

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

Report of Inspection

CO Report No. 47/69-1

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

Dates of Inspection: May 8 and 9, 1969

Dates of Previous Inspection: October 28 and 29, 1968

Inspected by: G. L. Madsen 7/7/69
G. L. Madsen, Reactor Inspector Date

Reviewed by: N. C. Moseley 7/7/69
N. C. Moseley, Senior Reactor Inspector Date

Proprietary Information: None

SCOPE

An announced routine inspection was made of the U. S. Army Materials and Mechanics Research Center (AMMRC), 2 Mwt water moderated and cooled research reactor at Watertown, Massachusetts. The inspector was accompanied by Mr. R. McDermott, Reactor Inspector, who will assume responsibility for future facility inspections.

SUMMARY

Safety Items - None

Noncompliance Items - Three items of noncompliance were detected:

1. A fourth shim safety rod was installed. (Section F.1.)
2. New fuel elements of increased uranium content were installed in the reactor. (Section F.2.)
3. The licensee had 11 Kg U-235 in his possession in violation of the 9.35 Kg license limit. (Section O.2.)

Unusual Occurrences - A fuel element was dropped 30 feet onto the pool floor during the most recent outage. The only damage that occurred was to the end of the element which was pushed in. The fuel plates were not broken. (Section O.)

Status of Previously Reported Problems - None

Other Significant Items - 10 uCi of activity, contained in liquid wastes, was inadvertently released to the surrounding ground when an underground radioactive liquid waste storage tank developed a leak. The release is considered to constitute a burial of radioactive wastes and is within the burial limits specified in 10 CFR 20, Appendix C. The licensee has agreed to submit a report of this occurrence to the Commission in accordance with the facility license as a possible unsafe condition.

Management Interview - An exit interview was held with Mr. J. O'Connor and the following topics were discussed:

1. Change to New Fuel

The inspector questioned whether DRL approval had been granted for the change from 70 and 140 gm U-235 elements to 100 and 200 gram U-235 elements. Mr. J. O'Connor stated that DRL was aware of the modification and that he interpreted change No. 2 of the facility license to allow for the modification. The inspector's position was that change No. 2 did not allow this modification as it only considered operation at 2 Mwt with both primary loops valved in. The inspector stated that the intent of change No.2 would be resolved between Compliance and DRL and that Mr. O'Connor would be contacted again on this issue.

2. Fourth Shim Safety Rod Addition

The inspector questioned whether DRL approval had been obtained to permit the addition of the fourth shim safety rod. Mr. O'Connor stated that he interpreted change No. 2 to permit this modification. The inspector did not agree with Mr. O'Connor's interpretation and stated that he would contact Mr. O'Connor again on this issue.

Subsequently, Mr. O'Connor was contacted by telephone on May 13, 1969. The topics of discussion centered on the existence of 200 gm U-235 fuel and the fourth shim safety

rod in the present core. The inspector informed Mr. O'Connor that the intent of change No. 2 was to allow only for 2 Mwt operation with both primary loops valved in. The inspector stated that the present license as amended and containing change Nos. 1 and 2 and the Safety Analysis (in lieu of technical specifications) does not authorize the 200 gm U-235 fuel elements or the addition of the fourth shim rod. Mr. O'Connor was informed that his action of changing to new fuel and the addition of the fourth rod was classified as noncompliance with the present license* and that a citation would be issued. Mr. O'Connor replied that he still felt he was right in being able to make the change in fuel and rods based on his interpretation of change No. 2. The inspector questioned Mr. O'Connor on his intended action pertaining to future reactor operation in view of the inspector's position that AMMRC was in noncompliance with the license. Mr. O'Connor stated that he was not ready for an immediate reply. Mr. O'Connor asked if it would correct the situation if AMMRC would return to three shim rods and the original fuel. The inspector informed him that a return to this condition would rectify the situation but that a citation for past noncompliance would still be issued. Mr. O'Connor questioned whether a quick amendment to the license could be obtained to allow for operation with the new fuel and the fourth shim rod. He was informed by the inspector that AMMRC must request this of DRL. Mr. O'Connor concluded the conversation by stating that he would contact DRL, make a decision on his future action, and contact the inspector no later than May 14, 1969.

O'Connor contacted Region I by telephone on May 14, 1969, and stated that the reactor would remain subcritical until approval to operate with the stated fuel and rod changes were authorized by DRL.

*OMRO Publication No. 7, pp. 12 and 13 specifies 140 gm fuel and three shim safety rods. This publication is a part of the Safety Analysis Report which is used, pursuant to 10 CFR 50.36 (c)(5), as technical specifications.

