
8. Install the platform deck plates.
9. Nuclepore Experiment:
    A. Recouple and lock Nuclepore drive roll.
    B. Attach PVC air lines to the drive roll.
    C. Install rubber grommet and attach rabbit drive mechanism.
    D. Place shield box door back on rails and shut it. Pin door fully shut.
    E. Recouple take-up spline coupling.
    F. Open Nuclepore air supply valve and reset all tension controls.
    G. Test run film.
    H. Place the experiment in its desired operational mode in accordance with approved procedures.
10. Inform operators of the system status.

SECTION III

1983 REVISIONS TO THE HAZARDS SUMMARY

The third paragraph of section 8.4 is deleted and replaced by the following two paragraphs.

A plenum plate adaptor (plenum, design duplicates the reflector plenum plate between Beamports A and D) was inserted occupying the two large graphite element positions on both sides of the reg. blade and new irradiation baskets inserted. This includes one 15° solid aluminum element with a two inch and a three inch irradiation basket; one 30° graphite element; a two inch row two irradiation element and two small graphite elements. All the wedge irradiation baskets and each of the three inch baskets have self powered neutron detectors monitoring the irradiation spaces.

All samples that are irradiated are verified to be covered by an approved RUR, prepared, and scheduled for irradiation by the Reactor Services group. A record is kept of all irradiations. Various forms are now utilized. The type of form is determined by the type of sample and position required for irradiation.

SECTION IV

PLANT AND SYSTEM MODIFICATIONS

AUGUST 1982

Modification 81-23: This modification installed phonojacks in the power supply leads for the valve 552A and 552B solenoids (primary vent valves). The jacks are of the normally closed type and require the insertion of a plug for compliance testing. This modification provides a safer and more reliable method for interrupting power to these valves than the old method which involved the lifting of electrical leads. The continuity of the power supply to the valves is checked in the last steps of compliance testing.

Modification 81-23 presents no unresolved safety questions. It increases operator safety while working with electrical control systems.

NOVEMBER 1982

Modification 82-1: This modification installed an adaptor fixture in the reflector tank to accommodate small 15° graphite irradiation elements replacing two existing graphite elements on either side of the regulating blade.

Modification 82-4: This modification placed a 15° solid aluminum reflector element in the south position adjacent to offset "B", created by Modification 82-1. This element has a 2" diameter sample position and a 3" diameter sample position. These sample positions are instrumented with self powered neutron detectors. The north position created by 82-1, adjacent to offset "C", currently uses previously installed H-1, H-2, and H-3 elements.

Modifications 82-1 and 82-4 present no unresolved safety questions. These modifications increase the sample irradiation facilities in the reflector region consistent with existing installed assemblies.

JANUARY 1983

Modification 83-1: This modification installed 1/4" O.D. x 3" long stainless steel pins, with ring clips threaded through the eyelet at each end, in the valve operating linkage for valves 543A and 543B. The installation of these pins with ring clips, in the valve operator linkage coupling, prevents the pins from falling out.

Modification 83-1 presents no unresolved safety questions. This modification increases the reliability of the operation of the 543 valves.

SECTION V

NEW TESTS AND EXPERIMENTS

New experimencal programs during the period of July 1982 through June 1983 are as follows.

RUR264 Experimenter: Don Alger/John Lindsay

Description: Installation of a new neutron radiography facility was completed in July 1982 with the capability to do real-time neutron radiography or conventional film radiography. The facility was designed to allow radiography of larger objects and to have a lower radiation level next to the unit compared to the old neutron radiography facility.

SECTION VI

SPECIAL NUCLEAR MATERIAL ACTIVITIES

1 July 1982 through 30 June 1983

1. SNM Receipts: During the year, the MURR received fuel from Rockwell International Energy Systems Group (Atomics International). In December of 1982, the fuel fabrication facility at Atomics International was closed and fabrication equipment was transferred to Babcock & Wilcox (B & W) at Lynchburg, Virginia. Fuel elements that were stored at Atomics International were also transferred to B & W for storage and eventual shipment to MURR when required for entry into the reactor fuel cycle. A total of 27 new fuel elements were received.

