INDUSTRIAL RESEARCH & APPLICATION 6

CLOSED CYCLE WATER REACTOR

IR&A 6 Closed Cycle Water Reactor

	Date	To	From	Class	Pkg. No.	To	From	Class
1	12-5-63	AEC 1144 Westinghouse Elec. Corp Combustion Eng. Inc. Water Reactor Study Closed Cycle Water Reactor Study	vee					
2	8-5-64	AEC 1144/1	et					

SR&A-6. Closed Cycle Water Reactor

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August 5, 1964

AEC 1144/1

COPY NO. 51

AEC 1144/1

ATOMIC ENERGY COMMISSION

1000 MWE BOILING WATER REACTOR PLANT FEASIBILITY STUDY

Note by the Acting Secretary

The Assistant General Manager for Research and Development has requested that the attached memorandum from the Director of Reactor Development be circulated for the information of the Commission.

F. T. Hobbs
Acting Secretary

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8-5-64

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UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D. C.

July 30, 1964

MEMORANDUM

TO : A. R. Luedecke, General Manager

THRU : S. G. English, Assistant General Manager for Research and Development

FROM : Frank K. Pittman, Director
Division of Reactor Development

SUBJECT: 1000 MWe BOILING WATER REACTOR PLANT FEASIBILITY STUDY -- GEAP-4476

SYMBOL : RD:PCW:RMG

My memorandum of November 21, 1963* concerning the 1000 MWe Closed Cycle Water Reactor Study by the Westinghouse Electric Corporation indicated that a similar study was under contract with the General Electric Company to determine the feasibility of a 1000 MWe Boiling Water Reactor. This study has been completed and a copy of the final report (GEAP-4476) is attached for your information.

The General Electric Company, with the assistance of Ebasco Services, Inc., investigated the technical and economic feasibility of a 1000 MWe Nuclear Power Plant using one Boiling Water Reactor and compared this concept with a 1000 MWe plant using two identical reactors. The study assumed plant startup in 1968; therefore, no research and development effort was permitted. However, a brief investigation of an advanced system was carried out to determine what design improvements might reasonably be expected if startup were deferred two years and the cost of any required development. The estimated cost of the development program required for the advanced design is of the order of $5,000,000; the study was not meant to indicate that government support would necessarily be required.

The reference plant studied was a single reactor system with a non-reheat steam cycle. Three alternate designs also considered included: 1) single reactor with a reheat steam cycle, 2) twin reactors with non-reheat steam cycle, and 3) twin reactors with a reheat steam cycle. All plants include twin, half-capacity turbine-generator units to avoid extrapolation to a single 1000 MWe T-G, which GE did not consider realistic in the time period involved. It is presumed that the cost of a single unit would be less than the twin units when the former become available.

*Circulated as AEC 1144.

The study indicates that any of the four plant arrangements considered are feasible with no research and development and can be built with realistic extrapolation of equipment items in current product lines. The non-reheat steam cycles show an economic advantage (about 0.1 mill/kwh at 80% load factor) over the reheat cycles. Using Commission study ground rules, the estimated costs for the reference design involving a single reactor are $152 per installed KW and 4.93 mills/kwh. The twin reactor plant costs were estimated to be $154 per KW and 5.04 mills/kwh. The small indicated advantage for the single reactor plant could be negated if one assumes a slightly higher load factor for the twin reactor plant than for the reference design. This assumption could be justified on the basis of the indicated shorter refueling time for the twin reactor plant and its ability to run at half capacity under some circumstances that would require complete shutdown of the single reactor.

The costs of the plants studied would, of course, vary with the actual commercial applications of 1000 MWe plants due to variations in financing methods and indirect cost percentages of specific situations. The costs of large components, such as the single reactor plant pressure vessels, would be expected to decrease as actual fabricating experience is gained.

Attachment:*
GEAP-4476

*On file in the Division of Reactor Development.

DRo 1-6. Closed Cycle Water Reactor

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December 5, 1963

AEC 1144

COPY NO. 53

AEC 1144

ATOMIC ENERGY COMMISSION

1000 MWE CLOSED CYCLE WATER REACTOR STUDY

Note by the Secretary

The General Manager has requested that the attached memorandum from the Director, Division of Reactor Development, be circulated for the information of the Commission.

W. B. McCool

Secretary

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12-5-63

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OPTIONAL FORM NO. 10
5010-104

UNITED STATES GOVERNMENT

Memorandum

TO : A. R. Luedecke, General Manager
Office of the General Manager
Thru: Spofford G. English, AGMRD

DATE: NOV 21 1963

FROM : Frank K. Pittman, Director
Division of Reactor Development

SUBJECT: 1000 MWE CLOSED CYCLE WATER REACTOR STUDY

RD:PCW:RMG

Attached for your information is a copy of the 1000 MWe Closed Cycle Water Reactor Study prepared by the Westinghouse Electric Corporation under contract to the Atomic Energy Commission. In view of the general trend within the electric utility industry towards larger unit sizes and the apparent decrease in cost per kilowatt of capacity with increasing size for nuclear plants, we obtained the cooperation of Westinghouse in studying a nuclear plant of 1000 MWe capacity involving a single pressurized water reactor. The purpose was to establish the technical and economic feasibility of such a plant through preparation of a reference design. Potential problem areas were investigated and the research and development effort required for their solution estimated.

Fabrication of the large, thick-walled pressure vessel was considered most likely to be the limiting item. Therefore, Combustion Engineering Incorporated was requested to study the feasibility of fabricating a vessel having an inside diameter of 202 inches and a wall thickness of 14 inches and to provide a firm price and delivery schedule. It was concluded that field fabrication of such a vessel was not feasible or desirable, but that complete shop fabrication was feasible although several shop modifications would be required to successfully handle the operation. (This analysis does not take into account the fabrication techniques proposed by the Seed and Blanket study.) Combustion has a program underway to provide their Chatanooga, Tennessee plant with the capability of handling vessels weighing up to 1,000 tons and over 20 feet in diameter; the vessel described in the subject report has a weight of 615 tons. They have also established the feasibility of transporting such vessels by trailer; however, the over-all load height involved is in excess of most over-pass or bridge clearances. Combustion has successfully formed a 14 inch steel plate in a recent trial run and is now performing metallurgical examinations to assure its acceptability.

A further careful evaluation of the complete plant design and nuclear analysis led to the final conclusion that a 1000 MWe all-nuclear plant employing a single pressurized water reactor is technically feasible and economically practical. No fundamental technical difficulties were uncovered that are not amenable to solution. Total plant cost was estimated to be $165 per net KWe and total power cost to be less than 5.8 mills/KWh. It was estimated that a 5-1/2 year research and development program costing approximately $10 million would have to be carried out to permit commercial operation of this plant by 1970; most of the development required is in the area of physics and core design. Nothing in the study was meant to indicate that government support would necessarily be required.

It should be noted that the plant cost estimates were made according to the ground rules of the Commission's Nuclear Power Plant Cost Evaluation Handbook and may not correspond to individual utility or manufacturer's procedures. A similar effort is currently under contract with the General Electric Company; a report will be available next spring.

Attachment:
1000 MWe Closed Cycle
Water Reactor Study Report *

*On file in the Secretariat and Division of Reactor Development.
D.C.