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

June 18, 1965

CO REPORT NO. 47/65-1

Title: U. S. ARMY MATERIALS RESEARCH AGENCY - WATERTOWN ARSENAL
LICENSE NO. R-65
Date of Visit: April 1, 1965

By : John R. Sears, Reactor Inspector

SUMMARY

A visit was made to the Watertown Arsenal Reactor. A change in beryllium reflector geometry has resulted in a better indication of approaching criticality during startup. A near mishap with a supplied air tank during an emergency drill dictates the need for more practice in donning this equipment. A satisfactory containment leak rate test was made. A leak of pool water through a make-up line resulted in the release of approximately 209 uc to a restricted area. An exit interview was held with members of the Safeguards Committee. Health Physics records were reviewed. No items of noncompliance were observed during the visit.

DETAILS

I. Scope of Visit

A visit was made to the Watertown Arsenal reactor of the U. S. Army Materials Research Agency at Watertown, Massachusetts, on April 1, 1965, by John R. Sears, Reactor Inspector, Region I, Division of Compliance. The visit included a tour

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Scope of Visit (continued)

of the facility, review of operating and health physics records, discussions with members of the operating staff, and a meeting with the Reactor Safeguards Committee. Persons contacted during the visit included the following:

Mr. John O'Connor, Chief, Reactor Operations Division
Mr. Charles Dady, Health Physicist
Mr. Leo Foley, Health Physicist
Mr. Paul O'Connor, Reactor Supervisor in Training
Mr. Joseph Vella, Reactor Operator
Mr. Richard Stanton, Reactor Engineer
Dr. Homer Priest, Chairman, Reactor Safeguards Committee
Dr. David Chipman, Reactor Safeguards Committee
Mr. John Antal, Reactor Safeguards Committee
Mr. Ken Tauer, Reactor Safeguards Committee

II. Results of Visit

A. Tour of Facility

The inspector toured the entire facility in company with Mr. J. O'Connor. There are two more spectrometers set up at the reactor since the time of the last visit. The slant tube facility for irradiating electronic components, sponsored by the Avco Corporation, has been removed.

In another experiment, samples are immersed in a well of liquid nitrogen in the shield. The nitrogen is in a radiation field and the Safeguards Committee had originally stated that there may be a hazard due to noxious gas formed there. Normally, this gas is vented to the stack. In case of containment isolation, the stack exhaust is closed off, and there the possibility exists that the gas would back up into the reactor room. The Committee had left it up to the operating staff to devise a means of getting rid

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Results of Visit (continued)

of the gas in such a situation. The operating staff had installed a relief on the system which discharged into a plastic bag. At the time of the last Compliance visit, the inspectors had questioned the integrity of the plastic bag. On the current visit, it was observed that the bag has been removed. Mr. J. O'Connor stated that the Safeguards Committee had decided that the amount of noxious gas formed would be so small that there is no need for this protection.

The inspector observed an aluminum tube bundle which had been removed from the heat exchanger. There were many holes in the tubes. Mr. J. O'Connor stated that a new all aluminum bundle has been installed. He said that there are already a few leaks in the new exchanger. He is proposing the installation of a stainless steel heat exchanger. Pieces of the discharged bundle have been sent to the Materials Laboratory at the Arsenal for study. Their analysis was stated to be quite simple in that aluminum will corrode in contact with the water that is available for cooling on the secondary side. The inspector observed that there is a radiation detector on the discharge of the secondary side. Furthermore, routine samples of this water are taken for analysis and as a double check on the detector.

Mr. J. O'Connor said that there has been no difficulty with control rod drives since the time of the last inspection visit.

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Results of Visit (continued)

The inspector reviewed the preventive maintenance records. The Arsenal has a comprehensive system of keeping records and scheduling tests, inspections and recalibrations. There are records of the inspection of the new stainless steel control rods after each 50 Mwd of operation, which is a license condition. The records also include rod drop time measurements. These were noted to be within design specifications.

The inspector read the console logbook from the time of the last inspection visit. No unusual occurrences were observed in this logbook. The inspector also reviewed the Supervisor's Manual which is kept in the control room. It was observed that the console operator has no curves of xenon buildup and decay. The only rod calibration curves available to the operator are these which were taken during the initial checkout of this machine.

The inspector examined the chart from the count rate recorder for the startup on the morning of the visit. This indicates that at shutdown the count rate was approximately 75 counts per minute and at critical the count rate was approximately 7,500, an increase of a factor of about 100. The increase was gradual, and commenced soon after the start of rod withdrawal. Mr. J. O'Connor stated that this was the result of shuffling of some beryllium reflector elements so that the startup counter sees more of the reflector-source through the core.

