U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-186/89001(DRP)

Docket Nos. 50-186; 030-02278 Licenses No. R-103; 24-00513-32

Licensee: University of Missouri
Research Park
Columbia, MO 65201

Facility Name: Research Reactor Facility

Inspection At: Research Reactor Facility, Columbia, Missouri

Inspection Conducted: March 6-10, 1989

Inspectors: R. J. Leemon
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Approved By: R. DeFayette, Chief
Reactor Projects, Section 3A

MAY 4 1989

Inspection Summary

Inspection from March 6-10, 1989 (Report No. 50-186/89001(DRP))
Areas Inspected: An announced team inspection of licensing actions; operational safety verification; maintenance/surveillance programs; modifications/design changes; reactor services - irradiation of samples and products; and radiological protection.
Results: One violation was identified (Severity Level IV) for failure to write a safety evaluation which documents the bases for the determination that the modification does not involve an unreviewed safety question in violation of 10 CFR 50.59 (see paragraph 4).

DETAILS

1. Persons Contacted

*J. Sheridian, Vice Provost for Research--Dean for Graduate School
*Dr. S. Morris, Interim Director
*C. McKibben, Assistant Director
*C. Edwards, Facilities Management
*W. Meyer, Reactor Manager
*L. Pitchford, Radiation Safety Officer, UM System
*J. R. Schuh, Sr. Research Specialist
*L. Manson, III, RXS Project Specialist (Topaz)
*M. Carter-Tritschler, Reactor Services Supervisor
*B. Reilly, Manager, Service Applications
*P. Miller, RXS Project Specialist (Isotopes)
*T. Schoone, Shift Supervisor
*D. Peeler, Neutron Scattering Technician
*C. Anderson, Shift Supervisor
*T. Seeger, Chief Research Electronic Technician
*S. Gumm, Reactor Service Engineer
*M. Evans, Chief Research Engineering Technician
*T. Young, Assistant RSO-UM System
*J. Ernst, Health Physicist
*Dr. G. J. Ehrhardt, Sr. Research Scientist
*Dr. A. R. Ketring, Sr. Research Scientist (RIA)
P. Neel, Sr. Research Laboratory Technologist
C. Conner, Laboratory Technologist
Dr. S. M. Langhorst, Research Scientist, Manager of Reactor Health Physics
W. Oladiran, Engineer

*Denotes those present at the exit interview on March 10, 1989.

Licensee Action on Previous Inspection Findings (IP 92701)

(Open) Open Item 186/87001-02(DRSS): Develop Method of Remote Sampling of Containment Air. The licensee identified a location to grab containment air samples and a permanent fixture will be installed to collect the samples in the near future. Once this installation is completed, this open item may be closed.

2. Operational Safety Verification

a. Operations

The inspector observed control room operations, reviewed logs and conducted discussions with control room operators during the inspection period. During these discussions and observations, the inspector ascertained that the operators were alert and cognizant of the facility conditions.

The inspector identified that the control room procedures are not being maintained as controlled documents. The procedures have

pages falling out of the book and pen changes made to them without approval of facility management. This is a poor practice.

Tours of the facility were conducted to observe facility equipment conditions, including potential fire hazards, fluid leaks, and excessive vibrations, and to verify that maintenance requests had been initiated for equipment in need of maintenance. The inspector observed the following fire hazards: three trash cans containing significant amounts of paper towels (one under a fire extinguisher and telephone, another one under a fire extinguisher), and a third one which contained oily paper towels. This third trash can did not have a cover as would be required for oily rags. Cardboard was also found throughout the facility. In the emergency generator room the inspector observed a pan under the emergency generator containing about an inch of oil, and oily rags on the floor. He also identified a large quantity of oil, graphite blocks, and boxes of records which were being stored there. By request of the inspector, the licensee removed the oil pan and stored oil from the emergency generator room the same day.

Facility cleanliness was determined to be inadequte as indicated by significant accumulation of dust on electrical panels, lighting fixtures, and motor control centers, and on several motor cooling fins which interferes with the air cooling of the motors.

The facility housekeeping was also determined to be inadequate as indicated by considerable clutter throughout the facility including loose parts, empty boxes and paper. An emergency eye wash bottle was broken with sharp points that could have entered one's eye if it was used in an emergency situation. After it was pointed out to the licensee, the bottle was removed and discarded.