Shipper	Elements	Grams U	Grams U-235
Atomics Int'l.	94, 95, 96, 97, 98, 99, 100, 101, 118, 119, 120, 121	22,388	20,853
B & W	150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 164, 165		

2. SNM Shipments: Spent fuel elements were shipped to Exxon Nuclear Company, Inc., Idaho Falls, Idaho, for reprocessing.

Shipper	Elements	Grams U	Grams U-235
MURR	17, 21, 26, 31, 33, 43, 46, 48, 15, 22, 27, 29, 53, 54, 63, 65	10,766	9,387

3. Inspections: No Special Nuclear Material Inspection was performed during this fiscal year.

4. SNM Inventory: As of 30 June 1983, the MURR financially responsible inventory was as follows:

Total U = 45,327

Total U-235 = 40,436

All of this material is physically located at the MURR.

Fuel elements on hand have accumulated the following burnup as of 30 June 1983:

Fuel Element Number	Accumulated Megawatt Days	Fuel Element Number	Accumulated Megawatt Days	Fuel Element Number	Accumulated Megawatt Days
M041	146.45	M078	146.52	M0100	88.53
M055	149.31	M079	115.35	M0101	86.17
M056	147.83	M080	146.15	M0118	94.61
M057	149.31	M081	144.46	M0119	87.84
M059	146.10	M082	114.98	M0120	94.61
M060	146.10	M083	144.46	M0121	87.84
M061	145.43	M084	142.87	M0150	73.47
M062	145.43	M085	142.87	M0151	96.16
M064	141.60	M087	147.57	M0152	73.47
M066	141.60	M088	10.69	M0153	96.16
M067	146.75	M089	147.57	M0154	67.21
M068	134.99	M090	116.69	M0155	33.56
M069	146.75	M091	112.31	M0156	67.21
M070	106.65	M092	116.69	M0157	33.56
M071	147.83	M093	112.31	M0158	15.13
M072	143.86	M094	115.13	M0159	15.13
M073	109.09	M095	128.94	M0160	0
M074	143.86	M096	115.13	M0161	0
M075	110.17	M097	128.94	M0162	0
M076	134.99	M098	88.53	M0164	0
M077	107.72	M099	86.17	M0165	10.69

Average Burnup = 102.15 MWD

Also MURR owns a total of 134 grams U and 54 grams U-235.

SECTION VII

REACTOR PHYSICS ACTIVITIES

July 1, 1982 through June 30, 1983

1. Fuel Utilization: During this period, the following elements reached their licensed burnup and were retired.

Serial Number	Core Designation	Date Last Used	MWDs
M067	AO-23	8-22-82	146.75
M069	AO-23	8-22-82	146.75
M059	AO-29	10-10-82	146.10
M060	AO-29	10-10-82	146.10
M064	AO-40	12-20-82	141.60
M066	AO-40	12-20-82	141.60
M081	AO-41	1-03-83	144.46
M083	AO-41	1-03-83	144.46
M072	AP-7	2-28-83	143.86
M074	AP-7	2-28-83	143.86
M061	AP-9	3-20-83	145.44
M062	AP-9	3-20-83	145.44
M078	AP-8	3-07-83	146.52
M080	AP-8	3-07-83	146.15
M056	AP-10	3-28-83	147.83
M071	AP-10	3-28-83	147.83
M087	AP-15	5-08-83	147.58
M089	AP-15	5-08-83	147.58
M084	AP-19	6-06-83	142.87
M085	AP-19	6-06-83	142.87
M068	AP-20	6-12-83	135.00
M076	AP-20	6-12-83	135.00

Normally 24 fuel elements are listed as retired, but due to increased shipping costs for new and irradiated fuel, fuel elements that cannot be utilized during a normal fuel cycle (previous definition for retirement) are retained in the active fuel cycle structure for possible use in an abbreviated fuel cycle.

Due to requirements of having less than 5 kg of unirradiated fuel on hand at one time, initial criticalities are normally conducted with four new elements or fewer as conditions dictate. A core designation consists of eight fuel elements of which only initial critical fuel element serial numbers are listed in the following table. To increase operating efficiency, fuel elements are used in mixed core loading, therefore, a fuel element fabrication core number is different from its core load number.

