

U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-002/90001(DRSS)

Docket No. 50-002

License No. R-28

Licensee: University of Michigan  
Phoenix Memorial Laboratory  
Ford Nuclear Reactor  
Ann Arbor, MI 48109

Facility Name: Ford Nuclear Reactor

Inspection At: University of Michigan, Ann Arbor, Michigan

Inspection Conducted: November 13-16, 1990

Inspectors: William Snell for  
T. Ploski

12/5/90  
Date

William Snell for  
T. Kozak

12/5/90  
Date

Approved By: William Snell  
William Snell, Chief  
Radiological Controls and  
Emergency Preparedness Section

12/5/90  
Date

Inspection Summary

Inspection on November 13-16, 1990 (Report No. 50-002/90001(DRSS))

Areas Inspected: Routine, announced inspection of the licensee's emergency preparedness (IP 82745) and radiological controls (IP 80745, 83743, and 86740) programs. Licensee actions on previously identified items were also reviewed. The inspection involved two inspectors and one accompanying inspector.

Results: One non-cited violation was identified regarding the untimely periodic recalibration of eight of eleven instruments in the gaseous effluent monitoring system. The licensee's corrective actions were timely and adequate, satisfying the criteria of 10 CFR Part 2, Appendix C, Paragraph V. One non-cited violation was identified for licensee-identified, reportable occurrence No. 13 regarding tritium concentration in the heavy water reflector tank. The licensee's initial notification, followup report, and corrective actions were timely and thorough, satisfying the criteria of 10 CFR Part 2, Appendix C, Paragraph V.G.1.

The 1990 annual audit of the licensee's overall operations and safety programs, which has usually addressed the emergency preparedness and/or radiological controls programs, was performed by different auditors during July and October 1990. The report of the July 1990 audit was not available for review, since the licensee has been repeatedly unsuccessful in obtaining a final report from the auditor. The licensee was advised to establish an audit report due date with future auditors. The adequacy of the 1990 audit will be evaluated during a future inspection.

All other aspects of the licensee's radiological controls and emergency preparedness programs were acceptable.

## DETAILS

### 1. Persons Contacted

R. Fleming, Director, Michigan Memorial-Phoenix Project  
R. Burn, Reactor Manager  
G. Cook, Assistant Reactor Manager, Operations

The above and several other licensee representatives attended the November 16, 1990, exit interview. The inspectors contacted other licensee personnel during the inspection.

### 2. Licensee Action On Previously Identified Items

(Closed) Open Item (002/89002-01): Perform a comprehensive ALARA review to determine if reasonably achievable steps are available to reduce personnel exposure associated with work in the research reactor facility.

The licensee performed an extensive review of each job performed in the research reactor facility, identifying personnel exposures associated with the jobs and where the most exposure occurred. The licensee determined that the majority of personnel exposure was due to the ambient radiation field in the reactor fuel pool area, where personnel were located during handling of irradiated sources. The licensee has implemented the use of more efficient tooling for source removal and is investigating other methods to further reduce workers' time in the fuel pool area. The licensee is also considering the use of shielding packages which would be installed in the source handling area. Personnel exposures were trending downward this year, when compared to the 1989 personnel exposure data. This item is closed.

(Open) Open Item (002/89002 02): Perform another reactor pool evaporation study and develop a surveillance procedure to produce a more accurate assessment of the pool leak rate. The licensee's current provisions for determining pool leak rate, and current considerations for upgrading this assessment capability are described in Section 4.e of this report. This item remains open.

### 3. Emergency Preparedness Program (IP 82745)

#### a. Emergency Plan and Procedures

Records reviewed indicated that the plan had been reviewed and revised as necessary during 1989 and 1990, per the annual review commitment. Emergency Procedure EP-101 was revised during 1990 in response to lessons learned from the 1990 emergency drill. The Safety Review Committee approved this procedure revision during its September 1990 meeting. The licensee indicated that senior reactor operators have essentially been required to memorize EP-101, Reactor Building Emergency.

