University of Missouri-Rolla
Nuclear Reactor Facility

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April 20, 2001

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

Dear Sir:

Please find enclosed the Annual Progress Report 2000-2001 for the University of Missouri-Rolla Reactor Facility (License R-79). This report is being filed under the reporting requirements of our Technical Specifications. Copies of this report are also being sent to our Regional Administrator and Project Manager.

Sincerely,

Dr. Akira T. Tokuhiro
Reactor Director

mk

Enclosure

xc: Marvin Mendonca, Project Manager (NRC)
Chancellor Gary Thomas (UMR)
Dr. Lee W. Saperstein, Dean, School of Mines & Metallurgy (UMR)
Mr. Ray Bono, Radiation Safety Officer(UMR)
Dr. Robert Mitchell, Dean, School of Engineering (UMR)
Dr. Russell Buhite, Dean, College of Arts and Science (UMR)
American Nuclear Insurers, c/o Librarian
Dr. Mark Fitch, Chairman, Radiation Safety Committee (UMR)
University of Missouri-Columbia Research Reactor (MURR)
Dr. Arvind Kumar, Chairman of Nuclear Engineering (UMR)

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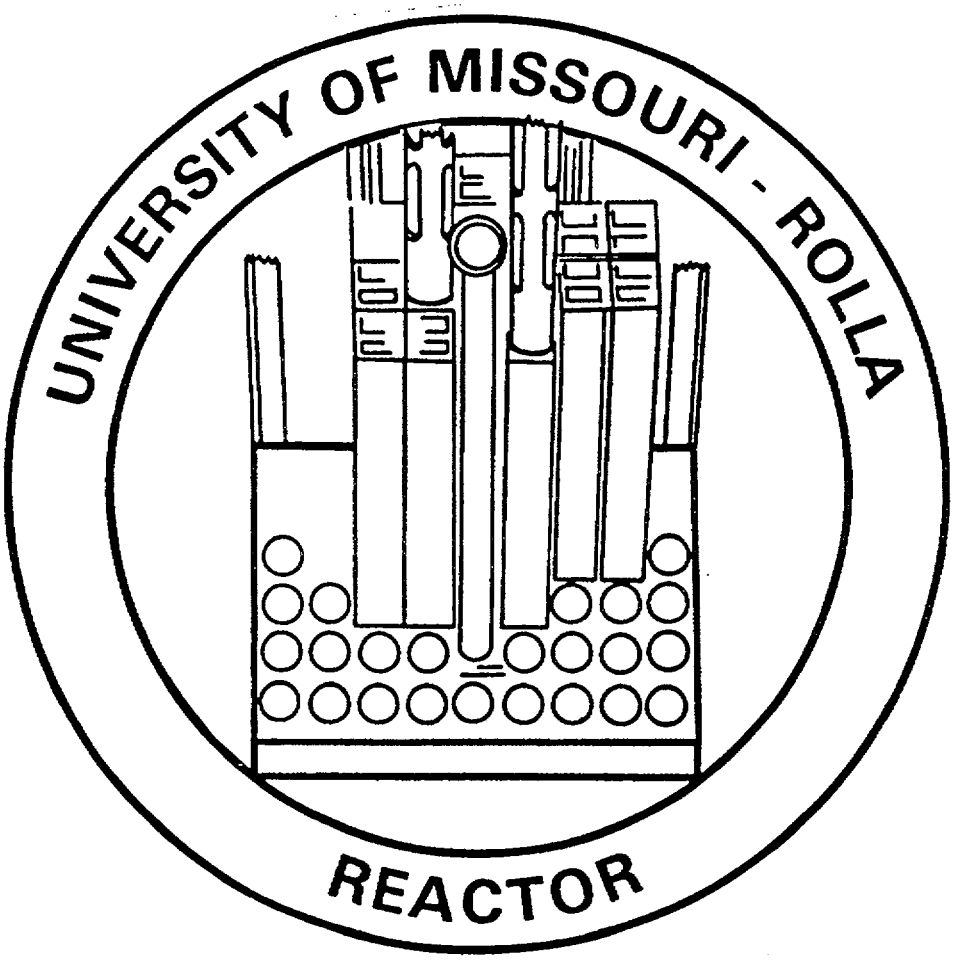
PROGRESS REPORT

2000-2001

UNIVERSITY OF MISSOURI-ROLLA

NUCLEAR REACTOR FACILITY



PROGRESS REPORT

2000-2001

UNIVERSITY OF MISSOURI-ROLLA

NUCLEAR REACTOR FACILITY

PROGRESS REPORT

FOR THE

UNIVERSITY OF MISSOURI-ROLLA

NUCLEAR REACTOR FACILITY

April 1, 2000 to March 31, 2001

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

SUMMARY

During the 2000-2001 reporting period the University of Missouri-Rolla Reactor (UMRR) was in use for 414 hours. The major part of this time, about 82% was used for class instruction, research, and training purposes.

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

The reactor facility supported several UMR courses over the year for a total of 2,779 student-hours. The reactor was visited by about 2,898 visitors during the past year. There were 637 participants, mostly high school students, in the U.S. Department of Energy Reactor Sharing Program.

The reactor produced 6,132 kilowatt-hours of thermal energy using approximately 0.27 grams of uranium. A total of 127 samples were irradiated in the reactor with most of them being analyzed in the Reactor Counting Laboratory.

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1.0 INTRODUCTION

This progress report covers activities at the University of Missouri-Rolla Reactor (UMRR) Facility for the period April 1, 2000 to March 31, 2001.

The reactor is operated as a university facility, available to the faculty and students from various departments of the university for their educational and research programs. Several other college and pre-college institutions have made use of the facility during the reporting period. The facility is also available for the training of reactor personnel from nuclear electric utilities.

1.1 Background Information

The University of Missouri-Rolla Reactor Facility attained initial criticality on December 9th, 1961. The UMRR was the first operating nuclear reactor in the state of Missouri. The reactor design is based on the Bulk Shielding Reactor at Oak Ridge National Laboratory. The reactor is a light water, open pool reactor cooled by natural convection flow. The fuel is MTR plate-type fuel. The initial licensed power was 10 kW. The licensed power was upgraded to 200 kW in 1966. During the summer of 1992, the reactor fuel was converted from high-enriched uranium fuel to low-enriched uranium.

