DOCKET NO. 50-39 file cy.

CURTISS-WRIGHT CORPORATION
RESEARCH DIVISION
QUEHANNA, PENNSYLVANIA
U. S. A.

February 21, 1958

AIR MAIL - SPECIAL DELIVERY

U. S. Atomic Energy Commission
Division of Licensing and Regulation
Washington 25, D. C.

Attention: Mr. Lyall Johnson, Chief
Licensing Branch

Gentlemen:

Application is hereby made to amend by addition of the numbered paragraphs which follow, the report number CWR 400-2 entitled, "Hazards Evaluation Report, Curtiss-Wright Reactor".

Report CWR 400-2 forms an integral part of our application for a Class 104 license to construct and operate a nuclear reactor. It is our intention that the following paragraphs be considered a part of this Hazards Evaluation Report, and therefore, a part of our application for license. The information which follows is being supplied in answer to questions raised by personnel of the Hazards Evaluation Staff of the Division of Licensing and Regulations.

1. With regard to the adequacy of shielding around the reactor pool walls, please refer to the main floor plan of the reactor bay, Figure 11 in CWR 400-2. On the two long sides and one end of the pool there is no excavation beneath the floor level shown in Figure 11. Therefore, there is no possible way for personnel to approach the pool walls other than at the main floor level where they are protected by a water shield at least 19½ feet thick.

   At the beam tube end of the pool the floor is dropped to approximately the same elevation as the bottom of the pool. With the reactor in position against the beam tubes the water thickness separating core and area accessible to personnel is only 4 feet. Because of this the shielding value of the 18 inch thick pool wall is augmented by 4 feet of dense concrete (> 280 lb per cu ft). This will reduce the radiation level in the beam room with the reactor at one megawatt thermal power to the same order of magnitude as natural background. There is no other area adjacent to any part of the reactor pool to which personnel could conceivably gain entrance.

2. The following comments are made relative to the use of both graphite and beryllium oxide reflector elements. Thirty graphite elements and eight BeO elements will be fabricated by Curtiss-Wright for use

U. S. Atomic Energy Commission
Attn: Mr. Lyall Johnson

February 21, 1958

in our reactor. These will all be canned in aluminum and helium leak tested to insure perfect welding. Reflector elements will be sufficiently different in design as to be clearly distinguishable from the fuel elements under the full depth of water in the pool. Moreover, each reflector element will have a large identification number engraved on two sides. These numbers will positively identify each element so that they cannot be mistaken for fuel elements and vice versa. Reflector elements will be logged into the core in exactly the same manner as fuel elements and a complete record of exposure of reflector elements will be kept just as for the fuel elements.

Our one dimensional IBM 704 calculation indicates that reflector savings for a 3 inch thick layer of graphite backed by water are approximately the same as for a 3 inch layer of BeO again backed by water. Based on this, we expect our control rods to be worth approximately the same amount in a graphite and a BeO reflected core. Unfortunately, we will probably not be able to run a definitive check on this because there will not be sufficient BeO elements to form a complete reflector.

Table III of CWR 400-2 gives the expected worth of our heavier regulating rod and the safety rods in a water-reflected and graphite-reflected core. These figures are based on experimental values obtained at the Pennsylvania State University reactor using similar fuel elements and rods. Values are not quoted for a BeO-reflected core because, as noted above, they would be approximately the same as for graphite, and there will be insufficient BeO to form a full reflector. A second, lighter stainless steel regulating rod with a 0.035 inch thick wall has been obtained. This rod will be worth 0.4% Δ k/k in the water-reflected core and 0.7% Δ k/k in a graphite or BeO-reflected core. This rod may be used in any core regardless of the reflector, while the heavier regulating rod included in Table III will be used exclusively for the water-reflected cores.

Rods will be calibrated in each loading in which they are to be used. In no case will a regulating rod be used if it is worth more than 0.70% Δ k/k. Either the rod will be physically modified or the arrangement of fuel elements and rods will be altered to reduce the regulating rod worth to 0.70% or less.

3. Regarding the effect of beam tube flooding on reactivity, reference is made to page 73 of CWR 400-2. The data given here show that flooding of the center beam tube (the worst case) would cause an increase in reactivity of about 0.4%. Slow flooding of the beam tubes would be prevented by the water draining away through a one inch line to the contaminated waste collection system. A second one inch line drains the vestibule of the beam tube. These may be seen in Figure 15 of CWR 400-2.

U. S. Atomic Energy Commission
Attn: Mr. Lyall Johnson

February 21, 1958

The beam tube itself (the hole through the concrete) has an 8.0 inch I.D. The beam tube extender (the four foot long aluminum tube which reaches from the reactor face to the concrete pool wall) is 8.0 inch I.D. at the wall and tapers to 6.06 inch I.D. over most of its length. The flange plate or spacer which connects the extender to the pool wall is 8-9/16 inch I.D. and 13-1/2 inch O.D.

4. The following paragraphs relate to monitoring of off-gases from the readioactive waste treatment plant. Because of the design of this system and the use for which it is intended off-gases are not considered to be a problem under normal usage. The system will not receive high level wastes. These will be segregated as they are generated and will be handled in small batches. The waste treatment system normally will receive only wastes with essentially no dissolved active gases. Any operations which would generate significent fission gases would be called to the attention of the health physics group and the entire operation would be closely monitored, including the disposal of wastes.

