UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

OCT 2 4 1989

Docket No. 50-002

University of Michigan
ATTN: Dr. Ronald F. Fleming
Director
Michigan Memorial-Phoenix
Project
Phoenix Memorial Laboratory
Ann Arbor, MI 48105

Gentlemen:

This refers to the team inspection conducted by Messrs. A. Dunlop, Jr., R. Landsman, R. Paul, and Ms. E. Matson of this office, and Mr. T. Michaels of the Office of Nuclear Reactor Regulation on September 11-14, 1989, of activities at the University of Michigan Ford Nuclear Reactor authorized by NRC Operating License No. R-28 and to the discussion of our findings with Dr. R. Fleming at the conclusion of the inspection.

The enclosed copy of our inspection report identifies areas examined during the inspection. Within these areas, the inspection consisted of a selective examination of procedures and representative records, observations, and interviews with personnel.

No violations or deviations with NRC requirements were identified during the course of this inspection.

In accordance with 10 CFR 2.790 of the Commission's regulations, a copy of this letter and the enclosed inspection report will be placed in the NRC's Public Document Room.

We will gladly discuss any questions you have concerning this inspection.

Sincerely,

Edward G. Greenman, Director
Division of Reactor Projects

Enclosure: Inspection Report
No. 50-002/89002(DRP)

cc w/enclosure:
R. Burn, Nuclear Reactor Manager
Licensing Fee Management Branch
DCD/DCB (RIDS)

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U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-002/89002(DRP)

Docket No. 50-002 License No. R-28

Licensee: University Of Michigan

Facility Name: Ford Nuclear Reactor

Inspection At: Phoenix Memorial Laboratory, Ann Arbor, Michigan

Inspection Conducted: September 11-14, 1989

Inspectors: A. Dunlop, Jr. _____ Date

R. B. Landsman _____ Date

R. C. Paul _____ Date

E. R. Matson _____ Date

T. S. Michaels _____ Date

Approved By: R. L. Hague, Chief
Technical Support Staff _____ Date

Inspection Summary

Inspection on September 11-14, 1989 (Report No. 50-002/89002(DRP))
Areas Inspected: Announced team inspection to review actions on previous inspection items (92701); followup of reportable occurrences (92700); organization, logs, and records (39745); reviews and audits (40745); requalification training (41745); procedures (42745); surveillance and maintenance (61745); experiments (69745); fuel handling (60745); transportation activities (86740); material control and accounting (85102); and radiological controls (83743).

Results: Of the 12 areas inspected, no violations or deviations were identified in the report. However, there were two issues that warrant licensee attention: (1) performance of a comprehensive ALARA review to determine if exposures can be reduced (Section 13.e); and (2) conduct a reactor pool evaporation study to determine a more accurate pool leak rate (Section 13.1). In addition, there was a concern whether the requalification training program was being met with respect to oral examination on emergency procedures (Section 7). It appears that the intent of the requirement is being satisfied, although the wording in the program should be clarified.

DETAILS

1. Persons Contacted

University of Michigan

*R. F. Fleming, Director, Michigan Memorial-Phoenix Project
*R. R. Burn, Nuclear Reactor Laboratory Manager
*G. M. Cook, Assistant Manager for Operations
*K. Conway, Health Physicist
M. Driscoll, Acting Director, Radiation Control Service

Additional station technical, operational, and administrative personnel were contacted by the inspectors during the course of the inspection.

*Denotes those attending the exit meeting on September 14, 1989.

2. General (92706)

This inspection, which began on September 11, 1989, was conducted to examine the research reactor program at the University of Michigan Ford Nuclear Reactor (FNR). The facility was toured shortly after arrival. The general housekeeping of the facility remains satisfactory, as was noted in the previous inspection (Inspection Report No. 50-002/88001(DRP)).

