UNIVERSITY OF MISSOURI

UNIVERSITY OF MISSOURI RESEARCH REACTOR

ANNUAL REPORT 1983-84

RESEARCH REACTOR FACILITY

UNIVERSITY OF MISSOURI

RESEARCH REACTOR FACILITY

REACTOR OPERATIONS

ANNUAL REPORT

AUGUST 1984

Compiled by the Reactor Staff

Submitted by

J. C. McKibben
Reactor Manager

Reviewed and Approved

Don M. Alger
Acting Director

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SECTION I

REACTOR OPERATIONS SUMMARY

Fiscal Year 1983-1984

The following table and discussion summarize reactor operations in the period July 1, 1983 through June 30, 1984.

Date	Full Power Hours	Megawatt Days	Full Power Percent* of Total Time	Full Power Percent* of Schedule
July 1983	706.4	294.44	94.98	106.38
Aug. 1983	689.8	288.13	92.94	104.10
Sep. 1983	674.0	281.02	93.67	104.91
Oct. 1983	666.6	277.79	89.61	100.36
Nov. 1983	668.3	278.43	92.81	103.95
Dec. 1983	692.7	288.66	93.12	104.29
Jan. 1984	706.1	294.33	94.94	106.34
Feb. 1984	638.1	266.30	91.83	102.85
Mar. 1984	690.6	288.13	92.94	104.10
Apr. 1984	639.4	267.20	89.07	99.76
May 1984	656.5	273.81	88.33	98.92
June 1984	666.4	285.68	95.23	106.65
Total for Year	8,094.9	3,383.92	92.46% of time for yr. at 10MW	103.55% 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 1983

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

On July 6, a dip in electrical power caused a reactor scram. The power dip was verified by the University Power Plant, systems were inspected and reactor power was restored. On July 17, a manual rod run-in was initiated when the secondary system make-up valve stuck shut. The make-up valve was inspected and exercised and the reactor returned to operation.

Major maintenance for July included verification and inspection of fuel elements for the Nuclear Regulatory Commission SNM inspection.

AUGUST 1983

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

On August 8, a rod not in contact with magnet rod run-in occurred when blade "D" disengaged from its magnet during routine shimming. The anvil was cleaned and its position with respect to the guide tube was checked. During the subsequent start-up, blade "D" fell off again. The offset guide tube was aligned and the reactor returned to operation.

On August 12, there were two reactor scrams caused by momentary loss of electrical power. The losses of power were verified by the University Power Plant. The reactor was refueled and returned to operation.

Major maintenance for August included regeneration of Pool D. I. bed "R" and the replacement of offset "C" with a new style offset.

SEPTEMBER 1983

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

On September 26, the reactor scrammed during a start-up by a static charge buildup on the Channel 4 range switch. The switch was cycled and the reactor was restored to power.

On September 29, a manual rod run-in was initiated during a start-up due to the failure of Channel 4. A broken solder connection on a gain potentiometer lead was found and repaired on Channel 4 and the reactor was returned to operation.

Major maintenance items for September included repair of the breaker for the primary demineralizer pump; replacement of the regulator on nitrogen bank "B"; and low power runs for reactivity and rod worth calculations.

OCTOBER 1983

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

On October 3, the reactor scrammed due to loss of site electrical power. The cause was found to be a tripped feeder breaker in the distribution system for Research Park. Site power was restored in approximately three hours. The emergency generator operated during this time, but in a degraded state due to problems with the fuel mixture. The emergency generator gas tank was drained, flushed and refilled and the emergency generator was load tested satisfactorily. On November 1, a letter was sent to the Director of Nuclear Reactor Regulation explaining the circumstances and the corrective action taken.

On October 6, the reactor was manually scrammed because of a mechanical failure of the inner airlock door. A trolley hinge support pin sheared, which allowed one side of the door to slip from its normal position. The door was repaired and the reactor returned to operation.

Major maintenance items for October included the installation of two new four inch reflector irradiation positions; the replacement of the MV/I module in the temperature monitoring circuit for the primary outlet leg; the replacement of valve S-2 control motor; the regeneration of pool DI bed "T"; and the repair of the inner airlock door.

NOVEMBER 1983

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

On November 15, the reactor scrammed on low pool flow when an operator accidentally bumped the on/off switch for pool pump 508-B. All safety systems functioned normally and the reactor returned to operation.

On November 29, pressurizer pressure sensor 938 initiated a reactor loop low pressure scram. The reactor was being shutdown by manual rod run-in at the time of the scram, in response to a reactor system low pressure alarm. The pressure loss had been caused by a separation in the pressurizer pressure gauge line in room #114. The gauge line was repaired and the reactor returned to operation.

Major maintenance items for November included replacement of the drive motor for the pool temperature recorder; the regeneration of pool DI bed "V"; the installation of two sleeves in beamport "F" centertube; and the performance of the regulating blade calibration for a nuclear engineering class.

DECEMBER 1983

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

On December 14, loss of site electrical power resulted in a reactor scram and isolation. Site power was restored in approximately five hours. The emergency generator, after operating satisfactorily for two hours, tripped off due to high temperature. The thermostat was found stuck closed and was replaced. The generator was then restarted and it assumed its electrical load until site power was restored. The reactor was secured and a shutdown checksheet had been completed prior to the emergency generator trip.

On December 15, the day of its weekly automatic exercise, the emergency generator was found in a tripped condition, which would not have allowed it to operate automatically. The cause was felt to be a mispositioned electrical connection on the high temperature trip sensor. On January 13, 1984, a letter was sent to the Director of Nuclear Reactor Regulation explaining the circumstances and corrective action taken.

On December 17, a high power rod run-in was initiated by electrical feedback through Channel 4, which was received while electronics technicians were investigating a problem with Channel 2 and 3 IRM chart drive. Full power was recovered in five minutes.

On December 19, the reactor scrammed with pool loop low flow annunciated. No actual decrease in pool flow was observed on any instrumentation. Whether the green or yellow leg of the pool loop low flow scram circuit had caused the scram could not be determined, so the "white rat" electronic surveillance unit was installed to determine the scram source, if any subsequent scrams occurred.

