UNIVERSITY OF MISSOURI

Annual Report 1981-82

RESEARCH REACTOR FACILITY

UNIVERSITY OF MISSOURI

RESEARCH REACTOR FACILITY

REACTOR OPERATIONS

ANNUAL REPORT

August 1982

Compiled by the Reactor Staff

Submitted by

J. C. McKibben
Reactor Manager

Reviewed and Approved

D. M. Alger
Associate Director

TABLE OF CONTENTS

SECTION I

REACTOR OPERATIONS SUMMARY

The following table and discussion summarize reactor operations in the period July 1, 1981 to June 30, 1982.

Date	Full Power Hours	Megawatt Days	Full Power Percent* of Total Time	Full Power Percent* of Schedule
July 81	692.7	291.73	93.10	104.26
Aug. 81	670.7	279.59	90.15	100.95
Sep. 81	674.6	281.26	93.69	104.92
Oct. 81	522.8#	221.05#	70.27#	78.69#
Nov. 81	627.1	262.01	87.10	97.54
Dec. 81	693.1	285.78	93.16	104.32
Jan. 82	661.1	276.31	88.86	99.51
Feb. 82	606.2	252.75	90.21	101.02
Mar. 82	696.8	290.50	93.66	104.88
Apr. 82	663.1	276.54	92.10	103.14
May 82	673.0	281.14	90.46	101.30
June 82	629.1	262.40	87.38	97.85
Total for Year	7,810.3	3,261.06	89.16% of time for yr. at 10MW	99.865% 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.

#The reactor shutdown at 2000, October 15, to perform major maintenance, replacement of the beryllium reflector, the reactor returned to normal operation at 0800 on October 24.

JULY 1981

The reactor operated continuously during July with the following exceptions: two maintenance shutdowns on July 13 and 27; nine scheduled shutdowns for flux trap sample changes; and four unscheduled shutdowns.

On July 14 and 27, the reactor was shutdown by a rod-run-in when blade "C" disengaged from its magnet. The blade "C" mechanism was pulled to investigate the problem, the upper housing was realigned and the reactor returned to operation.

The reactor was shutdown by loss of site electrical power on July 19 and 20. Both power outages were verified with the University Power Plant and the reactor returned to operation.

Major maintenance items in July included installation of new Nuclear Instrumentation detectors in channels 3 and 6, the installation of a new drain collection tank (DCT), and the visual inspection of seven fuel elements.

Nuclear Regulatory Commission Region III inspector, A. Finley, conducted a Special Nuclear Material Accountability inspection from July 29 through July 31.

AUGUST 1981

The reactor operated continuously during August with the following exceptions: nine scheduled shutdowns for flux trap sample changes; three maintenance shutdowns on August 10, 24, and 31; and one unscheduled shutdown, August 6.

The unscheduled shutdown (manual scram) occurred when the pool loop "B" flow transmitter (912F) developed a leak on the high pressure sensing lne. The reactor was subcritical at the time of the manual scram. (A startup was in progress following a flux trap sample changeout when the leak was discovered.) The leak was repaired and the compliance check (CP-7B) for pool flow loop "B" was completed and the reactor returned to normal operation.

Major maintenance items for August consisted of regenerations of two DI-200 beds, work on realigning the regulating rod, and the installation of a new secondary flow transmitter (Rosemount).

SEPTEMBER 1981

The reactor operated continuously in September, with the following exceptions: eight scheduled shutdowns for flux trap sample changes; two maintenance shutdowns on September 14 and 28. There were no unscheduled shutdowns in September.

Major maintenance items for September included preparation of the National Lead cask for fuel storage, completion of the National Lead cask loading sequence, the repair of the emergency generator electric fuel pump switch, and the completion of a physics startup on test core BNB. The emergency generator failed to start on September 28, when the starting sequence was initiated by the automatic weekly exerciser; but started up when tested in manual. This was reported to the Nuclear Regulatory Commission in a letter to the Director of Licensing dated October 27, 1981.

OCTOBER 1981

The reactor operated continuously in October with the following exceptions: four scheduled shutdowns for flux trap sample changes; one maintenance shutdown from October 15 to October 24 to replace the beryllium reflector; and three unscheduled shutdowns.

On October 6, the reactor was shutdown, by a rod-run-in, when blade "D" was bumped by an operator retrieving a sample spacer on the reflector.

A Power Level Interlock Scram shutdown the reactor on October 24. Air trapped in DPS-929 caused erratic indication in control. The detector was vented and the reactor returned to normal operation.

A loss of site power caused a reactor shutdown on October 28. The power outage was verified with the University Power Plant and the reactor returned to normal operation.

Major maintenance items for October consisted of replacement of the drive motor for cooling tower fan #2 and the replacement of the beryllium reflector (SMP-11). The old beryllium reflector had been installed in original construction, and had been used for approximately 26,000 MWD of operation.

Mr. K. R. Ridgway, NRC Region III inspector, conducted a routine safety inspection on October 26-30, 1981. No items of noncompliance with NRC requirements were identified during the course of this inspection.

NOVEMBER 1981

The reactor operated continuously in November with the following exceptions: ten scheduled shutdowns for flux trap changes; three maintenance shutdowns on November 2, 16, and 30; and six unscheduled shutdowns.

On November 9, following maintenance day, there was a rod not in contact with magnet rod-run-in as blade "A" fell off during the normal startup. The anvil was cleaned and the upper housing realigned. The second unscheduled shutdown occurred during the subsequent startup, when blade "A" fell off again. The pool was pumped down and the housing was realigned from the refuel bridge to minimize drag of the anvil on the housing tube. A rod drop was performed on blade "A" and the reactor returned to normal operation.

The unscheduled shutdown on November 19 was caused by the pool reflector differential pressure transmitter PT-917. The shift supervisor checked all indications and found no anomalies, the reactor was returned to normal operation. The unscheduled shutdown on November 27 was caused by an electrical glitch in the

PT-917 circuit. The shift supervisor inspected and vented the transmitter and verified all systems normal and returned the reactor to normal operation.

An unscheduled shutdown occurred on November 27 and again on November 28, when the reactor scrammed while acknowledging a high level annunciator alarm while filling the demineralized water tank. No cause for the scram was indicated on the annunciator board and all indications were normal. The reactor was returned to normal operation.

The annunciator circuits were inspected by the Electronics Shop during maintenance day on November 30. The source of the electrical problem could not be determined. The "white rat" system was installed in the jumper board panel for the safety system to detect what contacts in the safety system were causing the scrams. This monitor detects momentary opening of a safety system relay contact.

Major maintenance items for November were: replacement of reflector graphite element number 6; replacement of the cooling tower exhaust fan; replacement of the emergency generator electric fuel pump breaker; and replacement of the drain valve on the pool strainer with a ball type valve.

DECEMBER 1981

The reactor operated continuously in December with the following exceptions: nine scheduled shutdowns for flux trap sample changes; two maintenance shutdowns on December 14 and 28; one shutdown for operator training; and three unscheduled shutdowns.

The unscheduled shutdown on December 2 was a scram caused by an electrical glitch. After the shift supervisor investigated and found no anomolies, the reactor was returned to normal operation. On the next sample shutdown on December 3, the yellow leg trip actuator amplifier was replaced. The unscheduled shutdown on December 13 was a manual scram to replace the inner airlock door motor. The second unscheduled shutdown on December 13 was a manual rod-run-in to replace the breaker for the inner airlock door drive motor.

Major maintenance items for December were the replacement of the inner airlock door drive motor and its breaker, and the replacement of the drive motor for cooling tower fan number 2.

JANUARY 1982

The reactor operated continuously in January with the following exceptions: thirteen scheduled shutdowns for flux trap changes; four maintenance shutdowns on January 7, 11, 18, and 25; one shutdown for operator license examinations on January 11; and two unscheduled shutdowns.

On January 8, blade "D" fell off during a shimming evolution. The housing on blade "D" was adjusted and the reactor was returned to normal operation.

The unscheduled shutdown on January 14 was a high power scram thought to be caused by a sample off-gassing in the flux trap. The sample was replaced with a spacer and the reactor was returned to normal operation.

Major maintenance items for January were: repair of pump 508A pump bearings and mechanical seal; three spent fuel shipments; and replacement of the source range detector.

FEBRUARY 1982

The reactor operated continuously in February with the following exceptions: nine scheduled shutdowns for flux trap changes; two shutdowns for flux trap reactivity measurements; three maintenance shutdowns on February 1, 8, and 22; and one unscheduled shutdown.

On February 18, there was a reactor scram and isolation caused by a short circuit in the ARMS Recorder. This short circuit was inadvertently caused by the electronics technician trouble shooting a drive malfunction in the ARMS Recorder. The containment building was evacuated as per emergency procedure for reactor isolation. After surveys taken by Health Physics' personnel showed all radiation levels were normal, the reactor was returned to normal operation.

MARCH 1982

The reactor operated continuously in March with the following exceptions: eight scheduled shutdowns for flux trap sample changes and two maintenance shutdowns on March 8 and 22. There were no unscheduled shutdowns in March.

Major maintenance in March included Machine Shop repair and balancing of primary pump P501A and operations regeneration of DI-201 bed "Q".

APRIL 1982

The reactor operated continuously in April with the following exceptions: ten scheduled shutdowns for flux trap changes; two maintenance shutdowns on April 5 and 19; and one unscheduled shutdown.

On April 1, there was a reactor scram caused by a loss of site electrical power. All systems were checked by the shift supervisor. Electrical power was restored by the Power Plant and the reactor was returned to normal operation.

On April 5, the new 3" irradiation hole was installed in the H position of the graphite reflector. This new H-3 element replaced the existing 2" element and the solid element of the H position. The S-Basket, Reuter-Stokes Air Force and Bulk Pool Lead Shield Irradiation Facilities were removed from the reflector at this time, in preparation for installation of the new Bulk Pool Lead Shield Irradiation Facility under offset "D".