The reactor was operated on a 10-day operational and 4-day shutdown schedule during 1988 and the first 8 months of 1989. There were 13 unscheduled shutdowns in 1988 and 17 through August of 1989. The high number (11) of shutdowns during Cycle 304 of 1989 were due to a failed card in the Log N period circuit that required extensive troubleshooting to determine the cause. Other shutdowns resulted as follows: nine were caused by loss of offsite power, five manual operator action due to abnormal events, four equipment failures, and only one as a result of personnel error.

No violations or deviations were identified.

3. Action on Previous Inspection Items (92701)

a. (Closed) Open Item (002/88002-01): Effectiveness of steps taken to implement ALARA for reactor operators. See Section 13.e for closure of item.

b. (Closed) Open Item (002/88002-02): Verify rated fan flows of the FNR exhaust stacks. Stack Nos. 1-4 were measured for airflow, the results of which indicated the total airflow through the four stacks is about the same as measured in 1976. However, the distribution of the airflow among the stacks changed. The change in airflow for stack Nos. 2 and 3 will decrease the reported particulate and argon-41 releases because the flow rates of these fans has been reduced.

c. (Closed) Open Item (002/88002-03): Evaluate reactor water loss. See Section 13.1 for closure of item.

No violations or deviations were identified.

4. Reportable Occurrences (92700)

(Closed) Reportable Occurrence No. 12, dated January 16, 1989, and follow-up report dated May 3, 1989; Release of Fission Products from the Ford Nuclear Reactor. A routine 15-minute analysis of the reactor pool water on December 27, 1988, after the reactor had been shutdown for an extended period (Christmas holiday), showed elevated concentration levels of fission products:

iodine-131:	2.76E-6 microcuries/ml
xenon-133:	1.39E-5 microcuries/ml

In addition, on January 5, 1989, air samples were taken above the reactor core that showed very small, but detectable quantities of the following daughter fission products:

rubidium-88:	2.35E-10 microcuries/ml
cesium-138:	4.47E-11 microcuries/ml

The licensee commenced investigating to determine which fuel element was releasing fission products by removing one fuel element at a time from the core. The licensee also developed a pool water sampling technique by sampling the pool water over each element in the core during natural recirculation power operations (80KW) to aid in determining the leaking element. A liquid sipping tube was designed and placed directly over each element to obtain a water sample that was pumped through an ion exchanger resin column to collect and concentrate any fission product ions. By these techniques, fuel element number-204 was confirmed to be the only fuel element releasing fission products.

The licensee removed fuel element number-204 from the core and placed it in the pool fuel storage area, and identified it as a leaking fuel element so it will not be reused in the core. Babcock & Wilcox, the fuel manufacturer, was informed of the event. Records and radiographs taken when the fuel element was manufactured were reviewed, however, no anomalies were noted.

In order to be able to detect failed fuel more effectively, the licensee has replaced the 2-week analysis of the reactor pool water after sampling with a 1-week analysis. This will allow the short-lived source of high background, sodium-24, to decay away but relatively short-lived fission products such as iodine-131 are still detectable. In addition, xenon-133 was determined to be a significantly more sensitive fission product indicator than iodine-131 and will also be checked in future 1-week analyses. Molybdenum-99 will also be checked to provide a strong indicator of particulate releases. Finally, monthly air samples will be taken above the reactor pool to be analyzed for daughter fission products, such as rubidium-88 and cesium-138.

The inspector reviewed the pool water and air analyses during and subsequent to the removal of element-204 and concluded the licensee had correctly identified the leaking element.

The initial notification and followup reports were both timely and accurate. The licensee was inventive and systematic in determining and confirming the leaking fuel element. Corrective actions implemented should help in the early detection of any future leaking fuel elements.

No violations or deviations were identified.

5. Organization, Logs, and Records (39745)

The facility organization was reviewed and verified to be consistent with the Technical Specifications and Safety Analysis Report (SAR). The minimum staffing requirements were verified to be met during reactor operation, and fuel handling or refueling operations.

The reactor logs and records were reviewed to verify that:

a. Records were available for inspection.

b. Required entries were made.

c. Significant problems or incidents were documented.

d. The facility was being maintained properly.

