CAL:LF
Docket No. F-39

MAY 29 1957

Curtiss-Wright Corporation
Research Division
Brighton Road
Clifton, New Jersey

Gentlemen:

Transmitted herewith is a notice of the proposed issuance of a construction permit for a 1000-kilowatt pool-type research reactor proposed to be constructed by you at Quehanna, Pennsylvania.

Paragraph E of your application amendment filed on December 28, 1956, states in part as follows:

> ...To allow the fuel element fabricator sufficient working excess, application is hereby made for 6 KG of U-235 in the following form:
>
> • • •
>
> 4.5 Kg of U-235 to be delivered to the applicant named herein. Accountability and return to the Atomic Energy Commission, of the balance, to be the responsibility of the Fabricator.

You will note, however, that the issuance of the special nuclear material allocation in the proposed construction permit is not to be construed as an approval by the AEC of the transfer to your fabricator of financial responsibility for any portion of the material which may be shipped to it by the Commission on your order.

In order that your fabricator may assume this responsibility, it will be necessary for it to submit to the Commission a request for authorization to assume financial responsibility for all or a portion of the special nuclear material. Such a request should include information regarding the fabricator's financial qualifications to assume that responsibility.

bcc: C. A. Nelson, INS
B. S. Loeb, RD
D. F. Musser, NMM
R. L. Southwick, IS
R. Lowenstein, OGC

Sincerely yours,

H. L. Price
Director
Division of Civilian Application

DFlax/mjm

OFFICE ▶	CAL	CAL		CA	CA
SURNAME ▶	CTEdwards	LJohnson		FKPittman	HLPrice
DATE ▶	5/2/57				

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UNITED STATES ATOMIC ENERGY COMMISSION
(DOCKET NO. F-39)
CURTISS-WRIGHT CORPORATION

NOTICE OF PROPOSED ISSUANCE OF CONSTRUCTION PERMIT

Please take notice that the Atomic Energy Commission proposes to issue to the Curtiss-Wright Corporation, a construction permit substantially as set forth in Appendix A below unless on or before 15 days after publication of this notice in the Federal Register a request for formal hearing is filed in the manner prescribed by Section 2.102(b) of the Commission's Rules of Practice (10 CFR Part 2). There is annexed as Appendix B a Memorandum submitted by the Division of Civilian Application which summarizes the principal features of the proposed reactor and the principal factors considered in reviewing the application for license. For further details see the application for license at the Commission's Public Document Room, 1717 H Street, N. W., Washington, D. C.

FOR THE ATOMIC ENERGY COMMISSION

H. L. Price
Director
Division of Civilian Application

Dated at Washington, D. C.
this 27th day of May 1957.

APPENDIX A

CONSTRUCTION PERMIT

The Curtiss-Wright Corporation (hereinafter referred to as "Curtiss-Wright") on October 24, 1956, filed its application for a Class 104 license to construct and operate a nuclear reactor (hereinafter referred to as "the reactor"). Amendments to the application were filed on December 28, 1956, and March 12, 1957. The application as amended will be referred to herein as "the application".

The Atomic Energy Commission (hereinafter referred to as the "Commission") has found that:

A. The reactor will be a utilization facility as defined in the Commission's regulations contained in Title 10, Chapter 1, C.F.R., Part 50, "Licensing of Production and Utilization Facilities."

B. Curtiss-Wright proposes to utilize the reactor in the conduct of research and development activities of the types specified in Section 31 of the Atomic Energy Act of 1954.

C. Curtiss-Wright is financially qualified to construct and operate the reactor in accordance with the regulations contained in Title 10, Chapter 1, C.F.R.; to assume financial responsibility for the payment of Commission charges for special nuclear material and to undertake and carry out the proposed use of such material for a reasonable period of time.

D. Curtiss-Wright is technically qualified to design and construct the reactor.

E. Curtiss-Wright has submitted sufficient information to provide reasonable assurance that a reactor of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that additional information required to complete its application will be supplied.

F. The issuance of a construction permit to Curtiss-Wright will not be inimical to the common defense and security and to the health and safety of the public.

Pursuant to the Atomic Energy Act of 1954 and Title 10, C.F.R., Chapter 1, Part 50, "Licensing of Production and Utilization Facilities", the Commission hereby issues a construction permit to Curtiss-Wright to construct the reactor as a utilization facility. This permit shall be deemed to contain and be subject to the conditions specified in Sections 50.54 and 50.55 of said regulations; is subject to all applicable provisions of the Atomic Energy Act of 1954 and rules, regulations and orders of the Atomic Energy Commission now or hereafter in effect; and is subject to any additional condtions specified or incorporated below.

A. The earliest completion date of the reactor is July 1, 1957. The latest date for completion of the reactor is January 31, 1958. The term "completion date" as used herein means the date on which construction of the reactor is completed except for the introduction of the fuel material.