Fabrication Core No.	Serial No.	Core Load Designation	Initial Operating Date
32	M094	A0-23	8-09-82
32	M096	A0-23	8-09-82
32	M095	A0-25	8-30-82
32	M097	A0-25	8-30-82
32	M098	A0-29	10-04-82
32	M099	A0-29	10-04-82
32	M0100	A0-29	10-04-82
33	M0101	A0-29	10-04-82
35	M0119	A0-36	11-19-82
35	M0121	A0-36	11-19-82
35	M0118	A0-40	12-13-82
35	M0120	A0-40	12-13-82
39	M0150	AP-7	2-14-83
39	M0151	AP-7	2-14-83
39	M0152	AP-7	2-14-83
39	M0153	AP-7	2-14-83
39	M0154	AP-10	3-20-83
39	M0156	AP-10	3-20-83
39	M0155	AP-15	4-26-83
39	M0157	AP-15	4-26-83
31	M088	AP-20	6-07-83
40	M0165	AP-20	6-07-83
40	M0158	AP-23	6-19-83
40	M0159	AP-23	6-19-83

2. Fuel Shipping: Sixteen spent fuel elements were shipped from our facility during the fiscal year. The following list contains the serial numbers of the fuel elements that were shipped.

M015	M026	M033	M053
M017	M027	M043	M054
M021	M029	M046	M063
M022	M031	M048	M065

3. Fuel Procurement: At the present time, the Babcock & Wilcox Company is establishing facilities to fabricate MURR fuel at Lynchburg, Virginia. This work is contracted with U.S.D.O.E. and administered by the Idaho Operations Office.

4. Licensing Activities: A physical security plan (10CFR70:67) that was submitted May, 1980 was reviewed by the NRC and our staff in May 1983. A revised physical security plan was submitted in June 1983 and final approval is still pending. A reactor emergency plan was submitted in September of 1982 and approval is pending. A request for an increase in Special Nuclear Material Inventory under our Facility License was submitted in December of 1982. A revision to Technical Specifications 4.4.d requiring two pool pumps operating submitted in February 1982 is still pending.

   No changes were made to our Facility License No. R-103 (Docket No. 50-186) during this fiscal year. The latest amendment to our license is Amendment 14 which was issued April 14, 1981.

5. Reactor Characteristic Measurements: During the fiscal year, 47 reactor refueling evolutions were completed. An excess reactivity verification was performed for each refueling and the average excess reactivity was 3.06%. MURR Technical Specification requires an excess reactivity value of less than 9.8%.

   Reactivity measurements were performed for 31 evolutions to verify reactivity parameters for the flux trap. Shim blade calibrations were performed at selected rod heights in support of reactivity measurements.

   A physical inspection of the following fuel elements was performed to verify the operational parameters:

M056	from	Core 27	during April 1983
M061	from	Core 28	during April 1983
M062	from	Core 28	during April 1983
M071	from	Core 29	during April 1983
M078	from	Core 30	during April 1983
M087	from	Core 31	during April 1983

All measurements were within operational requirements.

Computer analysis of the reactor core is being accomplished using Citation Computer Code. A master's degree will be awarded to Larry Livingston for his work in this area.

SECTION VIII

SUMMARY OF RADIOACTIVE EFFLUENTS RELEASED TO THE ENVIRONMENT

Sanitary Sewer Effluent
From 7-1-82 through 6-30-83
Descending Order of Activity Released

