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

Report of Inspection

CO Report No. 47/68-2

Licensee: U. S. Army Materials and Mechanics Research Center
License No. R-65
Category E

Date of Inspection: April 24 and 25, 1968

Date of Previous Inspection: February 27 and 28, 1968

Inspected By: R. T. Carlson for 6/17/68
G. L. Madsen, Reactor Inspector Date

Reviewed By: R. T. Carlson 6/17/68
R. T. Carlson, Sr. Reactor Inspector Date

Proprietary Information: None

SCOPE

A special, scheduled 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 B. H. Faulkenberry, Reactor Inspector. The primary purpose of the visit was to conduct a final review of approved reactor modifications.

SUMMARY

Safety Items - None

Noncompliance Items - None

Unusual Occurrences - None

Status of Previously Reported Problems - The proposed Safety Analysis Report and Technical Specifications, for increasing power level to 5 MWt, is still under consideration by DRL. DRL has reviewed and approved resumption of operation at a 2 MWt power level

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with certain reactor modifications. These modifications have been completed in accordance with the authorization (Section T).

Other Significant Items - The facility emergency plans were reviewed and found to be adequate (Section D).

During flow testing, an unusual noise was detected in one of the heat exchangers. A metal fragment, originating from the initial fabrication, was located and removed. No apparent damage was incurred (Section E 2.).

Licensee inspection of the boron stainless rods revealed no flaws or apparent deterioration (Section F).

A containment leak test was satisfactorily performed. The containment building overpressurization device was inadvertently blown during the testing (Section K).

Refueling of the core was in progress. The procedures, in use, were reviewed and deemed adequate (Section O).

A beam tube was successfully removed, prior to core loading and with the reactor pool filled. A special beam tube holding device was fabricated for this operation (Section S).

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

1. Reactor Modifications

   The inspector reviewed the content of the AEC Regulations, Sections 50.36 (c) and 50.59. Mr. O'Connor did not completely agree with the interpretation that the recent reactor modifications should not have been made prior to authorization by DRL. He stated, however, that steps would be taken to prevent a recurrence of this situation. He further stated that he is hopeful that the proposed Safety Analysis Report and Technical Specifications for 5 MWt operation will be approved and subsequent clarity of interpretation will result.

2. Emergency Plans

The content of the emergency plans was discussed. The inspector indicated to Mr. O'Connor that, with one exception, the present plans appeared adequate. The exception is the absence of specified review intervals. Mr. O'Connor agreed to give this item consideration.

3. Radiation Protection

The inspector stated a concern relative to the adequacy of beam tube radiation shielding. Mr. O'Connor stated that a slow, stepwise approach to power is planned, and assured the inspector that precautions would be taken to adhere to the requirements of 10 CFR 20.

4. Containment

The advisability of having a water leg overpressurization device, for the containment, was reviewed. Mr. O'Connor stated that he would give this subject additional consideration. The inspector indicated that the subject would be evaluated further by Compliance and would be referred to DRL for additional consideration. Also, that the results would be discussed with him during a subsequent visit.

The inspector met with General Gerace and indicated that no operational safety problems had been noted during the course of the inspection. The Compliance inspection program was also discussed. General Gerace expressed his appreciation for the information presented and indicated his desire to hear about and participate in correction of any safety problems which may arise.

DETAILS

A. Persons Contacted

Brigadier General F. J. Gerace, Director, AMMRC
Mr. Jack O'Connor, Chief, Nuclear Research Laboratory
Mr. Paul O'Connor, Assistant to Chief, Nuclear Research Lab.
Mr. Charles Dady, Health Physicist
Mr. Leo Foley, Health Physicist

B. Administration and Organization

General Gerace has replaced Colonel Riordan as Director of AMMRC. General Gerace's previous reactor experience is limited. He is strongly oriented towards administration.