B. The site proposed for the location of the reactor is the location at Quehanna, Pennsylvania, specified in the Preliminary Hazards Evaluation Report accompanying the application filed October 29, 1956.

C. The general type of facility authorized for construction is a light water cooled and moderated research reactor designed to operate at a thermal power level of 1,000 kilowatts, as described in the application.

This permit is subject to submittal by Curtiss-Wright to the Commission (by proposed amendment of the application) of the complete, final Hazards Summary Report (portions of which may be submitted and evaluated from time to time) and a finding by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the reactor in accordance with the specified procedures.

Upon completion (as defined in Paragraph "A" above) of the construction of the facility in accordance with the terms and conditions of this permit, upon the filing of any additional information needed to bring the original application up to date, and upon finding that the facility authorized has been constructed in conformity with the application as amended and in conformity with the provisions of the Act and of the rules and regulations of the Commission, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of the Act, the Commission will issue a Class 104 license to Curtiss-Wright pursuant to Section 104c of the Act, which license shall expire twenty (20) years after the date of this construction permit.

Pursuant to Section 50.60 of the regulations in Title 10, Chapter 1, C.F.R., Part 50, the Commission has allocated to Curtiss-Wright for use in the operation of the reactor, 8.1 kilograms of uranium 235 contained in uranium at the isotopic ratios specified in Curtiss-Wright's application as amended. Estimated schedules of special nuclear material transfers to Curtiss-Wright and returns to the Commission are contained in Appendix "A" which is attached hereto. Deliveries by the Commission to Curtiss-Wright in accordance with Schedule 1 in Appendix "A" will be conditioned upon Curtiss-Wright's return to the Commission of special nuclear material substantially in accordance with Schedule 2 of Appendix "A".

FOR THE ATOMIC ENERGY COMMISSION

Director
Division of Civilian Application

Attachment:
Appendix "A"

Date of Issuance:

APPENDIX "A" TO CURTISS-WRIGHT'S
CONSTRUCTION PERMIT
DOCKET NO. F-39

SCHEDULE 1

Estimated Schedule of Transfers of Special Nuclear Material from the Commission to Curtiss-Wright:

Calendar Year of Transfer		Kilograms of Contained U-235
1957		6.0
1959		4.0
1960-1976 (17 yrs. total of 5.0 per year)		85.0
	Total transfers	95.0

SCHEDULE 2

Estimated Schedule of Transfers of Special Nuclear Material from Curtiss-Wright to the Commission:

Calendar Year of Transfer	Kilograms of Contained U-235 Recoverable Scrap	Spent Fuel	Total
1957	1.5	-	1.5
1959	0.8	3.0	3.8
1960 - 1976 (17 yrs. total)	17.0 1/	64.6 2/	81.6
1977 - Return of Inventory	-	4.4	4.4
		72.0	91.3

1/ 1.0 kilogram per year

2/ 3.8 kilograms per year

APPENDIX B

MEMORANDUM

PART I - DESCRIPTION OF THE REACTOR

The Curtiss-Wright Corporation has submitted a license application 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 "pool" type or swimming-pool reactor. The core is immersed in a 20 ft. wide by 40 ft. long by 26 ft. deep pool with a minimum of 19 ft. of water covering the core. Considerations of neutron economy may at times dictate the use of a beryllium oxide reflector. 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 the type fuel elements contained in the Materials Testing Reactor (MTR) located at the National Reactor Testing Station, Arco, Idaho. There will be 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 about 90%. These elements are supported by a grid plate capable of accommodating a 9 x 6 array or a total of 54 elements. With this number of fuel elements many flexible arrangements are possible, and present plans do include placing peripheral rows of beryllium oxide elements as a 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.

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 Required at 100 kw	1000 kw
Negative temperature coefficient	.0006	.001
Equilibrium poisons (Xe, Sm, etc.)	.018	.040
Xe override	.000	.006*
Burnup (1000 days)	.0005	.005*
Rate of change of power level	.003	.003
Addition of smallest increment of reactivity available	.003	.003
Totals	.025**	.053**

* Only one of these values is indicated in the total shown

** 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 allow essentially all of the N^{16} activity to decay.

The reactor is to be housed in a 48 ft. wide x 120 ft. long 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 its 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 operating 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 for the MTR.

Although none of these previously built and operating units is exactly duplicated in the design of the proposed reactor, and while there are certain features proposed for this reactor, such as the greater 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 has been demonstrated by the extensive successful operation of these reactors and there is 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.