On April 19, a new offset, Assembly number 7, was installed in position A. The new Bulk Pool Lead Shield Irradiation Facility was installed under offset "D" at this time.

MAY 1982

The reactor operated continuously in May with the following exceptions: twelve shutdowns for flux trap sample changes; three shutdowns for maintenance; five shutdowns for RTP-5, Reactivity Measurement; and four unscheduled shutdowns.

On May 11 and 14, the reactor was scrammed due to loss of site electrical power. The power loss was verified with the University Power Plant by the shift supervisor.

The unscheduled shutdown on May 24 was caused by a static charge build-up on the WRM switch. The reactor scrammed while performing RTP-11, Reactivity Measurement. The WRM switch was wiped and reactor power was restored for RTP-11.

The unscheduled shutdown on May 25 was a manual scram to repair the gasket on the inner airlock door. The gasket was repaired and the reactor was returned to power of 10MW.

Major maintenance activities were: Containment Building Leak Test, RTP-13, performed on May 13; the replacement of primary pump P-501A on May 20; the replacement of reflector graphite element number 5 on May 20; and the inspection and gapping of fuel elements MO-53, MO-67, and MO-69 and the inspection of MO-80 on May 27. The containment leak rate was 12.1 scfm, which is less than the Technical Specification limit of 16.3 scfm.

JUNE 1982

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

On June 1 and 7, the reactor was shutdown to repair the airlock door. The timing sequence was adjusted and the door gasket was reinstalled and tested before the reactor was returned to power.

Two unscheduled shutdowns on June 8 were caused by a loss of site electrical power. The power losses were verified with the University Power Plant and the reactor was returned to power.

The unscheduled shutdown on June 24 was due to an electrical glitch on the annunciator caused by acknowledging and clearing an alarm. The annunciator was tested for normal operation and the reactor was returned to power of 10MW.

Major maintenance activities were: replacement of control tower fan number 3 motor on June 2; the disassembly and disposal of offset number 4 on June 7; replacing the mechanical seal on P513-A on June 14; replacement of channel number 4 Nuclear Instrument detector on June 14; replacement of the cylinder heads on the emergency generator on June 21; the replacement of P513A motor bearings on June 28; and the installation of the emergency generator fuel day tank and vacuum break system, Modification Package Number 82-3, on June 28.

SECTION II

OPERATING PROCEDURE CHANGES

As required by the MURR Technical Specifications, the Reactor Manager reviewed and approved the Standard Operating and Emergency Procedures (SOP). Two additional revisions (#11 and #12) have been made during the past year to the SOP manual which was issued June 1980. 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 vertical black line.

Also, a new SOP manual was issued October 1981 which revised the June 1980 manual. There have been six revisions made to the 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 (]). The October 1981 revision is enclosed with the Nuclear Regulatory Commission copy of the Annual Report. Additional copies may be obtained upon request.

REVISION NUMBER 11

TO JUNE 1980 MANUAL

SOP/VII-53	Revised 9/81
SOP/VII-54	Revised 9/81
SOP/A-7a	Revised 9/81

2. Start the waste pump (WP1) and verify flow through the bullseye.
3. Recirculate for 10 minutes prior to sampling.
4. Draw off sample through W22 and discard to liquid waste drain.
5. Draw off a sample through W22 for analysis.
6. Close W22 and secure the waste pump.
7. Close W6a, 6b, 10, 16, 17, 18, 19, 27.
8. Deliver the sample and completed form to the Nuclear Science Group for analysis.
9. Record taking of sample in Reactor Log.

VII.8.7 Pumping to Sanitary Sewer

Note: Can be done only with Shift Supervisor's Authorization. Check the following valves closed: W1, 2, 3, 15, 22, 23, 24, 25, 26, 27. If pumping with WP2, open W7 and 8 instead of W9 and 10.

A. Pumping WT2 to Sewer (check closed 6a, 6b)
1. Open W5a, 5b, 9, 10, 16, 17, 18, 19, 28 and 30.
2. Commence a virgorous air sparge through W41.
3. Start the waste pump (WP1) and verify flow through the bullseye.
4. Check the WT level frequently until the tank is empty.
5. When it is empty, shut W41 and secure the waste pump.
6. Close W5a, b, 10, 16, 17, 18, 19, 28 and 30.
7. Record the volume remaining on the Waste Tank Sample Form and return it to the Health Physics Office.
8. Record pumping evolution completion in the Reactor Log.

B. Pumping WT3 to Sewer
1. Check valves W5a, b closed.
2. Open W6a, 6b, 9, 10, 16, 17, 18, 19, 28 and 30.
3. Start the waste pump (WP1) and verify flow through the bullseye.
4. Check the WT level frequently until the tank is empty.
5. When it is empty, secure the waste tank pump.

Date ____________

PNEUMATIC TUBE IRRADIATIONS

Run	Clock Time		Name	Proj. No.	Room No.	Irradiation		File No.
	In	Out				Min	Sec	
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								

REVISION NUMBER 12

TO JUNE 1980 MANUAL

SOP/A-1a	Revised 10/81
SOP/A-1b	Revised 10/81

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).

____ 4. Visual check of CT equipment completed.
____ a. Oil level in CT fans normal (Monday startups).

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.

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.

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-up)
    b. Facility evacuation switch (check outer containment horns).(Monday start-up)
    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 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 after all systems are in operation.
    a. Check oil reservoir for pump P501A, 501B, and P533 for adequate supply. Add if necessary.
34. Routine patrol completed.
35. Reactor ready for startup.

Time (Completed) ____________________

____
Senior Reactor Operator

Rev. 10/81 App'd [signature]

REVISION NUMBER 1

TO OCTOBER 1981 MANUAL

SOP/A-8a	Revised 3/82
SOP/A-8b	Revised 3/82

Date ______________________

Reactor Routine Patrol

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											
	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 POWER ON (Run daily: 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 Sup. mlds. 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											
	Rm 114 particulate filter ΔP	< 2.5" H_2O											

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.

	Item	Standard										
28.	External Doors	All locked except east when sec on duty										
29.	CT basin water level	5-10"										
30.	Acid Day Tank Level	Visible										
31.	CT sump pumps	Operable										
32.	P-pump(s) running											
33.	Pump strainer ΔP	0-7.0 psi										
34.	Discharge Pressure											
35.	Pump Strainer ΔP	0-7.0 psi										
36.	Discharge Pressure											
37.	Tunnel sump pumps	Operable										
38.	WT Booster Fan	Running										
39.	Acid Control and pH	Flow 400-800 cc/min pH 7.5-8.5										
40.	Blowdown Control/Cond.	Flow 500-800 cc/min Cond. 2.0K-2.9K										
41.	Fission Product Monitor Flow	95-105 cc/min										
42.	Vlv control header pressure	90-120 psig										
43.	Pressurizer N_2 supply press	90-100 psig										
44.	Check Rm 114 from door											
45.	Deltech oil filter "red level" and blowdown	< 75% dark red										
46.	Seal trench	61-66" Run pump on days										
47.	Full N_2 bottles	total > 3										
48.	Bank A bottle press	> 250 psig										
49.	Bank B bottle press	> 250 psig										
50.	Bank on service	A or B										
51.	N_2 header pressure	135-145 psi										
52.	Waste Tank # 3 level											
53.	Waste Tank # 2 level											
54.	Waste Tank # 1 level											
55.	Doors to CT, WT's, Demin Rm 114 and CT Tunnel	Locked										
56.	Time of Completion of Patrol											
57.	Operator initials											

If a condition is normal, enter an "N" or a check "✓" in the applicable box. If the condition reading is abnormal, enter "AN" for the condition and circle it. Circle the reading if it is abnormal. Explain all abnormal readings or conditions in the remarks.

REMARKS:

Rev. 3/82 App'd [signature]

REVISION NUMBER 2

TO OCTOBER 1981 MANUAL

SOP/A-1b Revised 3/82

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).

____ 4. Visual check of CT equipment completed.
____ a. Oil level in CT fans normal (Monday startups).

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.

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.

___ 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-up)
___ b. Facility evacuation switch (check outer containment horns). (Monday start-up)
___ 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 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, 501B, 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 3

TO OCTOBER 1981 MANUAL

SOP/VII-16	Revised 4/82
SOP/VII-23	Revised 4/82
SOP/VII-37	Revised 4/82
SOP/A-1a	Revised 4/82

1. Connect the quick-disconnect hose to the master DI supply.]
]
2. Verify adequate level in T300 ~ 5000 gallons.]
3. Open DI valve.]

F. Open air valve RE25, bleed any oil or water from the air line via valve RE52. Adjust air regulator to 50 psig. Nofity the reactor control room of intentions to begin the transferring of water to the drain collection tank.

G. Check valve DI13 closed.

H. Open valve DI9.

I. Open valve DI10 (DI200) or DI11 (DI201) or DI12 (D202) depending on column to be transferred, to pressurize the DI column.

J. Slowly open DI14 to commence the transfer; monitor the transfer at the bullseye.

K. When transfer is complete, close DI14, close DI10, DI11, or DI12 respectively.

L. Open DI8 and vent all pressure from the column. The column will now be refilled and flushed two times by the following procedure.

   1. Open the DI supply, valves RE18 and DI3. Insure DI8 open.
   2. Open R2 and fill the respective DI column with DI water until it starts to exit via DI8.
   3. Close R2, DI8, DI3. This flush water will now be transferred to the primary/pool collection tank.
   4. Check DI13 closed and DI9 open.
   5. Open valve DI10 (DI200) or DI11 (DI201) or DI12 (DI202) to pressurize the DI column.
   6. Slowly open DI14 and monitor the transfer until all water has been transferred. Repeat the process for the second flush.
   7. Close DI14, DI9, DI10, DI11 or DI12.
   8. Open DI8 and vent all the pressure from the column. Caution: It is extremely important that valve DI14 be closed after the transfer of DI water to the drain

collection system. Failure to close this valve before proceeding further could result in the addition of raw water to the drain collection system.