3. Fuel Inventory

O'Connor was contacted by telephone on June 17, 1969, and informed by the inspector that the 11 Kg of U-235 indicated by the records to be on hand during the recent inspection was in noncompliance with the license limit of 9.35 Kg. O'Connor's position was that there was no safety problem in his estimation and that contract negotiations were in progress with National Lead Company to process 7500 grams of U-235. He stated that he expected this fuel to be clear of the building in two months.

DETAILS

A. Persons Contacted:

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

B. Administration

1. Organization

Dr. E. Scala is presently the Technical Director of AMMRC and is in charge of the research activities. Colonel J. C. Bennett was replaced by Lt. Colonel Mason who is the post commander and Deputy Technical Director.

One additional operator was licensed for the AMMRC facility. The staff includes five senior operators and two reactor operators.

2. Safeguards Committee

The Safeguards Committee met on April 2, 1969, and considered the following:

- a. 5 Mwt license status.
- b. Explosive handling procedures were approved and were unchanged from the previous year.

- c. A review was made of safety system checks where parallel components are used. Procedures are to be initiated to ensure that both components remain in operating condition.

The Reactor Safeguards Committee made a semi-annual inspection of the facility and no significant problems were recorded in the meeting minutes.

C. Operations

The reactor was shut down on November 8, 1968, to permit re-loading of the reactor core with new fuel elements, performance of low power physics testing for the new fuel, installation of a permanent emergency core spray cooling system, and installation of an additional safety shim rod. The majority of the scheduled activities have been completed and resumption of reactor operation was planned for the week beginning May 19, 1969.

The proposed Safety Analysis Report (SAR) and technical specifications (TS) for 5 Mwt operation are still under consideration by DRL. AMMRC has prepared a revised TS and supplements to the SAR which will be submitted to DRL in the near future.

Two unscheduled scrams occurred since the last inspection. These were caused by a nuclear instrument voltage regulator problem which has been corrected by component replacement.

F. Reactivity Control and Core Physics

1. Shim Safety Rods

The facility replaced the three original shim rods with rods of the same design on October 26, 1968. The reactor was subsequently operated at power levels up to 2 Mwt, until the last shutdown on November 8, 1969, to obtain a correlation of the total and individual rod worths with the retired rods. Mr. J. O'Connor reported that the total rod worth of the new rods compared favorably with those replaced.

The inspector reviewed the results of the rod drop times which were conducted on the new rods. The data consisted of photographs of oscilloscope traces indicating the rod drops. The oscilloscope trace was reported to be initiated

by a safety circuit trip and a vertical deflection on the trace was evident when the rod hit the "full in" limit switch. The rod drop tests were conducted for both a no-flow condition and with both primary coolant pumps operating. No discernible differences in drop times were evident. The following table of rod drop times is provided:

| <u>Date</u> | <u>Rod Drop Times (MS)</u> | | | |
|-------------|----------------------------|--------------|--------------|--------------------------|
| | <u>Rod 1</u> | <u>Rod 2</u> | <u>Rod 3</u> | |
| 5/24/68 | 420 | 410 | 410 | (Old Rods) |
| 1/21/69 | 480 | 430 | 410 | (New Rods - Pumps On) |
| 1/21/69 | 480 | 420 | 410 | (New Rods - No Flow) |

The rod drive clutches were rechecked on December 17, 1968, to ensure a proper setting of 37 pounds. These clutches are provided to prevent the potential problem of a control rod raising a fuel element during rod withdrawal. Rod calibration has been conducted during low-level physics testing since the shutdown on November 8, 1969. Mr. J. O'Connor reported that preliminary analysis of the data indicated the total rod worth is approximately 0.12 $\Delta k/k$ but that final data analysis was not complete. He also stated that the rod calibration data analysis would be complete before operation at 2 Mw. This should resolve the previously reported* reservations concerning the accuracy of the determinations of control rod worths.

Mr. J. O'Connor stated that an additional shim safety rod had been installed in the reactor during the recent outage. He also stated that this additional rod was of the same design as the other shim rods and that its installation was made in anticipation of early approval by DRL of the pending license change request permitting an increase in maximum power from 2 to 5 Mw. The additional shim rod is in accordance with the proposed technical specifications**

*CO Report No. 47/68-3.

**Safety Analysis Report, AMMRC, Section X - Technical Specifications, May 1, 1969.

which are undergoing current review by DRL but is in noncompliance with the existing license.*

2. Fuel

Mr. J. O'Connor informed the inspector that new fuel had been installed in the reactor and that low power physics tests on this fuel had been in progress during the current outage. He stated that a number (~30) of different core loadings and reflector configuration patterns have been tested. The anticipated configuration for the planned operation at 2 Mwt will consist of a fully beryllium oxide reflected 3 by 5 array of fuel. This loading will consist of 10 "full" and 5 "half" elements.