One feature of importance in these considerations is the characteristic of negative temperature coefficient shared by this reactor in common with others of this type. The negative temperature coefficient contributes to both the static stability and the dynamic stability of the reactor. A reactor possesses static stability in changing temperatures if it decreases in reactivity with an increase in temperature (negative temperature coefficient), i.e., if for any cause there is a rise of temperature within the reactor, the effective multiplication factor, or its ability to sustain a chain reaction, will then tend to decrease. Consequently, the rate of heat production or power level will also decrease, tending to offset the rise in temperature. Conversely, if the temperature coefficient were positive, the reactor would be unstable to temperature changes. The proposed Curtiss-Wright reactor possesses a relatively strong negative temperature coefficient of reactivity, which tends to insure stability in the event of probable types of power excursions. This characteristic of a strong negative temperature coefficient is consistent with the operating experience of other reactors of the MTR type.

The extent of density changes in the coolant or moderator brought about by changes in temperature has a strong influence on the sign and magnitude of the overall temperature coefficient. However, such density changes do not result instantaneously from temperature variations in the fuel elements, and as a result oscillations may develop in the neutron flux and reactor power. If such oscillations are rapidly damped out because of the inherent features of the reactor, the reactor is said to have good dynamic stability. Although this phenomenon has not been completely analyzed with respect to the proposed reactor, its general aspects should not be significantly different from satisfactory observations of this characteristic made in existing reactors having similar nuclear characteristics.

2. Radiation

Since an appraisal of the maximum credible accident has not yet been made, it has not been possible accurately to evaluate the effects of such an accident on the operating personnel of the applicant or upon the public in the areas adjacent to the reactor site. The present plans of the applicant do not include a vapor shell, and the protection of the public in the event of an accident is largely dependent on the isolation of the reactor. Whether operation under these conditions will prove to be acceptable will, of course, depend upon the results of an analysis of the maximum credible accident (which must be defined and approved prior to initial operation) and a determination that the level of containment proposed, when considered in conjunction with the isolation of the reactor, is sufficient to protect the public.

In lieu of a calculation based on the as yet undetermined maximum credible accident, the applicant has presented the results of calculations which would indicate that, should all the fission products from equilibrium operation at 1 MW be released under the most unfavorable meteorological conditions, some persons off-site might be subject to levels of irradiation greater than are considered safe for continued exposure and it would probably be necessary to institute evacuation procedures. However, based on a rather extensive body of relevant knowledge and successful operational experience with pool-type reactors, we believe that, when the maximum credible accident for this reactor has been defined, it will involve a release of much less than 100% of the fission products and that the risk to the public will be shown to be acceptably low.

3. Summary

The application has been reviewed at this time only for the purpose of determining whether, based on information contained in the application, and taking into account the wealth of experience which has been gained from operation of reactors of this general type, there is reasonable assurance that a facility of this general type, to be operated in the range of power levels proposed, can be designed, constructed and operated at the proposed site without undue risk to the health and safety of the public.

In making this determination, it has not been necessary as has been pointed out previously, to define the magnitude of the maximum accident which it is credible to expect might actually occur in this reactor. It has also not been necessary to examine closely those details of reactor design, the proposed instrumentation system, or the plan of operating procedures which have been presented thus far by the applicant.

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.

PART III - TECHNICAL QUALIFICATIONS

Since 1947, Curtiss-Wright in conjunction with the AEC and the Air Force has been actively engaged in the study of various proposals for nuclear aircraft power plants including calculations relating to a large number of reactor types. The Nuclear Power Department of the Company's Research Division now employs about 200 persons of whom fifty are directly involved in nuclear physics and instrumentation, and health physics.

Supervisory Personnel associated with the proposed reactor have had broad and varied experience at a number of installations devoted to nuclear research and technology including the Oak Ridge School of Reactor Technology, the Oak Ridge School of Nuclear Studies, the Oak Ridge National Laboratory, the Argonne National Laboratory, the Savannah River Plant, Pennsylvania State University, and the University of Rochester.

PART IV - FINANCIAL QUALIFICATIONS OF APPLICANT

Estimated cost of the facility is $2,470,549, and its estimated annual operating expense is $960,000. The inventory of special nuclear material is not expected to exceed $60,000 at any one time.

Curtiss-Wright's total current assets at December 31, 1955, were $194,000,000 while current liabilities were $69,000,000 making a current radio of 2.8 to 1. Its total assets amounted to $227,000,000, in which Stockholders' equity was $158,000,000 or 69.4 per cent. There is no long term debt.

Net sales have risen from $176,000,000 in 1951 to $509,000,000 in 1955. In the same period net income after taxes has increased from $7,000,000 to $35,000,000.

It is concluded from the above that Curtiss-Wright is financially qualified to construct and operate the research reactor for which it has sought a license and to pay Commission charges for the use and loss or consumption of special nuclear material loaned it.

PART V - CONCLUSIONS

Based on the above considerations, it is concluded that:

a. There is reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed site without undue risk to the health and safety of the public.

b. The applicant is technically and financially qualified to engage in the proposed activities.

FOR THE DIVISION OF CIVILIAN APPLICATION

H. L. Price
Director