The unit now needs to be refilled; NEVER LEAVE IT DRY.

M. Open DI3.

N. Open R2 and refill the column until water starts to exit via DI8.

O. Close R2, DI3, and DI8.

P. Close all other valves opened (DI supply, RE18).

Q. Log in the resin log the exact status of the DI column. The DI column is now ready for transfer.

VII.4.4 Preparation of Regenerate Solutions Required by Regeneration

VII.4.4.1 Acid Regenerate Selections for Regeneration

A. Determine the required draws.

B. Fill mixing tank to proper water level for the required draws.

C. Add acid via the measuring tank for the required draws.

VII.4.4.2 Acid Solution Strength

A. Specific gravity should be 1.172 @ 66°F.

VII.4.4.3 Caustic Regenerate Solutions for Generation]

A. Determine the required draws.]

B. Fill mixing tank to proper water level for the required draws.]

C. Commence air sparge of water.]

D. Add the necessary bags of caustic soda for the required draws.]

VII.4.4.4 Caustic Solution Strength]

A. Specific gravity should be 1.275.]

C. Throttle to 30-35 gpm.

D. Check closed RE2 and RE17.

E. Monitor the rinse by performing an alkalinity test as per "F" listed below.

F. Alkalinity Test: Obtain a 58.3 ml sample from RE23 of rinse water, add 2-3 drops of methyl orange indicator. While stirring, add 0.4N sulfuric acid, one drop at a time, until color changes from yellow to permanent faint pink or red. Each drop of acid solution equals 1 grain per gallon (17.1 parts per million, ppm) of alkalinity. At a resistance of 25K ohms, the alkalinity will be one grain or less.

Note: If the solubridge is used to check the conductivity of the rinse water, it must be turned off before the acid draw to prevent damage to the cell.

G. Close valves RE3, RE7 and RE18.

H. Close the DI supply valve and RE16.

VII.4.5.5 Intermediate Backwash

Inspect the resin through the sight glasses for proper separation. If the resin has not been properly separated, proceed with a DI water backwash for 10 minutes as per VII.4.5.2. When the separation is adequate, proceed with step VII.4.5.6.

VII.4.5.6 Sulfuric Acid Treatment

A. Switch disconnect to DI water.

B. Open DI supply valve.

C. Adjust RE19 for 3 gpm downflow.]

D. Secure solubridge.]

E. Open RE3, RE7 and RE16.]

F. Open RE1 and RE14.

G. Adjust RE17 for 4-5 gpm and vent the acid vent tank until full of water.

H. Check shut RE56, RE59, RE60 and RE62.]

I. Open acid pump isolation valves and close its breaker on MCC2.]

J. Open RE5 and RE58.]

K. Start acid pump and timer at control panel.]

L. Throttle RE57 for 1.5 gpm for 30 minutes.]

M. Monitor the vent tank while the acid treatment is in progress to insure air does not pass through to the regenerator. It may be necessary to vent excess air from the vent tank during the treatment.]

N. When the acid injection is completed, close valve RE5 and RE58 immediately.]

O. After each draw, rinse for 10 minutes.]

P. Open RE5 and RE58 for next draw.]

Caution: Do not allow air to be injected into the regenerator during the acid treatment. Air bubbles will carry acid up into the anion resin and reduce its capacity.]

Q. Continue rinsing without changing the valve lineup for 30 minutes.]

R. Close the acid pump suction and discharge valves, secure the pump's electrical power at MCC2 and thoroughly rinse the acid pump with DCW inside and out.]

S. Close RE57.]

VII.4.5.7 Acid Fast Rinse

A. Open DI supply valve.]

B. Open RE18 for maximum flow.]

C. Start T300 pump.]

D. Throttle RE18 flow to 30-35 gpm.]

E. Close RE1 and RE14. Then drain the acid vent tank and refill through RE1.]

F. Close RE17 and RE19.]

VII.4.8.13b Providing DI Water to T300 Without Reverse Osmosis Unit Makeup

A. Check valve 3 closed.

B. Open valve 1, open the T300 supply valve RE31.

C. Check valve 7 closed and place the low conductivity cutout circuit into operation using the procedure posted at the DI300 station.

D. Record the resistivity and water meter readings on the log.

E. Insure that the resistivity reading does not drop below 500 K ohms while making water for T300.

F. Upon completion of making DI water, log the resistivity and water meter readings on the log. Close master T300 valve, close valves 1 and 17. If the low conductivity cutout circuit was used, secure it.

G. If the resistivity drops to 500 K ohms, the life of the bed can sometimes be extended by following steps VII.4.8.10 through VII.4.8.12.

H. When the resistivity reading cannot be brought above 500 K ohms, it is necessary to regenerate the unit.

VII.4.8.13c Providing DI Water to DI200 Units]

A. Check valve 3 closed and close the T300 supply valve.]

B. Open valves 1, 7 and 13.]

C. Open R200 supply valve.]

D. Record the resistance and water meter readings on the log.]

E. Should the resistance drop below 500 K, resparge the unit.] If a higher resistance cannot be achieved, and the regen-] eration of a 200 series bed is required, continue to use] the DI water, for it is still better than DCW. Proceed to] regenerate as soon as possible.]

F. When DI water is no longer necessary for the 200 series,] close valves 1 and 7. Close the R200 supply valve.]

G. Record the resistance and meter readings on the log.]

VII.5 Skimmer System

VII.5.1 Normal Startup of the Skimmer System

The skimmer system is operated to remove floating debris from the pool at the normal operating level. If necessary, it is also possible to operate this system with the pool at refuel level by securing the skimmer box with valve 548A and recirculating the water with suction taken through valve 548B from approximately 1 foot below the refuel level.

The skimmer system is put into routine operation according to the following procedure:

A. Verify that no maintenance has been performed on the skimmer system since the last shutdown of the system. If maintenance has been performed on the system, verify that a system valve lineup checklist has been performed; if not, do so before proceeding.
B. Energize pump P532 by turning off-on switch located on the instrumentation panel in the control room to the on position. Vent the pump until it shows a steady discharge pressure.

VII.5.2 Pool Pump Down with the Skimmer System

A. Prior to pumping the pool down, insure that there is sufficient reserve volume in tank T301 to receive the water.
B. If the pool level is to be lowered below the skimmer suction box, change the suction lineup to the lower suction by closing valve 548A and opening V548B.
C. The skimmer pump discharge normally returns to the pool via valve 515H. Pumping the pool down is accomplished by closing valve 515H and opening valve 524 to redirect the discharge to T301. A single control switch on the drain collection system control board operates valve 515H and valve 524. This switch is normally left in the open

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).

____ 4. Visual check of CT equipment completed.
____ a. Oil level in CT fans normal (Monday startups).

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 and reset, as necessary, silicon integrator and totalizer setting.

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.

___ 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 2S8 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-up)
___ b. Facility evacuation switch (check outer containment horns).(Monday start-up)
___ 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 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 30% 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, 501B, 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 4

TO OCTOBER 1981 MANUAL

SOP/A-1a Revised 5/82

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 and reset, as necessary, silicon integrator and totalizer setting.

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.

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-up)
    b. Facility evacuation switch (check outer containment horns). (Monday start-up)
    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 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, 501B, 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 5

TO OCTOBER 1981 MANUAL

SOP/VII-16	Revised 6/82
SOP/VII-22	Revised 6/82
SOP/VII-24	Revised 6/82

1. Connect the quick-disconnect hose to the master DI supply.]
   ]
2. Verify adequate level in T300 ~ 5000 gallons.]
3. Open DI valve.]

F. Open air valve RE25, bleed any oil or water from the air line via valve RE52. Adjust air regulator to 50 psig. Nofity the reactor control room of intentions to begin the transferring of water to the drain collection tank.

G. Check valve DI13 closed.

H. Open valve DI9.

I. Open valve DI10 (DI200) or DI11 (DI201) or DI12 (D202) depending on column to be transferred, to pressurize the DI column.

J. Slowly open DI14 to commence the transfer; monitor the transfer at the bullseye.

K. When transfer is complete, close DI14, close DI10, DI11, or DI12 respectively.

L. Open DI8 and vent all pressure from the column. The column will now be refilled and flushed two times by the following procedure.

   1. Open the DI supply, valves RE18 and DI3. Insure DI8 open.
   2. Open R2 and fill the respective DI column with DI water until it starts to exit via DI8.
   3. Close R2, DI8, DI3. This flush water will now be transferred to the primary/pool collection tank.
   4. Check DI13 closed and DI9 open.
   5. Open valve DI10 (DI200) or DI11 (DI201) or DI12 (DI202) to pressurize the DI column.
   6. Slowly open DI14 and monitor the transfer until all water has been transferred. Repeat the process for the second flush.
   7. Close DI14, DI9, DI10, DI11 or DI12.
   8. Open DI8 and vent all the pressure from the column. Caution: It is extremely important that valve DI14 be closed after the transfer of DI water to the drain

collection system. Failure to close this valve before proceeding further could result in the addition of raw water to the drain collection system.

The unit now needs to be refilled; NEVER LEAVE IT DRY.

M. Open DI3.

N. Open R2 and refill the column until water starts to exit via DI8.

O. Close R2, DI3, and DI8.

P. Close all other valves opened (DI supply, RE18).

Q. Log in the resin log the exact status of the DI column. The DI column is now ready for transfer.

VII.4.4 Preparation of Regenerate Solutions Required by Regeneration

VII.4.4.1 Acid Regenerate Selections for Regeneration

A. Determine the required draws.

B. Fill mixing tank to proper water level for the required draws.

C. Add acid via the measuring tank for the required draws.

VII.4.4.2 Acid Solution Strength

A. Specific gravity should be 1.172 @ 66°F.

VII.4.4.3 Caustic Regenerate Solutions for Regeneration]

A. Determine the required draws.

B. Fill mixing tank to proper water level for the required draws.

C. Commence air sparge of water.

D. Add the necessary bags of caustic soda for the required draws.

VII.4.4.4 Caustic Solution Strength

A. Specific gravity should be 1.275.

M. After draining for 4 minutes, close RE15 and RE9, open RE16 and RE17 and re-establish a flow rate of 5-6 gpm at 100-110°F.