The inspector identified that maintenance was inadequate as indicated by the fact that over 1/4 of all facility lights were burned out; five different lights were burned out on the control room control board and no entry had been made in the equipment deficiency log to schedule maintenance to replace them. Some of these lights were either the tens, units, or decimal position of the control rod height indicators. The inspector also identified oil on the floor surrounding the air compressor and noted that the operators on their rounds did not clean up the oil, nor did they enter the need for repair in the equipment deficiency log.

The facility's tagging and labeling systems were determined to be inadequate: a 1980 red tag was still hanging in the facility but no explanation was available to explain if it was still needed; a 1986 equipment deficient tag was still hanging in the facility and it was not known if it was still in need of repair; and some operators do not know the location of all tags hanging in the facility. Furthermore, the facility does not have serialized tags, nor does it audit the tags hung in the facility. Many facility valves are not labeled, and labels have fallen off motor control

centers and switchboards and not replaced. Many electrical panels and switches have no labels or are labeled with dino tape or writing from felt tip pens.

The inspector, by observation and direct interview, verified that physical security was being implemented.

b. Unscheduled Reactor Shutdowns

The facility experienced 94 unscheduled reactor shutdowns during the time period July 1986 to February 1989. The licensee defines an unscheduled shutdown as any unplanned manual or automatic reactor scram or rod run-in that occurs after the rods-full-in indication on the control console clears during start up.

The inspector reviewed the unscheduled shutdowns through direct observations, discussions with licensee personnel, and review of records and charts of reactor power level, temperature, and flow. In all cases the reactor was safely shutdown or power was safely reduced. In all cases the reactor instrumentation operated as designed. At no time did the reactor scram due to high power or short period.

Approximately 60% of the shutdowns were scrams, with the remaining 40% rod run-ins. About 65% of the shutdowns were due to equipment failure with the majority of the failures electronic in nature. The problems with reliability of the instrumentation reflects the age of the system; some components are based on vacuum tube technology. The licensee repairs problems as they occur and if the problem appears to be generic in nature, preventive maintenance is done to units that have not failed. Work is in progress to improve reliability by replacing parts in the console power supplies.

Approximately 20% of the shutdowns were due to operator error when the power range instrumentation was not changed before the scram setpoint was reached. The system design requires the operator to change ranges to maintain power indication on scale during power level changes. The reactor will scram if a certain fraction of full scale is exceeded, even if full scale does not represent full power. If the operator does not switch ranges properly, a scram occurs. This design feature is found in most non-power reactors and contributes significantly to operator error scrams. Another source of scrams is the operator bumping control rods loose from their magnets while working on the reactor bridge.

The balance of the shutdowns was caused by loss of site electrical power which shuts down the cooling system pumps and scrams the reactor. The reactor convective cooling loop then transfers decay heat to the reactor pool without the need for the primary or pool cooling systems or the emergency generator. The reactor, including

the emergency generator, have operated as designed during these events. An uninterruptable power supply is to be installed in the near future.

The licensee evaluates and documents each unplanned shutdown by using an "unscheduled reduction in power" report. The report is completed at the time of the shutdown and includes information on cause of the shutdown and action taken to alleviate the cause of the shutdown. Each report is numbered and reviewed by facility management. The inspector noted that some of the forms reviewed required additional detail and interpretation by facility management to be understandable.

c. License Event Reports

The inspector reviewed licensee event reports submitted from March 1987 to February 1989. Eight reports were submitted and in all cases the report was written to notify NRC of the failure or degrading of a component or system required by the facility technical specifications. The reports were submitted in compliance with the requirements of Technical Specification 6.1 h.(2). In all cases the licensee determined the root cause of the event and initiated appropriate corrective action. All corrective action is complete and is summarized in the event reports. Where appropriate, the licensee considered the generic implications of the event and took actions to prevent problems from occurring in similar equipment.

d. Containment Isolations

If radiation levels detected in the exhaust air plenum or at the reactor bridge indicate an increase of one decade above previously established levels at the same operating condition, the reactor containment is automatically isolated and the reactor is scrammed. The containment can also be manually isolated from the reactor console.