The facility is equipped with several experimental facilities including a beam port, thermal column, pneumatic rabbit system and several manual sample irradiation facilities. Additionally, the facility is equipped with a counting laboratory that has gamma and alpha spectroscopy capabilities. The gamma spectroscopy system includes germanium and sodium-iodide detectors, associated electronics, and state-of-the-art data acquisition and spectrum analysis software. The alpha spectroscopy system consists of a surface barrier detector and data acquisition equipment. The

beamport experimental area is equipped with NE-213 and time-of-flight neutron spectroscopy systems.

1.2 General Facility Status

The UMRR operated safely and efficiently over the past year. No significant safety-related incidents or personnel exposures occurred. Dr. Nicholas Tsoulfanidis has served as Interim Reactor Director up to July 31, 2000. Dr. Akira Tokuhiro is now Reactor Director and Assistant Professor of Nuclear Engineering at the University of Missouri-Rolla. William Bonzer had served as Interim Reactor Manager and was appointed Reactor Manager effective September 1, 2000.

The license for UMRR has been extended to January 14, 2005, Amendment No. 16 (August 6, 1999). We have been working on relicensing during this period and will continue.

We are continuing efforts to upgrade our console using grant awards from DOE combined with money directly from reactor funds. We have received grant funds for Reactor Instrumentation upgrade in Spring 2000 and received notice of additional instrumentation funds for the Spring 2001.

The reactor has funded a graduate student to perform research in support of the relicensing effort. To date this research has focused on atmospheric dispersion modeling and dose assessments associated with normal operations and accident conditions.

The Reactor Facility was audited by an independent auditor from the University of Columbia on November 20, 2000. There were no significant areas of concern. We have entered into an agreement with the University of Missouri-Columbia to audit each other. This has been a very beneficial arrangement for both facilities involved.

The reactor staff has continued to review the operation of the Reactor Facility in an effort to

improve the safety and efficiency of its operation and to provide conditions conducive to its utilization by students and faculty. An "outreach" program, implemented over the past years, has been continued in order to let both students and faculty in a number of departments across campus know how the reactor could be used to enhance course work and research. As a result, additional classes have been using the Reactor Facility to augment their programs, including Physics 4 & 5, "Concepts in Physics"; Physics 7, "Environmental Physics"; Chemistry 8, "Qualitative Analysis Laboratory"; Physics 107, "Modern Physics"; Physics 207 "Modern Physics II, Physics 322, "Advanced Physics"; Chemical Engineering 261, "Introduction to Environmental Engineering"; Chemistry 2, "General Chemistry Laboratory"; Mechanical Engineering 229, "Energy Conversion"; Life Science 352, "Biological Effects of Radiation"; Chemistry 251, "Intermediate Quantitative Analysis"; Chemistry 355, "Instrumental Methods Laboratory"; Civil Engineering 310, "Senior Design Class", Basic Engineering 50, "Engineering Mechanics - Statics", and Engineering Management 386, "Safety Engineering Management".

SOPs have been revised over the past year in order to improve our operations and efficiency. The following is a list of SOPs revised during the reporting period:

Index	Index (Page 1)
SOP 204	Demineralizer Regeneration (Page 1)
SOP 501	Emergency Procedures For Reactor Building Evacuation (Page 7)
SOP 654	Measurement of ^{41}Ar Concentration In The Reactor Building Air
SOP 810	Weekly Check (Pages 7, 8 and 9)

The above listed SOP revisions are provided in Appendix B.

2.0 REACTOR STAFF AND PERSONNEL

2.1 Reactor Staff

Name	Title
Dr. Akira Tokuhiro[1)]	Director
Dr. Nicholas Tsoulfanidis[2)]	Interim Director
Mendy Kell	Senior Secretary
James Jackson	Senior Lab Mechanic and Reactor Operator
William Bonzer[3) & 4)]	Sr Electronics Technician and Interim Manager & Reactor Manager

[1)]Effective August 1, 2000
[2)]Interim Director effective January 6, 2000 - July 31, 2000
[3)]Interim Manager effective January 6, 2000 - August 31, 2000
[4)] Reactor Manager effective September 1, 2000

2.2 Licensed Operators

Name	License
William Bonzer	Senior Operator
James Jackson [1)]	Reactor Operator & Senior Operator
Akira Tokuhiro [2)]	Senior Operator

[1)]Upgraded to Senior Operator effective February 23, 2001
[2)] Received Senior Operator license effective February 23, 2001

2.3 Radiation Safety Committee

The Radiation Safety Committee meets quarterly. The committee met on 6/08/00, 09/11/00, 11/10/00, and 3/13/01 during the reporting period. The committee members are listed below.

Name	Department
Dr. Mark Fitch, (Chairman)	Civil Engineering
Mr. Ray Bono (Secretary, ex-officio, non-voting)	Occupational Health and Safety Services
Mr. William Bonzer	Nuclear Reactor, Reactor Manager
Dr. Nord L. Gale	Life Sciences
Dr. Arvind Kumar	Nuclear Engineering
Dr, Jerry Peacher	Physics
Dr. Eck Sinn	Chemistry
Mr. Randy Stoll	Director, Business Services
Dr. Akira Tokuhiro	Director, Nuclear Reactor
Dr. Nick Tsoulfanidis	Nuclear Engineering

2.4 Health Physics

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

Name	**Title**
Dr. Nick Tsoulfanidis [1)]	Radiation Safety Officer
Mr. Ray Bono [2)]	Director, Environmental Health & Safety Services and Campus Health Physicist; Radiation Safety Officer
Mr. Brian Smith	Safety Specialist
Veronica McAffrey [3)]	HP Technician
Drew Petteway [4)]	HP Technician
LeAnn Splitter [5)]	HP Technician
Julie Tucker [6)]	HP Technician
Micah Hackett	HP Technician
Heather Nydetgger[7)]	HP Technician
Gary Wilburn[8)]	HP Technician

[1)] Stepped down as RSO effective 10/22/00
[2)]Appointed RSO effective 10/23/00
[3)]Employed effective 5/2/00; Terminated effective 8/9/00
[4)]Employed effective 11/14/00
[5)]Employed effective 05/01/00
[6)]Employed effective 01/16/01
[7)] Terminated effective 12/11/00
[8)] Terminated effective 05/05/00

3.0 REACTOR OPERATIONS

Core designation 101W is presently in use. The "W" mode core is completely water reflected and is used for normal reactor operations. The "T" mode (core positioned near graphite thermal column) may be used for various experiments, including beam port and thermal column experiments.