On March 1, 1989, R. F. Fleming was appointed Director, Michigan Memorial-Phoenix Project, replacing W. Kerr who retired. On July 1, 1989, M. Driscoll was appointed the Acting Director, Radiation Control Service, replacing J. D. Jones who left the university; the university is in the process of selecting a permanent director.

Five people are scheduled for reactor operator (RO) license examinations and one for senior reactor operator (SRO) license examination in late October 1989.

During a review of the reactor log, the inspector noted instances where entries lacked sufficient detail. Examples included equipment removed from service but not returned to service, interchanging terms for scram and rod drop events, and not stating a cause for a scram. The licensee should ensure that the log is of sufficient detail to understand the event or actions taken. With respect to tracking equipment failures or deficient conditions, the licensee does not have a separate program or log to track equipment needing repair. CP-101, "Reactor Maintenance Schedule," does list each surveillance or maintenance activity that is required to be completed on a particular day. The licensee will evaluate whether a separate deficiency log sheet is necessary to track problems by stating the deficiency, corrective action performed, and subsequent retesting (if required).

No violations or deviations were identified.

6. Reviews and Audits (40745)

The licensee's review and audit program records were examined by the inspector to verify that:

a. Reviews of facility changes, operating and maintenance procedures, and design changes were performed by a safety review committee as required by Technical Specifications or SAR.

b. The Safety Review Committee (SRC) and/or subcommittee were composed of qualified members and that quorum requirements (five) and frequency (semiannual) of meetings had been met.

c. Required safety audits had been conducted in accordance with Technical Specification requirements and that identified problems were resolved.

Since the last inspection, two modifications have been initiated: Modification 102, the replacement of the linear level recorders (installed); and Modification 103, the electronic modules (2) connected to the gaseous activity detectors in the FNR stack and stack No. 2 (exhausts beam port off-gas system, pneumatic tube blower, chemical hood 3103, and Phoenix Memorial Laboratory (PML) exhaust).

The FNR has an agreement with the University of Lowell (UOL) and the Rhode Island Nuclear Science Center (RINSC) to perform an independent audit of the FNR as required by Technical Specification 6.2.8. UOL performed an audit in June 1989 and RINSC is scheduled to perform an audit in October 1989. Even though the UOL audit has not been received by the university, changes to some procedures have already been implemented from comments at the exit meeting. The inspectors also reviewed the 1988 audit performed by McMaster University Nuclear Reactor Manager. Comments associated with this report were adequately resolved by the licensee.

A review of the SRC meetings indicated that the committee was meeting all requirements. The SRC did not review any experiments since, in accordance with Technical Specification 6.2.7, the experiments performed were not "significantly different from tests and experiments previously performed at FNR."

No violations or deviations were identified.

7. Requalification Training (41745)

The inspector reviewed procedures, logs, and training records and interviewed personnel to verify that the requalification training program was being carried out in conformance with the facility's approved plan and NRC regulations. There were no changes in the requalification program. Requalification exams were successfully completed by five SROs and one RO in 1988. Three licensed SROs were exempted from examination, having recently received their initial license. The 1989 requalification program was not complete at this time and will be reviewed during the next inspection.

An informal training program developed by the licensee in 1987 has continued as each licensed SRO and RO is required to review a specific subject and complete a quiz. In 1988, the following areas were reviewed: security plan, emergency plan, health physics, a system description, and the retention tank overflow event. This program is an effective means of keeping operators informed of events, modifications, and procedure changes.

The Requalification Program, Section 2.2, Operator Performance Evaluation, states "The evaluation include an oral examination on all abnormal and emergency procedures . . . ," however, the licensee only orally examines operators on one emergency scenario a year. The licensee has the following two Emergency Procedures:

EP-101, "Reactor Building Emergency"
EP-201, "Emergency Pool Water Supply"

EP-101 has several conditions that would warrant shutting the reactor down or evacuation of the reactor building, while the purpose of EP-201 is to add emergency water to the reactor pool from the city water supply by opening four valves.