No violations or deviations were identified.

b. Organization

The licensee's emergency organization and its interface with offsite support organizations have remained unchanged since the last inspection. Letters of agreement with offsite support organizations have been updated biennially, with the next updates due during the first half of 1991. The licensee was aware that possible changes in the responsibilities of the campus security force could impact the licensee's agreement with the City of Ann Arbor Police Department.

No violations or deviations were identified.

c. Training

Periodic emergency preparedness training has remained adequate since the last inspection. The 1989 and 1990 annual drills were conducted, critiqued, and documented. Each drill was sufficiently challenging and tested different aspects of the overall emergency response program. The 1989 and 1990 emergency plan meetings, involving appropriate university staff and representatives from local support organizations, were conducted and adequately documented. Meeting topics included the latest annual drill and associated lessons learned.

Several emergency planning questions were among the topics in the 1989 and 1990 licensed operator requalification training program. The 1989 program had been completed, while the 1990 training was in the latter stages of completion. As a licensee initiative, more detailed emergency plan training had been completed by all licensed personnel as a self-study examination during 1989.

No violations or deviations were identified.

d. Notifications and Communications

There have been no actual activations of the licensee's emergency plan. The current plan revision clearly stated that the NRC will be notified within one hour of any emergency declaration. This clarification was being made during the previous inspection.

Records indicated that the building alarm has been tested as an integral part of the reactor startup procedure. The licensee also indicated that the alarm has been tested during the Fall as part of an orientation to persons who may be newly assigned to the building's laboratories.

Emergency response telephone numbers have been checked and updated at least annually, in accordance with an emergency plan commitment.

No violations or deviations were identified.

e. Audits

In accordance with Technical Specifications 6.2.8 and 6.2.9, annual audits of reactor operations and the safety of facility operations were performed by auditors who were presently or had recently been engaged in the management of a research or test reactor of comparable power level. The 1990 audit was conducted during July and October by representatives of two different research reactor facilities, who had been unable to visit the licensee's facility at the same time. The report of the October portion of the audit was not yet due. The individual who conducted the July segment of the audit had not yet submitted his report and has apparently been unresponsive to the licensee's efforts to obtain the required audit documentation. The licensee indicated the arrangement with the auditors included submittal of a final report; however, no deadline for providing the report had been negotiated. It had been assumed that the July audit report would be provided to the licensee within a "reasonable time limit," which has been exceeded from the licensee's and the inspectors' viewpoints. The licensee indicated that the first auditor was not delaying his report pending completion of the October portion of the audit. The 1990 audit reports will be evaluated during the next inspection.

No violations or deviations were identified; however, the following item should be considered for improvement:

- ° Future arrangements for annual audits should include the establishment of a mutually acceptable deadline for submitting a final audit report.

f. Emergency Equipment and Supplies

Emergency supplies have been stored and inventoried semiannually, as described in the plan. Records indicated that minor discrepancies identified during some inventories were corrected. Physical inspection of a supply closet identified no discrepancies when compared to the current inventory forms.

No violations or deviations were identified.

4. Radiological Controls (IP 80745, 83743, and 86740)

a. Qualification and Organization

The Ford Nuclear Reactor/Phoenix Memorial Laboratory (FNR/PML) Health Physics (HP) organization has continued to report to the University's Director, Radiation Control Services (RCS) in accordance with Technical Specification 6.1.e. Several staff changes occurred during 1990. The former RCS Director and FNR/PML HP had left the University earlier in 1990. The RCS position was filled by a former FNR/PML HP who was holding a different HP position at the University. The FNR/PML HP position remained open for approximately three months prior to being

filled on October 1, 1990. The current HP had held a similar position at a different research reactor for two and one-half years, and had earned a masters degree in Radiation Health Physics from the University of Michigan. The FNR/PML HP is assisted by a full time health physics technician.