Table 3-1 presents pertinent core data and Figure 3-1 shows the core configuration of core 101W. The excess reactivity, shutdown margin, and rod worths were measured in cold, clean conditions.

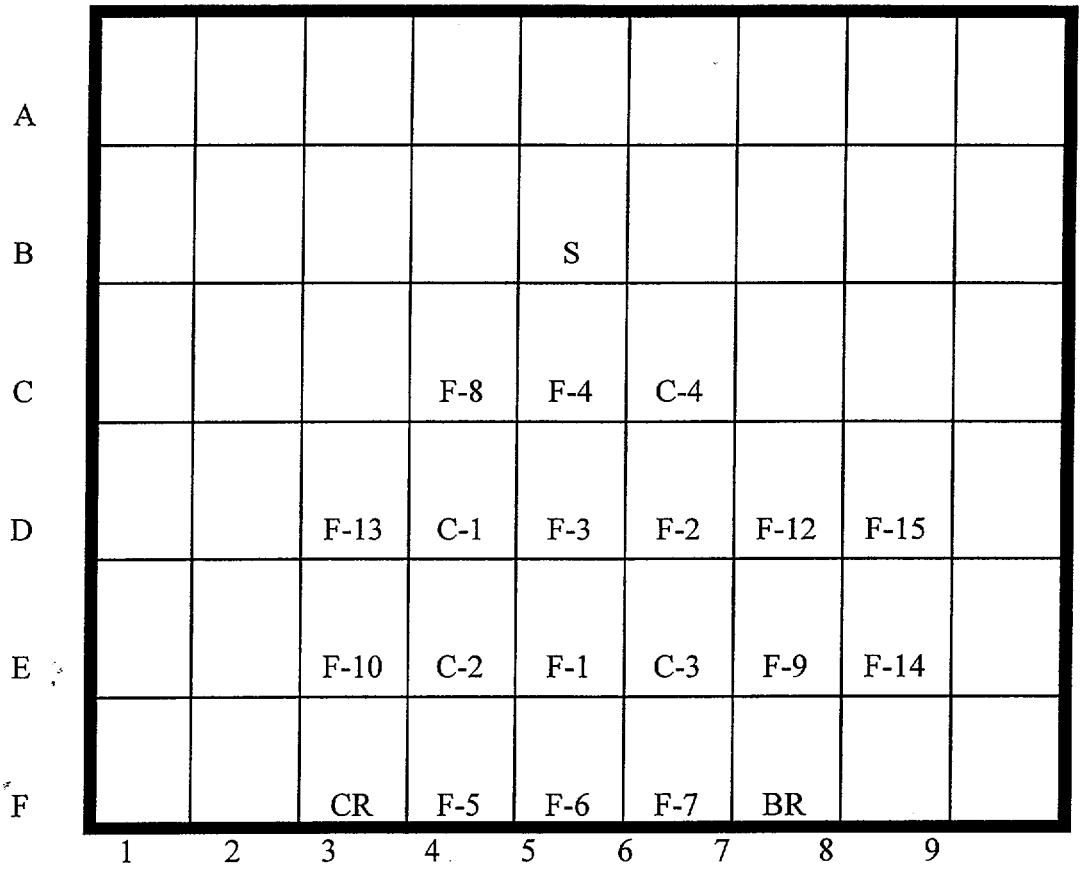
Table 3-1. Core 101W Technical Data

Parameter	Value
Rod 1	2.73% Δk/k
Rod 2	2.69% Δk/k
Rod 3	3.22% Δk/k
Reg Rod	0.371% Δk/k
Excess Reactivity	0.496% Δk/k
Shutdown Margin*	4.92% Δk/k

* Assumes Rod 3 (highest worth rod) and Reg Rod are fully withdrawn.

Table 3-2 presents a listing of unscheduled shutdowns (scrams, rundowns, and unplanned normal shutdowns) along with their causes and corrective actions. There were four unscheduled scrams. All scrams were caused by noise spikes within the safety channel/magnet drawer. The drawer was repaired and we are in the process of purchasing replacement drawers for the safety channels and magnet power supply. Three of the five rundowns listed were due to noise sensitivity of our new Gamma Metrics Wide Range Log drawer. The drawer appears to be especially

Figure 3-1. UMRR Core 101W Configuration



KEY TO PREFIXES

F - Standard Elements

C - Control Elements

BR - Bare Rabbit

CR - Cadmium Rabbit

S - Source Holder

sensitive to switching noise when the reactor is at or near full power. Switching associated with the auto controller and rod movements can induce enough noise to trip the 120% Full Power rundown. We have worked with Gamma Metrics to resolve the situation. We are continuing to work with Gamma Metrics to resolve the problem.

Since the 120% Full Power trip is set on the log power signal, the voltage change between 100% and 120% on an eight decade scale is very small. In the future we may argue that it is inappropriate to have a 120% trip on a logarithmic power channel and seek to change that particular technical specification. Although this situation is not considered a safety problem, we are committed to continue efforts to resolve the matter in a timely fashion.

Maintenance activities are listed in Table 3-3. Table 3-4 shows reactor utilization and Table 3-5 shows other facility usage.

Table 3-2. Scrams, Rundowns, and Unplanned Shutdowns

Date	Cause
4/04/2000	Reactor Rundown. 120% Demand Rundown. Student operator downscaled linear channel meter too soon. SRO instructed student operator of error and not to repeat error. SRO permission granted to restart reactor.
4/28/2000	Reactor Rundown. 120% Full Power Rundown. Reactor power at a stable 200 kW, 120% full power rundown occurred due to a noise spike during a control rod movement. No corrective action taken. SRO permission granted to restart reactor.
5/18/2000	Reactor Rundown. 120% Demand Rundown. Linear channel meter spiked when switching scales. No corrective action taken. SRO permission granted to restart reactor.
6/26/2000	Reactor Scram. 150% Full Power Scram. Reactor at a stable 180 kW, 90% full power. Spurious noise spike caused Safety Channel #1 to scram. No corrective action taken. SRO permission granted to restart reactor.

