U. S. ATOMIC ENERGY COMMISSION
REGION I
DIVISION OF COMPLIANCE

Report of Inspection

CO Report No. 47/68-3

Licensee: U. S. ARMY MATERIALS AND MECHANICS RESEARCH CENTER
License No. R-65
Category E

Dates of Inspection: October 28 and 29, 1968

Dates of Previous Inspection: April 24 and 25, 1968

Inspected by: G. L. Madsen 11/25/68
G. L. Madsen, Reactor Inspector Date

Reviewed by : N. C. Moseley 11/25/68
N. C. Moseley, Senior Reactor Inspector Date

Proprietary Information: None

SCOPE

An announced routine visit was made to the U. S. Army Materials and Mechanics Research Center (AMMRC), 2 Mwt research reactor, at Watertown, Massachusetts. The inspector was accompanied by Mr. F. S. Cantrell, Reactor Inspector.

SUMMARY

Safety Items - None

Noncompliance Items - None

Unusual Occurrences - None

Status of Previously Reported Problems - None

Other Significant Items - The AMMRC minimum operator coverage criteria fulfills the requirements of 10 CFR 50.54(m). (Section B)

Twenty reactor scrams were encountered in the past seven months. (Section C)

The fire protection coverage was reviewed and found to be adequate. (Section D)

Operation with two primary loops has been initiated. (Section E.2)

Rodworth measurements have not been made since the initial startup of the reactor. (Section F.3)

Management Interview - The inspector held an exit interview with Mr. O'Connor at the conclusion of the visit. Items discussed included:

1. Reactor Scrams

   The reasons for the reactor scrams during the last seven months were reviewed. Mr. O'Connor indicated the scram frequency did not appear excessive in that the majority of the scrams were associated with two problems, the cause of which were somewhat difficult to detect. In addition, he stated that each condition did not represent unsafe situations.

2. Primary System

   Reactor operation with two primary loops in service was discussed. Mr. O'Connor indicated an intent to continue checking out this mode of operation in conjunction with the future intent of raising reactor power to 5 Mwt.

3. Control Rod Worths

   The inspector indicated that the available control rod worth information appears to be short of optimum. Mr. O'Connor indicated an inherent problem in calibration

of rods with a beryllium reflector in that the in-hour equation does not accurately apply. He indicated that the rods would be calibrated with the new core loading in mid-November, 1968, and that an effort is being made to come up with a good rod calibration technique for this facility with the beryllium reflector. Mr. O'Connor agreed to discuss the rod calibration data with the inspector on completion of the measurements.

4. Containment Pressure Relief Device

The existence of a water leg containment pressure relief device was discussed. The inspector indicated that DRL is presently evaluating the acceptability of this device and the results would be discussed during a subsequent visit.

5. Fuel Storage Monitoring

The inspector indicated that the existing monitoring program, for the annular pool, does not meet the written requirements of 10 CFR 70.24 regarding storage of fuel elements; however, no immediate actions would be required of AMMRC since there is some question of the applicability of this regulation to reactor pools. Mr. O'Connor stated that he intended to await further information on this subject prior to initiation of any changes.

6. Containment Isolation Valves

The existence of one inlet and exhaust containment valve was discussed. Mr. O'Connor stated that work is in progress on answering a DRL question relative to meeting the single failure criterion for containment isolation.

DETAILS

A. Persons Contacted

Mr. Jack O'Connor, Chief, Nuclear Research Laboratory
Mr. Paul O'Connor, Assistant to Chief, Nuclear Research Lab.
Mr. Charles Dady, Health Physicist

B. Administration and Organization

1. Personnel

Colonel James C. Bennett has replaced General Gerace as Director of AMMRC. Colonel Bennett's experience is strongly directed towards administration. The reactor operational staff has been stable. The present staff includes four senior operators and two reactor operators that have active licenses for the AMMRC facility. One additional operator is presently in training and is scheduled to take a reactor operator licensing test in the near future. The inspector asked what AMMRC considered to be the minimum operator coverage. Mr. J. O'Connor stated that a minimum of two licensed reactor operators are present during reactor operation, one of which must be a senior reactor operator. This mode of reactor coverage fulfills the requirement of 10 CFR 50.54(m).

2. Reactor Safeguards Committee

The reactor safeguards committee conducted five meetings during the last six months. Items discussed included:

a. Review and approval of several updated operating procedures.

b. Review of proposed material irradiations.

c. Semi-annual review of reactor operations.

C. Operations

The reactor is operated on an eight-hour day, five days per week basis. Evaluation of the effects of the recently approved* two heat exchanger mode of operation is in progress. A review of records indicated to the inspector that the reactor had been operated within the 2 Mwt limit. Observations by the inspector of a reactor startup on October 29, 1968, indicated adequate operational control.

