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Title: WATERTOWN ARSENAL REACTOR

SUMMARY

A visit was made to the Watertown Arsenal Reactor. A new monitor at the pile top has been installed. Control rod dimensions have been checked once since the first rod did swell, with no further indication of swelling. A satisfactory containment test has been made. A preventive maintenance program has been instituted. The foundation for the stack has been completed.

Period of
Inquiry: September 26, 1962

DETAILS

I. Scope of Visit

A visit was made to the Watertown Arsenal Reactor at Watertown, Massachusetts on September 26, 1962 by John R. Sears, Reactor Specialist, Region I, Division of Compliance. The visit included a tour of the facility, the examination of logbooks and health physics records, and discussions with members of the operating staff.

Persons contacted during the visit included the following:

Mr. John O'Connor, Director of the Reactor
Mr. Charles Dady, Health Physicist
Mr. Richard Stanton, Reactor Engineer

II. Results of Visit

A. Tour of Facility

The inspector toured the facility in the company of Mr. John O'Connor, the Director of the Reactor. Mr. O'Connor stated that the schedule of operation of the reactor at the present time is for the reactor to run only during the regular daytime watch, 5 days a week. He stated that the usual running time is for approximately 6 hours.

It was observed by the inspector that there are now a number of spectrometers setup at the reactor and also a facility shielded with concrete blocks for neutron radiography. O'Connor stated that the flux level in the neutron radiography facility at the sample was approximately 10^6 neutrons/sq. centimeter per second, and that they had checked for radio-argon and this facility presented no particular problem in argon generation.

Mr. O'Connor stated that their use of the pneumatic tube facility has increased recently. He showed the inspector the kind of rabbit used. It is made of polyethylene with a screwed cap. O'Connor stated that he was investigating whether some ordinary polyethylene pipe might be used for rabbits in this facility.

One of the slant tubes, whose end terminates at the face of the beryllium reflector, has been converted to a facility for capsule irradiations. Tubes have been installed inside this slant beam tube and the capsules to be irradiated are charged and discharged by means of handling tubes or extension wires. The complete facility is flooded with water. This shielding water is changed weekly to prevent excessive activity buildup.

The tube has a lucite cover which is bolted to the flanged end of the tube. O'Connor stated that the method of discharge is for the lucite cover to be removed and the capsule is brought up where it is surveyed by an area survey instrument and then quickly placed in a lead pig for transit.

One of the beam tubes has been converted to a facility for long wave neutron studies. The experimental device consists of a polished copper curved tube which extends down the center of the beam tube. In order to preserve the equivalent amount of shielding which is afforded by the water over the reactor core in a vertical direction, there is installed a long water-filled cylinder of the approximate diameter of a standard 55 gallon drum which surrounds the neutron wave guide tube. O'Connor stated that the amount of shielding afforded by this external water shield, plus the normal concrete shield and the water between the interior tube end and the core, is the equivalent of 17 feet of water.

It was observed by the inspector that next to each experimental facility was posted a diagram which gave the results of a radiation survey which had been done at that facility. Radiation warning signs, and magenta and yellow covered ropes were placed to comply with requirements of Part 20 for restricted area occupancy.

In the basement of the facility at the time of the inspection, the ion exchange column was being regenerated. Mr. O'Connor stated that they are considering the installation of a Nitrogen 16 instrument for determination of reactor power. This instrument would also be used as a detector of failed fuel elements. O'Connor stated that there was probably approximately a 4 minute delay from the time water left the core until it reached the present fission product monitor. The flow of water through the core in this reactor is downward; there is a delay in the Nitrogen 16 decay tank and finally there is a delay in the sample pipeline to the fission product monitor. This monitor has been moved out of the cell which holds the heat exchanger and pumps because the background level had been too high in that area. Moving the monitor out of the cell increased the delay time somewhat.

O'Connor also showed the inspector an area monitor and ionization chamber which has been installed directly over the core on the undersides of the floor plates at the reactor top. O'Connor stated that, in his opinion, this would probably give the gastest indidation of a ruptured fuel element. The installation of this monitor has been made since the last inspection to this facility.

It was also observed during the tour that there was evidence of some very slight leakage of water through the face of the shield. O'Connor stated that the pressure grouting of the shield had been completed about 6 months ago. He stated that the cost of the pressure grouting was approximately $20,000 and that, just recently, there was some evidence of some small

leaks of water through the shield. These leaks appeared to the inspector to be minimal. There was no water on the floor; there was simply some stain marks on the shield face. O'Connor said that he planned to wait until it appeared that these leaks were getting larger or more numerous before he had some more pressure grouting done.

B. Instrumentation

O'Connor said that the instrumentation on the console and the Control Board had recently been behaving well. The instrumentation is of modular design with each module built on a chassis which can slide out through the front of the Control Board panel. When these modules are reinstalled after service, sometimes good contact is not made. The solution is simply to push the module in toward the control board firmly to eliminate trouble.

The sigmabus on the scram system had been of the standard Oak Ridge design, in which the magnet current is gradually reduced as the scram point is approached. O'Connor and Stanton both said that this appeared to make the circuit oversensitive to any noise and they had been plagued by a series of spurious scrams. Stanton has designed a transistorized circuit which would give a sharp cutoff and they planned to install this circuit in the future. Stanton said that with the new circuit the holding current of the magnet would not be increased.

During the visit mechanics were installing an alarm on the pool level indicator. O'Connor stated that initially this alarm will go only to the control room, but he is planning later to tie this alarm to the guardhouse, so that if for any reason the water level in the pool was to decrease during off hours or the weekend the guards would be alerted.