Note: Excessive gas volume may build up, and may be vented by opening RE9.

N. Open and throttle valve RE55 to educt NaCl to the resin at a rate of 3/4-7/8 inch per minute (1.2-1.4 gpm) for 40 minutes. Continually observe the resin column for indication of offgasing; observe the draw down rate, the eductor flow and maintain proper temperatures. The temperature, flow rates, and peracentage of NaCl must remain within their limits to obtain the desired results.

O. After the total volume of 20% NaCl solution has been educted, close valve RE55 and allow the bed to rinse for a minimum of 40 minutes. If, however, at the end of the treatment excessive offgasing is still being observed, repeat the procedure after the 40 minute rinse with another 50 lbs. of NaCl by repeating steps J through O. If offgasing is not observed, proceed with step P.

P. Close DHW valve RE28, RE17 and RE2. Open RE18 and open RE3 for a 25-30 gpm flow. Allow the bed to rise an additional 30 minutes.

Q. Close valves RE27, RE18, RE3, RE7, RE16 to complete the NaCl treatment.

R. Log in the resin-filter log the exact status and location of all resin beds.

VII.4.5.2 Backwash

A. Connect the quick-disconnect hose to the DCW supply and open the master DCW supply valve (RE27).

B. Open valve RE18.

C. Open valve RE8 and RE16; close RE15.

D. Open valve RE4 gradually to give a flow rate of 15 gpm.

E. During the backwash, frequently inspect through the sight glass to insure that proper separation is being achieved. It may be necessary to vary the flow rate to obtain a good separation.

F. Backwash for 30 minutes minimum.

G. Close valves RE8, RE4, RE18, RE27, and RE16.

Note: Periodic hot water regenerations may be necessary to remove silicates which are not removed during cold water regenerations.

VII.4.5.3 Caustic Soda Treatment

A. Open the master DCW supply valve RE27.

B. Secure the solubridge.

C. Open RE2, RE7 and RE16. Close RE15.

D. Open RE17 and adjust flow rate to 7 gpm.

E. Close breaker on MCC2 for caustic pump.

F. Open caustic pump suction and discharge valve.

G. Check closed RE61, RE63, RE66 and RE67.

H. Open RE6 and RE65.

I. Start pump and timer with pushbutton on control panel.

J. Throttle RE64 to maintain caustic flow of 1.25 gpm for 40 minutes.

K. Ten minute rinse between draws.

L. To prevent caustic eduction during rinse, close RE6.

M. Open RE6.

N. When last caustic draw is completed, close RE6, RE64 and RE65 and let unit rinse as is for 30 minutes.

O. Secure the caustic pump at MCC2 and close its discharge valve.

P. After 30 minutes, close RE17, RE2, RE7, and RE27: secure DCW.

VII.4.5.4 Caustic Fast Rinse

A. Open RE18, RE3, DI water supply from T300 pump, and RE7.

B. Turn on T300 pump.

C. Throttle to 30-35 gpm.

D. Check closed RE2 and RE17.

E. Monitor the rinse by performing an alkalinity test as per "F" listed below.

F. Alkalinity Test: Obtain a 58.3 ml sample from RE23 of rinse water, add 2-3 drops of methyl orange indicator. While stirring, add 0.4N sulfuric acid, one drop at a time, until color changes from yellow to permanent faint pink or red. Each drop of acid solution equals 1 grain per gallon (17.1 parts per million, ppm) of alkalinity. At a resistance of 25K ohms, the alkalinity will be one grain or less.

Note: If the solubridge is used to check the conductivity of the rinse water, it must be turned off before the acid draw to prevent damage to the cell.

G. Close valves RE3, RE7 and RE18.

H. Close the DI supply valve and RE16.

VII.4.5.5 Intermediate Backwash

Inspect the resin through the sight glasses for proper separation. If the resin has not been properly separated, proceed with a DI water backwash for 10 minutes as per VII.4.5.2. When the separation is adequate, proceed with step VII.4.5.6.

VII.4.5.6 Sulfuric Acid Treatment

A. Switch disconnect to DI water.

B. Open DI supply valve.

C. Adjust RE19 for 3 gpm downflow.]

D. Secure solubridge.]

E. Open RE3, RE7 and RE16.]

F. Open RE1 and RE14.

G. Adjust RE17 for 4-5 gpm and vent the acid vent tank until full of water.

H. Check shut RE56, RE59, RE60 and RE62.

I. Open acid pump isolation valves and close its breaker on MCC2.

J. Open RE5 and RE58.

K. Start acid pump and timer at control panel.

L. Throttle RE57 for 1.5 gpm for 30 minutes.

M. Monitor the vent tank while the acid treatment is in progress to insure air does not pass through to the regenerator. It may be necessary to vent excess air from the vent tank during the treatment.

N. When the acid injection is completed, close valve RE5 and RE58 immediately.

O. After each draw, rinse for 10 minutes.

P. Open RE5 and RE58 for next draw.

Caution: Do not allow air to be injected into the regenerator during the acid treatment. Air bubbles will carry acid up into the anion resin and reduce its capacity.

Q. Continue rinsing without changing the valve lineup for 30 minutes.

R. Close the acid pump suction and discharge valves, secure the pump's electrical power at MCC2 and thoroughly rinse the acid pump with DCW inside and out.

S. Close RE57, RE58 and RE5.]

VII.4.5.7 Acid Fast Rinse

A. Open DI supply valve.

B. Open RE18 for maximum flow.

C. Close RE1 and RE14. Then drain the acid vent tank and refill through RE1.]

D. Start T300 pump.]

E. Throttle RE18 flow to 30 - 35 gpm.]

F. Close RE17 and RE19.

REVISION NUMBER 6

TO OCTOBER 1981 MANUAL

SOP/I-17	Revised 6/82
SOP/I-18	Revised 6/82
SOP/A-16a	New Addition 6/82
SOP/A-16b	New Addition 6/82

Table IV (continued)

		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	---	9 (below ℄)	---	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	---	---	31	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)	[3]61	---	---	psig]

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

________________/________
Month Year

D. I. WATER MAKEUP LOG

|← Fill in only if sending DI water. →|

Day	Time		Conductivity			Water Meter			Remarks
	Start	Stop	RO Unit	T-300		Start	Stop	Net	
				Start	Stop				

Rev. 6/82 App'd JC Vhe

NOTE: THIS PAGE INTENTIONALLY LEFT BLANK

SECTION III

REVISIONS TO THE HAZARDS SUMMARY REPORT

1982 REVISIONS TO THE HAZARDS SUMMARY

1. Page 1-1, section 1.1.2: Delete "animal quarters" in the seventh line.

2. Page 1-1, section 1.1.3: Delete "a laboratory for reactor operations" in the last line.

3. Page 1-2, section 1.1.3: Replace the word "five" with "four" in the third line of the first paragraph.

4. Page 1-2,3, section 1.1.3: Delete "and consists of two regions. The intermost region...the fuel region".

5. Page 1-3, section 1.1.3: Change "4" to read "up to 4" for the number of p-tube irradiation positions.

6. Page 1-3, section 1.1.3: Delete "8" for the number of reflector irradiation positions.

7. Page 1-4, section 1.1.3: Delete the last paragraph of this section.

8. Page 1-8, Table 1.1 EXPERIMENTAL FACILITIES: Delete "1.61 inch" for the flux trap. Change "4" to read "up to 4" for p-tubes. Delete "8" and change "baskets" to "positions" for reflector irradiation.

9. Page 1-9, Table 1.1 FLUX TRAP: Change "1.61"" to read "3-5/16"".

10. Page 1-9, Table 1.1 WATER ISLAND: Change "1.33" to read "5".

11. Page 3-3, section 3.2.1 LIST OF SERVICES IN THE SEAL TRENCH: Change "4" inch to read "6" inch in item 2.

    Add: Item 10. 3/8" copper drain to sewer for Beamport B
    Item 11. 1-1/4" vacuum line
    Item 12. 3/4" pvc Film irradiator helium supply
    Item 13. 3/4" pvc Alternate air supply line to exhaust plenum backup doors from emergency air compressor.
    Item 14. 3/4" pvc (blanked)

12. Page 3-5, section 3.2.6: Delete the last part of the first sentence "and one 4" exhaust line from the blower".

13. Page 4-9, Table 4.1: Change "Average Power Density... .303 MW/liter at 10 MW". Change "Max$_{K_{eff}}$ with One Stuck Rod 6.2 Kg(25) Core... .938".

14. Page 4-10, Table 4.1: Change "Equilibrium Xenon Worth 6.2 Kg(25) Core... -0.02730 $\Delta K/K$". Add: Change Peak to Equil. ratio to 2.22." Change "Equilibrium Samarium Worth... -0.008275 $\Delta K/K$".

15. Page 4-11, Table 4.2: Add under the heading "Energy Group Structure for Four Groups". Add in the left side of the table:

Fission Spectrum	Group
--	4
--	3
.25	2
.75	1

16. Page 24 and 25a of Addendum 1: Delete the last three paragraphs and replace with: "The generator will run for approximately 30 minutes weekly under no load conditions. This is accomplished by a timer in which the generator runs on Monday mornings. The generator is load tested on a semi-annual interval."

17. Page 7-5: Change "weekly" to "prior" to startup in the third paragraph.

18. Page 7-5: Change "4" to "6" in the first paragraph of section 7.1.7.

19. Page 7-7: Add after the last paragraph: "A longer air operated fuel handling tool is presently being used. The pool level remains at its normal level when using the longer tool. Fuel can be transferred to the X, Y or Z baskets using the longer tool."