Through direct observations, discussions with licensee personnel, and review of records, the inspector determined that an isolation occurred on July 19, 1988, when the bridge radiation monitor alarmed. A licensee employee had moved an activated detector that was undergoing testing in the pool for a customer towards the surface of the pool. The radiation levels generated at the surface of the pool from this manipulation exceeded the radiation monitor set point of 50 mR/hr. The person who moved the detector had been warned by the shift supervisor beforehand not to move the detector without permission from a reactor operator. Standard Operating Procedure HP-4 allows materials less than 100 mR/hr to be moved in the pool provided that a licensed reactor operator or a qualified sample handler is available to provide monitoring support of the operation. The detector was moved without proper monitoring or permission. The individual involved was prohibited from working around the reactor bridge and left the facility several months later at the end of his employment contract.

3. Maintenance/Surveillance Program

The inspector reviewed the licensee's maintenance/surveillance program as it is implemented through the use of compliance checks (license or Technical Specification items), PM program (all other items not covered by compliance checks), discrepancy logs (form used to identify equipment problems), and the maintenance day meeting. No administrative procedures exist to control the overall program or any of its components.

Work on reactor systems/components is scheduled during the maintenance day meeting and a maintenance day work list is issued outlining the work to be performed by the different groups (operations, electronic shop, or machine shop) during the next weekly maintenance outage. The inputs for the work list are obtained from the compliance checks and PM program schedules, and the discrepancy logs. As soon as work is completed, the items are signed off and the schedules are updated immediately.

A review of the program records and interviews with licensee personnel showed that:

a. Commitments made in 1988 LERs have been included in the PM program.

b. A good vibration trending program exists for several pumps (reactor coolants, pool cooling, service water).

c. Instrument calibration records included "as found" readings in addition to the "as left" readings.

d. The licensee reviews all NRC Information Notices, Bulletins and Generic Letters for applicability.

e. A current schedule, which includes the time last performed and the next due date, is maintained for all compliance checks and PMs.

Three weaknesses were identified as follows:

a. The PM program procedures have no date of issuance or revision designation; therefore, it is not possible to ensure that the latest procedures are being used.

b. No individual component history file exists for equipment assigned to the machine shop. To obtain the maintenance history for that equipment requires the review of the monthly report for every year since the equipment was installed. An individual component history file exists for equipment assigned to the electronics shop but in several instances the file has not been updated since the summer of 1986.

c. The discrepancy logs are not sequentially numbered thereby preventing the verification that identified problems are not lost or destroyed.

These weaknesses are considered to be an Open Item (186/89001-01) pending their resolution.

4. Modifications/Design Changes

The licensee has no administrative procedures which control how a modification is processed; however, a nine page modification record is generated for each design change. The inspector reviewed the records maintained by the licensee regarding completed modifications and identified the following weaknesses:

a. Modifications No. 87-5 and 88-3 were not in the files. Since the licensee does not use a sign-out system, it required a search to determine who had taken them. The modification packages were found within a half hour.

b. Most of the modification packages on file are copies. It would be better to place the originals in the permanent storage system.

c. There were no records documenting that the post modification testing called for in Modification No. 87-5 was ever performed.

These weaknesses are considered to be an Open Item (186/89001-02) pending their correction.

The inspector reviewed the safety evaluation package for Modification No. 88-6, which was being installed at the time of the inspection. This modification involves the replacement of the present gasoline driven 45 KW emergency generator with a new diesel driven 300 KW emergency generator, the installation of a new substation, and replacing the Elgar line conditioned electrical power supplying reactor instrumentation and controls with an uninterruptible power supply. The safety evaluation performed to satisfy the requirements of 10 CFR 50.59 did not address any of the contemplated changes and failed to give the bases for the determination that the changes did not involve an unreviewed safety question. The safety evaluation package reviewed by the inspector consisted of the design specifications used to obtain bids and two simple statements identifying the fact that the Hazards Summary Report has to be amended after more details on the diesel generator are obtained, and that no unreviewed safety hazard existed because the new diesel generator and new uninterruptible power supply met or exceeded the capabilities of the existing system. The licensee's safety evaluation failed to consider the effects, if any, of the following changes:

a. The starting time of the diesel generator has been increased from the present 5 seconds (for the gasoline engine) to 10 seconds.

b. Since the planned design does not have the capability to synchronize the generator to the grid, all weekly surveillance tests will be done at either no load, or at best using the actual loads on the emergency motor control center. As described to the inspector that load could be as high as 30% of the diesel's capability. The licensee has no information from the diesel manufacturer to ensure operation at such low loads is not detrimental to the unit.

c. The unit is to be started cold and unlubricated during each weekly test. No information was available to determine if such routine starts were acceptable to the diesel manufacturer.