Later on December 19, a rod run-in occurred with no associated annunciation. An electronics technician had turned off the IRM chart recorder at the same instant. Electrical feedback was believed to have caused the rod run-in.

On December 20, the reactor scrammed on pool loop low flow. The source of the scram was verified by the "white rat" to be from the yellow leg and again no indication of actual flow decrease was observed on the instrumentation. The yellow leg reactor/pool dual trip circuit module for pool loop "B" and primary loop "A" flow was replaced. The reactor was returned to normal operation after compliance testing of pool and primary flows.

Major maintenance items for December included replacement of the dual trip unit for pool loop "B" and primary loop "A" flow; the replacement of Channel 2 and 3 recorder selector switch; the regeneration of pool DI bed "R"; the performance of reactivity worth of a shim blade; and the replacement of the emergency generator thermostat.

JANUARY 1984

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

On January 16, and again on January 22, a rod not in contact with magnet rod run-in occurred when an operator bumped the drive housing for a control rod. These occurred during routine sample handling evolutions.

The major maintenance item for January was the replacement of the MV/I module in the temperature monitoring circuit for the pool outlet leg.

FEBRUARY 1984

The reactor operated continuously in February, with the following exceptions: three shutdowns for flux trap sample changes; two shutdowns for maintenance; two scheduled reductions in power and two unscheduled shutdowns.

On February 4, the reactor scrammed due to an electrical power dip which was verified by the Power Plant. The reactor was refueled and returned to normal operation.

On February 7, the drain collection tank pump failed to start when its high level alarm was received. Reactor power was lowered for about fifteen minutes while electronics technicians jumpered the pump controls so it could be operated in manual.

On February 25, cooling tower fan #2 drive shaft failed as a result of mechanical wear. The drive shaft was replaced and the fan was put back in operation. During this evolution, fan #1 failed to operate in fast speed and reactor power was lowered to decrease the necessary cooling load. Fan #1 controller was repaired and the reactor returned to operation.

On February 27, a reactor scram and isolation occurred when high radiation from an iridium sample in a transfer cask tripped the area radiation monitor. The cask was believed to be empty and the scram occurred when the lid was removed, with Health Physics monitoring, prior to lowering the cask in the pool. The procedure for loading casks has since been revised to require cask lid removal under water. The reactor was refueled before returning to normal operation.

Major maintenance for February included replacement of cooling tower fan #2 motor and drive shaft; the repair of cooling tower fan #1 fast speed controller; the replacement of the stack monitor drive motor; the removal of cooling tower cell #3 from service for rebuilding; the regeneration of DI bed "T"; and the performance of low power runs for flux trap and control rod reactivity worths.

MARCH 1984

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

On March 15, an antisiphon system high level rod run-in occurred twenty minutes after a normal reactor start-up. The antisiphon line was believed to not have been blown completely dry prior to start-up. The line was blown dry and the rod run-in cleared in about two minutes. Full power was recovered in eight minutes.

Major maintenance items for March included placing cooling tower cell #3 back in service; removing cooling tower cell #1 from service for rebuilding; regenerating DI bed "V" and performing lower power runs for flux trap and control rod reactivity worths.

APRIL 1984

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

On April 10, the reactor scrammed with reactor loop low flow annunciated. No actual decrease in reactor flow was observed on any instrumentation. The specific leg of the reactor loop low flow scram circuit which caused the scram could not be determined. The "white rat" electronic surveillance unit was installed to determine the scram source on any subsequent scram.

On April 11, the reactor scrammed with reactor loop low flow annunciated. Again, no actual decrease in reactor flow was observed. The "white rat" indicated the scram source as primary loop A in the yellow leg. The yellow leg reactor/pool flow trip unit was replaced and after performing compliance testing on the new unit, the reactor returned to operation.

On April 20, a rod not in contact with magnet occurred three separate times when control rod "A" disengaged from its magnet during normal reactor start-ups. The cause was believed to be the anvil contacting the upper housing due to slight movement of the offset base. A special C-clamp (Modification Package 84-5) was attached to the back of offset "A" to eliminate movement of the base plate. The reactor returned to normal operation.

On April 21, the reactor scrammed on low pool flow when an operator accidentally bumped the on/off switch for pool pump 508-B. All safety systems functioned normally and the reactor returned to operation. This switch had been bumped, causing a scram, in November 1983 and has since been changed to prevent further unscheduled shutdowns of this nature.

On April 27, a rod not in contact with magnet rod run-in occurred when rod "D" disengaged from its magnet during routine shimming. While pulling the rods in gang on the subsequent start-up, rod "D" again disengaged resulting in a rod run-in. The control rod upper housing was realigned and the reactor returned to operation. The rod housing was suspected to have become misaligned the previous day during maintenance activities.

On April 29, the reactor scrammed due to an electrical power dip verified by the Power Plant. The reactor was refueled and returned to operation.

Major maintenance items for April included replacement of meter relays for PT 944 A/B and PT 943; replacement of the yellow leg flow trip module; replacement of the meter and relay module for PT 943; replacement of the IRM recorder drive motor; dumping of DI bed "R" and loading of DI bed "U"; removal from service of cooling tower cell #2 for rebuilding; placing cell #1 back in service; placing a special C-clamp on the back of offset "A"; and renewing the time delay relay in cooling tower fan #1 controller.

MAY 1984

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

On May 10, control blade "D" disengaged from its magnet during a normal reactor start-up, resulting in a rod run-in. The magnet current was increased from 90 MA to 120 MA and the reactor returned to operation.

On May 11, a manual rod run-in was initiated when both personnel airlock doors opened simultaneously. The sealing gasket for the outer airlock door pulled free from its seat during the out-of-sequence operation of the doors. The circumstrances of this occurrence was reported in a letter to the Director of Nuclear Reactor Regulation dated June 8, 1984. The gasket was reseated and the airlock doors were tested before the reactor returned to operation.

On May 18, a Channel 5 high power rod run-in was caused by an electrical glitch while changing the Channel 5 gain potentiometer setting. Electronics technicians investigated the problem on the next maintenance day.