20. Page 7-16: Change "aluminum storage tanks" to "carbon steel tanks" in the first sentence of section 7.2.2.

21. Page 7-17: Add "This system is presently not being used" at the end of section 7.2.3.

22. Page 7-19: Delete the words "located within the reactor containment building" from the second paragraph of section 7.2.8.

23. Page 7-20: Add after the heading for section 7.2.9: "A computerized telephone system has been installed in this facility. This new system incorporates a paging feature with several different phones being able to originate the page."

24. Page 5 of Addendum 2: Add after the second paragraph (See Section 12.2.2 revision 1977 for current requirements for RAC reviews.)"

25. Page 8-10: Change the words "four" to read "up to 4" and "seven" to read "up to 6" in the third sentence of the first paragraph of section 8.5.

26. Page 8-11: Change the word "four" to read "up to 4" in the first sentence of the second paragraph of section 8.5.

27. Page 8-11: Change the word "four" to read "up to 4" in the first sentence of the fourth paragraph of section 8.5.

28. Page 8-12: Delete "passes through the containment wall...for a long period of time where temperature is of prime concern" and replace it with "exhaust to the facility stack plenum".

29. DELETE: Section 8.4 and replace with:

8.4 Irradiation Baskets

Irradiation baskets are housed in the graphite reflector region between Beamport A and Beamport D. There were originally 12 removable graphite elements which could be replaced with irradiation baskets (modified graphite elements to house samples while being irradiated at relatively high thermal neutron fluxes). (rev. 1982)

This graphite region has been modified. A large wedge shaped irradiation basket occupies two rows of the original four row design. This wedge is an aluminum helium filled structure with six irradiation positions. A solid aluminum three-inch irradiation basket occupies two sections of another row. Two pneumatic tubes occupy two sections of the last row.

All samples that are irradiated are approved, 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.

30. Page 93 of Addendum 1: Delete "into the containment building. From there...evacuation alarm is initiated" and replace with "the facility exhaust stack plenum". Delete "On the fifth level of the containment...volume of 20,411 cfm", in the last paragraph of page 93 of Addendum 1, item 3.19, in section 8.5.

31. Page 8-13: Delete the second and third paragraphs of section 8.6 and replace with: "The graphite stack incorporates a bismuth filter, neutron radiographic variables aperture, and a slot for the irradiator case for the film irradiator experiment. The original thermal column door has been replaced with a new door that incorporates a film irradiator experiment. Figure 8.3 is a cross sectional view of the thermal column door, and the film irradiator experiment. The thermal column door moves on two floor level tracks and is driven by an electric motor through a gear reducer box. An electrical interlock assures that the control rods cannot be withdrawn unless the door is fully closed."

32. Page 9-3: Change "90%" to "60%" in the first paragraph.

33. Page 9-6, Table 9.1 #57: Change "90%" to "60%". Add "81...P-tube blower light...light." Add "85...Digital Readout...Digital Readout".

34. Page 9-7: Delete #50. Change #59 to read: "Intrusion Alarm Switch...2 Pos. Switch". Add: "78...Intercom Box". Add: "79...T.C. Door Shutter...2 Pos. Switch". Add: "80...Airlock Door Security Switch...2 Pos. Switch". Add: "82...P-Tube Blower Exhaust...2 Pos. Switch". Add: "83...Airlock Door Open Switch...P. B. Switch". Add: "84...Digital Selector Switch...25 Pos. Switch".

35. Pages 9-7 through 9-9, Table 9.2: Change complete table to read exactly as the following pages 9-7 through 9-9.

Table 9.2 presents a summary of the devices installed in the instrument cubicle. The "Number" column Table 9.2 refers to the identification on Figure 9.3. (rev. 1982)

TABLE 9.2

INSTRUMENT CUBICLE DEVICES

Item No.	Function
1	Annunciator
2	Source Range (Level) Channel 1 Recorder
3	Intermediate Range (Level) Channel 2 and 3 Recorder
4	Power Range (Level) Recorder
5	Area Radiation and Process Recorder
6	Reactor Water Inlet-Outlet Temperature Recorder, 2 Pen
7	Reactor Water Temperature Control Controller
8	Pool Water Inlet-Outlet Temperature Recorder, 2 Pen
9	Pool Water Temperature Control Controller
10	Reactor Water Flow Recorder, 2 Pen
11	Pool Water Flow Recorder, 2 Pen
12	Demineralizer Flow Recorder, 2 Pen
13	Secondary Flow Inlet-Outlet Temperature Recorder, 3 Pen
14	Reactor Water Inlet-Outlet Differential Temperature
15	Pool Water Inlet-Outlet Differential Temperature
16	In-Pool Heat Exchanger Differential Temperature
17	Primary Pressure
18	Differential Pressure Across Pool Reflector
19	Reactor Water Conductivity
20	Demineralized Reactor Water Conductivity
21	Pool Water Conductivity
22	Demineralized Pool Water Conductivity
23	Clock
24	"Reactor On" Indicating Light
25	Source Range Count Rate Scaler
26	Source Range Monitor
27	Channel 2 Intermediate Range Monitor
28	Channel 3 Intermediate Range Monitor

(9-7)

TABLE 9.2 (Cont'd)

INSTRUMENT CUBICLE DEVICES

Item No.	Function
29	Master Power (2CB1A/B)
30	Power Level Channel 4
31	Power Level Channel 5
32	Power Level Channel 6
33	House Relays for Interlock and Annunciator Use (K-1 Relay)
34	Regulating Blade Servo Amplifier
35	Area Radiation Monitoring
36	Area Radiation Monitoring
37	Area Radiation Monitoring
38	Noncoincidence Logic Unit Scram/Yellow
39	Actuator Amplifier Scram Unit/Yellow
40	Actuator Amplifier Scram Unit/Green
41	Noncoincidence Logic Unit Scram/Green
42	26 VDC Regulated Power and Magnet Current Indication and Adjustment
43	Fuel Rupture Monitoring
44	Safety System Relays (K-2 Relays)
45	Secondary Coolant Monitoring
46	Door 101 Open Lite and Tag
47	TV Monitor
48	South Wall Area Radiation Monitor
49	West Wall Area Radiation Monitor
50	North Wall Area Radiation Monitor
51	Fuel Storage Area Radiation Monitor
53	Cooling Room Area Radiation Monitor
54	Building Air Plenum Area Radiation Monitor
55	Bridge Area Radiation Monitor (4)
56	Bridge Area Radiation Monitor (2)
58	Noncoincidence Logic Rod Run-In Unit
59	Rod Run-In Actuator Amplifier
61	(Not Used)
62	Pump and Fan Operation "Off-On" (Note 2) (13)
63	(Not Used)

(9-8)

TABLE 9.2 (Cont'd)

INSTRUMENT CUBICLE DEVICES

ITEM NO.	FUNCTION
64	Annunciator Alarm Power Switch Off, Annunciator On, Horn Off, Both On
65	Valve Control (See Note 1) (8) Switch, 2 Pos "Auto-Man"
66	Valve Control (See Note 3) (12) Switch, 2 Pos "Open-Close"
67	Pump and Fan Control (See Note 2) (13) Fan Switch, 3 Pos "On-Off-On" Pump and Fan Control (See Note 2) (13) Pump Switch, 2 Pos "Off-On"
68	Valve Pos "Open-Closed" (See Note 4) Indicating Lights
69	Vent Duct MO Door 1 Stop Push Button
70	Vent Duct MO Door 2 Stop Push Button
71	Vent Duct MO Door 1 Indicator Light and Switch Push Button
72	Vent Duct MO Door 1 Indicator Light and Switch Push Button
73	Vent Duct MO Door 2 Indicator Light and Switch Push Button
74	Vent Duct MO Door 2 Indicator Light and Switch Push Button
75	Branch Circuit Protection Fuse (7)
131	16A Valve Closed Marker Plate and Light
132	16A Valve Open Marker Plate and Light
133	16B Valve Closed Marker Plate and Light
134	16B Valve Open Marker Plate and Light
135	Fan Failure Alarm Lights
136	Emergency Generator On
137	Secondary H_2O Temperature Hi
167	Back-Up Door Alarm
168	3 Off-Gas Recorders
169	Stack Monitor On Light, Hi/Lo Flow Alarm
170	Auxiliary Radiation Monitor and Nuclepore Alarm Panel
171	Radio
172	Power Level Monitor

NOTE 1: Valves A546A, A546B, A507A/B, A509, A545, A526, A527A, A527B

NOTE 2: Pumps P-1, P-2, P-3, Fans CT-1, CT-2, CT-3, Pumps P-501A, P-501B, P508A, P508B, P513A, P513B, P533

NOTE 3: Valves A546, 547, 507A/B, 509, 543A/B, 527E, 527F, 545, 526, 527A, 527B, 527C

NOTE 4: Valve Indicator Lights V546A, V546B, V507A/B, V509, V543A/B, V527E, V527F, V545, V526, V527A, V528B, V527C

(9-9)

TABLE 9.2 (Cont'd)

INSTRUMENT CUBICLE DEVICES

Item No.	Function
173	Mode Selector Switch 2S40
174	Mode Selector Switch 2S41
175	Drain Collection Control Panel
176	980/990 RTD Readout
177	Conductivity Amplifiers
193	Valve 552A Open Light
194	Valve 552A Closed Light
195	Valve 552B Open Light
196	Valve 552B Closed Light
197	Valve 552B Open/Normal Switch
198	Valve 527D Open Light
199	Valve 527D Closed Light
200	Valve 527D Open/Normal Switch
202	903A/B Reactor Water Inlet Temperature
203	903A/B Reactor Water Outlet Temperature
204	953 Reactor Water Outlet Hi Temperature Scrams
205	954 Reactor Water Differential Summer Temperature
207	In-Pool HX ΔT
208	903C/D Pool Water Outlet Temperature
209	903C/D Pool Water Inlet Temperature
210	952 Pool Water Differential Summer Temperature
211	911A/B Power Supply GE/MAC
212	919A/B Reactor Water Flow Square Root Converter
	912C/D Reactor Water Flow Square Root Converter
213	919A/B Pool Water Flow Square Root Converter
	919C/D Pool Water Flow Square Root Converter
214	955 In-Pool HX Temperature Differential
215	911A/B Power Supply GE/MAC
216	919A/B Reactor Water Demin. Square Root Converter
	919C/D Reactor Water Demin. Square Root Converter