Since there is more than one emergency procedure, the inspector questioned whether the licensee was meeting its requirement on examining on all emergency procedures. The licensee stated at the time the Requalification Program was written, FNR had only one emergency procedure (EP-201 added later). In addition, the licensee interpreted Section 2.2 as saying the operator should know all the procedures, but the examination is only a sampling. The inspector requested the Office of Nuclear Reactor Regulation (NRR) to clarify what the intent of Section 2.2 of the Requalification Program was when it was approved. NRR's response was that testing should consist of a sampling in specific areas. The FNR program, however, can be interpreted to mean that all emergency procedures needed to be orally examined. The licensee should submit a change to the Requalification Program to delete the word "all" from Section 2.2 to clarify the intent of the program.

No violations or deviations were identified.

6. Procedures (42745)

The inspector reviewed the licensee's procedures to determine if procedures were issued, reviewed, changed or updated, and approved in accordance with Technical Specifications and SAR requirements. This review also verified:

a. That procedure content was adequate to safely operate, refuel, and maintain the facility.

b. That responsibilities were clearly defined.

c. That required checklists and forms were used.

The operating procedures were separated on May 1, 1989, into four distinct procedure sets. These are: Operating Procedures, Administrative Procedures, Maintenance and Calibration Procedures, and Emergency Procedures. This was done to provide a better organization of procedures. Two complete sets of procedures are maintained; one in the control room and a master file in the Administrative Assistant's office. All procedures are maintained by a word processor and updated as necessary.

The inspector determined that the required procedures were available to the operators and the contents of selected procedures were found adequate.

While reviewing Technical Specification Table 3.2, "Required Safety-Related Instrumentation" and CP-216, "Ludlam Area Monitoring Calibration Procedure," the inspector noted inconsistencies between the alarm setpoints for the area radiation monitors. Table 3.2 lists the normal and the maximum setpoints for each monitor. The setpoints that the monitors are calibrated to per CP-216 are not the normal setpoints stated in Table 3.2. The licensee had revised the actual setpoints in CP-216 to better accommodate the instrumentation being used. The actual setpoints are above the normal setpoints, but below the maximum setpoints stated in Table 3.2. As such, there is no technical concern with the radiation monitors; nevertheless, Table 3.2 should be revised during the next update to incorporate the actual normal setpoints for the radiation monitors.

The data sheet for particulate air samples, HP-217, "Routine Airborne Surveillance," was updated in June 13, 1989, to change the maximum permissible concentration (MPC) of several isotopes. The inspector reviewed several of these data sheets after this date where the old data sheet was being used. However, the data sheets had been pen and ink changed to incorporate the new MPC limits. Although this is not a technical concern, the inspector informed the licensee that only up-to-date data sheets should be used; the licensee agreed.

During a review of completed OP-102, "Shutdown Checklist," the inspector noted one checklist that had been reviewed by the Assistant Manager, Reactor Operations, but the day and date of the shutdown was not filled in. Therefore, it is unknown as to which shutdown this checklist belonged to. The licensee will review its records in order to properly identify the date of the shutdown associated with this checklist. Review of all the remaining checklists for 1988 and 1989 did not uncover any other instances of missing data. This appears to be an isolated instance.

No violations or deviations were identified.

7. Surveillance and Maintenance (61745)

The inspector reviewed procedures, surveillance test schedules, and test records and discussed the surveillance and preventive maintenance program with responsible personnel to verify:

a. That procedures were available and adequate to perform tests.

b. That tests were completed within the required time schedule.

c. Test records were available.

A review of the Reactor Maintenance Schedule for 1988 and individual test records indicated the licensee's surveillance program was satisfactory.

No violations or deviations were identified.