On May 28, control rod "D" disengaged from its magnet during routine shimming causing a rod run-in. The anvil was found to have debris on its surface. The anvil was cleaned and the reactor returned to operation.

On May 29, a rod run-in occurred with no associated annunciation. The rod run-in occurred at the same time the 60% regulating blade withdrawn annunciation reset. The cause of the rod run-in was believed to be electrical feedback. The rod run-in was reset and full power recovered within twelve minutes.

Major maintenance items for May included the changeout of offset "A"; the performance of reactor startups for reactor operator examinations and the performance of the annual containment building leak rate check (RTP-13). The leak rate was calculated to be 8.4 SCFM, significantly less than the Technical Specification limit of 16.3 SCFM.

JUNE 1984

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

On June 1, a rod not in contact with magnet occurred when control blade "D" disengaged from its magnet during routine shimming. On the subsequent startup, this blade again disengaged causing a rod run-in. A broken pin was found in the amphenol connector that provides drive and magnet current to the rod mechanism. The connector was repaired and the reactor returned to operation. This faulty connector pin is believed to have contributed to the shutdowns in April and May where rod "D" disengaged from its magnet.

On June 8, the reactor scrammed due to an electrical power dip that was verified by the Power Plant. The reactor was refueled and returned to operation.

Major maintenance items for June included removing the Nuclepore irradiator case from the thermal column for future repair; the regeneration of DI bed "V"; and the performance of low power runs for a Nuclear Engineering experiment.

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 5 revisions (#13 through #17) 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 13
TO
OCTOBER 1981 MANUAL

Page Number	Date Revised
SOP/VIII-13	7/12/83
SOP/VIII-15	7/12/83

each insertion up to and including 10 minutes. For irradiations longer than 10 minutes, a mark will be placed on the rabbit for each 10 minute period or fraction thereof. For example, if a rabbit is irradiated for 25 minutes, it will receive 3 marks. When a rabbit has received six marks, it will be discarded. Each rabbit must be examined for cracks or other signs of potential failure before it is used.

VIII.3.4 Sample Irradiation Procedures

VIII.3.4.1 When an experimenter has met the requirements of VIII.3.3 and is ready to run his experiment, he shall call the reactor control room giving his

A. Name
B. Laboratory room number
C. Experiment file number and project number.]
D. Length of time the sample will be in reflector and how]
many samples will be irradiated.]

VIII.3.4.2 When the blowers are on, the system will be operated by the following procedure.

Note: The position of each control button (CB) and control light (CL) for the operation of the system from laboratories 216-228, 227-218 respectively are given on Figure VIII-1.

A. For laboratories (216-228, 227-218) which have switching or control stations, the circuit selector (CB-1) must be positioned to the control station of the experimenter's laboratory, i.e. 216.
B. Set the "Automatic-manual" control switch (CB-2) to the type of control desired.
C. If automatic control of the system is used, set the timer to desired irradiation time. Irradiation time as short as 2 seconds can be used; maximum time in automatic control modes is not to exceed 20 minutes. Irradiations in manual control in excess of 20 minutes must be approved by the Reactor Manager in writing.

REVISION NUMBER 14
TO
OCTOBER 1981 MANUAL

Page Number	Date Revised
SOP/A-8a	8/11/83
SOP/A-8b	8/11/83

REACTOR ROUTINE PATROL Date: ______________

1.	Time of start of patrol.							
2.	Time and date all charts.							
3.	Check ARMS trip settings.							
4.	Visual check of entire pool.							
5.	Anti-siphon tank pressure.	36 psig ± 3 psi						
6.	North iso door seal press.	18-28 psig						
7.	South iso door seal press.	18-28 psig						
8.	5th level backup doors.	Open						
9.	5th level detector reading.	0-3.5 mr/hr						
10.	5th level trip point set.	3.5 mr/hr						
11.	16" iso vlv A air pressure.	45-55 psig						
12.	Emerg compress on standby.	Bkr closed, vlv open, gage 90-120 psig						
13.	Containment hot sump pumps.	Operable						
14.	Door 101 seal pressure.	18-28 psig						
15.	BP Floor	Conditions normal.						
16.	Fuel Vault	Locked						
17.	Inner airlock door seal press.	18-28 psig						
18.	Outer airlock door seal press.	18-28 psig						
19.	T-300 level.	> 2000 gal.						
20.	T-301 level.	< 6000 gal.						
21.	Labyrinth Sump	Level < Alarm Pt.						
22.	RO Unit (Run daily:) Power ON (to T-300 or drain)	ON (Run on 0700 routine for > 4 hrs.)						
23.	RO Unit Temp	24-28°C/standby						
24.	RO Unit Pressure	190-200 psig/standby						
25.	EG Rm. (Batt. check Sun. mids.) (EG OP switch to Auto) (Gas > sight glass)	Thermostat > 50°F Temp > 40°F						
26.	T-300, 301 Room	Thermostat > 55°F Thermostat > 40°F						

On the first routine patrol of the day or the first patrol after a startup, drain all water from the anti-siphon system. If draining causes the pressure to drop significantly, return to the middle of the band (36 psig) and record the pressure here. If a condition is normal, enter an "N" or a check "✓" in the applicable box. If the condition or reading is abnormal, enter 'AN" for the condition and circle it. Explain all abnormal readings or conditions in the remarks.

REMARKS:

Rev. 8/11/83 App'd [signature] SOP/A-8a

REVISION NUMBER 15
TO
OCTOBER 1981 MANUAL

Page Number	Date Revised
SOP/VII-45	9/19/83
SOP/A-7a	9/19/83
SOP/A-11a	9/19/83

sludge is dumped via a 3" drain line at the north end of WT3 or the south end of WT1 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 radioactive 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. 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. MURR is allocated 80% of the University's limit, i.e. 800 millicurie per year for carbon-14, 4 curies per year for H-3 (tritium) and 800 millicuries per year of other radioactive material. 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. If the 10 CFR 20 limits are not exceeded and the total activity of radionuclides does not exceed 10 mCi of tritium or 2 mCi of other nuclides, the Shift Supervisor may authorize the water to be pumped to the sanitary sewer. Any tank containing water with an activity greater than 2 mCi of other nuclides will be discharged only with the approval of the Reactor Manager.

