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PART I - DESCRIPTION OF THE REACTOR

As an enclosure to its license application for a Research and Development Facility, the Curtis-Wright Corporation submitted a Preliminary Hazards Evaluation Report for a reactor to be built and operated on an 80 sq. mile tract of land at Quehanna, Pennsylvania. The proposed reactor is a one megawatt light water moderated and cooled, solid fuel type often referred to as a swimming-pool reactor. Considerations of neutron economy may at times dictate the use of a BeO reflector. The core is immersed in a 20 ft. wide by 40 ft. long x 26 ft. deep pool with a minimum of 19 ft. of water covering the core. The reinforced concrete pool is separated into two sections, one being a three sided end section penetrated by three beam tubes for experimentation purposes, the other a 20 ft. x 24 ft. section used for bulk shielding studies.

The reactor core will be made of MTR type fuel elements containing a maximum of ten fuel bearing plates per element. Each plate is essentially a sandwich of aluminum-uranium alloy between two layers of aluminum cladding. A fuel element will contain about 170 gms of U-235 enriched to ~90%. These elements are supported by a grid plate capable of accommodating a 9 x 6 array or a total of 54 elements. This number of fuel elements would almost certainly now be used, but many flexible arrangements are possible, and present plans do include placing peripheral rows of BeO elements as reflector around the fuel elements. Previous experience with this type of core places the cold clean critical mass at 2.75 - 2.85 kg U-235 but usually the requirements for available reactivity to override xenon poisoning and experimental needs will increase the critical mass to 3.4 or 3.6 kg.

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In this case, the applicant states that the maximum reactivity requirements for prolonged operation at 100 kw and 1000 kw are as follows:

Source	Reactivity 100 kw	Required at 1000 kw
Negative Temp. Coefficient	.0006	.001
Equilibrium Poisons (Xe, Sm, etc.)	.018	.040
Xe override	.000	.006*
Burnup (100 days)	.0005	.005*
Adequate rate of change of power level	.003	.003
Addition of smalles increment of reactivity available	.003	.003
Totals	.025**	.053**

* Only one indicated in total
** No allowance made for experimental reactivity requirements

The reactor control system consists of three (3) safety shim rods and one (1) control rod. The boron carbide safety-shim rods have a reactivity control worth of 2.5% each for a water reflected core and 3.8% each for a beryllium-oxide reflected core. The stainless steel control rod under similar conditions will have reactivity worth of 0.6% and 1.2% respectively. The safety-shim rods are magnetically coupled to the drives which are capable of driving the rods at 24 in/min. Upon power failure or receipt of scram signal the rods will fall freely into the core. The control rod drive mechanism is rated at 6 in/min.

When operating at low power, up to 100 kw, convective cooling will be sufficient to cool the core. For operation at power levels in excess of 100 kw, water will be pumped through the core at 700 gpm and recirculated via a holdup tank to alloy essentially all of the N^{16} activity to decay.

The reactor is to be housed in a 48' wd x 120' lg bay of the Radioactive Materials Laboratory Building. The exterior construction consists of aluminum panels fastened to structural framework. Estimated leakage rate with all doors closed and the ventilator off is estimated to be one air change in 32 hours.

The site selected by Curtiss-Wright for their research facilities comprises 51,175 acres of which 8,579 are owned outright and 42,596 leased from the State of Pennsylvania for 99 years. This tract, approximating a circle of 10 miles diameter, lies in North Central Pennsylvania encompassing portions of Elk, Cameron and Clearfield Counties.

The reactor itself will be located a minimum of 3 miles from the present boundary of the property. The countryside surrounding the site is largely uninhabited with the closest towns of any appreciable size being 10 miles from the reactor. The area within a 25 mile radius has a population density of approximately 28 people/sq mile.

PART II - HAZARDS ANALYSIS

1. General Considerations

There is an extensive body of relevant knowledge and successful operating experience for reactors of the type under consideration. Pool-type reactors using fuel elements and having core arrangements generally similar to those proposed for this reactor have been safely and successfully operated for several years. The power levels of these reactors are in the 10 - 100 kilowatt range for the Geneva demonstration reactor and the Penn State reactors, the few megawatt range for the Oak Ridge reactors and the many megawatt range MTR.

While it is true that none of these previously built and operated units are exactly duplicated in the design of the proposed reactor, and while there are certain features proposed for this reactor such as the fairly great flexibility occasioned by the large number of available fuel positions (54) which will require special attention prior to the issuance of operational approval, the stability and predictability of pool-type reactors, which has been demonstrated by the extensive successful operation of these reactors, leaves no reason to doubt that an adequately engineered and carefully constructed reactor of the type proposed by the applicant should be capable of safe operation.

2. Critical Experiment

The contemplated procedure of loading by increments and determining the sub-critical multiplication curve whenever the active lattice is to be loaded in a previously untried configuration or when a large instrument or sample is to be placed adjacent to the core, if properly supervised and administered, provides positive control of the reactor during the approach to criticality.

3. Radiation Hazards Due to Release of Radioactive Material

In calculating the total radiation dose, at the site boundary, in the event of a maximum nuclear incident (the applicant has not specified the cause of the incident) releasing all the fission products from the reactor, after it had operated long enough so that an equilibrium quantity of these fission products were present, under the most unfavorable weather conditions, it is shown that a serious dose would be quite improbable. Actually, since a number of unrealistically pessimistic assumptions are included in this calculation, it seems quite apparent that radioactive hazards to the public from this reactor, is extremely small.

4. Conclusions

Based on the above considerations, but without attempting at this time to ascertain what credible accident might actually occur in this reactor (though there would certainly be less than the maximum accidents mentioned above) or examining closely those details of the reactor design, the proposed instrumentation system, or the plan of operating procedures, which have been presented thus far by Curtiss-Wright in its application for license, it is concluded that there is reasonable assurance that a reactor of this general type to be operated at the power level proposed, can be designed, constructed and operated at the proposed site without undue risk to the health and safety of the public.

This conclusion is reached with the understanding that, prior to the time when the reactor, as built, is allowed to go critical, a final evaluation of the hazard aspects of the completed reactor, the operating and supervisory procedures, and the emergency plans, must show that there is reasonable assurance that the reactor, whose detailed design is then known, can be operated as proposed without undue risk to the health and safety of the public.

The following items are noted as being representative of those to be discussed in more detail or more information furnished in the Final Hazards Summary Report.

1. Actual size of beam holes.

2. The reactivity worth of the control rod, with a beryllium reflector appears high.

3. How is the operator assured of the fact that the flexible hose is connected to the aluminum tube in turn attached to the plenum underneath the grid plate?

4. From a standpoint of direct radiation effects the use of one (1) foot of concrete shielding (pool wall on two sides and one end) is questioned. Perhaps a clearer understanding of the pool with respect to ground level along its sides and rear as well as an indication of the overall utilization of the area around the sides of the ppol would prove helpful.

5. The use of a 9 x 6 grid plate with 54 fuel positions possible should receive special attention and careful consideration.

6. The maximum rate of reactivity addition appears high.

7. Figure 3 shows a "fuel element storage rack" located in the front "beam-hole" section of the reactor pool. Are spent fuel elements planned for storage at this location andutilized for gamma irradiation?