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February 28, 1999

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

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

Enclosed is one copy of the Reactor Operations Annual Report for the University of Missouri Research Reactor. The reporting period covers 1 January 1999 through 31 December 1999.

If you have any questions, please feel free to call.

Sincerely,

J. Charles McKibben
Reactor Manager

:ls
enclosure

xc: Mr. Alexander Adams, USNRC
Mr. Craig Bassett, USNRC

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UNIVERSITY OF MISSOURI

UNIVERSITY OF MISSOURI RESEARCH REACTOR

REACTOR OPERATIONS ANNUAL REPORT

January 1, 1999 - December 31, 1999

RESEARCH REACTOR FACILITY

UNIVERSITY OF MISSOURI

RESEARCH REACTOR FACILITY

REACTOR OPERATIONS

ANNUAL REPORT

January 1, 1999 - December 31, 1999

Compiled by the Reactor Staff

Submitted February 2000 by

J. Charles McKibben
Reactor Manager
Associate Director

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SECTION I

REACTOR OPERATIONS SUMMARY

1 January 1999 through 31 December 1999

The following table and discussion summarize reactor operations in the period 1 January 1999 through 31 December 1999.

Date	Full Power Hours	Megawatt Days	Full Power % of Total Time	Full Power % of Schedule*
Jan 1999	689.48	287.41	92.67	103.79
Feb 1999	600.60	250.46	89.37	100.10
Mar 1999	655.73	273.39	88.14	98.71
Apr 1999	653.81	272.43	90.81	101.70
May 1999	664.49	276.88	89.31	100.03
Jun 1999	659.17	274.72	91.55	102.54
Jul 1999	656.83	273.52	88.28	98.88
Aug 1999	671.18	279.88	90.21	101.04
Sep 1999	652.87	272.12	90.68	101.56
Oct 1999	652.12	272.00	87.65	98.17
Nov 1999	628.23	261.92	87.25	97.72
Dec 1999	671.46	279.87	90.25	101.08
Total for Year	7855.97	3274.60	89.68	100.44

There were 15 unscheduled shutdowns recorded during the period 1 January 1999 through 31 December 1999. Of these unscheduled shutdowns, nine were scrams and six were rod run-ins.

Two of the unscheduled shutdowns were manually initiated, one scram and one rod run-in, to allow investigation and/or repair of various reactor equipment. Of the remaining thirteen unscheduled shutdowns: 2 Scram/Reactor Isolation occurred due to the air plenum ARMS detector being down scale to long and tripping to protect against a potential loss of signal; 1 Scram occurred due to electronic noise caused by testing a MU Police radio in the Control Room; 4 Scrams occurred due to failures associated with NI Channel #6 drawer or detector; 1 Scram occurred due to a failure of primary pump 501B, local stop/jog switch; 2 power range channel #5 high power rod run-ins occurred at different times when an operator was handling a silicon sample from the Red-3 positions too close to the detector; 2 Rod Run-ins occurred due to the Rod "B" disengaging from its magnet; one anti-siphon high level rod run-in occurred.

There were no Licensee Event Reports (LERs) submitted to the NRC in 1999.
All surveillance test results are documented to allow for inspection. The surveillance indicated compliance with Technical Specification requirements.

January 1999

The reactor operated continuously in January with the following exceptions: four shutdowns for scheduled maintenance and refueling. There were no unscheduled shutdowns this month.

Major maintenance items for the month included: removing the old detector and the drywell for intermediate range channel #3 and installing a new gamma metrics fission chamber and drywell for this nuclear instrument channel – per modification package #95-1; installing new cabling from the south penetration plate junction box to mechanical equipment room 114 junction head for the pool Th thermocouple.

February 1999

The reactor operated continuously in February with the following exceptions: six shutdowns for scheduled maintenance and/or refueling; and two unscheduled shutdowns.

On February 3, a manual scram was initiated when operators observed several spurious down spikes on power range monitor channel #4. Electronics technicians isolated the problem to the signal processor amplifier, which was subsequently switched. A complete calibration was performed and a startup was completed with no further problems of this type.

On February 17, a channel five (power range) high power rod run-in occurred soon after an operator removed a silicon sample from the graphite reflector. Typically an increase in channel #5 indication of 3-5% occurs when this particular silicon sample container is removed due to its position in relationship to the nuclear instrument detectors. Channel #5 had been indicating 107.5% to 108% just prior to this event. The operators were instructed to maintain channel #5 indication at a level that should preclude this type of incident from recurring.

Major maintenance items for the month included: replacing power range monitor change #5 power meter; completing modifications to Gamma Metrics signal processor-2, and transferring all trips, alarms, and indications from the old GE channel #5 to this drawer; installing a new fission chamber detector serving nuclear instrument channels 1, 2, and 4 into the new drywell located at the old channel #3 position and changing signal processors for this channel and adjusting its dip switch; dumping depleted pool deionization bed E and loading new bed V; draining and refilling secondary system to correct a pH balance.

March 1999

The reactor operated continuously in March with the following exceptions: seven shutdowns for scheduled maintenance and/or refueling.

Major maintenance items for the month included: removing from service and relocating the old channel #5 drywell and installing an uncompensated ion chamber in the west submerged drywell.

April 1999

The reactor operated continuously in April with the following exceptions: four shutdowns for scheduled maintenance and refueling; two unscheduled shutdowns.

On April 1, a power range channel #5 high power rod run-in occurred while an operator was handling a silicon sample from the Red-3 position. This is the same-type incident that occurred in March. In order to lessen the probability that this type of incident will recur, the operators have been instructed to maintain the power range nuclear instrument indications at 103% ± 02%.

On April 7, a Reactor Scram and Isolation of undetermined origin occurred. No unusual radiation levels were noted on any of the area radiation monitors that can initiate this type of scram. It is felt that the likely cause was a loss of signal trip in one of the air plenum area radiation monitors, which are designed to automatically trip if an input signal is not detected within a predetermined time limit. The internal radiation sources in these monitors were adjusted to produce a higher background signal. The reactor was returned to normal operation with no further problems of this type occurring during April.

Major maintenance items for the month included: replacing the flasher on the annunciator; adjusting the internal radiation sources in the air plenum area radiation monitors; performing the biennial change-out of control blade offset mechanism “A”.

May 1999

The reactor operated continuously in May with the following exceptions: four shutdowns for scheduled maintenance and refueling; two unscheduled shutdowns.

On May 3, a power level interlock scram was initiated by core discharge pressure transmitter 944B when a university owned “police” hand-held radio was tested in the reactor control room. Radio frequency interference produced fluctuation of the PT 944B meter indication, causing this spurious scram. This action was repeatable after the shutdown; this radio was no longer used in the control room during reactor operation.

On May 7, a reactor operator due to the inadvertent failure of both operating secondary pumps initiated a manual Rod Run-in and subsequent manual scram. An electronics technician was working on the secondary pH monitoring system in the cooling tower when he made an accidental contact with electrical leads of the secondary low-sump cutout circuit, causing an electrical short that interrupted power to the operating secondary pumps. This problem was quickly rectified and the reactor was returned to normal operation.

