U. S. ATOMIC ENERGY COMMISSION
COMPLIANCE DIVISION
NEW YORK

By: John R. Sears, Compliance Division
New York

Title: WATERTOWN ARSENAL REACTOR
Watertown, Massachusetts

SUMMARY

Water leaks from the pool through the concrete shield wall have cost about three months of operating time. There has been one instance of control rod binding on withdrawal. Nuclear instrumentation appears to be behaving normally.

Reviewed by: Robert W. Kirkman, Director
New York Compliance Division

Period of Inquiry: May 18, 1961

DETAILS

I. Scope of Inspection

A visit was made to the Watertown Arsenal Reactor at Watertown, Massachusetts, on May 18, 1961, by John R. Sears, Compliance Division, NY. The visit included a tour of the reactor, inspection of the shield where water leaks from the pool have occurred, examination of log books, and discussions with the reactor administrator and the reactor engineer. The principal persons contacted during the visit were the following:

Mr. John O'Connor, Reactor Administrator
Mr. Richard Stanton, Reactor Engineer

II. Results of Visit

A. History of Operations

Mr. O'Connor stated that the reactor had accumulated, so far, only about 4 megawatt days of operation. He said that a considerable amount of time had been devoted to repairing leaks in the concrete pool. He showed the inspector photographs of the outside of the shield wall, which indicated where the water leaks had occurred. O'Connor said that approximately 95 per cent of the leaks have now been taken care of. These have been stopped by means of fiber glass and epoxy resin on the inside of the pool and the annulus. The difficulty now is that a leak will be stopped in one location and it will then show up someplace else. O'Connor speculated that one of the fundamental difficulties may be in the method of making the concrete pour. One of the photographs showed to the inspector was of the concrete shield near the bottom floor level of the shield. The outside of the shield had been chipped away to investigate a leak, and as the grout on the outside was removed, it was revealed that the aggregate in the inside of the shield was still fairly dry and loose, and not held together by grout. O'Connor said that the shield had been built up by the pre-pakt method of concrete placement and there is the possibility that the grout never got to the area at the bottom of the shield wall in some places. O'Connor said that he has now referred the whole problem to the Army Corps of Engineers, and he said they are coming in within a week. His thought is that the final solution must be pressure grouting. O'Connor said that at the start of their investigation of the pool leakage problem, the water level in the pool had lowered about 4" per day. He said that the present rate of leakage is about 1/4" per day. He further stated that samples of the leakage water had been taken and analyzed for radioactivity, and they registered background.

O'Connor stated that approximately three months of operating time have been lost due to these leaks from the pool.

The beam tubes on this reactor are double piped. The pipe which extends to the core is capped at one end, flanged and bolted at its other end to an extension which is then imbedded in the concrete shield wall. The outer pipe contains an inner capped pipe, the inside end of which does not extend farther than the inside of the concrete shield wall, and it too has its outer end imbedded in the concrete. The purpose of this double pipe construction is to ensure against any possibility of losing the pool water through a beam tube extension being broken off by a heavy object dropping down through the pool on top of the pipe. O'Connor said that they had discovered that the flanged connection on the beam tube extension had not been properly welded to the pipe and this resulted in pool water leaking inside the tube. This had been discovered by the beam tube vent filling up with water. The pool was drained, the beam tube extension removed, and the flange rewelded.

B. Controls and Instrumentation -

During the inspection tour, it was observed that the hold-down mechanism on the control rod guide tubes was in place. This mechanism has been described in correspondence to the Commission. It was also observed that the control wiring for the control rod magnets and underwater position indicating devices has been equipped with amphenol connectors. On a shutdown, in order to gain access to the back row of fuel element locations, the rod drive support structure is swung out of the way. In order to do this, it is necessary to disconnect the amphenol connectors. This disconnection of the control wiring then ensures that there is no possibility of raising a control rod. A control rod drive extension may be manually moved, but without the energizing of the magnets, it is not possible to move the control rod poison section.

O'Connor described one difficulty that has been experienced with the control rods. The control rod drive is of Curtiss-Wright-Bendix design. Rod seated indication is obtained by a shoulder on the rod striking a plate, which in turn is connected by extension rods to an upper plate, whose movement in turn actuates an underwater micro-switch. The bottom plate, which the shoulder on the rod strikes, is of a ring-design with two ears extending through slots in the control rod guide tube. To these ears are attached the extension rods which extend to the upper ring plate, which finally actuates the switch. One of the extension rods had become disconnected, and this resulted in a slight cocking of the lower ring plate, and a slight binding of the control rod during withdrawal. O'Connor said that this was first noted by the fact that the control rod became detached from its magnet. This detachment of rod from rod drive was noticed by the energizing of the rod seated switch which lighted the rod drop light. The extension rod was repaired and to ensure against any repetition of any similar trouble, Waterstown personnel have also adjusted the spring tension on the clutch on the rod drive so that the clutch slips whenever it picks up more weight than the combination of the rod drive extension, rod drive, and the control rod itself. This adjustment of the clutch was made by swinging the rod drive out of the way and using the rod drive to pick up a simulated weight corresponding to the total weight of these three components, the rod extension, the rod drive, and the poison section.

O'Connor said that after the reactor contractor, Curtiss-Wright, had left, he rechecked all of the nuclear instrumentation thoroughly, and found it was operating well. He said that the period circuit on the count rate system is extremely erratic, and is not of much use during the startup. However, the count rate system itself is very reliable. It was observed that the background on the General Electric micro-micro-ammeter during shutdown was about 2 x 10-11 amps. This reactor has a plutonium-beryllium source, which is removed during operation in order not to burn up the plutonium. O'Connor said that there is always an ample background of neutrons for startup indication because even with the source removed, there are neutrons due to the photo neutrons from the beryllium reflector. There is a 2 count per second interlock on the count rate system, but even with the source removed, before startup, the count rate from the photo neutrons is above the 2 count per second level. O'Connor also stated that the count rate recorder is the principal indication of approaching criticality and that period meters, which are fed by the compensated ion chambers, do not indicate a period until after criticality is achieved. The level safety is actuated by relays in the amplifiers. The circuit in the micro-micro-ammeter is actuated by a recorder switch which is set at 120% of any range. The setting of the range switch on its lowest range for startup is on the checkoff list.

O'Connor also stated that due to the size of the core and due to the planned cycle of operation, the flux recordings probably would not give an accurate indication of the power level without constant re-calibration of the flux recording systems. This results from the varying amounts of control rod insertion as poisons build up and burnout proceeds. To answer this problem, O'Connor said that they are designing a BTU meter which will be their principal device for measuring power level. This meter will be fed by a signal relative to the delta T across the core, and a signal corresponding to the flow of coolant through the core.

O'Connor stated that there has been no difficulty with the reactor containment except that the gaskets on the personnel airlock doors have leaked and had to be repaired. He said that, even with leaks in these inflatable gaskets, the seal holds. This system simply uses much more compressed air, but the building seal is maintained by the gasket even while the gasket itself leaks.

A final difficulty which O'Connor described has been with his own personnel office. He said that he has had quite a problem convincing the civil servants in the Army Civil Service Personnel Office that Nuclear Engineers are required to manage the operation of a reactor. He said that the administrators in the personnel office appear to be of the conviction that there is nothing to running a reactor, since the reactor has been so safely designed.