Nuclide	Amount (Ci)	Nuclide	Amount (Ci)	Nuclide	Amount (Ci)
H-3	8.594E-01	AG-110M	1.652E-04	AU-198	1.113E-05
S-35	5.510E-01	LA-140	1.630E-04	CO-57	8.715E-06
ZN-65	3.203E-02	SN-113	1.363E-04	I-133	5.867E-06
CO-60	2.303E-02	RE-188	1.351E-04	NI-65	5.531E-06
CR-51	1.446E-02	RB-86	1.128E-04	NA-22	4.943E-06
SB-124	7.492E-03	CD-109	1.058E-04	CD-115	4.058E-06
TA-182	2.638E-03	RU-103	9.503E-05	CO-56	3.108E-06
MN-54	1.816E-03	TC-99M	9.077E-05		
SC-46	1.602E-03	NB-95	8.866E-05		
NA-24	1.191E-03	ZR-95	5.946E-05		
CO-58	1.033E-03	MO-99	5.843E-05		
RE-186	8.715E-04	I-131	5.803E-05		
CU-64	9.420E-04	BA-133	4.653E-05		
AS-77	5.861E-04	BA-139	4.515E-05		
TE-125M	5.474E-04	TA-183	4.199E-05		
SB-125	5.428E-04	SB-122	3.865E-05		
FE-59	3.382E-04	MN-56	3.100E-05		
BA-140	2.473E-04	HG-203	2.987E-05		
CS-137	2.332E-04	ZN-69M	2.651E-05		
CS-134	2.230E-04	K-42	1.658E-05		
SE-75	2.041E-04	GA-72	1.490E-05		

Stack Effluent
From 7-1-82 through 6-30-83
Descending Order of Activity Released

Nuclide	Amount (Ci)	Nuclide	Amount (Ci)	Nuclide	Amount (Ci)
AR-41	1.714E+03	CE-144	7.965E-06	CO-57	2.625E-07
H-3	1.270E+01	XE-131M	7.477E-06	MN-54	2.615E-07
I-133	1.627E-03	NA-24	3.929E-06	ZN-69M	2.535E-07
I-135	1.131E-03	CS-138	3.742E-06	AG-110M	2.107E-07
I-131	1.109E-03	SN-113	3.736E-06	BA-131	1.864E-07
I-134	5.717E-04	RB-86	3.342E-06	LA-140	1.754E-07
AS-77	5.001E-04	CE-139	2.548E-06	CS-137	1.726E-07
K-40	4.487E-04	CO-60	2.362E-06	NB-95	1.501E-07
XE-135M	3.759E-04	TC-101	2.144E-06	TE-123M	1.353E-07
I-132	3.092E-04	BA-140	1.591E-06	TE-123	1.073E-07
CL-38	2.602E-04	TE-132	1.556E-06	NA-22	1.048E-07
BR-82	1.057E-04	CR-51	1.182E-06	AU-198	9.716E-08
SE-75	4.260E-05	ZN-65	9.978E-07	AU-196	7.239E-08
XE-133	3.663E-05	KR-87	9.550E-07	TC-99M	6.308E-08
HG-203	3.422E-05	IN-114M	8.270E-07	HF-181	2.975E-08
BA-139	3.337E-05	CE-134	7.233E-07		
RE-188	3.124E-05	NI-65	7.158E-07		
XE-135	2.963E-05	CO-58	7.108E-07		
BI-214	2.955E-05	FE-59	5.916E-07		
AS-76	2.885E-05	KR-85M	5.849E-07		
PB-214	1.947E-05	EU-152	5.664E-07		
I-128	1.365E-05	GA-72	4.670E-07		
RE-186	1.355E-05	CD-115	2.660E-07		

SECTION IX

SUMMARY OF ENVIRONMENTAL SURVEYS

Environmental samples are collected two times per year at nine locations and analyzed for radioactivity. These locations are shown in Figure 1. Soil and vegetation samples are taken at each location. Water samples are taken at four of the nine locations. Results of the samples are shown in the following tables.