(9-9a)

TABLE 9.2 (Cont'd)

INSTRUMENT CUBICLE DEVICES

Item No.	Function
217	920A/B Reactor and Pool Water Low Flow Scram
218	919A/B Pool Water Demin. Square Root Converter
	919C/D Pool Water Demin. Square Root Converter
219	920C/D Reactor and Pool Water Low Flow Scram
220	911C Power Supply GE/MAC
221	Blower
222	Room 114 Door Open
223	Cooling Tower Tunnel Door Open
224	DI-200-Di-201 Door Open
225	DI-202-R200 Door Open
226	Cooling Tower Door Open
227	Alarm Cut Out Flasher
228	DCW Low Pressure Alarm
229	Fire Main Low Pressure
230	Channel 5 and 6 Recorder
231	Rod Drop On/Off Power Switch
232	Rod Drop Reset Push Button
233	Control Blade Drop Time
234	Rod A Drop Timer
235	Rod B Drop Timer
236	Rod C Drop Timer
237	Rod D Drop Timer
238	Alarm Cutout Switches
239	Mode Annunciation
240	RTD 980A Meter
241	RTD 980B Meter
242	DPS 928A Meter
243	DPS 928B Meter
244	DPS 929 Meter
245	919F Pool Water Flow Square Root Converter
246	920F Pressurizer Level Alarm Unit

(9-9b)

TABLE 9.2 (Cont'd)

INSTRUMENT CUBICLE DEVICES

Item No.	Function
247	920G Pressurizer Level Alarm Unit
248	920H Pressurizer Level Alarm Unit
249	Pressurizer Level Indication
255	PS 944A Meter
256	PS 944B Meter
258	V547 Position Indication
259	919E Reactor Water Flow Square Root Converter
260	Nuclepore Exhaust Valves
261	Hot Cell Isolation Valve

(9-9c)

36. Page 9-16, Table 9.3: Change #8 to read "Water tank T-301 Hi or Low Level". #9 to read: "Water tank T-300 Hi or Low Level", #13 to read: "20% withdrawn", #15 to read: "Jumper board in use", #16 to read: "Thermal column door open", #17 deleted, #25 to read: "Fuel vault intrusion".

37. Page 9-18: Change "36" to "40" in the second paragraph of section 9.6.1.

38. Page 9-18: Change "65%" to "60%" in the first paragraph of section 9.6.2.

39. Page 9-19: Change "65%" to "60%" in the sixth paragraph of section 9.6.2.

40. Page 9-22: Delete section 9.7.4 paragraph and replace it with: "A scintillation detector is installed in the return leg of the secondary piping. The output of the scintillation detector is fed into a log-count-rate-meter. This instrument provides a signal to the multipoint radiation recorder and a high radiation alarm to the annunciator."

41. Page 9-23: Change "105%" to "120%" and "110%" to "125%" in the third paragraph of section 9.8.1.1.

42. Page 9-24: Delete "and three flow switches" from the first sentence of section 9.8.2.1.

43. Page 9-25: Delete the last paragraph of section 9.8.2.1.

44. Page 10-1: Delete items 2, 3, and 4 under section 10.1.

45. Page 10-5: Delete "The 2 ton monorail crane listed in Section 10.1 will be used to service the area" from the sixth paragraph of section 10.3.

46. Page 11-10: Delete the second paragraph of section 11.7.

47. Page 11-12: Delete the last sentence of section 11.9.

48. Page 11-12, Section 11.10: Delete "Reactor Period (as indicated on channel 2 and 3).

49. Page 11-13: Delete the words "will be recorded as specified in Appendix A" from the first and second sentence on this page.

50. Page 13-3, Table 13.1: Change "void coefficients" to read "Island...x 6.48×10^{-4} and core... -2.51×10^{-3}".

51. Page 13-9: Change the first sentence to read: "a reduction to less than 23'".

52. Appendix: The following Appendices are deleted by this 1982 revision.

1	Appendix C	Radiation Safety Program
2	Appendix D	Internal Staff Resumes
3	Addendum 5	Appendix A, Change 1 to Technical Specifications dated 10-3-73
4	Addendum 2	Appendix II, Reactor Designer Technical Memoranda
5	Addendum 1	Appendix I, Preoperational Checkout Procedure for the Process Instrumentation and Interlock
6	10MW Preoperational Test Procedures	

53. Page 12-1, section 12.1: Last sentence of the second paragraph, change "5" to "7" and "Appendix E" to Figure 12.1".

54. Page 12-2, section 12.1: In the last paragraph, change "Dean of Research Administration" to "Associate Vice President Academic Affairs".

section 12.2.1. In the first sentence, change "Dean of Research Administration" to "Associate Vice President Academic Affairs".

55. Page 12-3, section 2.2.2: Delete the original first paragraph.

56. Page 9-22, section 9.8: Add after the heading "See Sections 9.14 and 9.15 for 10MW upgrade modifications."

SECTION IV

PLANT AND SYSTEM MODIFICATIONS

JULY 1981

Modification 81-15: Replaced the rectangular aluminum drain collection tank with a round dished-end stainless steel tank. This change incorporated oil separators on the inlet drains and a tank drain valve replacing the drain plug.

Safety Analysis Summary: Modification 81-15 presents no unresolved safety question. It changes the tank material and capacity and minimizes the potential leakage of radioactive water to the liquid waste collection system.

AUGUST 1981

Modification 81-18: Installed a new secondary flow detector in parallel with the existing Bailey flow sensor. The new flow detector is of the Rosemount design and provides a digital indication on the reactor control panel.

Safety Analysis Summary: Modification 81-18 presents no unresolved safety question. It provides provides a backup indication of secondary flow.

OCTOBER 1981

Modification 81-21: Permitted added clearance for the insertion and future removal of the beryllium reflector. This modification was the machining of the reflector support skirt to allow for increased clearance between the skirt and graphite reflector support plate. Aluminum oxides have been measured at 0.004" on materials in the pool for long periods. Burrs or defects that existed on the reflector support tank base could easily occupy 0.012". Original design designated a clearance of 0.010" nominal, between the outside of the beryllium support skirt and the graphite reflector support plate. This modification increased the clearance to 0.030".

Safety Analysis Summary: Modification 81-21: Modification 81-21 presents no unresolved safety question. This modification does not alter the size, location, position, or any other aspect of the beryllium reflector. This permitted the new reflector to be placed in position with greater ease and will facilitate future removal.

Modification 81-22: This modification is to facilitate removal of the terminal pins at each end of the pressure vessel tie rods. It will prevent dropping and loss of any component part and minimize the time required for installation and removal of the tie rods, decreasing radiation dose. The pin diameter and shear strength are identical to that specified by original design. Stainless steel bolts, nuts and jam nuts are replaced by stainless steel pins and a spring retainer clip attached to the tie rod end by stainless steel cable. The installation of the attachment nuts, on the tie rod flats, does not affect the function of the tie rods and minimizes radiation dose during work on the rods.

Safety Analysis Summary: Modification 81-22 presents no unresolved safety question. All materials at load bearing points are of equal strength to the original.

NOVEMBER 1981

Modification 81-20: This modification replaced the drain valves on the two primary and one pool strainers. The original valves, designated 518AE, 519AF, and 518AG, were 1/2" aluminum body, natural rubber, diaphragm valves. These valves were replaced with stainless steel ball valves to facilitate flushing the strainers and removal of debris.

Safety Analysis Summary: Modification 81-20 presents no unresolved safety question. The valves removed had a pressure rating of 200 psig while the new valves have a pressure rating in excess of 1000 psig. The rapid flushing afforded by a ball valve design will minimize radiation dose received by personnel when debris must be flushed from the strainers.

Modification 81-23: This modification is for use in Compliance Check CP-13, testing the vent tank system. This change incorporates a method of interrupting power to V552 A/B solenoids which is safer and should prove more reliable than the past method of lifting electrical leads. The use of insulated, dummy phono jacks provides the interruption of elec rical power to V552 A/B solenoids.

Safety Analysis Summary: Modification 81-23 presents no unresolved safety question. The continuity of the contacts will be checked as part of the compliance procedures when the plugs are removed and before the 552 A/B valves will be considered operable.

JANUARY 1982

Modification 81-7: This modification installed flanged connections on the primary relief valves to minimize chance of damage to the pipe bung in the primary loop. Because there are three interchangeable relief valves, the valve located in the pool also has flanged fittings installed.

Safety Analysis Summary: Modification 81-7 presents no unresolved safety question. The flanged connections allow easier removal, installation and testing of the relief valves.

APRIL 1982

Modification 80-5: This modification was the installation of a new Bulk Pool Lead Shield Irradiation Facility under offset "D". This modification removed the "S" basket, Reuter-Stokes Air Force Irradiation Facility, and the old Bulk Pool Lead Shield Irradiation Facility which were no longer in use.

Safety Analysis Summary: Modification 80-5 presents no unresolved safety question. The installation of the new Bulk Pool Lead Shield Irradiation Facility under offset "D" will allow an easier sample operation in the graphite reflector.

APRIL 1982

Modification 82-2: This modification replaced the 2" diameter H-2 irradiation reflector element and H-3 graphite reflector element with a single irradiation element dimensioned to accommodate a 3" diameter sample holder.

Safety Analysis Summary: Modification 82-2 presents no unresolved safety question. The installation of the new 3" irradiation position will allow the reactor to better serve the needs of its users.