8. Experiments (69745)

The inspector verified by reviewing experiment records and other reactor logs that:

a. Experiments were conducted using approved procedures and under approved reactor conditions.

b. New experiments or changes in experiments were properly reviewed and approved.

c. The experiments did not involve unreviewed safety question, i.e., identified in procedures.

d. Experiments involving potential hazards or reactivity changes were identified in procedures.

e. Reactivity limits were not or could not have been exceeded during an experiment.

The inspectors witnessed the removal and insertion of several experiments into the reactor pool. Appropriate procedures were followed and operators documented exact times for removal and insertions into the reactor's flux field.

No violations or deviations were identified.

9. Fuel Handling (60745)

The facility fuel handling program was reviewed by the inspector. The review included the verification of approved procedures for fuel handling and their technical adequacy in the areas of radiation protection, criticality safety, Technical Specification, and security plan requirements. The inspector determined by records review and discussions with personnel that fuel handling operations were carried out in conformance to procedures. There were 84 fuel shuffles from January 1988 through August 1989. A large number of the fuel shuffles (63) were the result of determining the leaking fuel element in early 1989 as discussed in Section 4.

No violations or deviations were identified.

10. Transportation Activities (86740)

The inspector reviewed the licensee's spent fuel shipping program for compliance with the requirements in Department of Transportation (DOT) and NRC regulations, 49 CFR Parts 172 & 173 and 10 CFR Part 71, respectively.

Byproduct material is transferred from the byproduct and reactor licenses only to customers who have a valid NRC or Agreement State license that authorizes the type and quantity of material. A transfer form is completed for each transfer and it contains the recipient's license number and its expiration date. The health physicist (HP) stated that about once a year the staff reviews copies of all of the customers' licenses to check expiration dates. He stated that if a license is past its expiration date, no material will be sent unless the customer provides evidence that a renewal is pending with the appropriate licensing agency. The inspector reviewed a sample of transfer records and customers' licenses. In all cases the recipient's license was current, and authorized the type and quantity of material when it was sent.

The inspector reviewed a sampling of records, conducted interviews, and observed several packages prepared for transportation by a common courier. No problems were identified with DOT requirements for these types of shipments.

When byproduct material is transferred to an authorized user on the University of Michigan campus, a Transfer Request Form is completed and filed with Central Radiation Control Services. This office verifies that the recipient is authorized by the Radiation Safety Committee to use the type and quantity of material at the location specified on the form. When all information is verified, a health physics technician picks up the material and transports it to the recipient.

However, based on the HP's statements, it appears the health physics technicians who carry byproduct material across campus, do not package or transport material in accordance with 10 CFR Part 71.5 (DOT regulation reference). The licensee has raised the question whether the university is required to follow these regulations when transporting radioactive material locally. Since this is an issue directly related to the byproduct license, it will be examined and resolved with the licensee during the next routine inspection of License No. 21-00215-04. Because of the licensee's controls in this area, it does not appear to be a safety issue.

No violations or deviations were identified.

11. Material Controls and Accounting

a. Research Facilities

Experiment facilities include ten horizontal beamports that provide a thermal neutron flux provided by a heavy water tank located against the north face of the reactor core, one vertical fast neutron beamport, two pneumatic tubes used to irradiate small targets, and a large space within the pool for sample irradiation in or near the

core. In addition, FNR has facilities for neutron activation analysis. Samples are counted and analyzed by FNR staff, or by the individual researchers using FNR facilities. Many samples are transferred to users who perform their own analyses on their own equipment. Directly adjacent and connected to the reactor pool are two hot cells for handling highly activated samples.

b. Interface Between Reactor and Byproduct Licenses

The Nuclear Reactor Laboratory is made up of two, contiguous buildings, the FNR and the PML, that are operated as a single facility under the Office of the Vice President for Research. The health physics responsibilities fall under the Office of the Vice President and Chief Financial Officer. These two offices are separate, equal, and parallel organizations. One HP and one health physics technician from Central Radiation Control Services is assigned full-time to FNR and PML. At the facility level, the HP coordinates directly with the Nuclear Reactor Laboratory Manager (NRLM), but is independent from him and the Office of Research. On the working level, these persons have a close, daily contact. The HP stated that the two offices have cooperated in their respective duties with no conflicts.