9/14/2000	Reactor Rundown. 15 Second Rundown. Reactor subcritical, 15 second period trip occurred due to noise spike from withdrawing control rods. No corrective action taken. SRO permission granted to restart reactor.
9/21/2000	Reactor Rundown. 15 Second Rundown. Reactor subcritical, 15 second period trip occurred due to noise spike from withdrawing control rods. No corrective action taken. SRO permission granted to restart reactor.
10/02/2000	Reactor Scram. 150% Full Power Scram. Reactor at a stable 50% full power. Noise spiked caused safety channel #1 to scram. Corrective action involved a maintenance check on the safety channel drawer. SRO permission granted to restart reactor.
10/04/2000	Reactor Scram. 150% Full Power Scram. Reactor at a stable 50% full power. Noise spiked caused safety channel #1 to scram. Corrective action involved a maintenance check on the safety channel drawer and inspection of UIC detector cables. SRO permission granted to restart reactor.
1/05/2001	Reactor Scram. 150% Full Power Scram. Noise spike caused safety channel #2 to scram. No corrective action taken. SRO permission granted to restart reactor.

Table 3-3. Maintenance

Date	Cause
07/03/00	Problem: Log Count Rate channel did not have an output reading to meter or recorder. Corrective Action: Replaced two transistors in the log count rate pre-amp and adjusted the pre-amp gain.
07/03/00	Problem: Noise in the Log Count Rate Recorder during 2 CPS trip. Corrective Action: Installed a noise suppressor on the 2CPS annunciator contacts.
08/21/00	Problem: Routine semi-annual calibration. Corrective Action: Performed a routine calibration of the control room instrumentation, thermal power calibration and miscellaneous equipment as listed in semi-annual calibration procedures.
9/11/00	Problem: Performed routine rod visual inspection, Corrective Action: Unloaded reactor core, removed control rod drive shrouds and magnets. Removed control rods and visually inspected them. Installed control rods, magnets, control rod drive shrouds and fuel elements. Performed control rod drop time tests. The visual rod inspections and rod drop time tests passed technical specification limits.

10/03/00 Problem: Safety channel #1 is scramming due to noise spikes.
Corrective Action: Checked safety channel settings for zero, span and trip. Replaced relays for rod withdrawal and rod insert. Replaced noise suppressor capacitors.

10/11/00 Problem: Safety channels are scramming due to noise spikes.
Corrective Action: Remove a UIC from the core to look at cable connections to the detector. Could not unseal the waterproof housing for the UIC. Reinstalled UIC into pool and positioned it near core.

1/10/01 Problem: Safety channel #2 is scramming due to noise spikes.
Corrective Action: Replaced two vacuum tubes, grounded pre-amp #2 input signal cable, and adjusted trip settings.

02/19/01 Problem: Routine semi-annual calibration.
Corrective Action: Performed a routine calibration of the control room instrumentation, thermal power calibration and miscellaneous equipment as listed in semi-annual calibration procedures.

Table 3-4. Reactor Utilization

1. Reactor use	414 hrs.
a. NE Classes, Reactor Sharing, and Other Instructions	339 hrs.
b. Maintenance Training	75 hrs.
2. Time at power	139 hrs.
3. Energy generated	6132 kW/hrs
4. Total number of samples	127
5. U-235 Burned	0.26702 g
6. U-235 Burned and Converted	0.3161 g

Table 3-5. Experimental Facility Use Other Than The Reactor

Facility	Hours
Bare Rabbit Tube	7.93 hr.
Cadmium Rabbit Tube	3.36 hr.
Beam Port	0 hr.
Other Core Positions	4 hr.
Total	15.29 hr.

4.0 PUBLIC RELATIONS

The reactor staff continues to educate the public about applications of nuclear science. Over 2,898 persons visited the facility during this reporting period. Tour groups are typically given a brief orientation and/or demonstration by a member of the reactor staff.

Table 4-1 lists some of the major occasions or groups and number of visitors for each event.

Table 4-1. Public Relations Program		
DATE	**PARTICIPANTS**	**NUMBER**
04/03/00	UMC NE 404, Advanced Reactor Laboratory	6
04/08/00	Spring Open House	49
04/26/00	UMR EngMgmt - Army	36
04/27/00	8th Grade Science Day	142
05/05/00	UMR Physics 107, Modern Physics	25
05/13/00	Graduation Blue Glow Tour	26
6/12-6/22/00	Jackling I Institute	
06/23/00	Brentwood Bus Tour	14
06/26/00	UMR Freshman Mentor Group	11
06/26/00	UMR Jackling I Institute	31
06/28/00	UMR Introduction to Engineering	56
07/25/00	UMR Chemistry Academy, (PRIMO Ahec)	12
07/27/00	UMR Introduction to Engineering	30
07/31/00	UMR Nuclear Engineering Summer Camp	12
08/02/00	UMR Jackling II Institute	31
09/25/00	UMR Chemistry Labs, Terry Bone	484
10/02/00	Chemistry Blue Glow Tour	10
10/13/00	UMR Campus Blue Glow Tour	158
10/14/00	Family Day Open House	155
11/06/00	UMR Basic Engineering TEAMS Competition Tour	26
11/11/00	Fall Open House	52
11/14-11/16/00	UMR Freshman Engineering	46
12/06/00	Offsite Emergency Training-Emergency Scenario w/RFD	7
02/05/01	Cub Scouts, Pack 145	12
03/05/01	UMC NE 404, Advanced Reactor Laboratory	9
03/12/01	WYSE Tour, Greg Hilmas, contact person	11
03/12/01	Admissions Reactor Tour	18

5.0 EDUCATIONAL UTILIZATION

The reactor facility supported several UMR courses in the past year for a total of 2,959 student-hours. The number of UMR students utilizing the facility was 879. This usage is a direct result of an aggressive and continuing campus wide "outreach" program. The reactor facility provided financial support for two students with hourly wages, and two Graduate

Research Assistants. Additionally, students from several universities, colleges and high schools have used the facility.

Table 5-1 lists UMR classes taught at the facility along with associated reactor usage for this reporting period.

The University of Missouri-Columbia Nuclear Engineering Department will be sending its NE 404, "Advanced Reactor Laboratory" class to our facility twice during Spring of 2001, (for a total of 12 hours) to participate in a wide variety of reactor experiments that they are unable to perform with their reactor. The laboratories are held in the evening (4:00 pm until 10:00 pm) and are conducted by the UMR reactor staff.