Sheet No: __________ Date: __________

PNEUMATIC TUBE IRRADIATIONS

Run No.	Clock Time In	Clock Time Out	Name	Total No. Runs	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									
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21									
22									
23									
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25									
26									
27									
28									
29									
30									
31									
32									
33									
34									

Rev. 9/19/83 App'd [signature]

SOP/A-7a

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 ($\mu Ci/ml$)	MPC	Activity (μCi)
a. H-3	12.3Y				
b.					

pH ________ TOTAL CONCENTRATION (b) ____________

Analysis by ____________ TIME ________ DATE ________

	Concentration ($\mu Ci/m$)		Total Volume (liters)		Activity (mci)
(a)		x		=	
(b)		x		=	

2. Approvals Required for:

Any Discharge . . . . ____________ Shift Supervisor

Discharge of > 10 mci of H_3, > 2 mci of other activity, 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 Discharged

REMARKS ____

Rev. 9/19/83 App'd [signature]

SOP/A-11a

REVISION NUMBER 16
TO
OCTOBER 1981 MANUAL

Page Number	Date Revised
EP-I-3	12/30/83

IMPORTANT TELEPHONE NUMBERS

	Office	Home	
Director, R. M. Brugger	882-4211, Ext. 230	445-6580	]
Associate Director, D. M. Alger	882-4211, Ext. 229	445-4775	]
Reactor Manager, J. C. McKibben	882-4211, Ext. 204	442-6728	
Reactor Operations Engineer, W. A. Meyer, Jr.	882-4211, Ext. 203	474-7368	
Reactor Shift Supervisor, N. Tritschler	882-4211, Ext. 214	474-6214	
Reactor Shift Supervisor, B. Bezenek	882-4211, Ext. 214	445-5680	
Reactor Shift Supervisor, C. Anderson	882-4211, Ext. 214	696-5506	
Reactor Shift Supervisor, V. Jones	882-4211, Ext. 214	445-2543	]
Health Physics Manager, MURR, O. Olson	882-4211, Ext. 227	874-8167	
Health Physics Technician, A. Deralius	882-4211, Ext. 226	449-1655	]
Health Physics Technician, R. Stevens	882-4211, Ext. 225	442-2539	]
University Police/Watchman's Office, UMC	882-7201		
Medical Center Health Physicist, P. Lee 2 Research Park Dev. Bldg.	882-7221	445-5275	
Radiation Safety Officer, UMca, J. Tolan 413 Clark Hall	882-3721	445-7787	
Physical Plant Emergency	882-8211 (Day)		
Physical Plant Emergency	882-3333 (Night)		]
Univ. of Mo. Hosp. & Clinics Emergency Center	882-8091		]
Univ. of Mo. Hosp. & Clinics Ambulance Serv.	911 (Will be dispatched by City of Columbia.)		]
Boone Hospital Center	875-4545		]
Boone Hospital Center, Admissions	875-3237		]
Boone Hospital Center, Emergency Room	875-3501		]
Boone Hospital Center, Ambulance Service	449-0937		]
Missouri State Highway Patrol, Jefferson City	314-751-3313		
FBI, Jefferson City	314-636-8814		

NOTE: For any emergency involving the City of Columbia, dial 911.

Rev. 12/30/83 App'd JCMc

REVISION NUMBER 17
TO
OCTOBER 1981 MANUAL

Page Number	Date Revised
SOP/A-1a	1/24/84
SOP/A-1b	1/24/84

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 (after maintenance day, check the four-pipe annulus drain valves for water leakage).
_____ i. Add DI water to beamport and pool overflow loop-seals.
_____ j. Vent the 6000 gallon pool hold up tank.
_____ 4. Visual check of CT equipment completed.
_____ a. Oil level in CT fans normal (after maintenance day).
5. Beamport Floor
_____ a. Beamport radiation shielding (as required).
_____ b. Unused beamports checked flooded (after maintenance day).
_____ c. Seal trench low level alarm tested (after maintenance day).
_____ 6. Emergency air compressor (load test for 30 minutes after maintenance day).
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. 1/24/84 App'd JCM

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 (after maintenance day). 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) (after maint. day).
_____ b. Facility evacuation switch (check outer containment horns) (after maint. day)
_____ 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 (after maintenance day).
_____ Channel 8 - Reactor Bridge (switch in "Normal") (after maintenance day).
_____ Channel 9 - Reactor Bridge backup (switch in "upscale") (after maint. day).
_____ 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 (after maintenance day).
_____ h. Reactor isolation horns switch in "Isolation Horns On" position. Valves and 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" ± .05".
_____ a. Check rod run-in function at 10% withdrawn and annunciator at rod bottomed.
_____ 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.
_____ 34. Routine patrol completed.
_____ 35. Reactor ready for startup.

Time (Completed) ______________

____
Senior Reactor Operator

SECTION III

1984 REVISIONS TO THE HAZARDS SUMMARY

There were no revisions to the Hazards Summary between July 1, 1983 and June 30, 1984.

SECTION IV

PLANT AND SYSTEM MODIFICATIONS

NOVEMBER 1983

Modification 83-3: This modification was designed to expand the irradiation spaces in the bulk pool (adjacent to the reflector tank). This modification provides two spaces for the irradiation of 4" diameter samples. Each irradiation space has its own self-powered neutron detector.

The irradiation element is constructed of aluminum canned reactor grade graphite and is similar in design to other irradiation elements presently in use. The element is consistent with existing irradiation facilities and does not interfere with other components or operation of the reactor.

FEBRUARY 1984

Modification 84-1: This modification installed an antomatically operated isolation valve in the 4" diameter secondary sump makeup water supply line. The valve is operated by a pneumatic actuator which allows the valve to close upon loss of site electrical power or when all three secondary pumps are secured. This modification was needed to prevent secondary sump overflow, particularly in the event of loss of site electrical power, when the cooling tower basement sump pump becomes inoperable and the cooling tower basement floods.