The university has implemented a system of transferring the byproduct material produced in the reactor to the broadscope license (License No. 21-00215-04). In most cases, when a sample is removed from the reactor pool, the type and estimated quantity of the radionuclide is recorded in a log book indicating that it is officially transferred to the broadscope license. An inspector reviewed the records. In some cases, the byproduct material is maintained and used under the reactor license. Examples of such cases include byproduct material produced using the pneumatic tubes and beamports, and activated steel transferred into the hot cell.

c. Reactor Utilization

Principle utilization includes neutron irradiation services, radiation damage studies, neutron activation analysis, radioisotope production, neutron radiography, and neutron spectroscopy. Other services that do not generate byproduct material are teaching and laboratory experiments for students, public utility reactor operator training, and public tours.

Byproduct radioactive material produced in the reactor is distributed to researchers on campus, to researchers in the FNR and PML buildings, and to outside institutions who possess valid NRC or Agreement State licenses. FNR does not irradiate gemstones or any other items that are released to the public or to any unlicensed persons.

During the last year, the reactor was used for about 6,000 experiment hours by the University of Michigan staff, 7,000 experiment hours for work done for other colleges, universities, and public institutions, and 20,000 experiment hours for Federal and industrial organizations. Total use was about 33,000 experiment hours.

d. Approval of Users and Control of Facilities

Each person who wishes to use the reactor services must complete a Reactor Utilization Request (RUR) form and file the form with the control room operator. The control room operator has control over the use of the beamports and the pneumatic tubes. He is required to have and review the RUR form before initiating the service. He also completes a Sample Irradiation History Log Book each time a pneumatic tube is used.

The RUR form contains a description of the experiment or work to be performed, the expected radionuclides and quantities, and the signature of the HP indicating that he reviewed the request and approved the radiation safety aspects. The NRLM also signs each form indicating that he has reviewed the reactor safety aspects of the experiment. If any requests are unusual, they are reviewed by the reactor SRC.

In addition, any user on campus must have a Radiation Control Services (RCS)-101 form which signifies that the broadscope license Radiation Safety Committee has reviewed and approved the user's radiation safety training, his proposed use, and facilities.

Several users at the FNR use material under the direct supervision of the HP and do not have an RCS-101 form. The health physicist has frequent contact and directly observes these users.

e. Control and Distribution of Samples

An inspector reviewed the licensee's system for maintaining an inventory of byproduct material produced in the reactor and transferred to the broadscope license. The system used when material is transferred to an authorized user located on campus appears to be adequate although specific records were not reviewed at this time. However, the licensee does not appear to have developed a method of inventorying material transferred to the broadscope license and used in the FNR and PML buildings. The HP stated that this involves less than 100 millicuries. In addition, some byproduct material is transferred to the broadscope license and then packaged and transferred to other licensees. The licensee should develop a more comprehensive inventory system to account for this byproduct material.

No violations or deviations were identified.

12. Review of Periodic and Special Reports (90713)

The inspector reviewed the previous two annual reports, Report on Reactor Operations-1987 and -1988, for timeliness of submittal and adequacy of information submitted. The reports adequately fulfill the requirements of Technical Specification 6.6.1.

No violations or deviations were identified.

