

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

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SUMMARY

A visit was made to the Watertown Arsenal Reactor for a routine inspection. The 175' stack is in operation, and all gaseous discharges are well below license limits. The Safeguards Committee appears to do an adequate job of prior evaluation of experiments. A successful containment leak rate test was made in March 1963. Control rod drop time tests are performed annually - time of the last tests averaged 540 milliseconds. Health Physics aspects of operation were reviewed and appear to be in compliance with 10 CFR 20.

DETAILS

I. Scope of Visit

A visit was made to the Watertown Arsenal Reactor at Watertown, Massachusetts, on July 22-23, 1963, by J. R. Sears, Reactor Inspector, Region I, Division of Compliance. The visit included a tour of the reactor and associated facilities; observation of reactor operation; review of operating logs and the minutes of the meetings of the Safeguards Committee; examination of health physics records; and discussions with members of the operating staff.

Principal persons contacted during the visit included the following:

Mr. John O'Connor, Reactor Chief  
Mr. Richard Stanton, Reactor Engineer  
Mr. Charles Dady, Reactor Health Physicist  
Dr. Charles Foster, Chairman of the Radioisotope Committee  
Mr. John Zagarella, Shift Supervisor

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## II. Results of Visit

### A. Tour of Facility

It was observed by the inspector that the 175' stack is now in operation. The stack is a steel stack constructed in four sections which are bolted together. It is located on a concrete pad just outside the reactor containment building. There is a flanged and blanked-off connection to the stack at its lower end for future use with the hot laboratories in the building adjoining the reactor.

The neutron radiography facility is still in place, although it was stated that the use of this facility has terminated.

The Avco Corporation is presently using two of the slant tubes for radiation damage studies on electronic components. Water shielding is used above the aluminum cans in which the samples for irradiation are placed. This water is in a separate circuit from the reactor pool water and it circulates by natural convection through a cartridge demineralizer.

In the control room, no significant changes have been made. Mr. Stanton stated that he has designed a new circuit for the control rod magnets. The present circuit design decreases the current to the holding magnet as the scram point is approached. The circuit which Mr. Stanton has designed incorporates transistors and gives a sharp cutoff at the release point. This new circuit has not been installed as yet.

The fission chamber drive has a low-level-count-rate interlock which prohibits rod withdrawal if the count-rate is below 2 counts/second. The actuating device for this interlock is a switch in the recorder of the count-rate system. It is possible to withdraw the fission chamber at the same time that one is moving control rods. The possible hazards in such a situation were discussed by the inspector with Mr. O'Connor. The inspector suggested that in some other reactors an interlock was placed in the fission chamber drive circuit, so that it is not possible to operate that drive while control rods are moving. Mr. O'Connor stated that they ensure that this does not happen by administrative control.

### B. Reactor Safeguards Committee

The inspector reviewed the minutes of the Reactor Safeguards Committee meetings. It appears that this Committee is an active working group. It holds meetings on an average of once a month. The minutes

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Results of Visit (continued)

indicate that the Safeguards Committee reviewed all of the reactor operating procedures, including amendments, revisions, and new procedures. It has also reviewed all of the proposed experiments in the reactor or with the reactor, and it has reviewed all proposed irradiations. One item of interest concerned a proposal by a Dr. Freeman of the Picatinny Arsenal to irradiate samples of 200 mg of ammonium perchlorate. Originally, the proposal was turned down by the Committee. The correspondence and minutes of the meetings indicate that there were a series of meetings before a final plan was arrived at by which this irradiation could be done. The final plan consisted first of irradiation of three samples of 5 mg each. These samples were then sent to Picatinny Arsenal where Dr. Freeman detonated them and observed whether or not there was any bulging of the container. A written report on his results was transmitted to the Watertown Arsenal Safeguards Committee, and the next step in his irradiation program was then permitted. The next step consisted of a slightly larger amount being irradiated for a slightly longer time, and it was not until after a series of progressively longer irradiations of progressively larger amounts of materials, followed by detonation of the material and observation of the results of the detonation, that the original proposed irradiation of 200 mg samples was permitted. The 100 mg sample was irradiated in a container of a volume of approximately 100 cc. This volume would ensure that the maximum pressure in the carrier, if the sample were to decompose under irradiation, would be approximately 3.2 atmospheres. The original proposal was for the containers to be made of pyrex glass. The records indicate that the radiation was finally done with the samples in containers of polyethylene tubing.

Further review of the Safeguards Committee meetings indicate that at one time the request had been made for a blanket approval by an experimenter to irradiate any and all materials of Atomic Nos. 3 to 83; such blanket approval was denied by the Committee and all irradiations still must be approved by the full Committee. Mr. O'Connor stated to the inspector that there has sometimes been objection to this formal system, but that in his experience, this system is not a hindrance to the experimental program. All members of the Committee work within walking distance of the reactor building, so that the convening of the Committee is not an arduous task. Furthermore, he stated that he thought that it was prudent to insist upon a Committee meeting on every proposed irradiation since this meant that there was at least a 24-hour wait between the review and evaluation of any experiments and the time at which these experiments actually took place.

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Results of Visit (continued)

Further review of these minutes indicate that the Committee is responsible for the review, evaluation, and approval of the following:

1. Experiments.
2. Operating procedures.
3. Proposed changes in equipment associated with the reactor which could have an effect on the safety of operation.
4. Local regulations for handling materials which have a potential radiation hazard.
5. Personnel monitoring procedures.
6. Investigation of accidents and abnormal situations where safety is potentially involved.

