UNITED STATES
ATOMIC ENERGY COMMISSION

DIVISION OF INSPECTION

REPORT

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REPORT

CF-45

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Dated FEB 2 6 1958

Title:

THE CURTISS-WRIGHT RESEARCH REACTOR

BRIEF OF FINDINGS

SUMMARY

The Curtiss-Wright Research reactor, located at Quehanna, Pennsylvania, was visited on January 30, 1958. The construction of this facility is nearing completion, although several weeks may be required to make the final installation and test of some equipment. Discussions were held with the operating staff and supervision concerning details of the reactor design, operating procedures and administrative controls. It is planned to revisit the Curtiss-Wright facility after completion of construction, before initial operation.

DETAILS

The Curtiss-Wright research reactor, a "swimming pool" reactor with MTR-type fuel elements, was visited on January 30, 1958, by Dr. Marvin M. Mann and Dr. Peter A. Morris. An inspection was made of the facility and discussions were held with Dr. Harry Reese, Assistant Manager of the Nuclear Power Department, Dr. C. J. Roberts, Chief, Research Reactor Division, Mr. G. C. Geisler, Head, Reactor Operations Section, and others.

It was observed that several items of construction were incomplete, and in some cases delivery of parts would require two or more weeks. Among these items, were the following:

1. The switch for activation of the safety circuit that causes a slow scram if the reactor bridge is moved was not installed.
2. A solenoid control for operation of the flapper valve in the cooling water system was not on hand.
3. The ion chambers, for control and safety systems, were not installed.
4. The aluminum tube and flexible hose for the cooling water system were not installed.
5. The pool had not yet been filled with water.

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Period of Inquiry:
January 30, 1958

During discussion with the Curtiss-Wright staff the following points were noted:

1. Pneumatic Rabbit

   The delivery tube has been soap tested for leaks, but has not been pressure tested with water in the pool.

2. Safety Rod Action on Scram

   Following a Fast Scram (magnet current interrupted) positive drive of the safety rods depends upon the action of either the operator or upon automatic initiation of a Slow Shutdown.

3. Coolant Flow

   During power operation above 100 kw proper coolant flow will depend upon the presence of suitable plugs in grid plate positions not containing fuel elements, reflector elements or irradiation capsules. Flow and temperature measurements are to be made in such a way that inadequate flow to a single fuel element cannot be detected. Consequently, "short circuiting" of flow through vacant grid plate positions can be controlled only by procedure during assembly of the core.

4. Building Leakage Rate

   The estimated leakage rate of the building, with doors closed and ventilator off, is one air change in 32 hours. No information was available, however, on the pressure differential assumed for this estimate.

5. Safety Rod Motion

   The speed of motion of the safety rods has been measured to be approximately 6-1/4 inches per minute. This rate of motion for simultaneous withdrawal of the three safety rods could introduce reactivity at the rate 0.063% per second for a water reflector and 0.093% per second for a graphite reflector. An analysis of the transients that would occur, as a result of such rod motion, in relation to the performance characteristics of the Curtiss-Wright safety system has not been made. Comparisons have been made with the results of Spert and Borax experiments to indicate the magnitude of a possible accident.

6. Regulating Rod Worth

   The reactivity held by the stainless steel regulating rod is stated to be 0.7% $\Delta k/k$ for a light water reflector and 1.2%

for a graphite reflector. It was also stated, however, that should a change in reflector or the reactor core be made, the worth of the regulating rod would be adjusted so as never to be worth as much as one dollar (the delayed neutron fraction).

7. Automatic Reactor Control

The Curtiss-Wright reactor is equipped with a Leeds and Northrup PAT-60 Servo Amplifier System. It was pointed out that experience at the Armour Research Foundation with this equipment showed that it was not fail-safe in some respects. This problem will be discussed by Curtiss-Wright with the L&N Company.

8. Safety System Actions

The safety system of the Curtiss-Wright reactor has both a Fast Scram and a Slow Scram. For the Fast Scram, magnet current is interrupted, allowing the safety rods to drop. For the Slow Scram, power to the safety amplifiers is interrupted, resulting in loss of magnet current somewhat later. The difference in time to affect these two actions is less than 100 milliseconds, however.

9. Procedures

General procedures have been prepared for reactor start-up preparation, reactor start-up (cold, clean), reactor start-up (high residual power level), level operation and shutdown. A detailed Reactor Checkout Procedure Form has been prepared. Emergency procedures, to anticipate as many credible accidents as possible, or to give directions when annunciation of abnormal operating conditions occurs, have not been prepared.

10. Organization

Within the Nuclear Power Department of the Research Division, there are a Research Reactor Division, a Reactor Operations Section, and a Curtiss-Wright Reactor Safeguards Committee. The general responsibilities of those groups have been specified; there remain some aspects of delegation of authority and channels of communication that are not clearly delineated. As an example, the reactor engineer is to make all minor decisions regarding operation of the reactor during his shift. The definition of minor decisions is not given.

The general background and training in reactor operation of the Curtiss-Wright staff is somewhat limited. One person, the head of the Reactor Operations Section, has had approximately two years' experience with the Pennsylvania State University research reactor and is licensed to operate this facility. Others of the staff have little or no experience in reactor operation.

COMMENT

It was apparent, at the time of the visit to the Curtiss-Wright facility, that construction had not yet been completed. Consequently, simulated operation, using normal procedures, could not be observed.

In addition to the physical limitations that preclude start-up of the reactor at this time, it is believed that other preparations for start-up were not complete. Primarily, these preparations would include systematic construction and trial of all operating procedures, to insure critical examination of these procedures and to familiarize the staff with them. With a relatively inexperienced staff, it is believed particularly important that such preparations be made before reactor start-up. Even so, it might be desirable, in this situation, to use the services of an experienced consultant during start-up and initial operation of the reactor. Curtiss-Wright personnel indicated that Dr. Robert Cochran of Penn State University, and a consultant to Curtiss-Wright, may be available at the time of start-up. However, no arrangements have been made for Dr. Cochran to participate. Further inquiry on this subject will be made at the time of the next inspection visit, when construction of the assembly is complete.

During the visit to the Curtiss-Wright facility it was determined that all of the fuel elements had been delivered and were on hand in the reactor building. A license, under 10 CFR Part 70, to receive and possess this special nuclear material, had not been issued. The presence of this material under these conditions apparently came about as a result of a misunderstanding on the part of Curtiss-Wright of the meaning of their construction permit, and/or failure on the part of the supplier (Sylvania Corning Nuclear Corporation) to adequately determine the status of the client's license or licenses to receive and possess the material. The Curtiss-Wright staff has already contacted the Licensing Branch, AEC, in an effort to rectify this situation as quickly as possible.