13. Radiological Controls (83743)

a. Organization

The health physics staff for the research reactor facility consists of a full-time HP, who is responsible for health physics activities in the research reactor facility and for work under the reactor research facility license and university broadscope license. Oversite of health physics activities in the facility continues to be supported by the university staff. The experience and technical qualification level of the permanent HP appears adequate, as does management support for the HP program.

b. Training

Orientation instruction and re-instruction remains essentially as described in Inspection Reports No. 50-002/86001 and No. 50-002/87003. Radiation safety instructions are given to all persons working in the reactor facility; tests are not given. Although it appears the training program for maintenance workers, reactor facility personnel, and visitors is sufficient to meet the requirements of 10 CFR 19, the inspector recommended additional instructions be given to beamport users. The licensee indicated this recommendation will be considered.

c. Audits

The 1988 annual audit required by Technical Specification 6.2.g conducted in July 1988 by a non-licensee auditor was reviewed by the inspector. No significant findings were identified; those items that were noted, were corrected. Corrective actions were reviewed; no problems were noted.

d. Bioassays

Licensee procedures require tritium urinalysis bioassays if the airborne tritium concentration exceeds one MPC during heavy water transfers. According to licensee records, no tritium analyses of reactor personnel were required from July 1988 to date because of this procedural requirement.

e. External Exposures

Reactor personnel and experimenters use vendor whole body film badges; TLD extremity monitors are provided for persons requiring extremity monitoring. Self-reading dosimeters are provided to visitors, temporary workers, and other personnel, as warranted. One weakness observed in the personal monitoring program was the absence of a Quality Assurance program wherein the licensee provides spiked dosimeters to the vendor. The NRLM agreed to consider implementing such a program.

Exposure records indicate the highest yearly individual whole body dose for 1988 was 1520 mrem, operator dose was about 10 person-rem, and the cumulative whole body dose for operators, management, and the health physicist is about 12 person-rem. It appears the operator dose and cumulative dose for 1989 will be about the same as 1988. The average annual reactor operator dose is about one rem, a factor of two higher than exposures pre-July 1987, when increased sample irradiations began. Increased sample work requires more reactor operator time over the reactor pool causing higher personal exposures.

During a previous inspection (Inspection Report No. 002/88002), the licensee stated they were aware of the generally increased personnel exposures and indicated certain steps were/would be taken to implement ALARA. The effectiveness of these steps was reviewed during this inspection and found to be satisfactory. For instance, the number of sample irradiations have increased by about a factor of five since July 1987, but reactor operator exposures increased by only a factor of two. However, the inspector could not determine if other reasonably achievable steps were available to further reduce exposures. As a result, the inspector suggested that the licensee initiate a comprehensive ALARA review to identify causes of exposure and to determine if further actions should be taken to reduce exposures. This matter was discussed with the licensee who indicated the assessment will be made. This is an Open Item (002/89002-01).

f. Posting, Labelling, and Control

Access to the reactor experimental area is limited to authorized personnel. Area survey maps and postings were current and reflected radiological conditions. In the experimental area, the inspector observed four beamport experiments, two of which had radiation fields that exceeded 100 mR/hr. Both areas were posted and controlled (locked) in accordance with 10 CFR 20.203 requirements.

g. Airborne Effluents

Airborne activity from the FNR is released through FNR-PML stack No. 2 and the FNR ventilation exhaust stack. This release path is continuously monitored for gaseous (argon-41), particulate, and iodine radioactivity. The calibrations of the stack gas, iodine, and particulate monitors are calculated in accordance with Technical Specification requirements. Selected calibration procedures for effluent monitors were reviewed; no significant problems concerning the calibration methodology were noted. However, an anomaly was found in the calibration results of a gas activity detector (GAD) concerning the calibration factor used to determine the number of counts per minute to equal one MPC of argon-41. The anomaly could cause an error in the non-conservative direction. The licensee indicated a procedural revision will be made to correct this problem. The inspector selectively reviewed airborne effluent analyses and release calculations for 1988. Using the allowed dilution factor of 400, gaseous effluents were less than Technical Specification limits.

h. Liquid Effluents

Liquid effluents were discharged to the sanitary sewer on a batch basis after the discharge tank contents are recirculated and sampled. Samples are analyzed for gross beta, tritium, and isotopic gamma activities. Records reviewed indicated that batch release concentrations were within 10 CFR 20 limits using the approved 300 dilution factor. The inspector reviewed calculational methods and no problems were noted. The current dilution factor used for liquid releases is 300; a conservative value because the dilution factor calculated in 1971 was about 900. The reactor health physicist recently performed another evaluation and found the average annual dilution factor to be about 950. Based on this and the 1971 evaluation, the licensee is considering a change to the Technical Specifications that would allow a dilution factor greater than 300, to about 700 to 800. Using the 300 dilution factor causes the licensee to report greater than actual radioactive concentrations.