The reactor operational organization has been stable. The present operating staff includes four senior operators and two operators that have active reactor licenses for the AMMRC facility. In addition, the two health physicists previously held operator licenses and one man is in training for an operator's license. The available staff is deemed, by the inspector, to be adequate for the present mode of operation.

C. Operations

The reactor has been shutdown since July 1967 for modifications in connection with the proposed increase in power level to 5 MWt. The proposed Safety Analysis Report and Technical Specifications for 5 MWt operation is still under consideration by DRL. AMMRC requested*and received approval** to operate at a power level of 2 MWt with certain specified reactor modifications. The latter referenced document brought to AMMRC's attention that the reactor modifications, which AMMRC reported as being complete, involved changes to their current Technical Specifications, which pursuant to Section 50.36 (c) of the AEC Regulations, is their Safety Analysis Report. It was also pointed out, in the subject document, that the modifications should not have been carried out until they had been authorized by the Commission, even though AMMRC may have determined that these changes did not involve unreviewed safety questions. It was additionally pointed out that the modifications to the primary coolant system may have involved a unreviewed safety question, as defined in Section 50.59 (c) of the AEC Regulations.

These subjects were discussed at length with Mr. O'Connor during the visit. Mr. O'Connor indicated that he does not necessarily agree with the interpretation rendered, but stated that steps would be taken to prevent a recurrence of this situation.

*Letter to Division of Reactor Licensing, from John J. O'Connor, Chief, Nuclear Research Laboratory, dated March 1, 1968.
**Change No. 1, License No. R-65, dated April 7, 1968.

Reactor fuel loading was in progress during the inspection. This subject is discussed further in Section O of this report. Telephone communications with the licensee, subsequent to the visit, indicated that criticality was attained on April 26, 1968.

Mr. O'Connor stated that operation of the reactor will continue to be on an 8 hour a day, five days per week basis.

D. Facility Procedures

The facility emergency plans were reviewed with Mr. O'Connor. The review revealed that the emergency plans are composed of reactor and AMMRC installation instructions. When compared with the Reactor Inspection Manual, Section 0205, the following was determined:

1. Lines of authority are clearly defined. Rosters of responsible personnel are readily available and have been revised recently.

2. Coordination of the plans is maintained with appropriate organizations. The post guards are familiar with the emergency plans and have incorporated them into their procedures. Provisions have been made for hospital coverage for contaminated injuries at the New England Deaconess Hospital, in Boston, Massachusetts. Additional hospital arrangements have been made with St. Elizabeth Hospital in Brighton, Massachusetts and Mount Auburn Hospital in Cambridge, Massachusetts. The local Watertown Fire Department provides fire coverage. Provision has been made for supplemental police coverage by the Massachusetts State Police.

3. Identified emergencies and unusual conditions include loss of power, radioactive gaseous releases - including that associated with the MCA, primary system high activity, fires, and earthquakes. Two general categories of emergency are considered; namely, Reactor Emergency and AMMRC Post Emergency.

4. Instrumentation is available in the control room for detecting emergency conditions. Continuing information would be available in the control room and at the emergency control center to permit evaluation of hazards following the initiation of emergency actions.

5. The emergency plans spell out immediate actions, care and control of personnel, and secondary actions for control of the emergency conditions. The plans include consideration for back shift actions and responsibilities.

6. Methods of communicating emergency conditions include:

   a. Public address systems

   b. Reactor containment evacuation alarm

   c. AMMRC post evacuation or take cover sirens

   d. Telephones for off-site relaying of information

7. Equipment maintained in the emergency cabinet in the emergency control center includes:

   a. Radiation monitoring instruments

   b. Respirators

   c. Decontamination equipment

   d. First-aid devices

   e. Radiation zone clothing

   The locked cabinet contains an inventory list. Periodic inventory and maintenance checks are included in the operating procedures. A key for the emergency cabinet is contained in a glass container attached to the cabinet.