The annual containment building leak rate compliance test was successfully performed on May 16/17.

June 1999

The reactor operated continuously in June with the following exceptions: four shutdowns for scheduled maintenance and refueling. The biennial emergency drill involving outside agencies was satisfactorily conducted this month.

Major maintenance items for the month included: replacing the air solenoid for motor operated isolation door 504; loading a new pool deionization bed; and replacing the actuator for in-pool heat exchanger valve 546 A.

July 1999

The reactor operated continuously in July with the following exceptions: four shutdowns for scheduled maintenance and refueling; two unscheduled shutdowns.

On July 6, a channel #6 drawer inoperative nuclear instrument anomaly scram occurred. No anomalies were indicated on any other instrumentation. The drawer was reset and tested satisfactorily. The anomaly could not be duplicated at this time. A short-form startup check sheet was completed and a Hot Reactor Startup was performed.

On July 15, a channel #6 drawer inoperative nuclear instrument anomaly scram occurred again. Electronics technicians eventually traced the problem to a faulty negative 15-volt power supply, which was replaced. The instrument was tested satisfactorily and the reactor was returned to normal operation.

Major maintenance items for the month included: replacing the flange gasket on the primary DI filter inlet valve; replacing the negative 15 volt component of the power supply for power range NI channel #6; replacing solenoid values 529-O and 529-P for primary DI isolation values 527 E and 527 F— per modification package 96-3 (addendum 1); rebuilding pool isolation value 509 actuator; replacing the fission chambers to signal processor drawers one and two.

August 1999

The reactor operated continuously in August with the following exceptions: seven shutdowns for scheduled maintenance, refueling, and reactor operator examinations. There were no unscheduled shutdowns this month.

Major maintenance items for the month included: replacing the in-pool heat exchanger T_h RTD.

September 1999

The reactor operated continuously in September with the following exceptions: four shutdowns for scheduled maintenance and refueling; and two unscheduled shutdowns this month.

On September 20, 1999, a rod not in contact with magnet rod run-in occurred during a normal reactor startup when control blade "B" disengaged from its magnet while being shimmed out. The reactor was subcritical at the time. Investigation revealed a moderate misalignment of the magnet-seating surface (anvil) and the guide tube. The guide tube was realigned and the anvil surface was cleaned. The reactor was then returned to normal operation.

On September 22, 1999, a reactor loop low flow scram occurred when primary pump 501B secured upon the failure of its local stop/jog switch. Primary pump 501A remained in continuous operation. The stop/jog switch was repaired and tested satisfactorily by electronics technicians and the reactor was refueled and returned to normal operation.

Major maintenance items for the month included: replacing the auto controller for the primary heat exchanger secondary water bypass valve (S-1); replacing the meter for primary heat exchanger temperature RTD 980 A; realigning the guide tube for control blade "B"; repairing the local stop/jog switch for primary pump 501B; replacing solenoid value A-151—a component of the containment air isolation value cabinet manifold; performing a reactivity worth startup for the new six-barrel flux trap sample tube.

<u>October 1999</u>

The reactor operated continuously in October with the following exceptions: four shutdowns for scheduled maintenance and refueling; and five unscheduled shutdowns this month.

On October 3, 1999, a nuclear Instrument Anomaly scram occurred. A Power Range Monitor Channel #6 drawer inoperative alarm was indicated. No unusual or anomalous readings or recordings were indicated on Channel #6 or any other instrumentation at (or prior to) the time of the scram. An electronics technician performed a complete Channel #6 drawer calibration check with no anomalies noted. The reactor was refueled and returned to operation.

On October 4, 1999, a reactor scram again occurred due to a Channel #6 drawer anomaly. Electronics Technicians subsequently replaced the Channel #6 drawer and detector, an uncompensated ion chamber. The reactor was returned to normal operation and no further problems of this type have recurred.

Later, on October 4, a rod not in contact with magnet rod run-in occurred when control blade B disengaged from its magnet during a normal startup. The reactor was sub-critical at the time. The control blade guide tube was re-aligned and the Amphenol connector was inspected.

On October 26, 1999, during a scheduled shutdown (maintenance day), electronics technicians discovered and repaired two broken leads to the magnet coil on control blade B Amphenol connector. It is believed that the unscheduled shutdown occurring on October 4, 1999 (where the blade B magnet became disengaged) was a direct result of these (undiscovered) broken leads.

On October 11, 1999 an anti-siphon high-level rod run-in occurred soon after a normal start up following a maintenance day shut down. Operations quickly drained the water and secured the rod run-in. Operators had not ensured that the anti-siphon system was completely drained. They were instructed to do so in the future.

On October 22, a reactor scram occurred due to a spurious reactor isolation trip from an area radiation monitor (ARM). No unusual or anomalous radiation readings were indicated prior to or at the time of this scram. Electronics technicians believed that the trip was likely caused by a temporary loss of signal to one of the four ARMS detectors capable of initiating reactor scram/isolations. These ARM detector model types are designed so that if a one-minute lapse occurs between input pulses, an internal failure alarm initiates the equivalent of a high alarm, resulting in a scram/reactor isolation not attributable to high airborne radioactivity. False "loss of signal" alarms are normally prevented by an installed source, which should provide a consistent signal. Electronics technicians source checked, tested, and verified the satisfactory operability of these detectors. The scram/isolation functions were tested and operated satisfactorily. No particular cause for this occurrence was determined and it has not recurred since.

Major maintenance items for the month included: replacing the nuclear instrument Channel #6 drawer and detector; replacing containment building supply fan run coil; replacing the valve operation air compressor to the main air compressor check valve; replacing the jog/stop switch on pool pump 508B.

<u>November 1999</u>

The reactor operated continuously in November with the following exceptions: six shutdowns for scheduled maintenance and refueling.

Major maintenance items of the month included the following: Shipping eight spent fuel elements to Savannah River, Akin, South Carolina; completing the biennial changeout of control blade offset C; installing a new jumper position (G-26) which will allow "jumpering" of relay 2K14 positions 13 and 14. (This is used in certain compliance tests while the reactor is shut down.); testing the new six-barrel flux trap sample holder; replacing the motor/pump coupling on secondary pump P-2; emptying the depleted pool deionization bed B and loading the new bed E; replacing the low voltage power supply and trip unit on the wide range monitor drawer.

<u>December 1999</u>

The reactor operated continuously in December with the following exceptions: five shutdowns for scheduled maintenance or refueling.

Major maintenance items of the month included installing Jumper Y-24 per modification package 75-1, addendum one.

SECTION II

MURR PROCEDURES

January 1, 1999 through December 31, 1999

This section includes the summary of procedure changes required by Technical Specification 6.1.h(4) to be part of the annual report. These procedure changes were reviewed and approved by the Reactor Manager or Health Physics Manager to assure the changes were in accordance with 10CFR50.59. These procedures are also reviewed by the Procedures Review Subcommittee of the Reactor Advisory Committee to meet 10CFR50.59 requirements.