Detection Limits

Matrix	Alpha	Beta	Gamma	Tritium
Water	0.2 pCi/l	2.5 pCi/l	0.04 pCi/l	9.1 pCi/ml
Soil and vegetation	0.2 pCi/g	2.5 pCi/g	0.04 pCi/g	9.1 pCi/g

1. Sampling Date: 10-27-82

Determined Radioactivity Levels
Vegetation Samples

Sample	Beta pCi/g	Alpha pCi/g	3H pCi/ml	Gamma pCi/g
1-V-22	15.2	< .2	< 9.1	< 0.04
2-V-22	13.0	< .2	< 9.1	< 0.04
3-V-22	12.1	< .2	< 9.1	< 0.04
4-V-22	15.2	< .2	< 9.1	< 0.04
5-V-22	18.1	.5	< 9.1	< 0.04
6-V-22	10.9	.3	< 9.1	< 0.04
7-V-22	12.7	< .2	< 9.1	< 0.04
8-V-22	8.4	< .2	< 9.1	< 0.04
9-V-22	12.2	< .2	< 9.1	< 0.04

Determined Radioactivity Levels
Water Samples

Sample	Beta pCi/l	Alpha pCi/l	3H pCi/ml	Gamma pCi/l
4-W-22	< 2.5	.2	< 9.1	< 0.04
6-W-22	3.6	< .2	< 9.1	< 0.04
8-W-22	7.2	< .2	< 9.1	< 0.04
9-W-22	13.3	.4	< 9.1	< 0.04

Determined Radioactivity Levels
Vegetation Samples

Sample	Beta pCi/g	Alpha pCi/g	Gamma pCi/g
1-S-22	6.9	< .2	< 0.04
2-S-22	6.2	.5	< 0.04
3-S-22	6.2	.5	< 0.04
4-S-22	5.9	< .2	< 0.04
5-S-22	7.3	.3	< 0.04
6-S-22	6.7	< .2	< 0.04
7-S-22	3.9	< .2	< 0.04
8-S-22	5.2	< .2	< 0.04
9-S-22	7.9	.5	< 0.04

2. Sampling Date: 4-28-83

Determined Radioactivity Levels
Vegetation Samples

Sample	Alpha pCi/g	Beta pCi/g	Gamma pCi/g	Tritium (pCi/ml)
1-V-23	0.3	18.3	< 0.04	< 9.1
2-V-23	< 0.2	29.8	< 0.04	< 9.1
3-V-23	< 0.2	20.9	< 0.04	< 9.1
4-V-23	< 0.2	29.1	< 0.04	< 9.1
5-V-23	< 0.2	28.1	< 0.04	< 9.1
6-V-23	< 0.2	27.2	< 0.04	< 9.1
7-V-23	< 0.2	16.9	< 0.04	< 9.1
9-V-23	< 0.2	25.2	< 0.04	< 9.1

Determined Radioactivity Levels
Soil Samples

Sample	Alpha pCi/g	Beta pCi/g	Gamma pCi/g
1-S-23	0.24	4.0	< 0.04
2-S-23	0.37	9.0	< 0.04
3-S-23	0.33	5.7	< 0.04
4-S-23	0.27	8.4	< 0.04
5-S-23	0.46	8.2	< 0.04
6-S-23	0.25	6.9	< 0.04
7-S-23	0.31	12.3	< 0.04
9-S-23	0.37	11.0	< 0.04
10-S-23	0.29	12.4	< 0.04

Determined Radioactivity Levels
Water Samples

Sample	Alpha pCi/l	Beta pCi/l	Gamma pCi/l	Tritium (pCi/ml)
4-W-23	0.4	5.0	< 0.04	< 9.1
6-W-23	< 0.2	4.7	< 0.04	< 9.1
9-W-23	< 0.2	38.4	371 pCi/l of I-131	< 9.1
10-W-23	< 0.2	6.7	< 0.04	< 9.1

Radiation and Contamination Surveys

The following table gives the number of surveys performed during FY 82-83.

Radiation	Contamination
406	305

Sixty-eight (68) Radiation Work Permits were issued during the year.