APRIL 1984

Modification 84-5: This modification was installed on offset mechanisms "A" and "C", to attach each mechanism to its reflector tank base pedestal. These were needed to more securely hold the offset mechanisms in place when their normal method of hold-down, stainless steel 7/8" -9 bolts threaded into stainless steel guide sockets, galled when attempting to remove offsets "A" and "C", during maintenance activities, April 19, 1984.

This modification installed a "C" clamp with tightening stainless steel bolts to span across the reflector tank pedestal base and the hold-down block at the rear of the offset mechanism. A "C" clamp will be used until tooling and procedures are developed for a permanent repair of the hold-down mechanism.

SECTION V

NEW TESTS AND EXPERIMENTS

New experimental programs during the period of 1 July 1983 through 30 June 1984 are as follows:

RUR150 Experimenter: Sue Langhorst/C. Park

Description: An addendum was added to the RUR to include neutron activation analysis of water samples for small amounts of thorium.

RUR210 Experimenter: Gary Ehrhardt

Description: An addendum was added to the RUR to include irradiation of small quantities of potassium iridic chloride.

RUR265 Experimenter: Mark Prelas

Description: The experiment is to measure vacuum ultra violet fluorescence production efficiencies. The fluorescence is generated from neutron absorption in the Boron-10 coating of the experiment tube inserted in beamport F.

SECTION VI

SPECIAL NUCLEAR MATERIAL ACTIVITIES
1 July 1983 through 30 June 1984

1. SNM Receipts: A total of 26 new fuel elements were received from Babcock and Wilcox (B & W), Lynchburg, Virginia. These had been fabricated by Atomics International, Canoga Park, California, and shipped to B & W after December, 1982. B & W is holding 17 elements, serial numbers M0132 through M0149 except M0139 which was not made. Shipment of these to MURR will begin in late 1984.

Shipper	Elements	Grams U	Grams U-235
B & W	M058, M0102, M0103, M0104, M0105, M0106, M0107, M0108, M0109, M0111, M0112, M0113, M0114, M0115, M0116, M0117, M0122, M0123, M0124, M0125, M0126, M0127, M0128, M0129, M0130, M0131	21,554	20,074

2. SNM Shipments: A total of 24 spent fuel elements were shipped to Exxon Nuclear Company, Inc., Idaho Falls, Idaho, for reprocessing.

Shipper	Elements	Grams U	Grams U-235
MURR	M041, M055, M056, M057, M059. M060, M061, M062, M064, M066, M067, M068, M069, M071, M072, M074, M078, M080, M081, M083, M084, M085, M087, M089	16,183	14,122

3. Inspections: A routine safeguards inspection was conducted by the Nuclear Regulatory Commission (NRC), Region III office, on 13-15 July 1983. MURR Special Nuclear Material Control Procedures were reviewed and found adequate to enable MURR to comply with 10CFR70.51(c) requirements (accounting procedures for SNM in possession). Uranium burnup calculations were found in agreement with NRC 742 Material Balance Reports. Shipping and receiving procedures and records were found adequate and NRC 741 Nuclear Material

Transaction Reports were found adequately documented and properly filed with NRC. Internal fuel transfers and storage records were reviewed. Inventory of fuel and non-fuel material was physically identified and no discrepancies in inventory records were noted. By letter from NRC, Region III, dated 29 July 1983, no items of noncompliance with NRC requirements were identified during the course of this inspection.

4. SNM Inventory: As of 30 June 1984, MURR was financially responsible for the following DOE owned amounts:

Total U = 47,112 grams

Total U-235 = 42,124 grams

Included in these totals are 36 grams of U and 34 grams of U-235 non-fuel, DOE owned. In addition to these totals, MURR owns 134 grams of U and 54 grams of U-235. All of this material is physically located at the MURR.

Fuel elements on hand have accumulated the following burnup as of 30 June 1984:

Fuel Element Number	Accumulated Megawatt Days	Fuel Element Number	Accumulated Megawatt Days	Fuel Element Number	Accumulated Megawatt Days
M058	27.39	M0103	27.39	M0126	89.96
M070	119.84	M0104	67.59	M0127	89.96
M073	142.73	M0105	47.41	M0128	66.64
M075	143.81	M0106	49.01	M0129	89.74
M076	135.00	M0107	47.41	M0130	66.64
M077	129.94	M0108	49.01	M0131	89.74
M079	143.08	M0109	23.91	M0150	124.49
M082	145.72	M0111	23.91	M0151	144.51
M088	106.39	M0112	0	M0152	124.49
M090	145.76	M0113	0	M0153	144.51
M091	148.48	M0114	0	M0154	119.82
M092	145.76	M0115	0	M0155	137.89
M093	148.48	M0116	0	M0156	128.84
M094	147.60	M0117	0	M0157	137.89
M095	143.74	M0118	144.99	M0158	144.60
M096	147.60	M0119	144.83	M0159	144.60
M097	143.74	M0120	144.99	M0160	95.09
M098	145.96	M0121	144.83	M0161	97.96
M099	143.82	M0122	57.42	M0162	95.09
M0100	145.96	M0123	77.18	M0164	97.96
M0101	143.82	M0124	74.38	M0165	106.39
M0102	67.59	M0125	60.22		

Average Burnup = 98.98 MWD

SECTION VII

REACTOR PHYSICS ACTIVITIES

1 July 1983 through 30 June 1984

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

Serial Number	Core Designation	Date Last Used	MWDs
M091	AP-46	11-14-83	148.48
M093	AP-46	11-14-83	148.48
M090	AP-50	12-14-83	145.76
M092	AP-50	12-14-83	145.76
M073	AP-52	12-20-83	142.73
M075	AP-52	12-20-83	143.81
M095	AP-52	12-20-83	143.74
M097	AP-52	12-20-83	143.74
M094	A-5	2-02-84	147.60
M096	A-5	2-02-84	147.60
M099	A-10	2-27-84	143.82
M0101	A-10	2-27-84	143.82
M0151	A-15	3-29-84	144.51
M0153	A-15	3-29-84	144.51
M0118	A-16	4-05-84	144.99
M0120	A-16	4-05-84	144.99
M079	A-23	5-17-84	143.08
M082	A-23	5-17-84	145.72
M098	A-23	5-17-84	145.96
M0100	A-23	5-17-84	145.96
M0119	A-24	5-24-84	144.83
M0121	A-24	5-24-84	144.83
M0158	A-24	5-24-84	144.60
M0159	A-24	5-24-84	144.60