A. CHANGES TO THE STANDARD OPERATING PROCEDURES, 2[nd] ed., Effective Date: 5/2/89.

As required by the MURR Technical Specifications, the Reactor Manager reviewed and approved the following:

Revision No. 23, dated 9/24/99:
Revision No. 23 incorporated various minor changes, which were consistent with the original purpose of the procedures. This revision incorporated a change to cover the new Acid Storage Tank and transfer system; a change in pre-startup check of nuclear instrument signal processor drawers; replacing any reference to Shift Supervisor with Lead Senior Reactor Operator; revisions to better define when the Reactor Bridge ARM Upscale switch can be in the upscale position; and other minor editorial corrections.

B. CHANGES TO THE MURR SITE EMERGENCY PROCEDURES AND FACILITY EMERGENCY PROCEDURES

As required by the MURR Technical Specifications, the Reactor Manger reviewed. Based on this review Revision No. 30 was issued 1/31/00 and will be covered in 2000 annual report.

C. CHANGES TO HEALTH PHYSICS STANDARD OPERATING PROCEDURES, BYPRODUCT MATERIAL SHIPPING PROCEDURES AND PREPARATION OF BYPRODUCT MATERIAL FOR SHIPMENT PROCEDURES

The University of Missouri Research Reactor Radiological Control Procedures and Procedures for Preparation for Shipment and Shipment of Byproduct Material have been reviewed and are approved as written. The procedures were found to provide adequate control of radiation exposure to MURR personnel and to the public.

The following is a summary of revisions to Health Physics Standard Operating Procedures issued in 1999:

HP/I-4, Rev. 5	Personnel Indoctrination Documentation: was revised to update procedure references.

HP/I-7, Rev. 2	Beamport Area Access: was revised to clearly state that the access doors should be closed and locked prior to reactor startup.
HP/II-4, Rev. 5	H-3 Air Samples: was revised to delete instructions for the use of the Delta 300 scintillation counter and add instructions for the use of the Packard 2300 scintillation counter.
HP/II-4, Rev. 6	H-3 Air Samples: was revised to include complete instructions for calculating tritium activity from the data produced by the Packard 2300 scintillation counter.
HP/III-1, Rev. 5	Calibration of Radiation Survey Instruments: was revised to include more aspects of ANSI standard N323-1978 and add specific sections for friskers, air monitoring equipment, survey meters and ARMS detectors.
HP/III-3, Rev. 3	Calibration of the Stack Particulate Channel: NMC Model AM-22IF: was revised to include instructions to count the EFF.FILTP1 standard prior to performing analysis.
HP/III-3, Rev. 4	Calibration of the Stack Particulate Channel: NMC Model AM-22IF: was revised to include instructions to count the L10 standard prior to performing analysis and require tag out of all hoods and glove boxes.
HP/III-4, Rev. 4	Calibration of the Stack Iodine Channel: NMC Model AM-22IF: was revised to include instructions to count the EFF.CHAR standard prior to performing analysis.
HP/III-4, Rev. 5	Calibration of the Stack Iodine Channel: NMC Model AM-22IF: was revised to include instructions to count the L10 standard prior to performing analysis and require tag out of all hoods and glove boxes.
HP/III-5, Rev. 6	Calibration of the Stack Iodine Channel: NMC Model AM-22IF: was revised to include instructions to count the EFF.GAS standard prior to performing analysis
HP/III-5, Rev. 7	Calibration of the Stack Iodine Channel: NMC Model AM-22IF: was revised to include instructions to count the L10 standard prior to performing analysis and require tag out of all hoods and glove boxes.
HP/III-6, Rev. 1	Stack Monitor Preventative Maintenance: NMC Model RAK: was revised to include preventative maintenance as part of the calibration procedure.
HP/III-7, Rev. 2	Calibration of Stack Monitor System: NMC Model RAK: was revised to include instructions to notify the control room and turn off the air pump prior to starting the calibration sequence.

HP/III-7, Rev. 3	Calibration of Stack Monitor System: NMC Model RAK: was revised to include specific instructions for accessing the test mode for running a voltage plateau.
HP/III-10, Rev. 2	Calibration of Stack Gas Channel: NMC Model RAK: was revised to include instructions to revise the spread sheet used to calculate argon release.
HP/III-14, Rev. 3	Calibration And Operation of Eberline BC-4 Beta Counter or Eberline SAC-4 Alpha Counter: was revised to change the specified count time from 5 minutes to "long enough to yield 10,000 counts."
HP/III-14, Rev. 4	Calibration And Operation of Eberline BC-4 Beta Counter or Eberline SAC-4 Alpha Counter: was revised to list the correct calibration source.
HP/III-15, Rev. 1	Portal Monitor Calibration/Optimization: was revised to update the list of equipment required to perform the calibration and provide clearer instructions for entering the test parameters in the microprocessor.
HP/III-16, Rev. 2	Portal Monitor Figure of Merit Functional Test: was revised to add a maximum value for background counts and instructions for entering the test parameters in the microprocessor.
HP/III-17, Rev. 2	HFM-10 Calibration/Optimization: was revised to provide instructions for entering the test parameters in the microprocessor.
HP/III-18, Rev. 3	HFM-10 Source Check: was revised to include a maximum value for background counts.
HP/III-22, Rev. 1	Quench Curve on the Searle Liquid Scintillation Counter: was revised to provide instruction for the Packard LSC.
HP/III-23, Rev. 0	Preparing Tritium Standard for Searle Liquid Scintillation Ctr.: was deleted because the Searle was no longer in use.
HP/IV-5, Rev. 7	Cobalt-60 Facility Safety Checks: was revised to include instructions to use an audible alarming dosimeter when entering the Co-60 facility and steps were modified to be easier to understand.
HP/IV-9, Rev. 0	Can Melting Procedure: is a new procedure covering the volume reduction of aluminum cans.
HP/V-2, Rev. 4	Analysis of Radioactivity in Environmental Samples: was revised to remove references to the Searle LSC.
HP/V-3, Rev. 4	Changing Stack Monitor Filters: Eberline PING 1A, Serial Number 257: was revised to provide instructions for the Eberline instrument rather than the NMC previously covered by the procedure.

HP/V-4, Rev. 1	Changing Stack Monitor Filters: NMC Model RAK: was revised to include instructions to call the control room for chart readings prior to starting the procedure.
HP/V-4, Rev. 2	Changing Stack Monitor Filters: NMC Model RAK: was revised to more concise instructions for accessing and using the menus in the microprocessor.
HP/V-7, Rev. 6	Waste Tank Analysis: was revised to include the protocol to use on the Packard LSC when analyzing for H-3, S-35, and Ca-45.
HP/V-7, Rev. 7	Waste Tank Analysis: was revised to include the new protocol to use on the Packard LSC when analyzing for H-3, S-35, and Ca-45 and clarified instructions for calculating activity.
HP/VII-2, Rev. 4	Handling Radioactive Material in the MURR Pool: was revised to include instructions on when to perform contamination surveys.
HP/VIII-1, Rev. 4	Emergency Air Sampling: was revised to include instructions for using the portable high volume air sampling unit.