i. Instrumentation and Equipment

The inspector reviewed selected calibration records for gaseous detectors (GADs, Procedure No. HP-209), moving air particulate monitors (MAPs, Procedure No. HP-208), and the Capintec Ionization Chamber, (Procedure No. HP-210), for the period June 1988 through July 1989. Calibrations were accomplished in accordance with applicable Technical Specifications and procedures; no discrepancies were found. The two GADs are calibrated for argon-41 and continuously monitor ventilation exhaust from the FNR and the FNR-PML stack No. 2; the MAPs monitor stack effluents, the pool floor and beam port floor. The Capintec is used during the calibration of the GADs. Operators verify building exhaust and area alarm setpoints once per shift, in addition to routine MAP operational checks.

Calibration records of laboratory counting instruments were reviewed. The gas proportional counter was calibrated quarterly in accordance with Procedure No. HP-211. The Ge(Li) system is calibrated semiannually with a multi-nuclide NBS traceable liquid standard. Calibration records were also reviewed for portable survey instruments; no problems were identified.

j. Surveys

Direct and smear surveys of the entire facility are conducted in accordance with procedural requirements. Additional direct radiation surveys are conducted each shift, monthly, and quarterly at selected locations and upon removal of pool equipment and experiments. Survey results for calendar year 1988 to date were selectively reviewed; contamination levels were low and observed results were comparable to those obtained during facility tours. The highest radiation levels noted are in the FNR basement; there appears to be minimal contribution from neutron radiation. Radiation fields near and around the reactor fuel pool when the reactor is operating range from 15-20 mR/hr at working levels.

Contamination surveys are conducted in accordance with Procedure No. RP-102. The inspector selectively reviewed the licensee's contamination survey records for calendar year 1989 to date. Contamination levels are low; the licensee's survey program appears adequate for current work activities.

k. Pool Water Chemistry and Heavy Water Reflector Tank Tritium

Selected gamma isotopic results of pool water samples, taken twice weekly, were reviewed for the last quarter of 1988 to date. Quarterly tritium analyses of the heavy water tank indicated the tritium inventory remained less than 50 curies, as required by Technical Specification 3.5.b. No abnormal activity or trends were noted.

l. Reactor Pool Water Leakage

During a previous inspection (Inspection Report No. 002/88002), the licensee was requested to perform an evaluation to determine evaporation rates and leakage rates from visible leaks from the reactor pool in order to quantify reactor water loss, and to determine if water leakage was migrating into an unexcavated area under the reactor. The licensee measured pool water makeup, surface evaporation and leakage, and sump collections (sumps which collect pool and other sources of water from the facility). The results of the study suggested that all leakage could be accounted for, however, there were significant variations in the results which reflected the uncertainties in the measurements, and in the contributing sources of water flowing into the sumps. The study also showed that none of the radionuclide concentrations of the leaking water exceeded 25% of the 10 CFR 20 unrestricted area limits. As a result of a discussion between Region III personnel and the licensee concerning the uncertainties of the study, the licensee stated they will perform another reactor pool evaporation study, and they will develop a surveillance procedure which should produce a more accurate pool leak rate. This matter was discussed at the exit interview and will be reviewed at another inspection. (Open Item No. 002/89002-02)

No violations or deviations were identified.

14. Exit Interview

The inspector met with licensee and contractor representatives denoted in Paragraph 1 during and at the conclusion of the inspection on September 14, 1989. The inspector summarized the scope and results of the inspection and discussed the likely content of this inspection report.

The licensee acknowledged the information and did not indicate that any of the information disclosed during the inspection could be considered proprietary in nature.