The Reactor Sharing Program, which is funded by the U.S. Department of Energy, was established for colleges, universities, and high schools which do not have a nuclear reactor. This year, 637 students and instructors from 28 institutions participated in the program. Table 5-2 lists those schools and groups that were involved in this year's Reactor Sharing Program. The majority of our participants were high school students. We coordinate with the Admissions Office to schedule high school students to see other items of interest at UMR after they have visited our facility, such as the student group of American Nuclear Society, the Computer Integrated Manufacturing Lab, the Foundry, Ceramics Engineering, Mineral Museum, Computer Center, Experimental Mine, Solar Car, Electron Microscope, and Stonehenge. The Reactor Sharing Program serves as a strong campus-wide recruiting tool by getting high school students to the university and hopefully sparking some interest in our campus.

Table 5-1. UMR Classes at Reactor Facility
2000-2001 Reporting Period

	CLASS NUMBER/TITLE	# OF STUDENTS	TIME AT REACTOR	STUDENT HOURS
04/18/00	UMR NE 204 - Radiation Measurements	11	2.00	22.00
04/19/00	UMR NE 204 - Radiation Measurements	11	2.00	22.00
04/20/00	UMR NE 204 - Radiation Measurements	11	2.00	22.00
04/26/00	UMR EngrMgmt Army	36	1.00	36.00
05/05/00	UMR Physics 107, Modern Physics	25	1.000	25.00
9/25-9/28/00	UMR Chemistry Labs, Terry Bone	484	0.50	242.00
11/14-11/16/00	UMR Freshman Engineering	46	0.50	23.00
01/23/01	UMR NE 204 - Radiation Measurements	6	2.00	12.00
01/24//01	UMR NE 25 - Nuclear Technology Applications	12	1.00	12.00
01/25/01	UMR NE 204 - Radiation Measurements	6	2.00	12.00
02/13/01	UMR Biological Sciences 352	3	1.500	4.50
02/21/01	UMR NE 25 - Nuclear Technology Applications	4	2.00	8.00
02/26/01	UMR EngMgmt 386 - Safety Engineering Management	30	1.00	30.00
02/28/01	UMR Chemistry Labs, Terry Bone	86	0.50	43.00
03/01/01	UMR Chemistry Labs, Terry Bone	33	050	16.50
03/07/01	UMR NE 25 - Nuclear Technology Applications	12	1.00	12.00
03/20/01	UMR NE 25 - Nuclear Technology Applications	1	2.50	2.50
Fall 2000	UMR NE 304, Reactor Laboratory I	9	30.00	270.00
Fall 2000	UMR NE 306 - Reactor Operations	6	36.00	216.00
Fall 2000	UMR NE 490 Research, (Matt Adler-Safety Analysis of UMR Rx)	1	320.00	320.00
Fall 2000	UMR CE 490 Research (Ellen England-Filtration of Contaminated Water)	1	50.00	50.00
Fall 2000	UMR Physics Res., Dr. Bertino-Reactor Core-Gamma Exposure	1	42.00	42.00
Winter 2001	UMR NE 306, Reactor Operations	6	36.00	216.00
Winter 2001	UMR UMR NE 308, Reactor Laboratory II	7	80.00	560.00
Winter 2001	UMR NE 490 Research (Matt Adler-Safety Analysis of UMR Rx)	1	320.00	320.00
Winter 2001	UMR CE490 Research (Ellen England-Filtration of Contaminated Water)	1	75.00	75.00
Winter 2001	UMR Physics Res., Dr. Bertino-Reactor Core-Gamma Exposure	1	20.00	20.00
	Totals	**854**	**1061.75**	**2778.50**

Table 5-2. Reactor Sharing Program (2000-2001)		
DATE	**PARTICIPANTS**	**NUMBER**
04/04/00	Southwest Missouri State University, Dr. Robert Mayanovic, Instructor	6
04/07/00	Waynesville High School, Ann Jarrett & Michelle Hill, Instructors	27
04/11/00	Berkley High School, (Admissions arranged)	17
04/17/00	Newburg High School, (Admissions arranged)	47
04/20/00	Crossroads High School, Tanda Pommier, Instructor	25
04/26/00	St. Louis Public Schools, Junior High School, Barbara Howard, Contact	36
05/03/00	Success Junior High School	11
05/03/00	Whitfield High School, Debra MacIvor, Instructor	61
05/05/00	Dent-Phelps School, (Admissions arranged)	28
05/09/00	St. James 7th Grade, (Admissions arranged)	29
05/17/00	Ritenour High School, Richard Witt, Instructor	11
05/18/00	Salem Green Forest School, (Admissions arranged)	10
06/14/00	Truman Elementary School, Shelley Klossner, Instructor	27
06/15/00	Linn Middle School, Brett Phillips, Instructor	30
10/31/00	Mansfield High School, Pam Probert, Instructor	26
11/07/00	East Central College, Laura Deason, Instructor	16
11/07/00	South Iron High School, Tom Scheilbree, Instructor	15
11/21/00	West Plains High School, Carol Campbell	20
11/28/00	Conway High School, Hugh Townsend, Instructor	8
11/30/00	Washington High School, Rich Schwentker, Instructor	33
02/13/01	Thomas Jefferson High School, Mike Jones, Instructor	30
02/21/01	Ash Grove High School, Sally Keith, Instructor	10
02/22/01	St. Elizabeth High School, Janice Weiberg, Instructor	11
03/02/01	School of the Osage, Leslie Smith, Instructor	21
03/08/01	Nixa High School, Laura Kovach, Instructor	16
03/08/01	Fair Grove High School, Janet Beavers	13
03/13/01	Hazelwood West High School, Mr. Carl Herman, Instructor	22
03/20/01	Potosi High School, Susan Tiefenaues	31
	TOTAL	**637**

6.0 REACTOR HEALTH PHYSICS ACTIVITIES

The health physics activities at the UMR Reactor Facility consist primarily of radiation and contamination surveys, monitoring of personnel exposures, airborne activity, pool water activity and waste disposal. Releases of all by-product material to authorized, licensed recipients are surveyed and recorded. In addition, health physics activities include calibrations of portable and stationary radiation detection instruments, personnel training, special surveys and monitoring of non-routine procedures.

6.1. Routine Surveys

Monthly radiation exposure surveys of the facility consist of direct gamma and neutron measurements. No unusual exposure rates were identified. Monthly surface contamination surveys consist of 20 to 40 swipes counted separately for alpha, and beta/gamma activity. No significant contamination outside of contained work areas was found.