No violations or deviations were identified.

b. Training

Orientation instruction and re-instruction remained essentially as described in Inspection Reports No. 50-002/86001 and No. 50-002/87003. Radiation safety instructions have been given to all personnel working in the reactor facility; no tests are given. The licensee has included additional instructions for beamport work in its orientation instructions.

No violations or deviations were identified.

c. Bioassays

Licensee procedures required tritium urinalysis bioassays if airborne tritium concentration exceeds one MPC during heavy water transfers. According to licensee records, one tritium urinalysis of reactor personnel was performed between September 1989 and this inspection because of this procedural requirement; no significant results were found. During this time period, the licensee had no indication of reactor personnel being exposed to iodine; therefore, no thyroid counts were performed on reactor personnel.

No violations or deviations were identified.

d. Personnel Monitoring

The licensee continued to use vendor supplied film and extremity badges which have been issued monthly to reactor personnel and experimenters. Records indicated that the highest yearly whole-body and extremity doses in 1990 to date are 1070 mrem and 3060 mrem, respectively, which are both below 10 CFR 20.101 limits. The licensee has implemented a Quality Assurance program wherein, on a quarterly basis, the licensee exposes film badges to a known dose, provides these badges to the vendor for reading and then compares the results. No discrepancies have been noticed between the vendor's results and known exposure values.

During a previous inspection (Inspection Report No. 002/89002), the inspector was unable to determine if the licensee had adequately evaluated jobs in the research facility to determine if reasonably achievable steps were available to reduce personnel exposures. The licensee performed an extensive evaluation of all jobs in the reactor research facility and determined that the major source of exposure to personnel was from the ambient radiation field (15-20 mrem/hr) in the fuel pool area during handling of irradiated sources. The licensee investigated means to reduce the time spent

in the reactor fuel pool area and has implemented the use of more efficient tooling for source handling. Also under investigation are a variety of shielding packages which could be used in the pool area during source handling. It appears that 1990 total exposure will be less than either of the previous two years' data.

No violations or deviations were identified.

e. Liquid Effluents

Liquid effluents have been discharged to the sanitary sewer system on a batch basis after the discharge tank's contents were recirculated and sampled. Samples were analyzed for gross beta, tritium, and isotopic gamma activities. Records indicated that batch release concentrations were within 10 CFR 20 limits, using the approved 300 dilution factor.

No violations or deviations were identified.

f. Surveys

Direct or smear surveys have been conducted in accordance with procedural requirements. Additional direct radiation surveys have been conducted shiftly, monthly, and quarterly at selected locations and upon removal of pool equipment and experiments. Survey results for calendar year 1990 to date were selectively reviewed. Contamination levels were very low and radiation surveys were commensurate with levels seen during facility tours. The inspectors noted that some radiation survey copies used for indicating radiation fields in the beamport areas were difficult to read. The licensee indicated that better copies would be placed in the area.

No violations or deviations were identified.

g. Airborne Effluents

Airborne effluents activity is released from the FNR through Stack No. 2 and the FNR ventilation stack. This release path is continuously monitored for gaseous (argon-41) activity using two Gaseous Activity Detectors (GADs); for particulates using three Moving Air Particulate detectors (MAPs); and for exhaust radiation levels by three NaI and five G-M detectors. The inspector selectively reviewed the licensee's airborne effluent analyses and release calculations for 1990 to date. Using the allowed dilution factor of 400, the gaseous effluents were less than five (5) percent of the technical specifications limits.

No violations or deviations were identified.

h. Instrumentation and Equipment

The inspector reviewed the calibration results of laboratory counting instruments. No significant problems were noted. During facility tours, portable survey instruments were observed to be

calibrated and operating. Calibration records of portable survey instruments were reviewed. The licensee has been calibrating these detectors in accordance with requirements.

