UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON 25, D. C.

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WESTINGHOUSE ELECTRIC CORPORATION

DOCKET NO. 50-22

FACILITY LICENSE AMENDMENT

License No. TR-2
Amendment No. 1

License No. TR-2 is amended as follows:

1. Amend paragraph 1 to read as follows:

"1. This license applies to the heterogeneous, light water cooled and moderated 20,000 kilowatt (thermal) testing reactor (hereinafter referred to as "the facility") which is owned by Westinghouse Electric Corporation and located near Waltz Mill in Westmoreland County, Pennsylvania, and described in Westinghouse Electric Corporation's application attested February 29, 1956, and amendments to the application attested August 3, and 20, 1956, September 17, 1956, February 4, 1957, April 29, 1957, August 7, 1957, September 5, 1957, August 7, 1958, September 29, 1958, October 30, 1958, December 16, 1958, January 27, 1959, February 5, 1959, May 26, 1959, September 4, 1959, and November 12, 1959, (herein collectively referred to as "the application") and for which Construction Permit No. CPRR-8 (henceforth designated CPTR-1) was issued by the Commission on July 3, 1957."

2. Amend subparagraphs 3.a.(1) and (2) to read as follows:

"3.a.(1) Unless otherwise authorized by the Commission in writing, Westinghouse Electric Corporation (hereinafter referred to as "Westinghouse") shall not operate the facility at a power level in excess of 60,000 kilowatts (thermal).

3.a.(2) Unless otherwise authorized by the Commission in writing, Westinghouse shall not load the facility in a manner such that the shutdown reactivity with all control rods inserted in the core is less than 5%.

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3. Add the following operating restrictions:

3.a.(8) Unless otherwise authorized by the Commission in writing,

(a) Westinghouse shall retain the bubble formation apparatus and the special detection channel described in the application in the reactor during the power escalation program until stable operation at the 60 megawatt thermal power level has been established;

(b) The ratio of the maximum heat flux in the reactor to the burnout heat flux shall never exceed one-half;

(c) The reactor shall not be operated in such a way that the ratio of core steam void volume to core coolant volume exceeds one percent; and

(d) When the reactor is being operated with the automatic control system, the magnitude of boiling induced neutron level perturbations shall not exceed 5% or whatever lesser value is necessary to prevent erratic behavior of or oscillatory interaction between the boiling phenomenon, the reactor power level and the automatic control system."

This amendment is effective as of the date of issuance.

FOR THE ATOMIC ENERGY COMMISSION

R. L. Kl..k
Deputy Director
Division of Licensing & Regulation

Date of Issuance:

JAN 8 1960

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UNITED STATES ATOMIC ENERGY COMMISSION

HAZARDS ANALYSIS BY THE HAZARDS EVALUATION BRANCH

DIVISION OF LICENSING AND REGULATION

AMENDMENT APPLICATION NO. 14 TO LICENSE NO. TR-2

WESTINGHOUSE TESTING REACTOR

DOCKET NO. 50-22

Introduction

By application dated May 27, 1959, the Westinghouse Electric Corporation requested amendment of License No. TR-2 to permit an increase in the authorized maximum power level of the Westinghouse Testing Reactor from 20 to 60 thermal megawatts. Supplementary technical data respecting this application was filed with the Commission on September 4 and November 11, 1959.

As stated in the WTR Final Safety Report (WCAP-369 (Rev.)), the WTR was designed and constructed to permit eventual operation at a power level of 60 thermal megawatts. The initial license application, however, requested authorization to operate to a maximum of only 20 thermal megawatts. The check-out, testing and initial operational phases of the reactor and operation at power levels up to 20 thermal megawatts have been carried out. Using experimentally determined plant performance parameters and characteristics, the successful performance of the reactor and plant at power levels up to 60 thermal megawatts has been predicted. These predictions and the observance of certain additional operating limitations and procedures which are specified, form the basis for the present license amendment application for authorization to conduct a specified stepwise power escalation program up to power levels of 60 Mw.

Discussion

The factors investigated in the proposed increase to 60 megawatt operation were the following:

1. Reactor hydraulic and thermal performance.
2. Reactor nuclear performance.
3. Reactor and plant instrumentation.
4. Shielding.
5. Disposal of routine airborne activation products.
6. Effects on experimental facilities.
7. Accident analysis.

The investigations of these items are briefly summarized below.

For 60 megawatt operation with a designed coolant flow to the core of 16,000 gpm and core coolant inlet temperature of 140°F, calculations show that the heat flux in the hottest channel in the core will be a factor of more than

two below that which would result in bulk boiling in the channel and a factor of more than three below that which would result in burnout of the element. The calculations indicate that there may be some local nucleate boiling in the hot channel.