Failure to write a safety evaluation which documents the bases for the determination that the modification does not involve an unreviewed safety question is a violation (186/89001-03) of 10 CFR 50.59.

5. Reactor Services - Irradiation of Samples and Products

The irradiation of samples and products at MURR is performed under the reactor license, R-103, by staff in the Reactor Services Division. The division is comprised of three main areas of production, each staffed separately but coordinated under one group leader. The three areas are: gemstones (topaz) and nuclepore; silicon bars; and radioisotope applications (RIA).

a. Gemstone (Topaz)

MURR is allowed to release gemstones having less than exempt concentrations of byproduct materials to persons exempt from licensing in accordance with 10 CFR 30.14. After the gemstones have been processed and analyzed to determine whether they are below exempt concentration limits, they are transferred to License No. 24-00513-36E. Gemstones found to be below the exempt concentration limits can then be transferred to unlicensed persons such as wholesalers and jewelers. If gemstones are above the exempt concentration limits, MURR holds them for decay and further processing and analysis. The inspector verified, by sampling, that only material below exempt concentration limits was transferred to unlicensed persons. The licensed program will be inspected in depth at a later date.

b. Silicon

Silicon irradiation began in 1973-1975 and accounts for the largest production program at MURR in terms of mass processed per year, which is currently about eight metric tons per year (approximately eight million grams). The silicon is of high purity and the irradiation causes transformation or "doping" effects in the bars which are subsequently decayed, processed, annealed, and analyzed. About ten percent of these bars are randomly selected from each lot and put through MURR's quality assurance testing. This consists primarily of counting the bars on a germanium/lithium (GeLi) counting system to qualify and quantify remnant radioactive impurities to ensure that the bars are below exempt concentrations prior to release. Upon release, the bars are shipped to a Japanese Company for use as industrial products. The inspector verified by sampling that the shipped bars were below exempt concentrations.

c. Radioisotope Applications (RIA)

RIA irradiations have been performed at MURR since it opened in 1966 and have increased especially in the last three years. Several

thousand grams of samples are irradiated every year. The area showing the most growth involves samples irradiated for medical applications, such as samarium-153 EDTMP for experimental palliative bone cancer treatments in canines and humans. Licensee representatives stated that MURR does not irradiate any samples, other than silicon and topaz, that are subsequently released to the public under exempt concentration limits. Samples and products are irradiated for research, medical, and commercial purposes but are released while "hot" with the induced radioactivity requested by the customer. MURR stressed that "hot" samples and products are released only to persons who possess valid NRC or Agreement State licenses. A wide variety of customers receive these services ranging from large radiochemical manufacturers to small businesses. Reactor services staff emphasized that prospective customers must not only possess valid licenses but the customer must be licensed for the radionuclide, chemical/physical form, and quantity requested from MURR. The staff described an incident in which a customer requested irradiation services but was subsequently found to be unlicensed for one of the resulting radionuclides. MURR is still holding that customer's samples and refuses to release them to unlicensed persons.

The staff described in detail its procedures for handling sample irradiation service requests. These procedures are similar for the gemstone and silicon programs and appear to be adequate.

Licensee representatives described their procedures to ensure that customers are appropriately licensed. Approximately three months prior to the expiration date of a customer license, MURR contacts the customer by mail to request a copy of their "deemed timely" letter (indicating NRC's receipt of a renewal application) and a copy of the new license as soon as it becomes available. The staff stated that it had not had problems with customers letting their licenses expire while requesting MURR's services. The inspector reviewed several customer licenses and identified no discrepancies or violations. The inspector expressed concern, however, that a customer, especially a small business, could terminate its license without notifying MURR and subsequently, one of the customer's researchers may innocently or deliberately attempt to continue obtaining irradiation services from MURR without benefit of a license. Licensee representatives agreed that such a situation could occur and they will try to develop a mechanism to prevent it (50-186/89001-04).

The inspector examined MURR's procedures and facilities for shipment of "hot" products and identified no violations.

d. Facility Tour

The facilities where many of reactor services activities are performed were inspected, including the reactor pool, various laboratories where products are processed and analyzed, the GeLi detector system for silicon counting, the newly designed and built