Due to the requirement of having less than 5 kg of unirradiated fuel in possession, initial criticalities are obtained with four new elements or fewer as conditions dictate. A core designation consists of eight fuel elements of which only the initial critical fuel element serial numbers are listed in the following table. To increase operating efficiency, fuel elements are used in mixed core loadings. 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
39	M0160	AP-26	7-18-83
39	M0162	AP-26	7-18-83
39	M0161	AP-29	8-07-83
40	M0164	AP-29	8-07-83
35	M0123	AP-37	9-26-83
35	M0125	AP-37	9-26-83
35	M0122	AP-38	9-29-83
35	M0124	AP-38	9-29-83
35	M0126	AP-46	11-07-83
35	M0127	AP-46	11-07-83
35	M0128	AP-50	12-01-83
35	M0129	AP-50	12-01-83
36	M0130	AP-50	12-01-83
36	M0131	AP-50	12-01-83
32	M0102	A-3	1-16-84
32	M0104	A-3	1-16-84
33	M0105	A-9	2-16-84
33	M0107	A-9	2-16-84
33	M0106	A-17	4-05-84
33	M0108	A-17	4-05-84
27	M058	A-18	4-12-84
32	M0103	A-18	4-12-84
32	M098	A-23	5-10-84
33	M0111	A-23	5-10-84

2. Fuel Shipping: Twenty-four spent fuel elements were shipped from MURR to Exxon Nuclear Company, Idaho Falls, Idaho. The identification numbers of these elements are:

M041	M061	M069	M081
M055	M062	M071	M083
M056	M064	M072	M084
M057	M066	M074	M085
M059	M067	M078	M087
M060	M068	M080	M089

3. Fuel Procurement: Babcock and Wilcox, Lynchburg, Virginia is MURR's current fuel assembly fabricator. This work is contracted with the U. S. Department of Energy and administered by E G & G Idaho, Idaho Falls, Idaho. E G & G notified us 13 June 1984 that B & W will be rolling 12 MURR fuel assemblies by October, 1984 and plans to roll 36 assemblies in Fiscal Year 1985.

4. Licensing Activities: A revised physical security plan (10CFR70.67) was approved by the NRC on 12 August 1983. This is Amendment 15, the latest amendment to our Facility License No. R-103 (Docket No. 50-186). A reactor emergency plan was approved by the NRC on 27 June 1984. A request for an increase in Special Nuclear Material Inventory under our Facility License submitted in December, 1982 is pending. A revision to Technical Specifications 4.4.d requiring two operating parallel pool pumps submitted in February, 1982 is pending.

5. Reactor Characteristic Measurements: Sixty-four refueling evolutions were completed. An excess reactivity verification was performed for each refueling and the average excess reactivity was 3.24%. MURR Technical Specification 3.1(f) requires that the excess reactivity be less than 9.8%.

   Reactivity measurements were performed for 11 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.

   M096 form Core A-32 during March 1984

   M0120 from Core A-35 during March 1984

   All measurements were within operational requirements.

SECTION VIII

SUMMARY OF RADIOACTIVE EFFLUENTS RELEASED TO THE ENVIRONMENT

Sanitary Sewer Effluent
From 1 July 1983 through 30 June 1984
Descending Order of Activity Released

Nuclide	Amount (Ci)	Nuclide	Amount (Ci)	Nuclide	Amount (Ci)
S35	5.51E-01	TA183	4.39E-04	TC99M	4.23E-05
H3	1.06E-01	SM153	4.34E-04	HG203	4.09E-05
CO60	9.95E-02	CS137	3.73E-04	AU198	4.00E-05
ZN65	8.05E-02	CE144	3.42E-04	AS76	3.40E-05
CR51	8.41E-03	IR192	3.15E-04	RE188	3.33E-05
MN54	5.80E-03	CS134	2.88E-04	SN113	2.94E-05
TA182	5.25E-03	MN56	2.45E-04	PA233	2.26E-05
SC46	4.76E-03	CO57	2.33E-04	K42	2.26E-05
NA24	2.66E-03	SE75	1.98E-04	TE123M	2.04E-05
SB124	1.88E-03	NB95	1.56E-04	I133	1.79E-05
AG110M	1.72E-03	ZR95	1.07E-04	GA72	1.50E-05
AS77	1.27E-03	BA140	1.05E-04	W187	9.77E-06
CU64	1.16E-03	CD109	8.96E-05	BR82	8.12E-06
CO58	9.90E-04	CD115	8.82E-05	I132	7.24E-06
SB125	6.08E-04	SB122	7.16E-05	HF181	5.86E-06
LA140	6.04E-04	RB86	7.09E-05	I131	5.21E-06
FE59	5.83E-04	NA22	6.27E-05	EU152	5.12E-06
RE186	5.59E-04	ZN69M	4.60E-05	AU196	2.35E-06
TE125M	5.08E-04	BA133	4.55E-05		

Stack Effluent
From 1 July 1983 through 30 June 1984
Descending Order of Activity Released

Nuclide	Amount (Ci)
AR41	1.25E+03
H3	1.25E+01
I133	2.33E-03
I135	1.79E-03
I131	1.52E-03
I134	1.47E-03
AS77	6.49E-04
K40	5.47E-04
I132	4.21E-04
XE135M	4.12E-04
TA182	2.53E-04
CL38	2.20E-04

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 eight 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. Sampled during November 1983.