C. Control Rods

This reactor at one time had experienced the swelling of one control rod. This has been reported in a former inspection report and also by correspondence of the Watertown people to DL&R. At that time, all of the control rods were removed and their dimensions were checked at approximately 13 locations. Since then, the control rods have been checked once more in November 1961. The inspector was shown a copy of the readings of the first and second dimensional checks and these readings indicate that there had been no further swelling of any of the rods up to that time. The rods have not been checked since November 1961, because there has been no reason to unload the core since then. O'Connor stated that he felt assured that there was no swelling of the rods because the spring loaded clutch on the rod drives is of a ratchet design; and if any rod were to stick because of swelling or any other reason, the ratchet clutch would slip and the operator could hear this slipping. Furthermore,

O'Connor stated the rod position indication transmitter is on the rod side of the clutch so that if an operator were to call for more rod movement by throwing the switch on the console, he would observe that the rod was not moving by the fact that the rod position indicator did not move. O'Connor agreed that it might be prudent to take periodic rod drop time measurements as a further insurance that no trouble was starting with the rods, and he volunteered that he would take such measurements within the next month, and periodically thereafter.

D. Containment

O'Connor showed the inspector the results of the containment leak rate tests which had been performed in March of 1962. This test results indicated that when the building is pressurized to 2 lbs/sq inch, it leaks approximately 1.9% of the volume of the building in 24 hours. O'Connor also stated that they have not experienced any problems with the inflatable gaskets on the airlock doors.

E. Emergency Power

An emergency power gasoline generator has been installed outside of the building and it is tied into the 440 circuit to the M-G set through an automatic transfer switch. The M-G set has a 440 volt motor and a 120 AC volt generator. This furnishes a regulated supply for all components of the reactor.

When the regular source of 440 volts is cut off, the emergency gasoline generator is automatically started. This emergency gasoline generator is test started weekly. The gasoline engine is equipped with antifreeze.

The emergency power source was primarily installed for power to the fans in the hoods over the radiochem labs adjacent to the labs.

F. Logbooks

The console logbook was reivewed by the inspector. The entries in this logbook are made both by the reactor operator and also by the shift supervisor. Review of these logbooks showed no unusual events other than scrams due to electronic troubles, either noise or poor contact on the modular components.

An experimental logbook is also kept in the control room. This is a log which describes experiments performed on the reactor such as flux napping of the core, or rod worth experiments, and also describes experiments which are inserted into the reactor or which are performed at a beam hole.

Operating procedures are detailed on daily checklists, startup and shutdown checklists and weekly checklists.

The reactor personnel have recently instituted a system of preventive maintenance of which includes checking various components on a regular basis. A productrol chart is installed in the reactor director's office for keeping track of the progress of the preventive maintenance program.

G. Army Inspection

O'Connor stated that his facility had been inspected for four days during the month of June 1962 by a team of 12 inspectors from the Army Engineers. These 12 inspectors were in turn accompanied by 2 surveillance inspectors whose mission, according to O'Connor, was to inspect the inspectors. O'Connor stated that, as of this date, he had not received a copy of their formal inspection report, although he had been given pencil written summaries of the inspection groups' observations at the time of the inspection.

H. Health Physics

The inspector reviewed the health physics records with Mr. Charles Dady. These include personnel monitoring records, records of releases of gaseous and particulate activity to the atmosphere, and also records of the activity discharged in liquid waste.

These records indicate that there has been no violation of 10 CFR 20, either in personnel exposures or releases to the atmosphere. Dady stated that the reactor pool water is sampled and analyzed every Monday. This means that a decay takes place over the weekend since operations are shutdown on Friday night. After a week, during which 26.5 megawatt hours of operation had been accumulated, the sample on Monday analyzed at 20×10^{-6} uc/ml. Dady said that the sample taken during operation usually analyzes at about 10^{-3} uc/ml and that approximately 90% of that activity was due to Na-24.

During the inspection the primary coolant ion exchange column was being regenerated. Records indicate that the resin in the column had lasted for approximately 10 months. The flush water used in regeneration is being held up in 55 gallon drums, approximately 200 gallons are used during regeneration. Dady said that at the surface of the can the reading is approximately 1 mr/hr of activity, approximately 3 months half-life. He stated he was in hopes of simply storing this water at the site till it had ecayed sufficiently so that he could empty it into the regular waste disposal facility.

The waste disposal facility consists of 3 tanks. The records, since October 1960, indicate that 322,000 gallons of water have been discharged and that this water contained a maximum of 470 uc. Dady said that the standard procedure before discharging any water was to pump the water between two tanks to ensure a good mixing, then to take a 1 liter sample and evaporate and count it.

Records of smears taken were reviewed. The health physicists make a weekly smear check of all areas of the reactor and the laboratories. Areas around the pneumatic tube discharge point are smear checked immediately after use of these tubes. Complete surveys are taken after any shielding change around beam tubes. Survey records are kept by the health physicist and a record of the survey is also posted at the location of the experiment.

The exhaust stack from the reactor room is equipped with an absolute filter and upstream of this filter is a Tracerlab gaseous and particulate detector. The gaseous detector readout is on a strip chart recorder. Dady stated that this detector had been calibrated for Argon 41 and a histogram record is kept of the releases. This record was reviewed by the inspector and it indicates that during a week in which 30 megawatt hours of operation are accumulated, the present maximum permissible concentration for effluent discharge is approached. O'Connor and Dady stated that this problem will be solved when the stack is installed. The inspector observed that the concrete foundation for the metal stack has been completely constructed, and it was stated that the installation of the stack is expected to start as soon as some contractual arrangements have been completed.