

ENGINEERING RESEARCH INSTITUTE

UNIVERSITY OF MICHIGAN

Progress Report to:

OFFICE OF SHIP CONSTRUCTION AND REPAIR

MARITIME ADMINISTRATION

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Project 2419

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1.0 FOREWORD

This report is a description of work loads completed for the Maritime Administration, U. S. Department of Commerce, during the contract period of July 1, 1955 - June 30, 1956.

The scope of the work proposed June 22, 1955, entitled "Proposal - Engineering Services for Nuclear-Powered Merchant Ships, for the Office of Ship Construction and Repair, Maritime Administration," was organized into project tasks subject to the direction of J. J. McMullen, Chief, Office of Ship Construction and Repair, Maritime Administration, Washington, D. C. The project tasks had as their objective the engineering design and assistance to Maritime Administration for early achievement of nuclear power in merchant ships coupled with a sound, long-range program for several nuclear-powered merchant ships.

The completion of the work loads described under Section 3.0 of this report are regarded as fulfilling the requirements of contractual commitments entered into by the University of Michigan, Engineering Research Institute, with the Maritime Administration. In addition to contract commitments, a number of additional special tasks were completed as requested orally and in writing by Dr. J. J. McMullen, Chief, Office of Ship Construction and Repair. These tasks and the work executed in their fulfillment are described in Section 4.0 of this report.

2.0 COMMITMENTS TO BE MET BY UNIVERSITY OF MICHIGAN
TO CONTRACT MA-1079 - ERI-2419

The scope of the proposal submitted to the U. S. Maritime Administration and serving as a basis of contract MA-1079 between the University of Michigan and the U. S. Maritime Administration covered the technical engineering and design services offered in the form of project tasks.

It was intended that the engineering and design services rendered by the staff of the University be coordinated closely with the overall program of the Maritime Administration covering construction programs, technical research and development projects, and other technical activities relating to the government and private shipping lines.

The project tasks proposed are listed briefly below.

2.1 Project Task No. 1 - Personnel

The Engineering Research Institute and the University of Michigan proposed to assist the Maritime Administration in locating personnel with proper qualifications, evaluating such qualifications with job descriptions and assisting in recruitment of persons for the special projects division of the Office of Ship Construction and Repair.

2.2 Project Task No. 2 - Assistance in the Planning and Preparation of Fiscal Budgets

The general objectives of the engineering and design services offered under this project task consisted in the planning and preparation of estimates of ranges of total costs essential for the overall nuclear-powered merchant ship program.

2.3 Project Task No. 3 - Nuclear-Powered Tanker

It was proposed to evaluate continuously capital requirements and to project cost of operations to design and construction phases of ship-building for nuclear tankers. This project task consisted of comparative capital and cost estimates and evaluations of a series of tanker designs, utilizing nuclear power as well as conventional power.

2.4 Project Task No. 4 - Nuclear-Powered Passenger/Cargo Ship

The objective of this project task was to render engineering and design services to the Maritime Administration through stages of plans, specifications, engineering and construction in a nuclear-powered ship.

2.5 Project Task No. 5 - Design Assistance for the President's Ship

The project task outline for the services by the staff of the University of Michigan was to provide design assistance to the Maritime Administration to assure that the responsibilities of associated groups participating in the projected program were met and that sound engineering and economic practices were sustained.

2.6 Project Task No. 6 - Studies and Evaluations of Future Power Reactors

The objective of this project task was to undertake a program of activities which continuously determined the state of progress of many reactor programs, projected the technology to applications for merchant shipping and made recommendations to the Office of Ship Construction and Repair as to which developments offered promise of utilization in ships.

2.7 Project Task No. 7 - Loading and Unloading Facilities of Reactor Fuels for Nuclear-Powered Merchant Ships

It was proposed that design criteria and engineering philosophies of the University of Michigan would be helpful to the Maritime Administration for instituting programs of this nature to the organizations who are properly qualified to undertake such activities.

3.0 FULFILLMENT OF CONTRACT COMMITMENTS

This section describes the work submitted by the University of Michigan in the course of execution of work under contract MA-1079, ERI-2419. The submissions described below we regard as fulfilling contractual commitments entered into by the University of Michigan under the terms of this contract.

3.1 Project Task No. 1 - Personnel Suggestions

The letter of September 16, 1955, of H. A. Ohlgren to Dr. J. J. McMullen fulfilled the commitments for assistance to the Maritime Administration for technical nuclear personnel organization, suggestions and procurement.

Alternate types of organizations were suggested and the list of personnel whose qualifications would suit them for work in their suggested types of duties for the Maritime Administration's technical program were provided.

3.2 Project Task No. 2 - Budgets

A report was submitted on October 21, 1955, entitled "Budget Considerations for Nuclear-Powered Ships for the Maritime Administration, Project 2419." This report was part of the program of technical assistance by the University of Michigan to the Office of Ship Construction and Repair, Maritime Administration, U. S. Department of Commerce. This report contained overall budget estimate summaries, estimate of personnel additions to the Office of Ship Construction and Repair, nuclear power plant estimates for ship building program, estimates for research and development of high temperature nuclear reactor and optimum closed-cycle gas turbine, and development costs for remotely operated port facilities.