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Results of Visit (continued)

B. Emergency Drill

The inspector reviewed records of emergency drills. Three drills had been held during the past year. One drill was held in the past month. Mr. J. O'Connor stated that he had considered the last drill to be unsatisfactory. He had shut down the reactor for one whole day of training in drill procedures, and in a general housekeeping type of cleanup. The problem in the emergency drill was in donning supplied air masks. These masks have a tank in which the air pressure is approximately 2,000 psig. The tank is equipped with a valve and a pressure gauge. Mr. J. O'Connor said that when one operator put on this equipment, the tank came very close to falling on the floor upside down. The consequences could have been that the stem might have snapped off. With 2,000 psig behind it, it might have become a projectile which could pierce a man's body. Mr. J. O'Connor said that, when he had asked the operators before the drill whether or not they were familiar with the donning of this equipment, they all replied very emphatically that they were. However, the drill indicated that there was a very real need for much more practice.

C. Health Physics

The inspector reviewed with Mr. Charles Dady the health physics records. There have been no personnel exposures over the limits of 10 CFR 20 since the time of the last visit. The highest accumulated exposure over a period of a year is about 1 rem. A major portion of this exposure was due to work during a shutdown when a beam tube extension was changed. The procedure employed was, first, to unload the core and put the discharged fuel into the water filled annulus. Then the pool was drained and the working area monitored. A man descended into the pool to change the tube manually. Mr. Dady said

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Results of Visit (continued)

that this operation was always covered by health physics, and the job was broken up so that no one man got the whole exposure.

The records of gaseous effluents were reviewed. The maximum concentration released since the time of the last visit was 3.5×10^{-6} uc/ml. Mr. Dady said that this was practically all argon. The maximum permissible concentration is 8.4×10^{-4} uc/ml because of the dilution factor through the 175 foot stack.

Records of liquid effluents released to the Metropolitan District Sewer indicate that, in the past year, 793,000 gallons of liquid were released. The concentration of activity was always below the limits of 10 CFR 20. The large amount of liquid released comes principally from dilution following regeneration of the ion exchange column. Approximately 200 gallons of wash liquid are released to the 40,000 gallon retention tank. The Arsenal dilutes the wash water by filling up the retention tank with fresh well water. The records show that the health physicist always take a representative sample of the retention tank contents before release into the sewer. Before sampling, the retention tank is recirculated via a pump. Pump suction is at the bottom of the tank and the discharge is at the top. The inspector questioned Mr. Foley and Mr. Dady on how they are assured that liquid does not leak from the concrete retention tank. This subject has been discussed on previous inspection visits with Mr. Dady and Mr. Foley. The inspector pointed out that sometimes regeneration is done on the four to twelve shift, and a crack might develop

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Results of Visit (continued)

during the night before the day shift would have an opportunity to dilute the tank. Mr. Dady stated that their present procedure is to examine visually the level of the liquid in the retention tank once-a-shift by counting the rungs on the access ladder above the level of the liquid. He agreed that it would be prudent for the Arsenal to consider the installation of a better system of monitoring this level. He stated that, in preparation for 5 Mw operation, he is planning on an automatic liquid level detector.

D. Containment Leak Rate Test

The inspector reviewed a report from the operations group to the Reactor Safeguards Committee on a containment leak rate test which was held on March 4 - 7, 1965. With the inner airlock door closed and outer open, the achieved leak rate at 2 psig was 0.17% of the building volume per day. With the outer door closed and the inner open, the leakage was 1.43% per day. The difference was due to the pinching of a door gasket, which was subsequently repaired.

E. Unusual Occurrence

The inspector reviewed a report from Mr. J. O'Connor, through the Chief of the Nuclear Research Laboratory, to the Members of the Reactor Safeguards Committee, on a release which occurred during the containment leak rate test mentioned in paragraph II.D. The following information was gathered from a review of this report and subsequent discussion with Mr. J. O'Connor.

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Results of Visit (continued)

On March 3, 1965, make-up water was added routinely to the pool. This make-up water was added through the demineralizer in building 97, adjacent to the reactor building. When the make-up was completed, the demineralizer was secured but the make-up line was not valved off in the coolant room in the reactor building, as is the normal procedure. The inspector inquired of Mr. J. O'Connor whether there is a written procedure for this operation. Mr. J. O'Connor said that the procedure specified which valves on the demineralizer should be opened or closed, but the make-up valve in the coolant room was not mentioned in the procedure. The containment shell was secured, and pressurized for the annual leak rate test on March 4, 1965. During the test, a leak was discovered in the make-up line at the flange joint, immediately outside of the containment shell, in the piping access pit, south of the west airlock. At that time, it was not known that the valve in the make-up line was not shut off. Mr. J. O'Connor stated that they assumed that the leak was simply demineralized water from the elevated pipes in building 97. There was no way of stopping this leak during the containment test from outside the containment shell, since the flange joint where the leak occurred was between the shell and the shut-off valve and check valve. The water was leaking into the pit, the bottom of which is approximately six feet below ground level. No tests for activity of this water were made since, as mentioned before, it was assumed that the water was clean demineralized water. The inspector observed that this pit is covered with the steel grating and an insulated cover. Mr. J. O'Connor said that he considers this to be part of the restricted area of the reactor because the grating and cover provide control over the pit and all work in the pit requires a radiation work permit.