The new fuel elements are dimensionally equivalent to the old elements but differ in uranium content. The old "full" elements contained 140 grams U-235 and the elements designed to accept shim and regulating rods ("half" elements) contained 70 grams U-235. The new "full" and "half" elements contain 200 and 100 grams U-235 respectively. Mr. J. O'Connor stated that the new fuel was installed in anticipation of the 5 Mwt license change and that DRL was aware and had granted approval for the use of the new fuel elements. The inspector requested to see the written DRL approval and was presented with the AMMRC letter of request** for change No. 2 of their license and the DRL approval of change No. 2. The inspector stated to Mr. J. O'Connor that it appeared that he had used an extremely liberal interpretation of change No. 2 to justify changing over to new fuel and the installation of a fourth shim safety rod. The inspector also stated that it appeared that the only authorization granted by change No. 2 was the operation at 2 Mwt with both primary coolant loops valved in. Mr. J. O'Connor did not agree with this position and stated that his letter to DRL requesting change No. 2 had referenced the proposed Safety Analysis Report (SAR)***, under current

*Pursuant to 10 CFR 50.36 the present AMMRC license is deemed to include the entire Safety Analysis Rpt as technical specifications. OMRR Publication No. 7, which is a part of the safety analysis, specifies three shim rods on p. 13 and 140 grams U-235 per fuel element on p. 12.

**Letter dated September 4, 1968, from AMMRC to DRL.

***Safety Analysis Report, AMMRC, July 5, 1968.

DRL review, for the requested license change to permit a maximum power level of 5 Mwt. His interpretation of DRL's approval of change No. 2, he stated, would therefore allow the fuel changeover and the addition of the fourth shim rod as they are described in the SAR. The inspector stated that the exact intent of change No. 2 would be resolved with DRL and that Mr. O'Connor would be contacted again on these issues.

Mr. O'Connor was contacted by telephone on May 13, 1969, and informed by the inspector that he was in noncompliance with the existing license* and that a citation would be issued for the installation of the new fuel and the addition of the fourth shim rod. (See Management Interview)

K. Containment

The containment leak rate tests were completed April 14, 1969. Two tests were conducted and the largest leakage rate recorded was 0.802%/psi/day for a 24-hour test. This rate is within the license limit of 2%/psi/day.

During the current outage, manually operated butterfly valves were installed in series with the containment isolation valves in the containment ventilation intake and exhaust lines. The manual valve installed in the ventilation intake line was placed on the outside of the containment building to permit better accessibility. The manual valve in the exhaust line is located adjacent to the control room inside the containment dome. The installation of these valves was in response to the inspector's previous inquiries** into the single failure criterion for the containment isolation system.

Redundant solenoid operated valves were installed in the control air lines on the automatic containment isolation valves. The new valves are connected in parallel with the original solenoid valves in the control air lines and will vent the air from the containment

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**CO Report No. 47/68-3.

isolation valve operator and close the valve if either solenoid is energized. This modification was also made to meet the single failure criterion. This modification was determined by the inspector not to be an unreviewed safety item.

L. Emergency Core Cooling

The inspector witnessed the operation of the recently installed emergency core spray. The pool was drained during the test and the following was noted:

1. The supply piping is permanently mounted and the spray initiation is made by means of easily accessible manual valves (2) near the control room.
2. The spray heads consist of four fire nozzles which are fixed in place and provide a highly directional spray on the reactor core. These spray heads are located just above the normal pool water level.
3. The flow rate of the spray nozzles was estimated by the inspector to be in excess of 60 gpm.
4. The spray reaching any fuel installed in row G of the grid plate would be impaired due to the nuclear instrument chambers being located above this row. Mr. J. O'Connor said that he was aware of this problem and that no fuel would be placed in this row when operating with conditions that would require the core spray system to be in service.

O. Fuel Handling

1. Dropped Fuel Elements

Region I was notified by telephone on May 7, 1969, and by a confirming telegram on May 8, that a new MTR fuel element was dropped 30 feet onto the floor of the reactor pool on May 6, 1969. The pool was empty of water at the time.

During the inspection it was evident that the only damage experienced was to the fuel element. The element landed on its end and the "snout" was pushed up into the element. No fuel plate breakage was evident nor was there any evidence of damage to the grid plate or beam tubes.

At the time the element was dropped, the fuel was being raised to the pool top for inspection and the handling tool was bumped against the overhead crane, releasing the element.

Mr. J. O'Connor stated that the fuel inspection method in use at the time the element was dropped was a very infrequent one but that AMMRC was currently evaluating improvements that can be made to the handling tool to provide positive jar-proof locking. He also reported that the replacement cost for the damaged element was approximately \$1200.00. This event will not delay operation of the facility.