6.2. By-Product Material Release Surveys

There were no shipments of by-product material released on-campus from the reactor facility. There was one shipment released off-campus consisting of a 2 gram ore sample containing 0.5 microcuries activity during this reporting period.

6.3. Routine Monitoring

Thirty-five reactor facility personnel and students involved with operations in the reactor

facility are currently assigned film badges. Three are read twice per month (Reactor Staff) and thirty-two are read once per month. There are four area beta-gamma, LUXEL, Optically Stimulated Luminescence (OSL) badges, and three personnel get TLD ring badges for materials and X-ray work on campus. There are 21 area badges assigned on campus for beta and gamma monitoring. In addition, 5 digital direct-reading dosimeters, 4 chirpers, and 6 ion-chamber dosimeters are used for visitors and high radiation area work. There have been no significant personnel exposures during this reporting period.

Visitors are monitored with direct reading dosimeters. No visitor received in excess of 5 millirem.

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

Pool water activity is monitored monthly to ensure that no gross pool contamination or fuel cladding rupture has occurred. Gross counts and spectra of long-lived gamma activity are compared to previous monthly counts. From April 2000 through March 2001 sample concentrations averaged 1.37×10^{-6} μCi/ml.

Release of gaseous Ar-41 activity through the building exhausts is determined by relating the operating times of the exhaust fans and reactor power during fan operation to previously measured air activity at maximum reactor power. During this period, an estimated 37.88 millicuries of Ar-41 was released into the air.

6.4. Waste Disposal

Solid waste, including used water filters, used resins and contaminated paper is stored

and/or transferred to the campus waste storage area for later shipment to a commercial burial site. Water is analyzed for radioactive contamination and approval is required before the water is released. During this period no waste was transferred from the Reactor Facility.

6.5. Instrument Calibrations

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

7.0 PLANS

The reactor staff will be heavily involved in four major projects during the next reporting period; 1) Administrative changes 2) relicensing 3) implementation and revision of the new strategic plan, 4) installing new reactor nuclear instrumentation, 5) reactor operator training program.

7.1 Administrative Changes

As of now the reactor staff has been reduced by 25% as we are filling the electronic technician position with a permanent employee. Reactor operations continue to proceed but strain the capacity to perform projects that required a full staff.

7.2. Relicensing

Relicensing activities will continue during the upcoming reporting period. Our present license has been extended and is valid until January, 2005. Emphasis will be directed toward the SAR accident scenarios and Emergency Plan.

7.3. Strategic Plan

A strategic plan has been developed to help the facility achieve its vision "to become nationally recognized as the leading educational and training university reactor in the country and to become recognized as the leading 200 kW facility in terms of research". The strategic plan identifies strategic goals and action items. The action items will be initiated over the coming year and will guide the facility towards its vision.

7.4. Instrumentation Upgrade

The reactor console upgrade is well underway. Several pieces of new equipment have been installed under the provisions of 10 CFR Part 50.59. We plan to install a new Linear drawer, Source Range drawer and a new annunciator panel during the upcoming reporting period. Most of the changes will be made under the provisions of 50.59 ; however, some changes may require NRC approval.

7.5 Reactor Operator Training

The reactor facility and UMR Nuclear Engineering Department are developing and coordinating a reactor operating training program to license NE students to operate the UMRR. These licensed students would perform licensed duties at the UMRR and assist training other reactor operators and trainees.

APPENDIX A.

STANDARD OPERATING PROCEDURES

CHANGED DURING THE 2000-2001

REPORTING YEAR

CONTROLLED COPY

*** UMR REACTOR STANDARD OPERATING PROCEDURES ***

SOP: INDEX Title: **INDEX**

Revised: January 3, 2001

SOP 100-199 Routine Reactor Operation

SOP 200-299 Facility Operations

Rev.

SOP 300-399 Special Operations

William Bonzer

Revised By: William Bonzer

Approved By: Akira Tokuhiro

A. PURPOSE

The purpose of this procedure is to provide guidance for performing the resin regeneration, associated sample collection and to make certain that regeneration will not take place until all equipment and retention tanks are in place and functional. Rev.

B. PRECAUTIONS, PREREQUISITES, OR LIMITATIONS

1. **THIS STATEMENT TAKES PRECEDENCE OVER ALL OTHERS IN THIS SOP AND MUST BE COMPLETED BEFORE PROCEEDING FURTHER IN THIS SOP.** Additional liquid waste retention tank(s) must be installed before any regeneration takes place. Liquid waste retention capacity must exceed volume of waste that is excepted to be generated. Valves must be installed to allow for the segregation of the different effluent. The installation of such tanks must be performed in accordance with written procedures approved by the Reactor Director. Reactor Directors' permission must be obtained prior to initiating this SOP. The Reactor Director should review this procedure for adequacy and consider the various issues associated with liquid waste discharge such as release limits, solubility (10CFR20) and pH prior to approving a regeneration. Rev.

2. Two personnel should be present dressed in lab coats and eye protection for all caustic and acid transfers.

3 The Reactor Manager should be informed when the system is returned to service.

4. Ensure water flow to the make-up sump is maintained to prevent draining of make-up sump which would cause air to be sucked into the demineralizer.

5. WATCH LEVEL WHEN USING ACID AND CAUSTIC TANKS TO ENSURE THAT NO AIR IS DRAWN INTO THE SYSTEM WHEN THE LEVEL IS LOW.

7. Each step must be performed in a timely manner to prevent a faulty regeneration.

7. SOP 205 must be used in conjunction with this procedure.

8. The numbers referred to in this procedure are the valve numbers found on the valve tags.

9. Sampling of liquids sent to the retention tank should consist of three grab samples collected at the beginning, middle, and end of each process (i.e. backwash, caustic rinse, and acid rinse). Sampling of liquids discharged to the sewer system may consist of either grab sampling as described above or "trickle" sampling using a continuous draw sample collection technique during discharge.