JUNE 1982

Modification 81-16: This modification replaced the installed acid and caustic pumps in the regeneration system. The new pumps are better able to handle the severe environment of strong acid and caustic.

Safety Analysis Summary: Modification 81-16 proposes no unresolved safety question. The installation of these high quality pumps will minimize the hazards of working with strong corrosives.

Modification 82-3: Replaced the existing gasoline day tank with one of a larger capacity and provided a vacuum break system to minimize vapor lock on the emergency generator.

Safety Analysis Summary: Modification 82-3 proposes no unresolved safety question. The installation of the larger gasoline day tank and vacuum break system will enhance the reliability of the emergency generator.

SECTION V

NEW TESTS AND EXPERIMENTS

New experimental programs during the period of July 1981 through June 1982 are as follows.

RUR150	Experimenter:	David Troutner
	Description:	The RUR was amended to include irradiation of 10 microcuries of Am-241 for the purpose of determining the fission product yields.

SECTION VI

SPECIAL NUCLEAR MATERIAL ACTIVITIES

1 July 1981 through 30 June 1982

1. SNM Receipts: During the year, the MURR received fuel from Rockwell International Energy Systems Group (Atomics International). A total of 18 new fuel elements were received.

Shipper	Elements	Grams U	Grams U-235
Atomics Int'l.	70, 73, and 78 through 85, 71, and 87 through 93	14,928.91	13,904.3

2. SNM Shipments: Spent fuel elements were shipped to U.S.D.O.E. Savannah River Plant for reprocessing.

Shipper	Elements	Grams U	Grams U-235
MURR	M03, M038, M05, M039, M034, M040, M044, M042, M018, M020, M019, M036, M014, M045, M035, M047, M032, M016, M030, M037, M023, M024, M025, M028	16,148.33	14,077.38

3. Inspections: On July 29-31, 1981, Safeguards Inspection was conducted by Mr. A. G. Finley of Region III, USNRC. One item of noncompliance was identified during the course of his inspection.

4. SNM Inventory: As of 30 June 1982, the MURR financially responsible inventory was as follows:

Total U = 37,218

Total U-235 = 33,145

All of this material is physically located at the MURR. In addition, MURR has three 350 gram elements stored at Atomics International.

Fuel elements on hand have accumulated the following burnup as of 30 June 1982:

Fuel Element Number	Accumulated Megawatt Days	Fuel Element Number	Accumulated Megawatt Days
M015	147.16	M067	132.27
M017	147.68	M068	95.58
M021	147.80	M069	132.27
M022	143.13	M070	91.97
M026	148.61	M071	41.62
M027	148.22	M072	103.84
M029	148.76	M073	91.97
M031	146.65	M074	103.84
M033	146.59	M075	93.05
M041	146.44	M076	95.58
M043	146.44	M077	93.05
M046	146.09	M078	105.44
M048	146.09	M079	105.44
M053	147.53	M080	89.50
M054	147.53	M081	105.69
M055	149.30	M082	89.50
M056	41.62	M083	105.69
M057	149.30	M084	60.19
M059	115.88	M085	60.19
M060	115.88	M087	51.42
M061	100.61	M088	0.00
M062	100.38	M089	51.42
M063	145.98	M090	40.03
M064	112.98	M091	50.09
M065	145.98	M092	40.03
M066	112.80	M093	50.09

The three 350 gram fuel elements stored at Atomics International have the following inventory content:

Total U = 1,112.39 grams

Total U-235 = 1,036.19 grams

Also MURR owns a total of 128 grams U and 49 grams U-235.

SECTION VII

REACTOR PHYSICS ACTIVITIES

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

Serial Number	Core Designation	Date Last Used
M038	A0-12	08-06-81
M040	A0-12	08-06-81
M020	AP-1	08-10-81
M016	AP-1	08-10-81
M037	AP-2	08-24-81
M026	AP-6	10-06-81
M017	AP-6	10-06-81
M043	AP-9	11-09-81
M041	AP-9	11-09-81
M033	AP-10	11-16-81
M021	AP-10	11-16-81
M031	AP-13	12-28-81
M017	AP-15	01-10-82
M026	AP-15	01-10-82
M046	A0-4	02-08-82
M048	A0-4	02-08-82
M015	A0-7	03-14-82
M027	A0-7	03-14-82
M022	A0-7	03-14-82
M029	A0-7	03-14-82
M055	A0-14	06-07-82
M057	A0-14	06-07-82
M063	A0-17	06-28-82
M065	A0-17	06-28-82

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
29	M072	AP-1	08-06-81
29	M074	AP-1	08-06-81
29	M075	AP-2	08-10-81
30	M077	AP-2	08-10-81
29	M070	AP-5	09-14-81
30	M078	AP-5	09-14-81
29	M073	AP-5	09-14-81
30	M079	AP-5	09-14-81
30	M081	AP-12	11-30-81
30	M083	AP-12	11-30-81
30	M080	AP-13	12-15-81
30	M082	AP-13	12-15-81
30	M084	AO-5	02-08-82
31	M085	AO-5	02-08-82
27	M056	AO-7	03-09-82
31	M087	AO-7	03-09-82
29	M071	AO-7	03-09-82
31	M089	AO-7	03-09-82
31	M090	AO-12	04-04-82
31	M091	AO-12	04-04-82
31	M092	AO-12	04-04-82
32	M093	AO-12	04-04-82
31	M088	(initial criticality will be next fiscal year)	

2. Fuel Shipping: Twenty four 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.

M03	M024	M037
M05	M025	M038
M014	M028	M039
M016	M030	M040
M018	M032	M042
M019	M034	M044
M020	M035	M045
M023	M036	M047

3. Fuel Procurement: At the present time, MURR fuel is being fabricated by Rockwell International Energy Systems Group of Canoga Park, California. This work is contracted with U.S.D.O.E. and administered by the Idaho Operations Office.

4. Licensing Activities: A revised physical security plan as per 10CFR70:67 that was submitted May 16, 1980 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: In September 1981, an initial criticality startup was performed on Test Core BNB (MWD's 750) to benchmark reflector response and general criticality conditions. The reactor's original Be reflector was replaced during a maintenance shutdown scheduled between October 15, and October 23, 1981. The original reflector had a power history of 26,529 MWD which was accumulated between 1966 and 1981. The power level for the Be reflector was 5MW until 1975 at which time it was raised to 10MW. After the Be reflector replacement, Test Core BNB (MWD's 750) was used to measure the new Be reflector response and general criticality conditions. Test Core ANB (NWD's 92) and Core AP-8 (MWD'S 493) were also used in physics measurements. Shim blade calibrations and reactivity measurements of triple barrel flux trap holder were performed to verify reactivity parameters.

   A series of four (4) reactivity measurements for various flux trap sample loadings were performed during May of 1982. A physical inspection of the following fuel elements was performed at approximately 130 MWD's to verify the operational parameters:

M053 from Core 27 during May 1982

M067 from Core 28 during May 1982

M069 from Core 29 during May 1982

All measurements were within operational requirements.

Computer analysis of graphite reflector was accomplished using Citation Computer Code. A master's degree was granted to Mark Pohlman for his work in this area.

SECTION VIII

SUMMARY OF RADIOACTIVE EFFLUENTS RELEASED TO THE ENVIRONMENT

Released to Sanitary Sewer - 7-1-81 to 6-30-82

Nuclide	Amount (Ci)	Nuclide	Amount (Ci)
H-3 via cooling tower drain	.001	Sb-125	.001
		I-131	< .001
H-3	.812	I-133	< .001
Na-24	< .001	Cs-134	< .001
K-42	< .001	Cs-137	.001
Sc-46	.006	Ba-140	< .001
Cr-51	.012	Ga-72	< .001
Mn-54	.004	Ta-182	< .001
Co-57	< .001	La-140	< .001
Co-58	.002	Ce-144	< .001
Fe-59	.001	Na-122	< .001
Co-60	.046	Cd-115	< .001
Zn-65	.106	Zn-69m	< .001
Ni-65	< .001	Ba-139	< .001
Se-75	< .001	Tc-99m	< .001
As-76	< .001	Mo-99	< .001
As-77	.004	Hf-181m	< .001
Ag-110m	.002	Au-196	< .001
Sn 113	< .001	Au-198	< .001
Sb-122	< .001	Hg-203	< .001
Sb-124	.006		

Stack Effluent - 7-1-81 to 6-30-82

Nuclide	Amount (Ci)	Nuclide	Amount (Ci)
H-3	16.265*	Pb-212	< .000001
Na-24	.000001	Tc-99m	< .000001
Cl-38	.000428	Tc-101	.000005
Ar-41	2504.1	In-114m	.000006
Sc-46	< .000001	Cd-115	< .000001
Mn-54	< .000001	Sb-122	< .000001
Co-57	< .000001	I-128	.000011
Co-58	.000001	I-131	.000646
Co-60	.000006	I-132	.000220
Cu-64	.000016	Te-132	.000001
Zn-65	.000001	I-133	.000982
Se-75	< .000001	Xe-133	.000029
As-76	.000002	I-134	.000360
As-77	.000519	I-135	.000706
Br-82	.000073	Xe-135	.000002
Kr-85m	.000001	Xe-135m	.000276
Kr-87	< .000001	Cs-137	< .000001
Rb-89	.000004	Cs-138	.000014
Zr-97	< .000001	Ba-139	.000038
Mo-99	.000001	Ce-139	.000002
Sb-124	< .000001	Ba-140	.000002
Sn-113	< .000001	La-140	.000002
Ag-110m	< .000001	Ce-144	.000004
Fe-59	< .000001	Hf-181m	< .000001
K-40	.000433	Ta-183	.003143
Na-22	< .000001	Ir-192	< .000001
W-183m	.003143	Au-196	< .000001
Xe-131m	.000015	Hg-203	.000097
Cs-138	.000014	Bi-214	.000024
Au-198	< .000001	Pb-214	.000013

*.742 Ci evaporated via cooling tower.