2. Fuel Inventory

Region I contacted Mr. J. O'Connor by telephone June 17, 1969. He was asked how much U-235 was in his possession during the most recent inspection on May 8 and 9, 1969. He reported that 11 kg of U-235 were on hand during the stated period and at the present time. He was informed by the inspector that this amount of U-235 was in noncompliance with the existing license limit* of 9.35 kg and was asked for his position on this matter. Mr. J. O'Connor stated that no safety problem existed with the 11 kg of fuel in his possession and that contract negotiations were underway with National Lead Company to process 7.5 kg of U-235. He reported that this fuel could be expected to clear the building in two months.

The 11 kg U-235 includes the new fuel obtained by the licensee covered in Section F.2. of this report.

P. Radiation Protection

The personnel exposure records for CY 1968 and the first quarter of 1969 were reviewed. The highest accumulated exposure recorded for CY 1968 was 500 mrem and for 1969 was 140 mrem. No exposures were detected to have exceeded the limits of 10 CFR 20.

*License No. R-65, Amendment No. 3, Paragraph 3.B.

Q. Radioactive Waste Systems

1. Unplanned Release

An unplanned release of 4900 gallons of radioactive liquid waste occurred during the period between February 20 and 27, 1969. Total activity released was reported by Mr. Dady, the health physicist, to be 10 uCi. The release occurred from a 40,000 gallon underground liquid waste storage tank located adjacent to the containment building. The leaking point in the tank, determined by the tank level indicator, is at the 11 foot elevation in the tank. Mr. J. O'Connor stated that he suspected that the leak was located at the penetration that the tank inlet (fill) line makes with the tank. Detection of the loss by the licensee was made by noting that the tank level recorder had begun indicating a decreasing tank level on February 20, 1969, and the recorder had leveled out at 11 feet on February 27, 1969. During this period the level indicator recorder had shown a drop in level from 15 to 11 feet but this had not been detected. Administrative controls are now in effect to maintain the tank level below the leaking point until scheduled repairs are made. The key to the locked tank inlet valve is in the possession of the health physicist.

The tank contents were sampled after the release and the gross activity was determined to be 5.7×10^{-7} uCi/ml. A gamma spectrum was made and indicated that the only gamma emitter present was Co-60. After a 60-day decay, the sample gross beta-gamma activity had decreased to 3.4×10^{-7} uCi/ml.

This release was reviewed by the Facility Safety Committee and they concluded that a report to DRL was unnecessary. The inspector's determination of this release is that it constitutes burial in the soil. The 10 uCi released to the surrounding ground would represent 10% of the limit of 10 CFR 20, Appendix C for burial in the soil.

It is considered by the inspector that an out-of-limit release to an unrestricted area is highly unlikely as the leaking point in the tank is approximately 3 feet underground and there is 75 feet of clay soil which separates the tank from the AMMRC boundary fence. Furthermore, the 10 CFR 20 limit

for release of the tank contents to unrestricted areas is 1×10^{-7} uCi/ml (based on no I-129, Ra-226, or Ra-228 present) and it can be reasonably expected that a minimum filtration factor of 5.7 would occur before any of the liquid waste reached the boundary.

Mr. J. O'Connor was contacted by telephone on June 23, 1969, and informed by the inspector that this was a reportable incident because Region I considers leaking radioactive storage tanks and underground lines as potentially unsafe conditions. O'Connor replied that he did not consider the item to be reportable but that he would report it to DRL.

2. Planned Releases

Planned liquid releases for CY 1968 totaled 186,000 gallons which included 932 uCi. This occurred in two dumps which were analyzed at 1 and 1.4×10^{-6} uCi/ml which were within the allowed limit of 3×10^{-6} uCi/ml. Releases for 1969 to date total 34,500, exclusive of the unplanned release, which included 74 uCi. Releases for 1969 were also within allowed limits.

A review of the gaseous release records for the period of October through December, 1968, indicate a maximum average monthly activity release of 0.22×10^{-10} uCi/ml of particulate and 1.77×10^{-6} uCi/ml of gaseous activity. Application of the authorized dilution factor of 10^{-10} seconds/cc for noble gases to the gaseous activity released (mainly A-41) revealed that these releases were within the limit of 10 CFR 20. The maximum average monthly particulate activity released represents 22% of the 10 CFR 20 limit. The gaseous and particulate releases for January through September, 1968, were reported in CO Report No. 47/68-3.

T. Facility Modifications

1. Fuel Elements - The facility has changed from 140 and 70 gram U-235 elements to 200 and 100 gm U-235 elements. (See Section F.2.)
2. Shim Safety Rods - The facility has installed a fourth shim safety rod. (See Section F.1.)

3. Slow Scram Circuitry - This has been modified to meet the single failure criterion. This modification has been reported to DRL.*
4. Containment Isolation - Manual butterfly valves have been installed in series with the automatic containment isolation valves. (See Section K.)

*Supplement to the Safety Analysis Report for AMMRC, May 1, 1969.