8. Health Physics instructions are available. The maximum allowable emergency personnel exposure is limited to 25 Rem.

9. Emergency drills are conducted on a semi-annual basis. Various emergency conditions are postulated and appropriate followup actions are taken.

10. The procedures are approved by the post commander or appointed delegates. Duty rosters are revised periodically. No specific schedule requirement for periodic review of procedures is included.

The emergency plans appear to be adequate for this facility; but could be improved by the incorporation of a specified review interval.

E. Primary System

1. Pool Liner

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

2. Primary Coolant System

Flow tests on the recently modified system** indicated that the Number 1 and 2 pumps can deliver 1100 and 1050 gallons per minute, respectively, while the two pump total flow is 1560 gallons per minute. The current Safety Analysis Report requires a flow of 930 gallons per minute.

During the flow testing, an unusual noise was detected in one of the heat exchangers. Investigation revealed a loose metal fragment, left over from the original fabrication, in the primary inlet bonnet of one exchanger. Mr. O'Connor stated that no apparent damage was incurred.

One primary pump and heat exchanger was observed to be isolated by closure of valves and removal of the valve handles. In addition, the electrical power to the pump had been de-energized and locked out. The isolation of a portion of the primary system, as described above, is in accordance with the requirements of the license***.

*CO Report No. 47/68-1, Section E. 1.
**CO Report No. 47/68-1, Section E. 2.
***Change No. 1.

3. Natural Convection Cooling

The natural convection cooling valve was observed to have been relocated from the manhole cover of the holdup tank to the side of the pedestal supporting the core. This arrangement permits colder water from the reactor pool to circulate through the core when convection flow is initiated rather than the warmer water from the holdup tank. This modification meets the requirements specified in Change No. 1.

F. Reactivity Control and Core Physics

The control rods were inspected by the licensee. No flaws were detected. Records indicate that control rod drop times were measured on April 17, 1968. The maximum recorded drop time was 810 milliseconds. The license requires inspection on a 50 MWd or annual basis. This requirement was met. The rod drop times compare favorably with previous results.

A review of records indicated that the recently modified Log N-Period system* was operationally checked and that it operated properly.

I. Auxiliary Systems

As was previously reported, a second cooling tower has been installed**. It is also noted that a second 1000 gpm pump has been added to the system. These additional facilities are available for use in conjunction with the secondary coolant system. These modifications were reviewed and observed to be in accordance with Change No. 1.

K. Containment

Containment leak rate tests were performed on March 7 and 8, 1968. The measured leak rate, with the outer airlock doors closed and the inner doors open, was 1.15%/psi per day. With

*CO Report No. 47/68-1, Section G.
**CO Report No. 47/68-1, Section I.

the outer doors open and inner doors closed, the leak rate was 0.43%/psi per day. These results were within the allowable leak rate of 2.0%/psi per day as required by the Safety Analysis Report.

During the outer doors closed and inner doors open test, shell pressure was 1.94 psi at the start of the test. About 14 hours after the test was initiated, shell pressure dropped rapidly. Investigation revealed the overpressurization device to be empty of water. A review of data indicated that shell pressure had reached 2 psi at which point the overpressurization device water expells to the stack. The device was subsequently leak checked and no leaks were found. The containment leak rate testing was discontinued at this point.

Records show that the results of the containment leak rate testing, including the abbreviated phase, were reviewed by Mr. O'Connor and the Reactor Safeguards Committee and deemed to be valid. The results of the leak rate tests are deemed acceptable by the inspector.

The inspector inquired as to the adequacy of the water leg overpressurization device. Pertinent facts which entered into the discussion are as follows:

1. The overpressurization device was installed in November 1963*.

2. With the normal water leg, the overpressurization device relieves at 2 psi differential pressure.

3. The maximum accident, for 2 MWt operation, postulates a resultant containment buildup of 1.15 psi**. The containment shell was designed to withstand 1.5 psi before reaching one-third the ultimate strength of the steel***.