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: 10-29-81

Determined Radioactivity Levels

Sample	Alpha	Beta	Gamma	Tritium
1 v 20	< 0.2 pCi/g	9.1 pCi/g	< 0.04 pCi/g	< 9.1 pCi/g
2 v 20	< 0.2 pCi/g	15.0 pCi/g	< 0.04 pCi/g	< 9.1 pCi/g
3 v 20	< 0.2 pCi/g	9.2 pCi/g	< 0.04 pCi/g	< 9.1 pCi/g
4 v 20	< 0.2 pCi/g	19.1 pCi/g	< 0.04 pCi/g	< 9.1 pCi/g
5 v 20	< 0.2 pCi/g	13.4 pCi/g	< 0.04 pCi/g	< 9.1 pCi/g
6 v 20	< 0.2 pCi/g	13.8 pCi/g	< 0.04 pCi/g	< 9.1 pCi/g
7 v 20	< 0.2 pCi/g	10.1 pCi/g	< 0.04 pCi/g	< 9.1 pCi/g
8 v 20	< 0.2 pCi/g	17.9 pCi/g	< 0.04 pCi/g	< 9.1 pCi/g
9 v 20	< 0.2 pCi/g	13.6 pCi/g	< 0.04 pCi/g	< 9.1 pCi/g
1 S 20	0.3 pCi/g	7.4 pCi/g	< 0.04 pCi/g	
2 S 20	< 0.2 pCi/g	7.5 pCi/g	< 0.04 pCi/g	
3 S 20	< 0.2 pCi/g	4.1 pCi/g	< 0.04 pCi/g	
4 S 20	0.2 pCi/g	4.6 pCi/g	< 0.04 pCi/g	
5 S 20	0.4 pCi/g	5.0 pCi/g	< 0.04 pCi/g	
6 S 20	< 0.2 pCi/g	4.2 pCi/g	< 0.04 pCi/g	
7 S 20	< 0.2 pCi/g	8.8 pCi/g	< 0.04 pCi/g	
8 S 20	< 0.2 pCi/g	6.4 pCi/g	< 0.04 pCi/g	
9 S 20	< 0.2 pCi/g	4.7 pCi/g	< 0.04 pCi/g	

4 W 20	< 0.2 pCi/g	7.7 pCi/l	< 0.04 pCi/l	< 9.1 pCi/g
6 W 20	< 0.2 pCi/g	5.9 pCi/l	< 0.04 pCi/l	< 9.1 pCi/g
8 W 20	< 0.2 pCi/g	7.3 pCi/l	< 0.04 pCi/l	< 9.1 pCi/g
9 W 20	< 0.2 pCi/g	11.1 pCi/l	< 0.04 pCi/l	< 9.1 pCi/g

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

2. Sampling Date: 4-27-82

Determined Radioactivity Levels

Sample	Alpha	Beta	Gamma	Tritium
1 V 21	< 0.2 pCi/g	25.4 pCi/g	< 0.4 pCi/g	< 9.1 pCi/g
2 V 21	< 0.2 pCi/g	23.1 pCi/g	< 0.4 pCi/g	< 9.1 pCi/g
3 V 21	0.2 pCi/g	23.4 pCi/g	< 0.4 pCi/g	< 9.1 pCi/g
4 V 21	< 0.2 pCi/g	32.2 pCi/g	< 0.4 pCi/g	< 9.1 pCi/g
5 V 21	< 0.2 pCi/g	34.2 pCi/g	< 0.4 pCi/g	< 9.1 pCi/g
6 V 21	< 0.2 pCi/g	41.6 pCi/g	< 0.4 pCi/g	< 9.1 pCi/g
7 V 21	< 0.2 pCi/g	25.8 pCi/g	< 0.4 pCi/g	< 9.1 pCi/g
8 V 21	< 0.2 pCi/g	24.8 pCi/g	< 0.4 pCi/g	< 9.1 pCi/g
9 V 21	< 0.2 pCi/g	32.2 pCi/g	< 0.4 pCi/g	< 9.1 pCi/g
1 S 21	< 0.2 pCi/g	12.8 pCi/g	< 0.4 pCi/g	
2 S 21	0.5 pCi/g	6.8 pCi/g	< 0.4 pCi/g	
3 S 21	0.2 pCi/g	8.4 pCi/g	< 0.4 pCi/g	
4 S 21	0.3 pCi/g	10.1 pCi/g	< 0.4 pCi/g	
5 S 21	< 0.2 pCi/g	11.7 pCi/g	< 0.4 pCi/g	
6 S 21	0.3 pCi/g	11.9 pCi/g	< 0.4 pCi/g	
7 S 21	0.7 pCi/g	12.2 pCi/g	< 0.4 pCi/g	
8 S 21	< 0.2 pCi/g	9.2 pCi/g	< 0.4 pCi/g	
9 S 21	1.2 pCi/g	21.5 pCi/g	< 0.4 pCi/g	
4 W 21	< 0.2 pCi/l	6.3 pCi/l	< 0.4 pCi/l	15.1 pCi/ml
6 W 21	< 0.2 pCi/l	3.8 pCi/l	< 0.4 pCi/l	15.3 pCi/ml
8 W 21	< 0.2 pCi/l	12.0 pCi/l	< 0.4 pCi/l	< 9.1 pCi/ml
9 W 21	0.4 pCi/l	113.0 pCi/l	< 0.4 pCi/l	12.1 pCi/ml

Radiation and Contamination Surveys

The following table gives the number of surveys performed during FY 81-82.

Radiation	Contamination
321	303

Forty-nine (49) Radiation Work Permits were issued during the year.

Miscellaneous Items

Reactor Health Physics developed the ability to analyze neutron spectra using a Bonner Spheres type spectrometer.

The Missouri Commission on Low Level Radioactive Waste met at the Reactor Facility for a discussion on radioactive waste disposal needs. The Manager of Reactor Health Physics gave a talk describing radioactive waste and disposal needs.

Replacement of the reactor beryllium reflector was accomplished using 14 manRem of exposure. The highest exposure for the calendar quarter for any person involved was 880 mrem.

Reactor Health Physics obtained equipment to perform alpha, beta and gamma spectrometry.

During the year, ALARA efforts used $28,000 on nine equipment items which is expected to result in 9 manRem/year exposure reduction. In addition, three of the items reduce or eliminate the potential for unplanned exposure to workers.

SECTION X

SUMMARY OF RADIATION EXPOSURES TO FACILITY STAFF, EXPERIMENTERS AND VISITORS

Personnel Monitoring (exposure in mrem)

1981

	July				August				September				October				November				December			
A	B	C	D	E	B	C	D	E	B	C	D	E	B	C	D	E	B	C	D	E	B	C	D	E
C	67	53	104	340	73	45	102	250	70	49	76	270	80	40	154	690	64	55	71	200	80	43	87	230
C-Spare*	18	4	27	50	15	3	50	100	15	5	192	640	14	19	155	630	18	5	118	230	5	3	90	170
U(C)	8	22	221	1100	12	33	649	15090	17	31	413	7670	34	14	381	1050	11	31	228	1000	23	30	150	850
U(C)-Spare*	2	0	0	0	2	1	3150	3150	2	6	310	1330	1	7	180	180	1	3	563	1610	3	3	113	230
G	42	4	55	140	22	4	70	160	26	3	73	130	3	29	90	130	49	0	0	0	29	3	120	200
G-Spare*	9	4	27	60	5	1	30	30	5	2	95	180	2	5	95	130	7	1	190	190	4	0	0	0
U(G)	12	2	545	810	9	1	720	720	6	6	266	510	8	5	200	510	15	1	30	30	7	8	526	3430
U(G)-Spare*	4	1	130	130	2	0	0	0	1	2	595	790	2	1	595	790	0	3	923	2490	0	0	0	0
D	0	49	97	345	10	26	102	200	10	27	121	290	0	38	65	170	0	40	96	250	9	32	94	230

1982

	January				February				March				April				May				June			
A	B	C	D	E	B	C	D	E	B	C	D	E	B	C	D	E	B	C	D	E	B	C	D	E
C	67	58	93	350	71	56	56	190	47	74	83	210	70	50	73	330	70	50	73	300	65	52	68	240
C-Spare*	9	7	70	310	11	5	74	200	6	15	40	120	14	10	33	180	14	3	60	140	27	5	164	150
U(C)	17	33	165	680	22	36	300	4100	33	21	223	2030	10	7	188	5990	30	50	263	3080	44	40	585	5410
U(C)-Spare*	0	3	143	430	2	5	136	280	7	5	124	300	3	7	98	260	0	3	100	160	14	7	543	2170
G	40	4	68	220	42	16	41	390	1	29	30	30	58	25	25	490	26	7	25	160	61	8	21	50
G-Spare*	1	1	530	530	5	0	0	0	1	15	60	60	6	1	20	20	8	0	0	0	6	3	37	70
U(G)	9	6	423	1850	6	9	268	1190	7	5	121	640	10	6	173	610	5	6	665	3080	+	+	+	+
U(G)-Spare*	0	1	380	380	1	0	0	0	4	0	100	180	0	0	0	0	2	0	0	0	+	+	+	+
D	13	28	92	200	11	29	83	210	15	27	101	270	13	29	96	205	12	29	117	725	10	29	61	280

Note:
C = monthly beta-gamma-neutron film badge
U(C) = monthly finger TLD
G = monthly beta-gamma film badge
U(G) = monthly finger TLD
D = self-reading dosimeter

Column Headings:
A = Type of dosimeter
B = Number reported as minimum
C = Number reported with exposures above minimum
D = Average of exposures above minimum
E = Single highest dosimeter reported

+Combined accounts with U(C) and U(C)-Spare.
*Used for temporary workers, new workers prior to issue of permanent, and replacement for lost badges.