The inspector reviewed the calibration records for the liquid effluent monitoring instruments to verify compliance with technical specifications. No problems were noted. However, upon review of the calibration records for the gaseous activity monitoring instruments, the inspector noted that eleven of the thirteen instruments used for this purpose were overdue for calibration, which is in violation of technical specification 4.6. Eight of the eleven instruments were under the Operations Staff (OP) cognizance and the other three were the responsibility of the HP staff. Calibration due dates for the gaseous activity monitors have been tracked differently by the two groups. In the OP staff's case, an oversight on the schedule used to indicate calibration due dates led to their eight instruments not being calibrated by the required time. The HP's equipment calibration problem stemmed directly from the staff changes described in Section 4a of this report. The licensee indicated that additional management oversight would be put in place on the OP staff schedule to reduce the possibility of missing calibration due dates, and that the HP staff would adopt a tracking system for calibration due dates that was analogous to the OP staff's system.

When informed of the overdue calibrations, OP and HP staffs performed calibrations over night on all but three of the overdue instruments. The remaining three will be recalibrated during the next scheduled reactor shutdown, which would be in about one week after this inspection. The instruments were all roughly one month past their calibration due dates. None were found to be out of specifications upon recalibration during this inspection. Reactor fuel pool analysis has been done twice weekly and would have indicated problems if abnormal activity releases have occurred.

In accordance with 10 CFR Part 2, Appendix C, Supplement IV, the inspector's discovery of the overdue calibrations would have been considered to be a Severity Level V violation. The overdue calibrations were of a minor safety and environmental significance since other means (reactor fuel pool analysis) were available to determine if abnormal release conditions existed, and since none of the instruments having overdue calibrations were found to be out of their calibration specifications when licensee staff performed the required calibrations during this inspection.

In accordance with 10 CFR Part 2, Appendix C, Paragraph V.A, the NRC will not normally issue a Notice of Violation, regardless of who identified the violation, for isolated Severity Level V violations, provided that the licensee has initiated appropriate corrective action before the inspection ends. Eight of the eleven instruments had been recalibrated during the inspection, while the other three would be calibrated during the following week's reactor shutdown. The licensee was implementing changes to the methods used by HP and OP staffs to track calibration due dates in order to prevent a recurrence of overdue gaseous effluent monitoring equipment



calibrations. These corrective actions were timely and responsive to the inspector's concerns. Therefore, no Notice of Violation will be issued. Instead, the matter is considered to be a non-cited violation.

One non-cited violation was identified.

i. Material Transfer

There have been no spent nuclear fuel shipments since the last health physics inspection. There were 48 spent fuel elements prepared for shipment and in storage in the reactor fuel pool. The licensee was awaiting arrival of the approved cask used to ship spent fuel, and anticipated shipping the spent fuel sometime within the next two months. The inspectors viewed a slide presentation showing how the licensee cuts both ends off the spent fuel elements in order to fit more elements into the cask. The presentation also showed the spent fuel loading and cask transfer processes.

Irradiated and waste material removed from FNR has been transferred to the University Radiation Control Services Organization for use at the University, transfer to off-campus recipients, or disposal. The licensee maintained copies of the recipients' license on file to verify the recipients were authorized to receive the material. The inspector selectively reviewed the licensee's survey and transfer records for such material.

No violations or deviations were identified.

j. Pool Water Chemistry and Heavy Water Reflector Tank Tritium

Selected gamma isotopic results of pool water samples, taken twice weekly, were reviewed for calendar year 1990 to date. No problems were noted.

Technical specifications (TS) require that the tritium content of the facility's 46 gallon heavy water reflector tank be maintained at less than 50 curies. Tritium is produced in the tank by deuterium absorption of neutrons. The licensee has normally maintained the tritium content of the tank at less than 50 curies by removing five gallons of tritiated heavy water and replacing it with five gallons of fresh heavy water, thus reducing the tritium activity by a factor of 41/46. Just prior to transfer, samples are taken from the tank to determine the curie content in the tank. On July 21, 1990, the licensee analyzed samples removed from the tank and determined the tank's curie content to be  $50.4 \pm 1.4$  curies, which is a violation of TS 3.5.b. The licensee reported this event to the NRC as required by TS 6.6.(2).a.