*License Change No. 2.

The proposed Safety Analysis Report and Technical Specification for 5 Mwt operation is still under consideration by DRL. AMMRC has been requested* to submit additional information. Mr. O'Connor stated that the information would be submitted in the near future.

A review of records indicated that 20 reactor scrams were encountered during the past seven months of operations. The causes of the scrams were as follows:

Causes	Number
Low Magnet Current - Rod No. 3	12
Low Magnet Current - Rod No. 1	1
Startup Channel - Cable	5
Startup Channel Chamber Position	1
Operator Error	1
	20

A review of reasons provided for scrams revealed that these events did not represent unsafe conditions.

D. Facility Procedures

1. Fire Protection

A review of fire protection procedures revealed the following:

a. Numerous fire extinguishers are available throughout the facility. A spot check, by the inspector, indicated that these extinguishers receive periodic servicing.

b. The licensee has a written fire plan. The plan specifies responsibilities and appropriate actions.

c. AMMRC has assigned post and building fire marshals.

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*Letter to Army Material and Mechanics Research Center from D. J. Skovholt, Division of Reactor Licensing, dated October 9, 1968.

d. The local Watertown Fire Department furnishes fire coverage.

e. If fire were to occur in the reactor console, the reactor would scram by tripping of one of the various scram devices. The reactor does not require re-circulation flow during shutdown, hence the facility could be evacuated in case of fire without significantly affecting nuclear safety.

The inspector feels that adequate equipment and instructions are available at the facility.

2. Operating Procedures

An inspection by the military inspection team in June 1968, revealed apparent operation procedure deficiencies. A review of the subject procedures, by the inspector, revealed that these deficiencies had been adequately resolved by updating and correcting the procedures or review by the AMMRC reactor safeguard committee indicated that no change was required.

E. Primary System

1. Reactor Pool

The leak rate through the recently installed stainless steel liner continues to be about 2 gallons per day.

2. Primary Coolant System

The facility was being operated with two parallel heat exchangers in service as authorized by change No. 1 of the reactor license. Primary flow was 1550 gallons per minute. Upon inquiry, Mr. O'Connor stated that no unusual conditions had been encountered with the two primary loop operation; however, the radiation dose level had approximately doubled in the vicinity of the heat exchangers with the decrease in primary water holdup time.

F. Reactivity Control and Core Physics

1. Control Rods

The control rods were visually inspected by the licensee in October 1968. No flaws or adverse conditions were detected.

Twelve reactor scrams have occurred during the last 6 months, as a result of insufficient rod magnet holding strength during withdrawal of rod No. 3. The rod drive shifts were straightened in September 1968, in an endeavor to eliminate possible mechanical friction areas. No scrams from this condition were encountered during the subsequent 1-1/2 months.

2. Start-up Channel Instrumentation

Five reactor scrams were encountered as a result of false indications from the start-up channel. The cause of the condition was determined to be associated with a faulty cable plug between the chamber and amplifier. No scrams were encountered during the subsequent two months.

3. Reactivity Control

The inspector inquired as to the availability of rod worth curves for the present loading configuration. Mr. O'Connor stated that the only rod calibration curves available are those which were taken during the initial checkout of the reactor. Since that date, the original boron carbide rods have been replaced with boron stainless steel rods.* Mr. O'Connor indicated that the replacement rod worths were established by comparison with the originally calibrated rods. The inspector questioned the validity of the reactivity numbers and their accuracy when used to determine excess reactivity and shutdown margins. Mr. O'Connor stated that the facility has interlocks and procedures which require rods to be at a shim range at criticality and that the minimum amount that the reactor would be subcritical when

*Amendment No. 4, License No. R-65.

shutdown, with all safety rods inserted, would be greater than the reactivity worth of the maximum worth rod. Mr. O'Connor also indicated that incremental rod worths have compared favorably with the calculated xenon contributions during operation. Upon further questioning, Mr. O'Connor agreed that the xenon contribution versus rod worths applied only to a portion of the rods and that the incremental rod composition, from the rods inserted position to the shim range interlock position, are assumed to be equivalent to the remainder of the rod. He also indicated that the reactivity worths of the stainless rods, were equivalent to the original rods at the shim range position. In addition, Mr. O'Connor stated that reloading of the core was scheduled to begin in mid-November 1968, at which time the rods would be calibrated.

K. Containment

1. Pressure Relief Device

The acceptability of the previously reported* water leg containment pressure relief device was reviewed. The inspector inquired as to the desireability of having an automatic refill device available. Mr. O'Connor stated that the pressure relief device would not be affected by the maximum reactor accident because the relief pressure point is greater than the attained containment pressure. The real purpose of the relief device was to prevent overpressurization of the containment in the event of an inadvertent release of compressed air. Mr. O'Connor also indicated that the AMMRC reactor is not presently required to have a relief device. The inspector indicated that the water leg pressure relief device is presently being evaluated by DRL in conjunction with the AMMRC proposed safety analysis.**

*CO Report No. 47/68-2, Section K.