Another item which had received the Committee's approval was a change in operating procedures. This change would allow a fuel element or a beryllium-oxide reflector element to be added to the outer edge of the core, or a fuel element and a beryllium-oxide element to be interchanged with each other, without a critical experiment, provided the shutdown margin is a minimum of 7% excess reactivity. The justification for this change in operating rules was that such an addition or interchange of fuel or reflector element would add a maximum of approximately 1% excess k, and in making such a change, three shim rods would be withdrawn approximately halfway.

Another item which the Committee considered was the fact that in the Avco series of irradiations the exhaust from the radiation tube should be tied into the regular reactor building exhaust through a charcoal filter. It was observed by the inspector that this installation was in accord with these specifications.

C. Containment Leak Rate Test

A containment leak rate test was made in March 1963. Records of this test indicate that the test was made by the reference volume method with the building pressurized to approximately 2 psig. The tests resulted in a leak rate of 0.15% of the building volume in 24 hours, with the inner door of the air lock closed and the outer door open. With the inner door open and the outer door closed, the achieved leak rate was 0.107% of the building volume in 24 hours. These leak rates were approximately a factor of 10 better than those of the tests made in February 1962. Mr. O'Connor said this improvement was the result of improving the seal around the air lock doors.

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Results of Visit (continued)

D. Control Rod

An instrumentation logbook, which is a chronological record of the day-by-day work of the instrumentation technician, was reviewed by the inspector. This logbook indicates that a control rod drop test was made in October 1962. The time of the rod drop was indicated on a scope and photographs taken. The time of the initiation of the drop was the time the scram button was pushed. Indication that the rod had dropped completely was obtained by a microphone attached to the control rod guide tube on its lower end. The records indicate that the drop times were all in the neighborhood of 540 milliseconds. Mr. O'Connor stated that the testing of control rod drop times was now on their preventive maintenance program and such tests will be made on a yearly basis. O'Connor also stated there has never been any indication of any sticking of their control rods and that the normal startup check includes at least three drops of all control rods from 3" of withdrawal. He further stated that they will presently have on hand replacement rods of boron stainless steel, and permission from LR has now been obtained for the installation of these new control rods.

E. Health Physics Records

The same film badge program which had been in effect during the last inspection visit to this facility, approximately a year ago, is still in use. Film badges are processed by the Army Signal Corps., Lexington, Kentucky. The beta-gamma badges are processed on a monthly basis and the neutron badges every two weeks. The records indicate that there had been no exposures above the limits of Part 20. Most monthly beta-gamma badges were seldom over 100 mr. There was one instance of a beta-gamma monthly badge reading approximately 962 mr. Mr. Dady stated that he had investigated the circumstances of this badge exposure on the basis of the radioactivity of the material involved and of the actions of the person who had been handling this material. Dady said that what must have happened is that the active material was left in a lab on a Friday afternoon and the badge must have been left on the same laboratory counter top for the whole week-end. He stated that he felt positive that the badge reading did not indicate a true exposure to the individual.

Records of the activity discharged in the air going up the stack were reviewed and all of these discharges have been well below the licensed limits. This facility, with the installation of the new 175' stack, now has a dilution factor on gaseous discharge of  $10^{-10}$  sec/cc. The present operating schedule for the reactor is still a maximum of 8 hours per day, 5 days per week, at 1 megawatt.

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Results of Visit (continued)

The records of discharge from the stack include a record of the calibration of the stack monitor for argon. The calibration results in a reading of 109 counts/minute being equivalent to an argon activity of  $2 \times 10^{-6}$  uc/cc. The Tracerlab factory calibration of the same monitor had stated that 125 counts/minute was equivalent to an activity of  $2 \times 10^{-6}$  uc/cc.

The records of liquid waste disposal indicate that the major source of liquid waste activity is in the regeneration of the ion exchange columns. The liquid effluent is discharged to any one of three 10,000 gallon tanks, where it is diluted with other liquid effluents from laboratories. It is circulated back and forth between two or three of these tanks, and a sample taken and analyzed before this liquid is discharged to the sewer of the Metropolitan District. Dady stated that he takes as their limit for the allowable release a value of  $3 \times 10^{-6}$  uc/ml, since there is no Ra-226 or plutonium in the effluent, and since the effluent is being discharged to a sewerage system. The records indicate that over a one-year period up to the date of this visit, approximately 155,000 gallons of effluent were discharged and that these contained approximately 1 mc of activity.

Mr. Dady stated that so far no solid radioactive waste disposal has been made from the reactor facility. He said that they are simply accumulating solid wastes in 55 gallon drums till there is sufficient waste for a full truck shipment.

F. Miscellaneous

Mr. O'Connor stated that during the month of June the facility had been visited by the Army Inspection Team for their annual appraisal. He said that the team consisted of five men and they had been at the facility a total of three days. He said that he thought they did a better job this year than last, and that this year they had even read the minutes of his Safeguards Committee. He said that they had indicated that their report would be satisfactory.

O'Connor also stated that he has a very real problem in hiring qualified reactor operators. He said that he had interviewed some graduates of the 2-year course in reactor technology from the Wentworth Institute, but the highest rating that he was authorized to offer them was a GS-4. Some very promising candidates had then accepted jobs as reactor operators at Brookhaven National Laboratory at approximately 25% more.