Written By: James Jackson

Approved By: Nicholas Tsoulfanidis

UMR REACTOR EMERGENCY PHONE LIST

Reactor Staff	**CELL/PAGER**	**HOME**	**WORK**
William Bonzer, Manager, SRO	465-5544	368-3727	341-**4384**
Jim Jackson, Sr. Lab Mechanic\RO		(573) 699-4897	341-**4291**
Akira Tokuhiro, Director	428-6420	368-7121	341-**4746**
Ray Bono, Health Physicist/Radiation Safety Officer	428-6469	364-5728	341-**4240**,4305, 4403
Mendy Kell, Senior Secretary		(573) 265-5832	341-**4236**
University Administrative Staff			
1. Director, UMR Police, William Bleckman		364-1294	341-**4345**
2. Chancellor, Gary Thomas		368-3552	341-**4114**
3. Vice Chancellor for Admin. Services, Steve Malott		364-7927	341-**4122**
4. Director, Physical Plant, Marvin Patton		364-6278	341-**4252**
5. Director, Health Service - Infirmary, Dwight Deardeuff, MD		364-0809	341-**4284**
6. Dean, School of Mines and Metallurgy, Lee W. Saperstein		368-3782	341-**4153**
7. Radiation Safety Officer, Ray Bono	428-6469	364-5128	341-**4240**, 4305, 4403
Local			
UMR University Police		341-**4300**	341-4111
Rolla City Police			**9-911**
Rolla Fire Department			**9-911**
Phelps County Hospital			**9-911**
Rolla Emergency Management Agency			**9-911**
State Agencies			
Missouri Highway Patrol			**368-2345**
Missouri State Emergency Mgt. Agency (24 hr.)			**(573) 751-2748**
Missouri Dept. of Natural Resources (24 hr.)			**(573) 634-2436**
Missouri Bureau of Environmental Epidemiology		(573) 751-6160	(573) 751-4674(after hrs)
Federal Agencies			
NRC, Lisle, IL, Region III			**1-800-522-3025**
NRC Duty Officer (24 hour)	**(301) 816-5100**	(301) 951-0550	(301) 415-0550
Other			
American Nuclear Insurers			**(860) 561-3433**
Radiation Emergency Assistance Center	**(423) 576-3131**	(423) 481-1000 (24 hrs)	

Revised: February 9, 2001

Rev.

William Bonzer

Revised By: William Bonzer

Approved By: Akira Tokuhiro

A. PURPOSE

To test the activity concentration of ^{41}Ar in the Reactor building air.

B. PRECAUTIONS OR LIMITATIONS

1. This procedure is to be annually performed by Health Physics personnel.
2. If other gamma activity is observed, then a second count is to be performed on a high-purity germanium detector to determine the isotope and activity.
3. A copy of the measurement results will be provided to the Reactor Manager.

C. PROCEDURE

1. Background Count Take a 600 second or longer count with the NaI detector in the Health Physics counting room and print out the spectrum to include the area where the ^{41}Ar peak will occur. Rev.

   Note: ^{22}Na has a 1.275 MeV gamma and ^{41}Ar has a 1.294 MeV gamma, so by using a sodium source for comparison it is easy to determine where the argon peak will occur.

2. Sampling

   a. The Reactor building air sample is taken with the air tank positioned on the west side of the Reactor pool over the fuel storage area. The Reactor building air sample is taken periodically to detect ^{41}Ar or any other gaseous activity in the containment building air.

   b. Position the air sample tank and collect the sample using an air pump. Allow the tank to completely fill and note the time and date of the sampling.

Revised By: Ray Bono

Approved By: Nicholas Tsoulfanidis

c. When sampling is complete, close the tank valves. Rev.

3. Analysis

a. Immediately transfer, within 10 minutes, the air sampling tank to the NaI detector in the Health Physics counting room. Position the tank inside of the lead shield by placing the tank in the lead shield with the hole for the detector on top. This allows the NaI to be placed inside the tank without placing the weight of the tank on the detector.

b. Count the sample on a range of about 0 to 2 MeV for at least 600 seconds with the detector shielded.

c. When the count is complete, set the start and stop channels to include the 1.294 MeV ^{41}Ar peak region, print out the spectrum and integrate.

4. Calculations

a. Determine the background count by integrating over the same channels in which the peak of the ^{41}Ar sample occurred. The background count should be done prior to the sample and enough channels printed out to obtain the background integral.

b. Do a background subtraction from the peak as follows:

$N = G - B$ where,

N = Net number of counts in the 1.294 MeV peak of ^{41}Ar (counts)

G = Gross number of counts in the 1.294 MeV peak of ^{41}Ar as determined in the integration of the printed spectrum (counts)

B = Gross number of counts found by integrating the background count over the same channels as G above (counts)

c. Determine the count rate of the 1.294 MeV peak of ^{41}Ar as follows: Rev.

R = N/t where,
R = Count rate in 1.294 MeV peak of ^{41}Ar (cps)
t = Count time (seconds)

d. Determine the concentration of activity of ^{41}Ar taken in the grab sample of the Reactor building air as follows:

$$A = \frac{cps}{eff} \cdot \frac{60sec}{min} = dpm \cdot \frac{1\mu Ci}{2.22 \times 10^6\ dpm} \cdot \frac{1}{vol.\ of\ tank} = \frac{\mu Ci}{ml}$$

A = Concentration of ^{41}Ar activity in sample (μCi/ml)
eff = Currently determined efficiency of the counting setup (i.e. NaI detector and volume of marinelli sample container) (cps/(μCi/ml))

5. Report Record the following data in the notebook labeled "^{41}Ar in the Reactor Building."

a. Date of sample
b. Time of sample
c. Count time (t)
d. Net peak count (N)
e. Peak count rate (R)
f. ^{41}Ar concentration (A)
g. Reactor power level
h. Building air flow rate (ft^3/min or m^3/min)
i. Fan number, operating at time sample was taken.

6. Test of Annunciators

6.1. Interlock Bypass

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

6.2. Servo Limits

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

6.3. Pool Demineralizer Effluent Conductivity High

a. Record pool and demin effluent readings.
b. Check the alarm setpoint by pressing the ALARM 1/ALARM 2 Key and observing "alarm 1 set" setpoint is 0.500 MΩ - cm.
c. Increase the alarm 1 setpoint to a number higher than the conductivity cell reading and press the enter key. Observe the "ALARM" indicator flashing on the display. Observe that the console annunciator and audible alarm are activated.
d. Reset the "alarm 1 setpoint" to 0.500 MΩ - cm.