The contents of the 3000 gallon capacity waste collection tanks are carefully sampled before treatment. The contents of any tank containing an unusually large amount of activity would be analyzed radiochemically. It would, therefore, be impossible for a large amount of dissolved fission gas or any other activity which had accidentally been allowed to enter the collection system to reach the evaporator undetected.

All pressure relief and vent lines from the evaporator and vaccuum receiver pass through an absolute filter before being discharged to the atmosphere. This is shown in Figure 21 of CWR 400-2. The performance of this filter in removing particulates will be monitored by sampling the effluent air stream from the filter during the evaporation process.

If the analysis of the waste solution before treatment has revealed the presence of significant amounts of fission gases which might be driven off during evaporation and would not be removed by the absolute filter, the monitoring would be extended to outside the waste disposal building. The evaporation process would not be undertaken until meterological conditions were such that the operation could be conducted safely and within the limits set by Part 20, CFR.

5. An application to operate a radioactive waste treatment plant and to discharge wastes therefrom has been submitted to the Commonwealth of Pennsylvania. This application has been received by responsible authorities in Harrisburg and has received favorable comment. However, the application must be passed on by the Sanitary Water Board before a permit can be issued. The Board is not scheduled to meet until March.

U. S. Atomic Energy Commission
Attn: Mr. Lyall Johnson

February 21, 1958

Until such time as official approval is obtained from the Commonwealth of Pennsylvania to dispose of radioactive wastes no such wastes, either solid, liquid, or gases will be released to the environment. Any wastes generated prior to said approval will be stored at the Radioactive Materials Laboratory and Research Reactor site.

6. Based on available experimental data from similar reactors and on theoretical calculations made by the reactor physics group at Curtiss-Wright, an average void coefficient of approximately $-5 \times 10^{-6} \Delta k/k$ per cc is predicted for the Curtiss-Wright Research Reactor.

The best temperature coefficient data over the range of interest (40-100°F) from a similar reactor comes from Battelle. These data indicate that the coefficient is positive from 40° to about 80°F. Above 80°F the coefficient is negative and around 100°F has a value of $-1.5 \times 10^{-5} \Delta k/k$ per °F. Because of the great similarity between the Battelle core and our own we would expect much the same result. Once we attain a power level in excess of 100KW we would expect to operate in the range of 80-100°F with a negative temperature coefficient. The reactivity allowance of 0.001 for temperature coefficient shown in Table VIII of CWR 400-2 is clearly more than enough if our core does prove to be similar to Battelle's.

It is our intention to measure both the void and temperature coefficients of reactivity during our initial low power experiments. This will be within three months of our first achieving criticality.

7. As indicated by Table VIII of CWR 400-2 we have allowed a builtin excess reactivity of only 0.2% for experiments. Work at the Pennsylvania State University has indicated that this is sufficient reactivity to cover most small irradiations and activations. In Stating that the total reactivity available for experiments is 0.2% it is our intention to limit the total worth of all small experiments of the type which could conceivably be removed rapidly to 0.2%.

Experiments involving more than 0.2% $\Delta k/k$ will be reviewed by the Curtiss-Wright Reactor Safeguards Committee (CWRSC) and must be approved before being carried out. Any individual experiment involving a worth of more than 0.2% will be installed in the partially unloaded core and the reactor will be brought to power by a critical experiment. Under no circumstances will an experiment worth more than 1.5% be installed in the reactor. Moreover, we will not install simultaneously or ever allow to be installed at any one time, more than two (2) individual experiments worth in the range of 0.2-1.5% $\Delta k/k$. This means that the total worth of experiments installed by means of critical experiments will never exceed 3.0% $\Delta k/k$, or including the 0.2% allowance for small experiments, the total worth of all experiments will not exceed 3.2%. The beam tubes will be considered as one experiment regardless of whether one, two, or three are in place. In other words, if one or more of the beam tubes are in use, only one other experiment in the 0.2-1.5% range will be permitted. This is reasonable since the total worth of all three beam tubes is less than 1.0% $\Delta k/k$.

U. S. Atomic Energy Commission
Attn: Mr. Lyall Johnson

February 21, 1958

The decision as to whether an experiment is worth more than 0.2% and less than 1.5% will have to be based on calculations and experience with similar experiments. However, the worth of all experiments will actually be measured as soon as they are installed and corrective action will be taken if they are found to exceed the appropriate limit. An experiment worth more than 1.5% will not be allowed to remain installed in the core, but will be removed and redesigned. An experiment which was thought to be worth less than 0.2% but proved to be worth more would be removed from the core (carefully) and either redesigned for less worth or submitted to the CWRSC for review.

All large experiments (0.2 - 1.5%) will be received by the CWRSC, with special considerations being given to the possibility of experiment and core suddenly being separated. Motion of the bridge is prevented by several locking devices. A motion interlock shuts down the reactor if motion greater than 0.1 inch occurs. In general, experiments would be installed so that relative motion of experiment and core is impossible. Whenever possible a motion interlock would be included so that relative motion will cause shutdown.

It is hoped that the above information will satisfactorily complete our application and that early action upon the application can be taken.

Very truly yours,

CURTISS-WRIGHT CORPORATION
RESEARCH DIVISION

Carlyle J. Roberts

C. J. Roberts
Chief
Research Reactor Division

CJR/mep

Sworn before me this
21 February 1958
Clarence [illegible]
NOTARY PUBLIC
CLEARFIELD, PA.
MY COMMISSION EXPIRES MAY 23, 1960