The following is a summary of revisions to procedures for preparation of byproduct material for shipment issued in 1999:

RP-2&2A, Rev. 0	Dissolving PM-149 Nitrate: new procedure to provide instructions for the preparation of PM-149 Nitrate for use in MURR laboratories or shipment to other users. PM-149 is used in radiopharmaceutical research.
IGO-P-33 Process, Rev. 11 P-33	Process Procedure: was revised to increase activity limits, clarify personnel contamination survey instructions and update instructions for working in the glove box.
IGO-P-33 Purification, Rev. 0	P-33 Purification Procedure: new procedure to provide instructions for subsequent purification of the posphorus-33 product. Procedure establishes required Health Physics controls and provides instructions for handling the material in the glove box.
IGO-Ho-166 Remote Process, Rev. 4	Procedure was revised to provide instructions for preparing multiple samples for shipment and changed filtering process.
IGO-Ho-DOTMP Process, Rev. 1	Procedure was revised to separate the QC checklist from the Health Physics check list.
IGO-EX-GEM 15	Analysis Preparation: was revised to include bins 4 and 5 for potential export.

IGO-EX-GEM 16	NaI Machine Sort<20mm Diameter: was revised to approve all machines for multistone counting and allow analysis of non-topaz stones
IGO-EX-GEM 18	Unloading NaI <20mm Diameter: was revised to include bins 4 and 5 for potential export.
IGO-EX-GEM 19	Sample Preparation: was revised to include bins 4 and 5 for potential export.
IGO-EX-GEM 22	HRGRS: was revised to include instructions for preparing the documentation for QA review.
IGO-EX-GEM 23	Processing Quarantined Samples: was revised to include bins 4 and 5 for potential export.

The following is a summary of the revisions to the byproduct material shipping procedures made during 1999.

IGO-S-00, Rev. 4	Income Generating Operations Administrative: Shipping: was revised to include definition of independent and concurrent verification. Revision included updating the defined responsibilities for Reactor Manager and Project Specialist as well as changing the group name throughout.

SECTION III
REVISIONS TO THE HAZARDS SUMMARY REPORT

January 1, 1999 through December 31, 1999

These changes were reviewed by licensed staff and members of the Safety Sub-committee and have been determined not to involve a change in Technical Specifications or an unreviewed safety question as defined in 10CFR50.59.

HAZARDS SUMMARY REPORT (ORIGINAL JULY 1, 1965)

Original HSR, page 9-22, Section 9.7.3:

Delete: "The off-gas monitoring system has an isokentic probe in the off-gas system plenum that supplies sample air to a filter paper monitored by a beta scintillation detector followed by a charcoal filter monitored by a gamma scintillation detector followed by a shielded gas chamber monitored by a Gieger-Miller tube. Output from each detector is shown on a log scale count meter on the instrument cabinet and on continuous chart recorders in the reactor control room. Audio alarms sound in the control room for low air flow, and for high radiation above a manually set limit for each detector."

Replace with: "The Off-Gas Radiation Monitoring System consists of a three-channel radiation detection system designed to measure the airborne concentrations of radioactive particulate, iodine, and noble gas in the exhaust air which is sampled by an isokentic probe located in the facility ventilation exhaust plenum. The radiation detection system is a self-contained unit consisting of a fixed filter monitored by a beta scintillation detector, a charcoal cartridge monitored by a gamma scintillation detector, and a gas chamber monitored by a beta scintillation detector shielded by three inches of lead (4π configuration). One-inch lead shields separate the individual detectors. The output from each radiation detector is displayed on a local meter in counts per minute (cpm) and on a strip-chart, three-pen recorder mounted on the instrument panel in the reactor control room. An audible and visual alarm alerts the operator to high activity or abnormal flow through the radiation detection system."

SECTION IV

PLANT AND SYSTEM MODIFICATION

January 1, 1999 through December 31, 1999

For each modification described below, MURR has on file the safety evaluation as well as documentation that it does not present an unreviewed safety question as per 10 CFR 50.59.

Modification 88-5:
Stack Monitor Replacement
This modification documents the replacement of the MURR stack monitor, a Nuclear Measurements Corporation Model AM-221F installed in May 1973, with a Nuclear Measurements Corporation Model RAK-22ABIB-PB6 stack monitor. Its capabilities allow for quicker activity and concentration assessments during routine or emergency stack releases.

Modification 88-5, Addendum 1:
Update of Original Modification Package 88-5
This addendum to modification 88-5 documents that the pre-operational tests for the Nuclear Measurements Corporation Model RAK-22ABIB-PB6 stack monitor are complete. The addendum provided a means to revisit and review the original modification package and to document the changes that were required to successfully complete the pre-operational tests prior to designating the Nuclear Measurements Corporation Model RAK-22ABIB-PB6 as the primary stack monitor.

Modification 96-3, Addendum 1:
Replace Current Solenoid Control Valve Designed for Intermittent Duty with One Designed for Continuous Duty
This addendum to modification 96-3, "Replace 529 Series Solenoid Control Valves for V527E and V527F with Redesigned Poppet Solenoid Valves," documents the replacement of the Schrader-Bellows model NC-N355-41-04553 solenoid poppet valves with ones designed for continuous duty, Schrader-Bellows model NC-N355-41-04853 solenoid valves. The material of the 'O'-rings accounts for the only difference between the two models. These solenoid poppet valves are used as the air control valves for valves 527E and 527F, the primary coolant demineralizer loop isolation valves.

SECTION V

NEW TESTS AND EXPERIMENTS

January 1, 1999 through December 31, 1999

No new experimental programs were developed during this period.

SECTION VI

SPECIAL NUCLEAR MATERIAL ACTIVITES

January 1, 1999 through December 31, 1999

1. SNM Receipts: A total of 20 new fuel elements were received from BWX Technologies, Inc., Lynchburg, Virginia.

Shipper	Elements	Grams U	Grams U-235
BWX	MO-530, MO-533, MO-535, MO-536, MO-537, MO-538, MO-539, MO-540, MO-541, MO-542, MO-543, MO-544, MO-545, MO-546, MO-547, MO-548, MO-549, MO-550, MO-551, MO-552	16,610	15,470

2. SNM Shipments: A total of 16 spent fuel shipments were shipped to DOE facilities at Savannah River Plant, Aiken, South Carolina.