Attempts were made to arrive at ranges of budget estimates for component parts for this program extending over an initial five-year program.

3.3 Project Task No. 3 - Nuclear-Powered Tanker

The report 2419-1-T, "Economic Analysis of Nuclear Powered Tankers in Persian Gulf to East Coast Service" was submitted by Harry Benford and Francis G. Bartlett in January, 1956. This study dealt with overall economic analyses of nuclear-powered tanker designs with preliminary resolution of important cost parameters for this type of vessel.

This report discussed the economics of the tanker vs. other types of ships and the economics of alternate types of tanker designs employing

nuclear power. Certain preliminary economic conclusions were reached regarding desirable sizes and ranges and duties of such ships, and the details are set forth at greater length in the report proper.

3.4 Project Task No. 4 - Nuclear-Powered Passenger/Cargo Ship

The report 2419-2-T, Technical Report No. 2, "Comparison of Two Proposals for the Initial Installation of Nuclear Power in a Merchant Ship" was submitted by Harry Benford and Francis G. Bartlett, February, 1956. This report dealt with aspects of the clipper design and thus finishes a comparison of economic aspects of tanker design which have been studied to this time with an alternate type of merchant ship.

3.5 Project Task No. 5 - President's Ship

The President's ship was not reviewed as proposed in the scope of work for this contract by specific direction of the Office of Ship Construction and Repair.

3.6 Project Task No. 6 - Studies and Evaluations of Future Power Reactors

Previously under an earlier contract the report "Nuclear-Powered Merchant Ships - A Technical Summary Report of a Proposed Tanker Installation," by M. E. Weech, et al., was submitted July 1, 1955, and bore the number 2362-3-T, H. A. O. - 58. This study dealt with a pressurized water type of completely enriched fissioning reactor.

During the completion of contract commitments under this project task, studies were undertaken of the liquid metal fissioning type of reactor and closed-cycle gas turbine system.

A study was completed on a liquid metal fissioning reactor and included in a report entitled "A Technical and Economic Summary Report of a Liquid-Metal Fuel Reactor and Closed-Cycle Air Turbine Tanker Propulsion Unit," and numbered 2419-3-T, H. A. O. - 65, by J. G. Lewis, et al.

Work is now completed and in reproduction of a study of the aqueous homogeneous reactor for merchant tanker propulsion. This is report 2419-5-T, H. A. O. - 71, "A Technical and Economic Study of an Aqueous Homogeneous Reactor Marine Tanker Propulsion System," by J. G. Lewis, et al.

3.7 Project Task No. 7 - Loading and Unloading Facilities

Preliminary negotiations were undertaken with the mechanical division of General Mills, Inc., Minneapolis, Minnesota. This firm submitted proposal 10979-A, Radioactive Materials Handling Study, on August 15, 1955, to the University of Michigan. This proposal was not consummated

into contract and no detailed engineering studies on mechanical handling and remote loading and unloading dockside facilities were conducted.

A report was submitted entitled "Reactor Fuel Handling Facilities at Harbors and Docks for Nuclear-Powered Ships," dated March 20, 1956, by H. A. Ohlgren to the Maritime Administration. This report dealt with present shipyard and harbor facilities and considerations affecting the alteration of dockside facilities for the unloading of nuclear ships and possible ranges of expenditures for such facilities.

4.0 SUPPLEMENTARY WORK COMPLETED BY REQUEST OF
OFFICE OF SHIP CONSTRUCTION AND REPAIR

Several tasks in addition to contract commitments were requested by the Office of Ship Construction and Repair, Maritime Administration, during the fiscal year and were completed as requested. These special tasks are described as follows.

4.1 Special Task No. 1 - Progress Report on Activities in Maritime Administration

On September 30, 1955, a report was submitted entitled "Nuclear Propulsion for Merchant Vessels Activities and Programs of the Maritime Administration - Progress Report to September 30, 1955." This report described general activities of the Maritime Administration in the field of nuclear merchant ship study programs and construction objectives to the Joint Committee for Atomic Energy. This report dealt with the general scope of study types of reactors under consideration and general objectives of the Maritime Administration in the nuclear-powered ship program.

4.2 Special Task No. 2 - Agenda to the House Merchant Marine and Fisheries Committee

At the request of J. J. McMullen a rough draft was submitted entitled "Agenda, Nuclear-Propulsion for Merchant Ships to the Merchant Marine and Fisheries Committee, October 15, 1955." This agenda, based on recommendations of Dr. McMullen, suggested some phases of present legislation which might be clarified to assist in the development of a commercial merchant fleet propelled by nuclear power.

4.3 Special Task No. 3 - Proposal Specifications for Nuclear Propulsion Systems

At the request of Dr. J. J. McMullen, work was undertaken to prepare specifications which would serve as a basis for the negotiation of study contracts and construction proposals by American industries for nuclear-powered ships of both a type which might be constructed in the near future and those which might require some development.