*Operations Report of US Army Research Agency Nuclear Reactor Facility, June 15, 1960 to December 31, 1964.
**Safety Evaluation, DRL, Amendment 6 to License No. R-65.
***Ordnance Materials Research Reactor, Publication No. 7, by J. J. O'Connor and L. S. Foster, dated December 1, 1956.

4. Containment pressures anticipated for the maximum accident, plus the effect of pressure increases associated with outside environmental temperature variations, would be less than the overpressure relief point of 2 psi.

5. Monitoring of the water level in the overpressure device is included on a checklist which is performed on a shiftwise basis.

The inspector indicated that this subject would receive additional evaluation and the results will be discussed during a subsequent visit.

O. Fuel Handling

Reactor core loading was in progress at the time of the visit. Previously, thirty fuel assemblies had been moved from the gamma facility to the reactor pool annulus. The reactor loading procedure was reviewed by the inspector and found to contain instructions relating to the following:

1. Estimation of critical mass of the projected loading;

2. Completion of reactor startup checks;

3. Evaluation of subcritical multiplication information for each fuel assembly loaded beyond 50% of estimate; and,

4. Methods of record keeping.

The loading procedure was deemed by the inspector to be adequate.

P. Radiation Protection

The subject of radiation control plans for the resumption of operation was discussed. Mr. Dady stated, that because of the recent reactor modifications, numerous surveys would be conducted during reactor power ascension. Particular attention is to be directed towards determining the adequacy of the beam port shielding. The inspector indicated that the results of the above surveys would be reviewed during the next inspection visit.

S. Experiments and Tests

The beam tubes have been modified as described previously*. The modification will permit removal of beam tubes without entering the reactor pool. This modification was authorized by Change No. 1 of the Operating License.

Mr. O'Connor stated that a beam tube was removed and re-installed while the reactor was full of water. This was done prior to core loading. Mr. O'Connor showed the inspector the specially designed hydraulic device used to control the position of the beam tube during installation or removal. The inspector observed that the hydraulic holding device also contains a manual braking device which is capable of retaining the beam tube in a fixed position in the event the hydraulic device should fail. The holding device will permit adequate control of the beam tube during removal or installation; however, the inspector questioned the desirability of performing this operation with the reactor core loaded.

The inspector inquired as to the difficulties encountered and the amounts of leakage observed during the test removal and installation operation. Mr. O'Connor stated that no significant difficulties were encountered, and that a very small amount of water escaped from the reactor pool during the operation.

T. Facility Modifications

The following modifications to the reactor, some of which were reported on previously, have been completed:

1. A stainless steel pool liner was installed. (Section E)

2. An additional primary system pump and heat exchanger was installed. (Section E)

3. The natural convection valve has been relocated. (Section E)

4. A double cell cooling tower and a second pump have been installed. (Section I)

*CO Report Nos. 47/67-2, paragraph II.H and 47/68-1, Section S.

5. The beam tube facilities were modified. (Section S)

6. The four pneumatic tube systems were removed*.

These modifications were reviewed and authorized by DRL** in conjunction with AMMRC's plan to resume operation at a power level of 2 MWt. The inspector's review indicated that these modifications were completed in accordance with the DRL authorization.

V. Reliability Information

1. The control rods were inspected and rod drop times were measured. The results were satisfactory. (Section F)

2. A containment leak test was performed and the results were satisfactory. (Section K)

3. A review of maintenance records revealed that various periodic checks had been completed. The completed checks included:

   a. The adjustment of control rod clutches

   b. Checking and calibration of radiation monitoring alarms

   c. Checking the proper actuation of the high reactor radiation alarm, which is located in the guardhouse

   d. Verification of proper isolation of the containment vessel

   e. Completion of instrument startup checks

*CO Report No. 47/68-1, Section S.
**License Change No. 1, License No. R-65, Docket No. 50-47.