Shipper	Elements	Grams U	Grams U-235
MURR	MO-474, MO-476, MO-478, MO-480, MO-481, MO-482, MO-483, MO-484, MO-485, MO-487, MO-489, MO-491, MO-493, MO-494, MO-495, MO-496	10,831	9,454

3. Inspections: One NRC inspection reviewed the SNM activities. No violations occurred.

4. SNM Inventory: As of December 31, 1999 MURR was financially responsible for the following DOE-owned amounts:

   Total U = 44,869 grams

   Total U-235 = 40,387 grams

Included in these totals are 36 grams of U and 34 grams of U-235 in DOE-owned non-fuel. In addition to these totals, MURR owns 171 grams of U and 90 grams of U-235. All of this material is physically located at MURR.

The fuel elements on hand have accumulated the following burnups as of December 31, 1999.

Burned-up Elements (18)

Element No.	MWD	Element No.	MWD	Element No.	MWD
MO-477	142.397	MO-499	142.191	MO-505	147.435
MO-479	142.397	MO-500	142.191	MO-507	147.435
MO-490	146.322	MO-501	147.901	MO-509	148.041
MO-492	146.322	MO-502	145.801	MO-510	146.348
MO-497	147.826	MO-503	147.901	MO-511	148.041
MO-498	147.826	MO-504	145.801	MO-512	146.348

Elements in Service (42)

MO-506	142.714	MO-525	45.377	MO-539	54.476
MO-508	142.714	MO-526	24.761	MO-540	9.469
MO-513	133.816	MO-527	45.377	MO-541	45.329
MO-514	127.034	MO-528	24.761	MO-542	31.934
MO-515	133.816	MO-529	37.451	MO-543	45.329
MO-516	127.034	MO-530	9.469	MO-544	31.930
MO-517	93.850	MO-531	37.451	MO-545	0.000
MO-518	86.089	MO-532	25.599	MO-546	40.910
MO-519	93.850	MO-533	54.476	MO-547	0.000
MO-520	86.089	MO-534	25.599	MO-548	40.910
MO-521	70.126	MO-535	30.037	MO-549	7.294
MO-522	62.297	MO-536	49.856	MO-550	9.569
MO-523	70.126	MO-537	30.037	MO-551	7.294
MO-524	62.297	MO-538	49.856	MO-552	9.569

Average Burnup (all elements): 81.41 MWD

SECTION VII

REACTOR PHYSICS ACTIVITIES

January 1, 1999 through December 31, 1999

1. Fuel Utilization: During the period January 1, 1999 through December 31, 1999, the following elements reached feasible burn-up and were retired.

Serial Number	Final Core	Date Last Used	MWD
MO-474	99-10	03/01/99	148
MO-476	99-10	03/01/99	148
MO-477	99-27	05/31/99	142
MO-479	99-27	05/31/99	142
MO-490	99-52	10/25/99	146
MO-492	99-52	10/25/99	146
MO-494	99-11	03/08/99	148
MO-496	99-11	03/08/99	148
MO-497	99-21	04/26/99	148
MO-498	99-21	04/26/99	148
MO-499	99-12	03/10/99	142
MO-500	99-12	03/10/99	142
MO-501	99-46	09/27/99	148
MO-502	99-28	06/07/99	146
MO-503	99-46	09/27/99	148
MO-504	99-28	06/07/99	146
MO-505	99-41	08/30/99	147
MO-507	99-41	08/30/99	147
MO-509	99-53	11/01/99	148
MO-510	99-63	12/31/99	146
MO-511	99-53	11/01/99	148
MO-512	99-63	12/31/99	146

Due to the requirement of having less than 5 kg of unirradiated fuel in possession, initial criticalities are obtained with 2 new elements or fewer as conditions dictate. A core designation consists of 8 fuel elements of which only the initial critical fuel element serial numbers are listed in the following table of elements in service December 31, 1999. To increase operating efficiency, fuel elements are used in mixed core loadings. Therefore, a fuel element fabrication core number is different from its core load number.

Serial Number	Fabrication Core Number	Initial Core Load Number	Initial Operating Date
MO-529	82	99-1	01-04-99
MO-530	82	99-26	05-17-99
MO-531	82	99-1	01-04-99
MO-532	82	99-3	01-18-99
MO-533	82	99-17	03-29-99
MO-534	82	99-3	01-18-99
MO-535	83	99-5	02-01-99
MO-536	83	99-16	03-22-99
MO-537	83	99-5	02-01-99
MO-538	83	99-16	03-22-99
MO-539	83	99-17	03-29-99
MO-540	83	99-26	05-17-99
MO-541	83	99-28	05-31-99
MO-542	83	99-36	07-19-99
MO-543	84	99-28	05-31-99
MO-544	84	99-36	07-19-99
MO-546	84	99-45	09-20-99
MO-548	84	99-45	09-20-99
MO-549	84	99-57	11-22-99
MO-550	84	99-59	11-29-99
MO-551	85	99-57	11-22-99
MO-552	85	99-59	11-29-99

2. Fuel Shipments: Sixteen spent fuel elements were shipped from MURR to Savannah River Site, Aiken, South Carolina. The identification numbers of these elements are:

   MO-474, MO-476, MO-478, MO-480, MO-481, MO-482, MO-483, MO-484, MO-485, MO-487, MO-489, MO-491, MO-493, MO-494, MO-495, MO-496

3. Fuel Procurement: BWX Technologies, Inc., Lynchburg, Virginia, is MURR's fuel assembly fabricator. This work is contracted with the U.S. Department of Energy and administered by Lockheed Martin, Idaho Falls, Idaho. As of December 31,1999, 353 fuel assemblies fabricated by BWX Technologies had been received and 351 used in cores.

4. Reactor Characteristic Measurements: Sixty Four refueling evolutions were completed. An excess reactivity verification was performed for each refueling. The largest excess measured reactivity was 2.56%. MURR Technical Specification 3.1(f) requires that the excess reactivity be less than 9.8%.

Two (2) reactivity measurements were made to measure the sample loading worth of the old type 3-Barrel Flux Trap sample holder and eight (8) reactivity measurements were made to characterize the new 6-Barrel Flux Trap holder. Technical Specification change was approved by NRC to run "movable" experiments in the 3 small tubes of the new 6-Barrel Flux Trap sample holder.

One Differential Blade worth measurement and one Primary Temperature Coefficient measurement were performed.