Determined Radioactivity Levels
Vegetation Samples

Sample	Alpha pCi/g	Beta pCi/g	Gamma pCi/g	Tritium pCi/g
1-V-24	< .2	12.6	< 0.04	< 9.1
2-V-24	< .2	16.2	< 0.04	< 9.1
3-V-24	< .2	15.1	< 0.04	< 9.1
4-V-24	< .2	14.6	< 0.04	< 9.1
5-V-24	< .2	15.6	< 0.04	< 9.1
6-V-24	< .2	10.2	< 0.04	< 9.1
7-V-24	< .2	16.1	< 0.04	< 9.1
10-V-24	< .2	27.8	< 0.04	< 9.1

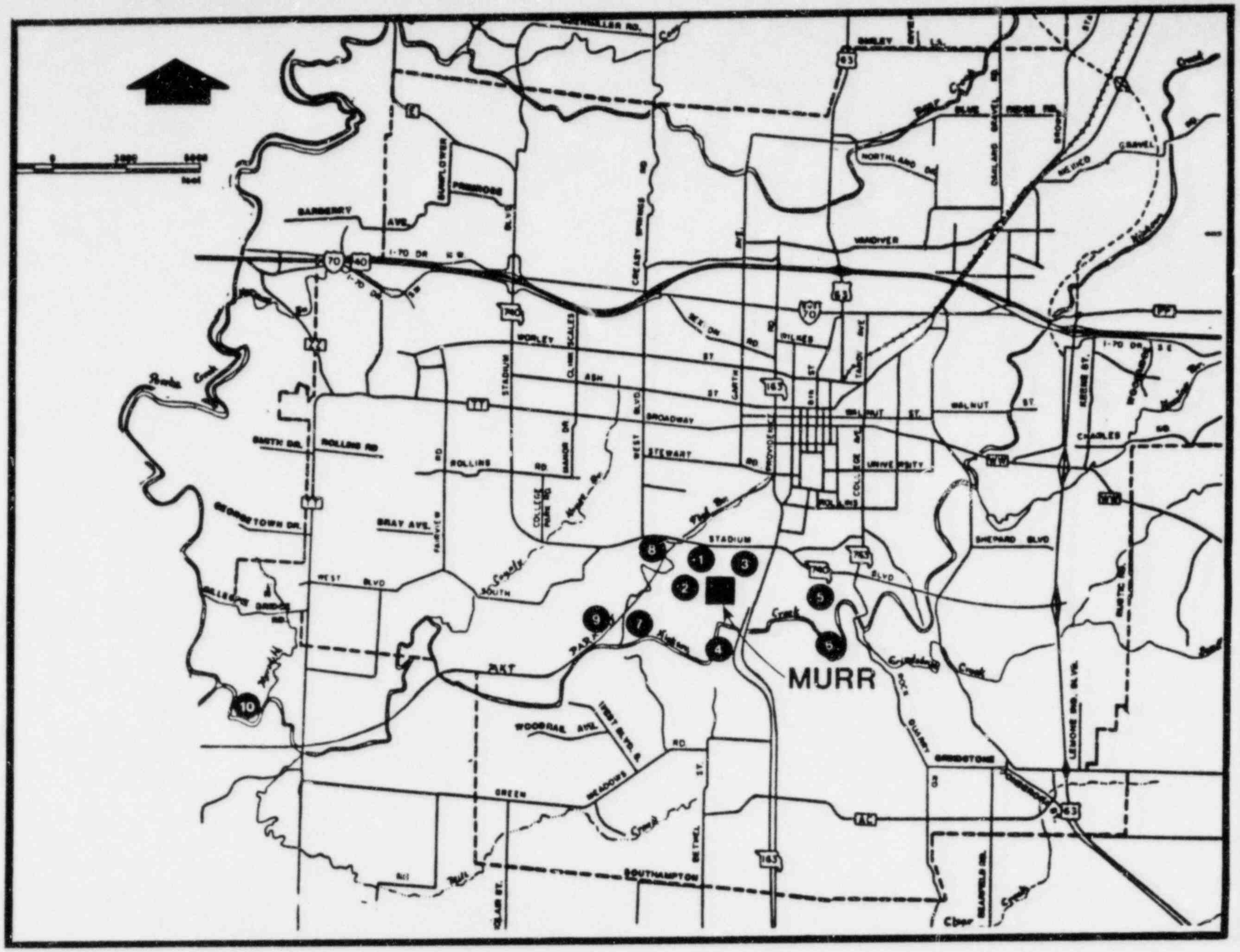

Figure 1. MURR Environmental Program Sample Stations

NOTE: September 1983 City sewerage plants at stations 8 and 9 closed. All waste water now processed at City Waste Treatment Facility at station 10.

Determined Radioactivity Levels
Soil Samples

Sample	Alpha pCi/g	Beta pCi/g	Gamma pCi/g
1-S-24	0.5	10.0	< 0.04
2-S-24	0.5	7.1	< 0.04
3-S-24	0.3	6.3	< 0.04
4-S-24	0.6	9.1	< 0.04
5-S-24	0.4	8.2	< 0.04
6-S-24	0.3	6.5	< 0.04
7-S-24	0.4	10.2	< 0.04

Determined Radioactivity Levels
Water Samples

Sample	Alpha pCi/g	Beta pCi/g	Gamma pCi/g
4-W-24	< 0.2	10.1	< 9.1
6-W-24	< 0.2	5.2	< 9.1

2. Sampled during May 1984.

Determineu Radioactivity Levels
Vegetation Samples

Sample	Alpha pCi/g	Beta pCi/g	Gamma pCi/g	Tritium pCi/g
1-V-25	< .2	14.9	< 0.04	< 9.1
2-V-25	< .2	11.9	< 0.04	< 9.1
3-V-25	< .2	13.3	< 0.04	< 9.1
4-V-25	< .2	18.4	< 0.04	< 9.1
5-V-25	< .2	17.3	< 0.04	< 9.1
6-V-25	< .2	18.3	< 0.04	< 9.1
7-V-25	< .2	14.8	< 0.04	< 9.1
10-V-25	< .2	13.5	< 0.04	< 9.1

Determined Radioactivity Levels
Soil Samples

Sample	Alpha pCi/g	Beta pCi/g	Gamma pCi/g
1-S-25	0.3	9.4	< 0.04
2-S-25	0.3	10.7	< 0.04
3-S-25	< 0.2	9.7	< 0.04
4-S-25	0.3	8.7	< 0.04
5-S-25	0.5	9.5	< 0.04
6-S-25	0.4	5.5	< 0.04
7-S-25	0.5	9.7	< 0.04
10-S-25	0.4	10.3	< 0.04

Determined Radioactivity Levels
Water Samples

Sample	Alpha pCi/g	Beta pCi/g	Gamma pCi/g	^3H (pCi/ml)
4-W-25	< 0.2	6.2	< 0.04	< 9.1
6-W-25	0.3	5.2	< 0.04	< 9.1
10-W-25	< 0.2	7.5	< 0.04	< 9.1

Radiation and Contamination Surveys

The following table gives the number of surveys performed during FY 83-84.