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7. "REACTOR ON" Lights

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

8. Building Evacuation Alarm

1. Announce over the PA, **"The Building Alarm will sound. This is a test. Do not evacuate the building."**
2. Push the Building Evacuation Alarm and note the audible alarm.
3. Reset Building Evacuation Alarm by pushing Scram Reset.
4. Announce over building PA **"Test complete. Acknowledge all further alarms."**

9. Nitrogen Diffusers

1. With the bridge intercom station selected, start diffuser #1. The green operation light should illuminate. Note the sound level of the pump and no unusual noise.
2. Shutdown the #1 pump and repeat step 1 for the #2 nitrogen diffuser.
3. Record results on form SOP 810.

10. Beam Port Warning Lights

1. Announce over the building PA. **"Attention personnel, stand clear of the Beam Port".**
2. Open the Beam Port by holding the beam port control switch in the open position until the "Red" (open) light comes on.
3. Acknowledge the annunciator alarm and verify that the Basement Level Warning Light (Flashing Red) activates.
4. Close the Beam Port by holding the Beam Port Switch until the Green (closed) light comes on. Reset the annunciator and observe that the light goes out.
5. Announce over the Building PA **"Beam Port secured"**. Complete SOP 810.

11. Shutdown Check - Complete a Shutdown Checklist (SOP 103) to ensure that all console equipment is secured.

12. Security System Check

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

12.1. Security Door

a. Hold in or close dead bolt on the security door.
b. Reset the alarm system.

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c. Open dead bolt switch by releasing or opening dead bolt and ensure alarm occurs in campus police dispatch station. Rev.

12.2. Ultrasonics

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

12.3. Duress

a. Momentarily depress the alarm button. Rev.

12.4. Doors

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

13. **Checklist Completed By** - The person who performed the checklist should sign and date in the blanks provided. If a nonlicensed operator performed the checklist, the licensed operator who supervised the checklist shall also sign and date the form.

14. **Reviewed and Approved** - The Reactor Manager or Reactor Director shall review and approve the checklist. Review and approval of the Weekly Checklist may be delegated to a Senior Reactor Operator in the event that both the Reactor Manager and Reactor Director are unavailable for the review.

APPENDIX B.

REVISED SAR

CHANGED DURING THE 2000-2001

REPORTING YEAR

Duke Energy

H. B. Barron
Vice President

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April 19, 2001

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: McGuire Nuclear Station
Docket Nos. 50-369 and 50-370
Occupational Radiation Exposure Report

McGuire Technical Specification 5.6.1 requires the submittal of an annual Occupational Radiation Exposure Report covering the previous calendar year. The attached report is submitted in accordance with 10CFR 50.4 and to meet this Technical Specification reporting requirement. The report provides a tabulation of the number of station, utility, and other personnel (including contractors) receiving exposure greater than 100mRem followed by the total dose for each respective worker classification and job function for the 2000 calendar year.

No administrative or regulatory limits were exceeded by any worker. There are no regulatory commitments contained in this submittal. Questions concerning this report should be directed to Kay Crane at (704) 875-4306.

H. B. Barron

cc: Mr. R. E. Martin Project Manager
U. S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, D.C. 20555

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Senior Resident Inspector
McGuire Nuclear Station

DUKE POWER COMPANY - MCGUIRE NUCLEAR STATION
TABULATION OF NUMBER OF PERSONNEL AND PERSON-REM BY WORK AND JOB FUNCTION FOR 2000

DATE: 04/12/01

WORK AND JOB FUNCTION	NUMBER OF PERSONNEL(>100 MREM) STATION EMPLOYEES	UTILITY EMPLOYEES	CONTRACT WORKERS AND OTHERS	TOTAL PERSON-REM(>100 MREM) STATION EMPLOYEES	UTILITY EMPLOYEES	CONTRACT WORKERS AND OTHERS
**IN-SERVICE INSPECTION						
ENGINEERING	0	0	0	0.000	0.000	0.000
HEALTH PHYSICS	1	0	5	0.001	0.000	0.049
MAINTENANCE	11	12	21	0.422	0.423	0.612
OPERATING	10	0	1	1.065	0.000	0.000
SUPERVISION	10	6	2	0.267	0.724	0.065
**REACTOR OPERS. & SURVEILLANCE						
ENGINEERING	4	0	1	0.332	0.000	0.000
HEALTH PHYSICS	17	0	38	1.296	0.000	0.670
MAINTENANCE	67	98	129	0.196	0.182	0.493
OPERATING	44	0	8	4.299	0.000	0.055
SUPERVISION	11	8	9	0.012	0.002	0.001
**REFUELING						
ENGINEERING	0	0	0	0.000	0.000	0.000
HEALTH PHYSICS	3	0	6	0.066	0.000	0.057
MAINTENANCE	7	38	1	0.247	7.096	0.000
OPERATING	0	0	0	0.000	0.000	0.000
SUPERVISION	1	2	6	0.013	0.151	0.274
**ROUTINE MAINTENANCE						
ENGINEERING	4	0	1	0.234	0.000	0.144
HEALTH PHYSICS	17	0	38	2.019	0.000	6.929
MAINTENANCE	67	90	127	14.351	14.744	45.955
OPERATING	35	0	16	0.499	0.000	2.813
SUPERVISION	11	6	9	0.592	0.269	1.272
**SPECIAL MAINTENANCE						
ENGINEERING	0	0	0	0.000	0.000	0.000
HEALTH PHYSICS	7	0	23	0.042	0.000	0.446
MAINTENANCE	42	62	41	0.647	1.842	3.496
OPERATING	1	0	13	0.006	0.000	0.247
SUPERVISION	11	2	4	0.755	0.075	0.017
**WASTE PROCESSING						
ENGINEERING	1	0	0	0.002	0.000	0.000
HEALTH PHYSICS	11	0	6	0.462	0.000	0.015
MAINTENANCE	5	3	1	0.001	0.001	0.000
OPERATING	4	0	12	0.089	0.000	0.127
SUPERVISION	0	0	0	0.000	0.000	0.000
**TOTAL						
ENGINEERING	4	0	1	0.568	0.000	0.144
HEALTH PHYSICS	17	0	38	3.886	0.000	8.166
MAINTENANCE	67	100	131	15.864	24.288	50.556
OPERATING	44	0	16	5.958	0.000	3.242
SUPERVISION	13	8	9	1.639	1.221	1.629
GRAND TOTAL	145	108	195	27.915	25.509	63.737

STATION TOTAL DOSE FOR 2000 WAS 133 PERSON-REM (TLD)