**Safety Analysis Report for AMMRC Reactor dated July 5, 1968.

2. Containment Isolation

The containment inlet and exhaust isolation valve systems were reviewed. The inspector noted that only one valve damper exists at the inlet and exhaust line. The dampers can be manually operated or automatically operated as a result of high containment radioactivity levels. Mr. O'Connor informed the inspector that work is in progress towards answering a DRL question* relative to the meeting of the single failure criterion for containment isolation. A review of records indicated no valve malfunctions during functional checking since 1966. The inspector indicated that the subject of single isolation dampers would be discussed with DRL and the results will be included in the DRL evaluation of AMMRC proposed Safety Analysis.

N. Emergency Power

Mr. O'Connor indicated to the inspector that the emergency power generator is no-load tested on a weekly basis by the post engineers. The post engineer indicated that no malfunctions of the generator had been encountered to date and that test records were available for review.

P. Radiation Protection

1. Personnel Exposures

A review of personnel film badge records for the period January through September 1968, revealed a maximum exposure of 500 mrem which is below the 10 CFR 20 limits.

2. Bear Tubes

A review of survey records indicated to the inspector, that adequate shielding was made available following the

*Letter to Army Materials and Mechanic Research Center from D. J. Skovholt, Division of Reactor Licensing, dated October 9, 1968.

reactor modification outage. Future activities of one beam tube facility will necessitate a need for a "High Radiation" zone control area. The inspector noted that photo-electric cells were being installed at the entry to the beam port area. Upon inquiry, Mr. O'Connor stated that the photo cell would be wired to produce a signal at the location and in the control room and would be in service prior to initiation of beam port activities which might cause the existence of a "High Radiation" zone.

The inspector noted that plastic tubes had been connected to the vent tubes for the active beam ports. Upon inquiry Mr. O'Connor stated that the containment Ar-41 activity ha increased as a result of the recent beam tube modification and necessitate corrective action. He stated that the temporary plastic vent lines were installed and are connected to the stack exhaust duct. This arrangement appears to have corrected the containment activity problem Mr. O'Connor indicated that permanent vent lines are scheduled to be installed.

3. Heat Exchanger Area

The inspector found the heat exchanger area to be designate as a high radiation area. Control devices were in service that fulfill the requirements of 10 CFR 20, paragraph 20.20 for high radiation areas.

4. Fuel Storage Monitoring

The applicability of 10 CFR 70, paragraph 70.24, to the storage of fuel elements in the reactor annular pool, was discussed with Mr. O'Connor. The inspector informed Mr. O'Connor that DRL is presently reviewing* this subject as it applies to storage of fuel at all reactor facilities. A review of the available monitoring devices revealed the following:

a. The pool top radiation monitor is the only area monitor that is relevant to this subject. It is located at the surface of the water, above the

*Memorandum from J. P. O'Reilly, CO:HQ to R. T. Carlson, CO:I, dated August 6, 1968.

reactor core. The storage annulus is shielded from this monitor by about 16 inches of concrete.

b. The normal alarm set point for the pool top monitor is 100 mr/hr. Readings during reactor operation at 2 Mwt are 8 to 10 mr/hr.

c. The pool top monitors are operated continuously, even during shutdown. The alarm point could be lowered, if required, by procedural control.

The inspector indicated that the existing monitoring program for the annual pool, does not appear to meet the written requirements of 10 CFR 70.24 regarding storage of fuel elements; however, no immediate actions would be required due to the pending resolution of this subject by DRL.

Q. Radioactive Waste Systems

1. Liquid Effluent

A review of records for the period January through September, 1968, indicated that 32,000 gallons of liquid waste had been discharged to sanitary sewer. The concentration of activity was below the limits of 10 CFR 20.

2. Gaseous Effluent

A review of gaseous release records for the period January through September, 1968, indicated a maximum average monthly activity release of 4×10^{-11} uCi/ml of particulate material and 1.65×10^{-6} uCi/ml of gaseous activity. Application of the authorized dilution factor of 10^{-10} seconds per cubic centimeter revealed the gaseous releases to be within the limits of 10 CFR 20.

V. Reliability Information

1. The control rods were visually inspected. No flaws were detected. (Section F.1.)

2. A review of maintenance records revealed that various periodic checks had been completed. The completed checks included: (a) rod inspection, (b) pool temperature calibration, (c) twenty second period calibration, (d) operational check of containment dampers, and (e) checking of high radiation alarms which are located in the guard house.