A stability analysis of this reactor indicates that oscillations in power may result when boiling occurs to the extent of a steam void volume to core coolant volume ratio greater than 1.8%. Hence, very great care would have to be exercised for any operations in which the void volume approached this value. The limitations and specifications for operation contemplated by the applicant would almost certainly prevent operation with more than a small fraction of this amount of steam present. Further, an in-core bubble formation device and sensitive neutron level detector has been designed and tested in the WTR. By use of this detector, the inception and degree of boiling in the WTR core can be determined, if it should occur, and operating conditions can be adjusted accordingly.

Minor power oscillations or erratic behavior of the reactor may also result from an interaction between the boiling induced perturbations in neutron level and the reactor automatic control system. Such an interaction has been observed in the MTR when operating with boiling induced neutron level perturbations of approximately $\pm$ 5%. Although boiling of such an extent as to cause such an interaction is not expected in operation of the WTR, its inception, if it should occur, can be determined with the sensitive neutron level detector installed and operating conditions can be adjusted accordingly.

To permit operation of the reactor at 60 megawatts, the fuel and experiment loading must be adjusted to provide sufficient excess reactivity to overcome the changed poisoning effects of temperature, fission product buildup and fuel burnup. The specification proposed by the applicant in this regard is that the control rods will provide a minimum shutdown margin of 5% in reactivity at all times. Since the maximum worth of any control rod is 3.8%, a shutdown margin of at least 1.2% will result with any one rod stuck out of the reactor. We believe the shutdown margin specified is adequate.

Checkout of the reactor plant instrumentation indicates that it is adequate for 60 megawatt operation. The reactor cutback and scram levels will be set at 110% and 125% respectively of the current target power level.

Shield radiation surveys and stack activity level measurements have been made during 20 megawatt operation. The measurements are considerably below permissible limits. From these measurements, the values expected for 60 megawatt operation will also be within permissible limits.

The experimental facilities in the reactor will not be changed for 60 megawatt operation. Since the heat rejection capabilities of the high pressure and temperature loops and capsule experiments remain the same, the size of fuel bearing experiments will be reduced for 60 megawatt operation. The effects of increased gamma heating induced thermal stresses and fast neutron embrittlement of the high pressure loop thimbles has been studied. The number of thermal stress cycles which could be permitted in the thimbles is several orders of magnitude greater than that which would be expected during the short times the

thimbles will be in use. The fast neutron exposure limit specified for the thimbles is 2.8×10^{21} nvt; after this flux exposure is reached the thimbles will be replaced. This value is below that used in the MTR for thimble replacement.

Accident situations which were previously analyzed for 20 megawatt operation have been re-analyzed for 60 megawatt operation. The nuclear excursion resulting from a startup accident, in which one assumes failure of the period scram but actuation of the overpower scram trip, is more severe due to the higher setting of the overpower scram. However, calculations show that even in this case the excursion will be terminated before the melting point of the fuel would be reached at the hottest point in the core. In the case of loss of coolant flow, the increased decay heating will raise the coolant remaining in the core to the boiling point in approximately 5 hours. This appears to be ample time to re-establish a coolant flow from emergency sources. The maximum credible accident analyzed previously involved a simultaneous rupture of all three high pressure and temperature thimbles. The consequences and probability of occurrence of this accident are not significantly altered by operation at 60 megawatts.

Conclusion

We conclude from our evaluation and from advice received from the Advisory Committee on Reactor Safeguards that, within the limitations and specifications provided, the proposed operation of the WTR at 60 megawatts, including also the proposed stepwise increases in power levels to this level, can be carried out without undue hazard to the health and safety of the public. In particular, the specifications and limitations which should be observed are:

1. The bubble formation device and boiling detector described shall remain in the reactor and be operated to measure the effect of bubble formation on the reactor power level during the power escalation program until stable operation at the 60 megawatt thermal power level has been established.

2. The ratio of the maximum heat flux in the reactor to the burnout heat flux shall never exceed one-half.

3. The reactor shall not be operated in such a way that the ratio of core steam void volume to core coolant volume exceeds one percent.

4. When the reactor is being operated with the automatic control system, the magnitude of boiling induced neutron level perturbations shall not exceed $\pm$ 5% or whatever lesser value is necessary to prevent erratic behavior of or oscillatory interaction between the boiling phenomenon, the reactor power level and the automatic control system.

Chief, Hazards Evaluation Branch
Division of Licensing and Regulation

Date: DEC 17 1959