SECTION VIII

RADIOACTIVE EFFLUENT

1 January 1999 through 31 December 1999

TABLE 1

SANITARY SEWER EFFLUENT

1 January 1999 through 31 December 1999

Descending Order of Activity Released for Nuclide Totals > 1.00E-05 Ci

Nuclide	Activity (Ci)
H-3	1.67E-01
S-35	3.15E-03
Co-60	1.49E-03
Ag-110m	9.12E-04
Zn-65	6.20E-04
As-77	5.43E-04
Yb-175	1.91E-04
Lu-177	1.25E-04
Na-24	6.60E-05
Sm-153	3.71E-05
Tm-170	2.89E-05
Eu-152m	2.53E-05
Eu-152	1.63E-05
Total H-3	**1.67E-01**
Total Other	**7.20E-03**

TABLE 2

STACK EFFLUENT

1 January 1999 through 31 December 1999

Ordered by % Technical Specification (TS) Limit

Isotope	Average Concentration uCi/ml	Total Release 1/99 - 12/99 Ci	TS Limit Multiplier	%TS*
Ar-41	2.45E-06	1.13E+03	350	69.9
Ce-144	2.03E-14	9.39E-06	1	0.102
I-131	1.06E-13	4.89E-05	1	0.0529
H-3	1.55E-08	7.16E+00	350	0.0443
Cd-109	2.67E-14	1.23E-05	1	0.0381
Co-60	1.19E-14	5.48E-06	1	0.0237
Eu-155	3.00E-14	1.38E-05	1	0.0150
Sc-46	1.76E-14	8.15E-06	1	0.0059
Tm-170	1.41E-14	6.53E-06	1	0.0047
Os-191	5.23E-14	2.42E-05	1	0.0026
Hg-203	1.65E-14	7.65E-06	1	0.0017
Zn-65	6.31E-15	2.92E-06	1	0.0016
Cs-137	1.32E-15	6.09E-07	1	0.0007
Au-196	1.43E-15	6.60E-07	350	0.0004
Pa-233	2.63E-15	1.22E-06	1	0.0003
Co-57	2.59E-15	1.20E-06	1	0.0003
Ce-141	2.20E-15	1.02E-06	1	0.0003
Hf-175	2.68E-15	1.24E-06	1	0.0003
Cl-38	5.46E-11	2.52E-02	350	0.0003
Ir-192	6.35E-16	2.93E-07	1	0.0002
Hf-181	9.84E-16	4.55E-07	1	0.0002
I-133	5.57E-13	2.57E-04	350	0.0002
Br-82	2.73E-12	1.26E-03	350	0.0002
Se-75	1.18E-15	5.46E-07	1	0.0001
As-77	2.99E-12	1.38E-03	350	0.0001
Sr-85	1.90E-15	8.79E-07	1	0.0001
Ba-133	8.28E-16	3.83E-07	1	0.0001
Ce-139	6.26E-16	2.89E-07	1	0.0001
Te-123m	4.23E-16	1.96E-07	1	0.0001
Ru-103	4.73E-16	2.19E-07	1	0.0001
Total				**70.2**

*Isotopes observed at <0.0001 % TS limit are not listed.

Stack Flow rate = 31,200 cfm

SECTION IX

ENVIRONMENTAL MONITORING AND HEALTH PHYSICS SURVEYS

January 1, 1999 through December 31, 1999

Environmental samples are collected two times per year at eight locations and analyzed for radioactivity. The sampling locations are shown in Figure 1. Soil and vegetation samples are taken at each location. Water samples are taken at three of the eight locations. Analytical results are shown in Tables 1 and 2.

Table 3 lists the radiation doses recorded by environmental monitors deployed around MURR in 1999. All doses are about 50 mrem/year or less, except monitor numbers 9 and 15. These monitors are located near the loading dock where packages containing radioactive material are loaded on transport vehicles. The doses recorded by these monitors are considered to be the result of exposure to packages in transit.

The number of radiation and contamination surveys performed each month are provided in Table 4.

Table 1
Summary of Environmental Set 55
April 1999

Detection Limits*

Matrix	Alpha	Beta	Gamma	Tritium
Water	1.37 pCi/l	2.78 pCi/l	196 pCi/l	4.07 pCi/ml of sample
Soil	1.37 pCi/g	2.78 pCi/g	1.24 pCi/g	N/A
Vegetation	2.75 pCi/g	5.56 pCi/g	3.05 pCi/g	4.07 pCi/ml of distillate

*Gamma and tritium analyses are based on wet weights while alpha and beta are based on dry weights.

Activity Levels -- Vegetation

Sample	Alpha (pCi/g)	Beta (pCi/g)	Gamma (pCi/g)	H-3 (pCi/ml)
10V55	< 2.75	15.9	<3.05	< 4.07
1V55	< 2.75	25.5	<3.05	< 4.07
2V55	< 2.75	15.6	4.39	< 4.07
3V55	< 2.75	27.1	<3.05	< 4.07
4V55	< 2.75	15.9	<3.05	< 4.07
5V55	< 2.75	15.1	<3.05	< 4.07
6V55	< 2.75	24.2	<3.05	< 4.07
7V55	< 2.75	23.5	<3.05	< 4.07