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Results of Visit (continued)

After the leak rate test was completed, access was made to the containment building. During a procedural checkout prior to startup of the reactor, it was discovered that the make-up valve in the coolant room had not been closed. It was immediately apparent that radioactive water had been leaking from the flange and analyses for radioactivity were made. The report to the Safeguards Committee states that although it is not possible to arrive at exact figures of the activity which was released, an estimate was made. The activity of the pool water at power was 1.77×10^{-4} uc/ml on March 3, 1965, that is, prior to the release. The leak rate was estimated to be 320 milliliters per minute, although it may have been slightly higher when the shell was pressurized. The activity at 7:30 am on March 8, 1965, was 8.75×10^{-6} uc/ml just prior to startup. The following table is the Arsenal's estimate of the release:

Time	Volume	Activity Concentration	Total Activity
March 3, 1965 2:00 pm to 11:00 pm	171 liters	1.77×10^{-4} uc/ml	30.3 uc
March 3, 1965 11:00 pm to March 8, 1965 9:00 am	1575 liters	9.8×10^{-5} uc/ml	154 uc
March 8, 1965 9:00 am to 4:00 pm	135 liters	1.77×10^{-4} uc/ml	24 uc

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Results of Visit (continued)

The total activity released was estimated to be 209 uc. The transit time from the pool to the leak is 145 minutes; therefore, short-lives activities would have died out. The activity leaking was stated to be primarily sodium-24. A sample of rain water in the pit was collected on March 8, 1965, and the activity was 3×10^{-6} uc/ml. Mr. J. O'Connor stated that in his opinion, this release was to a restricted area and consequently does not require a report to the AEC under 10 CFR 20. He said that some members of the Safeguards Committee felt that it should be reported. He also stated that the corrective actions taken were, first, to repair the leak and, secondly, he verbally instructed the operator to be sure that valves in the make-up line inside the containment shell are always closed when not in use. He also requested Arsenal plant engineers to relocate the check valve to a position on the inside of the containment shell. The inspector suggested to Mr. O'Connor that it might be prudent to write a written procedure to the operators on the correct valving during this operation. Mr. J. O'Connor agreed that this would be done.

F. Exit Interview

The inspector held an exit interview with the following personnel of the Reactor Safeguards Committee: Messrs. Dady, O'Connor, Tauer, Priest, and Chipman. The Committee had requested that the inspector brief them on the results of his visit. They also inquired as to his position on whether or not the release of activity mentioned in the previous section of this report was a reportable incident or not. The inspector pointed out that since access to the pit requires a radiation work permit and since the

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Results of Visit (continued)

probability of unauthorized personnel getting down into the pit is extremely remote, the inspector's position is that this release was to a restricted area, and a written report is not required.

The inspector discussed with the Committee the manner in which follow-up action is taken on its recommendations. For example, the Committee had suggested at one time that some means be established of containing possibly noxious gas from the liquid nitrogen cooled experiment. Evidently, the Committee had not followed up to see what kind of device was installed. Dr. Priest stated that they may have been remiss and that he would see that the Committee does a physical inspection on how their recommendations are carried out.

A second item the inspector discussed with the Committee was the fact that the reactor operator has no means available at the console for predicting criticality. He has no xenon curves. His rod calibration curves are from the initial check-out runs. The operators had informed the inspector that they do make a "seat of the pants" estimate of where criticality should occur on the basis of previous experience. These estimates are not based on any kind of addition or subtraction of the reactivity effects of poisons. The Chairman of the Safeguards Committee stated that they would look into this further in that the ready availability of such information might prove to be of value in enabling the operator to evaluate or to check proper performance of the reactor.

The inspector also discussed with the Committee the subject of reciprocal audits by other reactor personnel who are under Army surveillance. An extension of this would

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Results of Visit (continued)

be for agreements to be made for reciprocal audits with such places as Massachusetts Institute of Technology, Rhode Island AEC, Lowell Technological Institute, and other reactors in the New England area. Dr. Priest stated that this also would bear looking into.

Finally, the inspector discussed with the Committee a pending plan for the reorganization of the Arsenal reactor staff in which the position of Health Physicist would be a GS-9 position. The inspector stated that this position appears to be much too responsible to be manned by an inexperienced man in that one cannot hire competent people for such an important job at such a low rate. It was noted that the present Health Physicist does not intend staying at such a salary. The members of the Safeguards Committee indicated to the inspector that they felt the position of Health Physicist should not be de-emphasized.

Mr. T. O'Connor stated that the Army intends making a ten-man, three day inspection of this facility at the end of April.