The licensee's investigation into the cause of this problem revealed that there was likely an error in the measurement of the samples obtained prior to the previous transfer on April 13, 1990, which indicated the tank curie content to be 42.5 curies. This value

could not have been correct as the previous samples obtained on February 2, 1990, indicated a tank curie content of 48.0 curies prior to that transfer, which calculated to 42.8 curies after transfer. If such was the case, the tritium content would have had to decrease during operations between February 2 and April 13.

In addition to the measurement error, the licensee's investigation revealed a non-conservative error in the calculation of the tank's curie content dating back to 1985. In April 1985, the heavy water sampling procedure (HP-107) was changed from a volumetric to a gravimetric basis for calculating the tritium concentration in an effort to be more accurate. One step in the procedure converts the mass of heavy water to volume. The procedure specified the use of the density of water (1.0 gm/ml) versus the density of heavy water (1.11 gm/ml) in the conversion calculation. This results in an eleven percent error in the non-conservative direction. Upon recalculating the curie content of the tank over this time frame, nine of the twenty-five tank analyses were actually over 50 curies. All of these tank analyses had been assumed to be less than 50 curies based on original measurements and calculations.

The licensee's thorough corrective actions also included a trend study over the past five years to determine a tritium build-up constant to serve as a general check on the heavy water tank tritium analysis performed by the HP. Procedure HP-107 has been changed to require use of the correct density of heavy water. The licensee has arranged with independent parties to perform an accuracy check on their tritium measurements.

The safety hazards to the public as a result of this event are not significant. The 50 curie content limit is based on a complete rupture of the tank, total mixing of the heavy water with the reactor pool volume, evaporation of the tritiated pool water and discharge of that tritiated water to the environment. Licensee calculations indicate that the total release to the environment would be  $2.6E-3$  mpc. The inspector reviewed these calculations and found them acceptable.

The licensee's identification of the calculation procedure error, which resulted in the tank's tritium content to be computed as  $50.4 \pm 1.4$  curies, compared to the technical specification limit of 50 curies, is a non-cited violation, in accordance with 10 CFR Part 2, Appendix C, Supplement IV and 10 CFR Part 2, Appendix C, Paragraph V.G.1.

One non-cited violation was identified.

k. Pool Water Leakage

During the previous inspection (Inspection Report No. 50-002/89002), the licensee committed to prepare and implement a surveillance procedure to accurately measure pool leakage and collection of that leakage. The licensee appears to have implemented an adequate procedure for isolating all three sumps so that only reactor pool

water leaks into them during measurement of leak rate. The inspector noted that there is no limit set on the amount of water which is unaccounted for due to differences in water collected, calculated values for evaporation, etc. The licensee indicated that attempts to procure more accurate measuring devices will continue and that, at least, an error band will be calculated such that there will be reasonable confidence that all pool leakage is accounted for.

No violations or deviations were identified.

5. Exit Interview

On November 16, 1990, the inspectors met with those licensee representatives identified in Section 1 to present their preliminary inspection findings. The licensee was informed that the inspector's identification of overdue calibrations for eight of eleven gaseous effluent monitors and the licensee's identification of slightly higher than allowed tritium levels in the heavy water reflector tank were probably non-cited violations, in accordance with the criteria of 10 CFR Part 2, Appendix C, Paragraphs V.A. and V.G.1, respectively.

The inspectors shared the licensee's concern regarding the failure of an auditor to provide a final report for an audit performed in July 1990. The licensee was advised to negotiate a final report due date with future auditors. The July and October 1990 audit reports will be evaluated during a future inspection.

The licensee was informed that all other aspects of the radiological controls and emergency preparedness programs were acceptable.