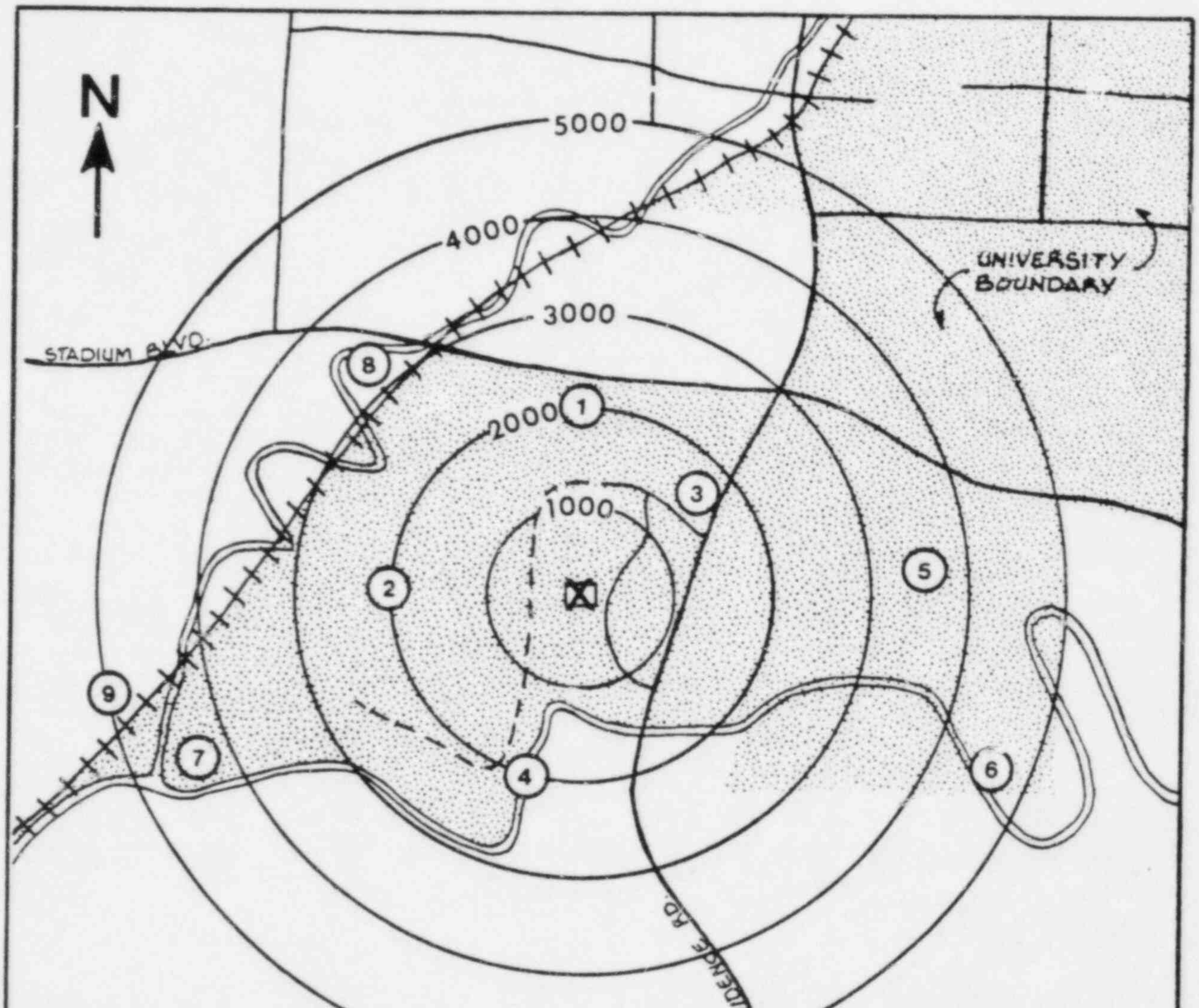
Miscellaneous Items

A program has been initiated for training new Health Physics Technicians to assure they receive a thorough knowledge of Reactor Health Physics procedures.

An analysis of radiation exposure to all monitored personnel except visitors and one day service persons, indicates the ALARA effort resulted in a reduction of 8.8 manRem during the year.

A real reduction of 25 manRem occurred from the 81-82 year, however, 14 manRem was used to replace the beryllium reflector in October 1981 and exposure time in badge-months was only 80% that of the 81-82 year.

Following the development of neutron spectra analysis procedures by a Nuclear Engineering student, Reactor Health Physics began neutron spectra surveys in the beamport areas. Lower neutron exposure levles are determined with the neutron spectrometer than indicated by the neutron survey meters.