Radiation	Surface Contamination	Air Samples
401	278	272

Twenty-nine (29) Radiation Work Permits were issued during the year.

Miscellaneous Items

Effective October 1, 1983, responsibility for routine monitoring of exhaust stack Ar-41 emission, Ar-41 in containment building air, and analyzing personnel urine for tritium was transferred from Reactor Chemistry to Reactor Health Physics.

Four procedures in the 10MW Standard Operating Procedures, Volume 5, Health Physics, were updated.

It was decided to produce two sets of procedures for Health Physics controls. The 10MW Standard Operating Procedure, Volume 5, Health Physics, will contain material needed by personnel not in the Health Physics group. A new set of procedures called "Internal Procedures and Guides" (IP's) is being written. This set is to contain detailed procedures that Health Physics personnel are to use which are not of interest to other personnel, e.g. calibration and use of swipe counters; changing filters on the stack monitor. This set contains six procedures at this time.

June 8, 1984, nine 55 gallon drums of reactor water system filters and resins were shipped to the Richland, Washington disposal site.

During the year, Reactor Health Physics built a counting well with a NaI detector attached to a MCA to analyze collected samples and radwaste.

During the year, three technicians were hired to replace previous staff members. All are experienced in Health Physics procedures.

Initiated a radwaste program which reduces the volume of waste generated at the work stations and uses engineered procedures to reduce the volume after waste is collected. Fifty to sixty percent reduction of final waste volume is anticipated.

SECTION X

SUMMARY OF RADIATION EXPOSURES TO FACILITY STAFF, EXPERIMENTERS AND VISITORS 1 July 1983 through 30 June 1984

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.

PERMANENT ISSUE FILM-BADGES

Beta, Gamma, Neutron Wholebody Badges: (Six badges are area monitors.)

	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
ME	50	37	37	49	55	56	78	59	67	58	62	64
AME	50	61	65	48	42	48	49	56	68	60	54	65
AE	67	80	52	76	79	81	92	95	109	99	136	97
HE	290	350	260	330	430	510	720	700	1060	980	1200	990

Beta and Gamma Wholebody Badges: (Six badges are area monitors.)

	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
ME	41	47	47	39	41	56	51	47	51	48	46	50
AME	3	7	4	3	3	2	5	8	8	7	8	7
AE	27	43	23	57	20	45	38	20	34	46	45	36
HE	40	100	40	100	40	50	120	80	120	130	120	110

TLD Finger Rings:

	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
ME	35	30	34	32	35	35	41	32	37	31	38	40
AME	29	33	31	29	31	24	33	34	37	35	31	36
AE	695	220	247	257	235	297	309	285	308	483	365	406
HE	15080	1870	1720	1340	2590	1470	1660	1750	2210	4210	2260	3830

SPARE ISSUE FILM-BADGES

Beta, Gamma, Neutron Wholebody Badges:

	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
ME	24	21	21	24	27	17	10	34	45	41	36	41
AME	6	4	18	8	7	2	3	10	1	6	9	7
AE	43	32	22	46	27	165	140	72	260	58	54	40
HE	130	70	90	110	60	230	200	170	260	190	150	140

Beta and Gamma Wholebody Badges:

	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
ME	18	17	29	24	16	14	19	31	27	32	31	30
AME	0	2	1	1	2	0	2	0	7	0	2	1
AE	0	45	10	10	10	0	10	0	17	0	5	100
HE	0	60	10	10	10	0	20	0	40	0	10	100

TLD Finger Rings:

	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
ME	14	12	16	15	16	15	17	17	17	18	14	18
AME	9	10	4	4	7	10	3	4	5	4	8	4
AE	209	386	58	190	274	213	187	123	192	145	126	63
HE	390	1300	130	550	110	360	290	210	370	350	410	150

DOSIMETERS

	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
ME	14	11	11	11	10	10	12	12	10	5	2	1
AME	28	30	30	27	27	27	26	29	36	41	44	44
AE	62	63	63	85	64	64	70	72	64	69	64	88
HE	235	195	195	215	485	485	365	260	288	247	240	240

COMMENTS ON SUMMARY OF RADIATION EXPOSURES

During July 1983, it was necessary to open an irradiated sample can with hand tools. A supervisor was chosen to perform the operation because higher than normal hand exposure was anticipated. The operation was monitored by a Senior Health Physics Technician. A TLD finger ring was worn on the tool hand. An exposure of 15080 mrem was received by the supervisor's hand. Total beta-gamma exposure for the supervisor for the month was 740 mrem.

During May 1984, an area monitor for the north beamport floor recorded gamma 139% higher than normal (1200 mrem compared to 865 mrem monthly average) because of work performed on beamport "D" during the month which temporarily raised exposure levels in the area. No unusual personnel exposures occurred as a result of the work.

UNIVERSITY OF MISSOURI

Research Reactor Facility

Rese..^h Park
Columbia, Missouri 65211
Telephone (314) 882-4211

August 24, 1984

Director of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Mr. Cecil O. Thomas, Chief
Standardization & Special Projects Branch
Division of Licensing

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

Subject: Annual Report as required by
Technical Specification 6.1.h(4).

Dear Sir:

Enclosed are two copies of the reactor operations annual report for the University of Missouri Research Reactor. The reporting period covers 1 July 1983 through 30 June 1984. The The remaining twelve copies will be sent in the near future.

Sincerely,

J C McKibben

J. C. McKibben
Reactor Manager

JCMK:vs

Enclosures (2)

cc w/report: U.S. N.R.C.
c/o Document Mgmt. Br.
Washington, DC

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