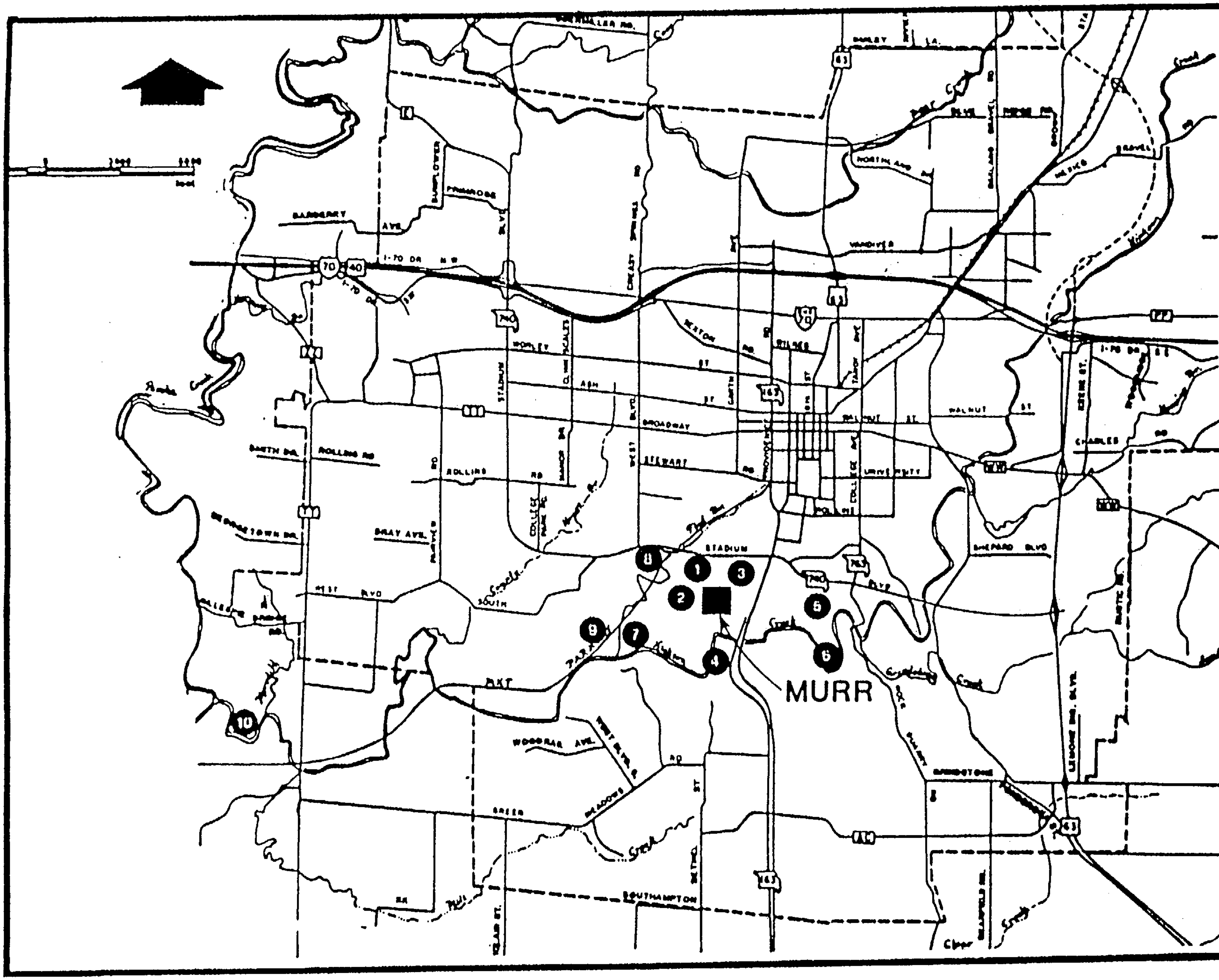

Figure 1. MURR Environmental Program Sample Stations

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

Activity Levels -- Soil

Sample	Alpha (pCi/g)	Beta (pCi/g)	Gamma (pCi/g)
10S55	< 1.37	12.2	5.85
1S55	< 1.37	10.9	8.62
2S55	< 1.37	5.86	7.11
3S55	< 1.37	7.69	5.16
4S55	1.55	8.99	6.52
5S55	< 1.37	11.2	5.56
6S55	< 1.37	7.30	6.53
7S55	< 1.37	11.9	5.14

Activity Levels – Water

Sample	Alpha (pCi/l)	Beta (pCi/l)	Gamma (pCi/l)	H-3 (pCi/ml)
10W55	< 1.37	17.59	5378	< 4.07
4W55	< 1.37	< 2.78	< 196	< 4.07
6W55	< 1.37	< 2.78	244	< 4.07

Sample 10W55 and 6W55 > MDA on NaI well detector. Analyzed sample 10W55 and 6W55 on HRGRS to determine specific radionuclides. Sample 10W55 was determined to contain 4.38 E-6 uCi/ml of Tc-99m. This radioisotope is utilized by hospitals and is often found in sample 10W. Sample 6W55 was determined to contain no activities significantly greater than background.

Table 2
Summary of Environmental Set 56
October 1999

Detection Limits*

Matrix	Alpha	Beta	Gamma	Tritium
Water	1.16 pCi/l	2.36 pCi/l	159 pCi/l	4.07 pCi/ml of sample
Soil	1.16 pCi/g	2.36 pCi/g	1.64 pCi/g	N/A
Vegetation	2.32 pCi/g	4.71 pCi/g	3.05 pCi/g	4.07 pCi/ml of distillate

*Gamma and tritium analyses are based on wet weights while alpha and beta are based on dry weights.

Activity Levels - Vegetation

Sample	Alpha (pCi/g)	Beta (pCi/g)	Gamma (pCi/g)	H-3 (pCi/ml)
10V56	< 2.32	8.09	< 3.05	< 4.07
1V56	< 2.32	< 4.71	< 3.05	< 4.07
2V56	< 2.32	< 4.71	< 3.05	< 4.07
3V56	<2.32	< 4.71	< 3.05	7.25
4V56	< 2.32	32.4	< 3.05	< 4.07
5V56	< 2.32	21.0	< 3.05	< 4.07
6V56	< 2.32	32.6	< 3.05	< 4.07
7V56	< 2.32	5.6	< 3.05	< 4.07

Activity Levels -- Soil

Sample	Alpha (pCi/g)	Beta (pCi/g)	Gamma (pCi/g)
10S56	< 1.16	13.0	8.24
1S56	< 1.16	12.9	9.32
2S56	< 1.16	10.2	7.25
3S56	< 1.16	10.0	6.96
4S56	< 1.16	11.3	8.14
5S56	< 1.16	9.30	8.69
6S56	< 1.16	9.00	8.40
7S56	< 1.16	10.3	7.50

Activity Levels -- Water

Sample	Alpha (pCi/l)	Beta (pCi/l)	Gamma (pCi/l)	H-3 (pCi/ml)
10W56	< 1.16	17.12	2121	< 4.07
4W56	< 1.16	2.39	230	< 4.07
6W56	< 1.16	4.38	<159	< 4.07

Sample 10W56> MDA on NaI well detector. Analyzed sample 10W56 on HRGRS to determine specific radionuclides. Sample 10W56 determined to contain 5.39 E-6 uCi/ml of Tc-99m and 1.61 E-6 uCi/ml of I-131. These are radioisotopes utilized by hospitals and sometimes found in sample 10W.

Table 3

Environmental TLD Summary

January through December 1999

Badge Number	Direction From MURR	Map Distance from MURR Stack (meters)	1st Qtr. 1999 Net mR	2nd Qtr. 1999 Net mR	3rd Qtr. 1999 Net mR	4th Qtr. 1999 Net mR	Total Net mR
1	Control	N/A	2.1	9.1	6.9	-1.8	16.3
2	Control	N/A	2.1	7.1	6.2	-3.0	12.4
3	WSW	N/A	5.7	13.7	8.5	2.6	30.5
4	Control	N/A	-4.3	9.1	5.6	-2.6	7.8
5	Control	N/A	4.9	8.0	4.2	-4.9	12.2
6	N	34	1.7	11.7	7.0	-3.3	17.1
7	NE	57	8.8	17.8	12.9	4.0	43.5
8	SW	27	-7.3	6.8	3.7	1.1	4.3
9	S	27	38.1	40.7	4.7	36.3	119.8
10	NE	149	-3.4	absent	0.5	-1.9	-4.8
11	NW	149	3.9	10.6	5.5	-1.7	18.3
12	ENE	301	1.6	7.3	absent	0.5	9.4
13	NNE	316	5.8	12.0	3.5	1.4	22.7
14	S	156	6.7	5.0	6.3	0.8	18.8
15	S	65	13.6	12.9	17.4	11.6	55.5
16	SE	107	6.7	4.0	1.8	-0.9	11.6
17	E	293	3.2	8.2	2.5	-3.5	10.4
18	NE	476	-4.8	3.5	-0.9	-5.4	-7.6
19	NNE	606	-3.5	0.7	absent	-5.4	-8.2
20	NE	907	-2.3	0.7	-7.9	-9.4	-18.9
21	SE	236	4.7	6.7	3.9	-1.2	14.1
22	ESE	168	absent	3.9	2.0	-2.1	3.8
23	NW	110	0.7	7.0	3.1	-3.8	7.0
24	SSW	328	3.7	5.8	2.2	-2.0	9.7
25	SSW	480	1.5	10.6	6.1	-0.7	17.5
26	SW	301	-1.6	5.1	3.5	-0.5	6.5
27	WSW	141	1.7	-0.3	-2.8	-6.1	-7.5
28	WNW	210	2.7	absent	3.9	7.3	13.9
29	NW	255	1.7	12.6	3.3	0.7	18.3
30	NNW	328	-1.2	4.5	3.3	-0.2	6.4
31	NNW	671	-0.3	7.4	5.3	0.4	12.8
32	NNW	724	0.8	10.4	6.0	-0.4	16.8
33	E	671	-5.3	absent	4.3	-0.3	-1.3
34	ENE	587	-2.5	4.8	1.4	-3.5	0.2
35	SSE	499	2.0	11.2	7.5	-0.1	20.6
36	SE	419	2.7	9.3	5.4	-1.6	15.8
37	NE	690	0.4	6.3	absent	-5.5	1.2
38	NW	556	-1.2	10.5	5.1	-1.0	13.4
39	W	491	-4.9	absent	7.2	-2.4	-0.1
40	N	514	-1.6	8.8	6.5	5.2	18.9
41	NNE	137	absent	4.7	0.8	-2.2	3.3
42	In Building	N/A	12.6	14.0	14.2	5.2	46.0
43	In Building	N/A	8.6	13.6	9.3	1.0	32.5
44	Distant Site	N/A	3.4	8.8	46.6	-3.6	55.2
45	S	65	2.0	4.2	8.3	-3.6	10.9