LOCATION OF SAMPLE STATIONS
RESEARCH REACTOR FACILITY
UNIVERSITY OF MISSOURI

Figure 1

SECTION X

SUMMARY OF RADIATION EXPOSURES TO
FACILITY STAFF, EXPERIMENTERS AND VISITORS
July 1, 1982 through June 30, 1983

1. Largest single exposure and average exposure are expressed in millirem.
2. Minimal exposure is defined to be gamma < 10 mrem; beta, < 40 mrem; neutron < 20 mrem.
3. M. E. = Number of monthly units reported with minimal exposure.
4. A. M. E. = Number of monthly units reported with exposure above minimal.
5. A. E. = Average mrem reported for all units above minimal.
6. H. E. = Highest mrem reported for a single unit for the month.
7. N. E. = No exposure registered.

PERMANENT ISSUE FILM-BADGES

Beta, Gamma, Neutron Wholebody Badges:

	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
ME	72	81	65	34	71	50	55	60	68	57	45	58
AME	40	41	60	80	42	57	52	47	39	45	59	46
AE	71	42	40	39	72	52	75	73	57	65	54	65
HE	230	110	120	190	210	180	240	170	190	190	230	260

Beta and Gamma Wholebody Badges:

	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
ME	43	33	44	49	37	36	21	41	29	36	39	40
AME	8	3	6	2	2	4	4	4	3	8	4	5
AE	50	20	17	25	75	48	40	30	30	39	45	22
HE	110	20	30	40	120	110	100	40	70	90	70	40

TLD Finger Rings:

	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
ME	34	52	56	45	35	37	33	33	33	40	46	40
AME	38	31	31	34	30	34	40	42	35	31	28	28
AE	494	194	149	429	306	243	191	282	291	232	205	197
HE	3770	1470	750	6170	3580	2680	1480	2240	5500	2750	910	1010

SPARE ISSUE FILM-BADGES

Beta, Gamma, Neutron Wholebody Badges:

	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
ME	17	30	23	33	18	10	23	14	20	18	20	14
AME	12	6	14	3	5	0	3	2	3	8	8	28
AE	204	105	50	60	66	0	23	35	60	33	28	36
HE	230	180	130	110	180	0	30	50	90	130	90	80

Beta and Gamma Wholebody Badges:

	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
ME	4	1	6	6	1	1	4	14	26	26	26	18
AME	3	1	0	0	0	0	0	0	1	3	1	0
AE	37	70	0	0	0	0	0	0	10	13	30	0
HE	70	70	0	0	0	0	0	0	10	0	30	0

TLD Finger Rings:

	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
ME	14	13	11	17	16	18	17	19	14	16	19	15
AME	6	5	8	5	5	1	3	0	7	3	2	5
AE	212	170	173	84	136	140	377	0	249	453	105	144
HE	620	350	670	160	200	140	850	0	1100	900	170	350

DOSIMETERS

	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
NE	16	13	17	17	17	14	17	20	16	19	16	17
AME	24	28	22	24	24	28	25	23	26	23	28	24
AE	24	28	22	24	24	28	25	23	26	23	28	76
HE	270	260	270	130	225	155	305	180	155	205	175	220

UNIVERSITY OF MISSOURI

Research Reactor Facility

Research Park
Columbia, Missouri 65211
Telephone (314) 882-4211

August 19, 1983

PRINCIPAL STAFF			
RA		ENF	
D/RA			
A/RA			
DRP			
DRMA			
DRMSP			
DE			
ML			
OL		FILE	

orig + 1

Mr. James Keppler
Regional Administrator
U. S. Nuclear Regulatory Commission
Region III
Glen Ellyn, Illinois 60137

Reference: Docket 50-186
University of Missouri Research Reactor
License R-103

Dear Sir:

Enclosed is one copy of the reactor operations annual report for the University of Missouri Research Reactor. The report period covers July 1, 1982 through June 30, 1983.

Sincerely,

J. C. McKibben

J. C. McKibben
Reactor Manager

JCMK:vs

Enclosure (1)

AUG 22 1983

IE24
1/1