Table 4

Number of Facility Radiation and Contamination Surveys

1999	Radiation	Surface Contamination*	Air Samples	RWP
January	51	51	12	9
February	54	54	12	9
March	69	69	12	12
April	62	64	15	9
May	54	55	12	11
June	47	48	9	9
July	42	42	12	7
August	57	57	9	4
September	52	52	12	2
October	64	64	15	6
November	42	42	13	6
December	66	66	15	3
TOTALS	660	664	148	87

* Note: In addition, general building contamination surveys are conducted each normal work day.

Miscellaneous Items

MURR made three radioactive waste shipments in 1999 for a total of 535 cubic feet of LSA waste.

In June 1999 Andrea Shipp was promoted to a Health Physicist position. In October, Derek Pickett resigned from his Senior Health Physics Technician position. The current Health Physics staff is as follows: Manager, Reactor Health Physics; Assistant Manager, Reactor Health Physics; one Health Physicist; 2 Senior Health Physics Technicians; one Health Physics Technician; one Senior Secretary; and one part time Student Assistant. Also in 1999 two new positions were created to support the facility wide safety program, a Safety Associate to deal with occupational safety and a Training Coordinator to who will focus on safety training.

SECTION X

SUMMARY OF RADIATION EXPOSURES TO FACILITY STAFF, EXPERIMENTERS AND VISITORS

January 1, 1999 through December 31, 1999

1. Largest single exposure and average exposure are expressed in millirem.
2. Minimal exposure is defined to be gamma <10 mrem; beta < 40 mrem; neutron < 20 mrem.
3. ME = Number of monthly units reported with minimal exposure.
4. AME = Number of monthly units reported with exposure above minimal.
5. AE = Average mrem reported for all units above minimal.
6. HE = Highest mrem reported for a single unit for the month.
7. Dosimetry services except for "Self Reading Dosimeters" are provided by R. S. Landauer, Jr. & Co., Dosimeter Types: "C" - X, Gamma, Beta, Fast Neutron (Neutrak 144), Thermal Neutron; "G" - X, Gamma, Beta; "U" - TLD (1 Chip Ring).

PERMANENT ISSUE BADGES

"C" Whole Body Badges (Deep Dose):

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
M E	78	93	73	79	88	70	83	75	84	76	67	69
A M E	52	35	53	48	41	59	45	54	40	51	51	44
A E	60	61	68	69	76	50	70	47	52	69	68	65
H E	200	180	260	220	290	160	220	160	180	230	230	170

"G" Whole Body Badges (Deep Dose):

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
M E	43	39	33	41	45	49	43	40	39	51	51	44
A M E	5	6	10	8	8	5	8	12	11	13	11	14
A E	60	52	45	31	26	42	66	43	55	48	53	43
H E	120	150	230	90	50	80	140	180	160	190	200	130

"U" TLD Finger Rings:

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
M E	104	99	95	103	87	105	97	124	99	104	99	95
A M E	67	73	77	82	97	81	94	65	88	92	82	74
A E	148	146	160	143	216	151	157	153	133	179	159	142
H E	640	530	610	520	2700	850	700	990	690	690	550	590

Self Reading Dosimeters:

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
M E	5	11	8	3	19	13	3	14	7	8	1	4
A M E	89	83	86	93	77	85	99	86	89	87	95	90
A E	56	48	51	51	54	47	56	35	48	59	46	54
H E	230	179	292	277	319	162	255	147	228	229	210	230

SPARE ISSUE BADGES

"C" Whole Body Badges (Deep Dose):

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
M E	35	36	35	30	16	30	25	27	37	25	42	40
A M E	3	2	6	1	1	4	1	3	2	2	2	3
A E	50	110	38	20	210	28	20	27	70	10	50	23
H E	120	110	160	20	210	70	20	50	130	10	80	40

"G" Whole Body Badges (Deep Dose):

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
M E	27	71	33	27	37	50	50	52	41	51	36	55
A M E	0	0	5	1	1	0	5	4	3	0	4	0
A E	0	0	20	40	10	0	12	13	27	0	18	0
H E	0	0	40	40	10	0	20	20	40	0	30	0

"U" TLD Finger Rings:

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
M E	8	10	8	8	4	11	11	7	8	9	14	12
A M E	5	7	11	1	9	8	2	9	15	4	10	13
A E	81	87	154	30	127	103	60	99	115	70	71	74
H E	170	160	330	30	530	210	60	160	490	110	220	150

ALARA Program

The ALARA program continues to function as intended. Occupational exposure, releases to the sanitary sewer and releases from the facility ventilation system are reviewed monthly to ensure that they are not only within the regulations but are also reasonable for the work performed. The average monthly whole body deep dose to individuals in each ALARA review group are shown in the following table:

Group Name	Average Monthly Dose
Director's Office	minimal
Engineering and Computing Services	minimal
Facility Operations	10 mrem
Health Physics	40 mrem
Income Generating Operations -- Analytical Chemistry	minimal
Income Generating Operations -- Irradiations/Processing	40 mrem
Income Generating Operations -- Shipping	100 mrem
Income Generating Operations -- Silicon	15 mrem
Income Generating Operations -- Topaz	10 mrem
Materials Analysis	minimal
Neutron Activation	minimal
Neutron Scattering	minimal
Reactor Operations	65 mrem
Radiopharmaceuticals	20 mrem