In conformity with this request, the following transmittals were prepared in cooperation with the personnel of the Office of Ship Construction and Repair.

"General Description of Task for the Construction and Engineering Study of Nuclear Propulsion Systems for a Commercial Tanker," submitted November 1, 1955.

"Invitation for Proposals-Project: Construction of a Nuclear Propulsion System for a Commercial Tanker and Studies for Economically Competitive Marine Nuclear-Propulsion Systems."

Suggested letter of transmittal for the above two items.

4.4 Special Task No. 4 - Evaluation of Proposals Received as a Result of Invitations Issued Based on Transmittals of Special Task No. 3

In March, 1956, at the request of the Office of Ship Construction and Repair, a group of personnel of the University of Michigan Engineering Research Institute spent one week in the offices of the Maritime Administration in Washington, D. C., reviewing a total of thirteen proposals which were received regarding construction or study of nuclear propulsion systems for merchant ships. A special series of forms was prepared for this task to facilitate review of the proposals received. These forms were intended generally to gauge the adherence of the contractors to the terms of the general description of task and of the invitation for proposals described under Special Task No. 3.

4.5 Special Task No. 5 - Report on Evaluation of Proposals

At the request of the Office of Ship Construction and Repair a special report was prepared covering the results of the proposal review of Special Task No. 4. A report was submitted entitled "Reviews of Proposals Submitted to Maritime Administration for Nuclear-Powered Ships," No. 2419-4-P, H. A. O. - 66, by H. A. Ohlgren, H. B. Benford, and J. G. Lewis, submitted May 2, 1956. This report generally summarized the details of the proposals submitted as described by the bidders and reviewed some of the background and other present commitments of the bidders based on information of the proposals.

4.6 Special Task No. 6 - Preparation of Rough Draft, Letters of Inquiry to Bidders

At the request of Dr. J. J. McMullen, a set of eleven rough draft letters were prepared for consideration for transmission to firms submitting proposals in response to the papers prepared under Special Task No. 3. These letters were for the purpose of clarifying the intent and scope of the various proposals and were transmitted to the Maritime Administration on May 17, 1956.

In addition to the transmittals mentioned above, numerous other communications were provided the Office of Ship Construction and Repair by way of reporting current progress on work accomplished. Minutes of the weekly meetings of the University of Michigan staff and faculty group conducting work on the contract for the Office of Ship Construction and Repair were provided currently during the progress of work. Reports of trips taken by University of Michigan personnel for contract work were transmitted to the Office of Ship Construction and Repair as the trips were completed.

5.0 LIST OF TRANSMITTALS COMPLETED DURING CONTRACT WORK

Following is a list of the transmittals provided to the Office of Ship Construction and Repair during the course of the contract work and as mentioned in detail above.

2419-1-T

"Economic Analysis of Nuclear Powered Tankers in Persian Gulf to East Coast Service."

Harry Benford, Francis G. Bartlett; January, 1956.

2419-2-T

"Comparison of Two Proposals for the Initial Installation of Nuclear Power in a Merchant Ship (Duplicate STR in Clipper vs. Modified STR in Tanker)."

Harry Benford, Francis G. Bartlett; February, 1956.

2419-3-T

"A Technical and Economic Summary Report of a Liquid-Metal Fuel Reactor and Closed Cycle Air Turbine Tanker Propulsion Unit."

J. G. Lewis, et al.; July, 1956.

2419-4-P

"Reviews of Proposals Submitted to Maritime Administration for Nuclear Powered Ships."

H. A. Ohlgren, H. B. Benford, J. G. Lewis; May 2, 1956.

2419-5-T

"A Technical and Economic Study of an Aqueous Homogeneous Reactor Marine Tanker Propulsion System."

J. G. Lewis, et al.; July 15, 1956.

2419-6-P

"Progress Report to: Office of Ship Construction and Repair, Maritime Administration."

H. A. Ohlgren; July, 1956.

September 16, 1955

Letter of H. A. Ohlgren to Dr. J. J. McMullen, suggesting names, organization, and procurement of technical nuclear personnel.

September 30, 1955

Progress Report - "Nuclear Propulsion for Merchant Vessels - Activities and Programs of the Maritime Administration.

October 15, 1955

"Agenda, Nuclear Propulsion for Merchant Ships to the Merchant Marine and Fisheries Committee."

October 21, 1955

"Budget Considerations for Nuclear-Powered Ships for the Maritime Administration."

H. A. Ohlgren

November 1, 1955

General Description of Task for the Construction and Engineering Study of Nuclear Propulsion Systems for a Commercial Tanker.

November 1, 1955

Invitation for Proposals

Project: Construction of a Nuclear Propulsion System for a Commercial Tanker and Studies for Economically Competitive Marine Nuclear Propulsion System.

November 1, 1955

Suggested Letter of Transmittal for General Description of Task and Invitation for Proposals.

March 20, 1956

"Reactor Fuel Handling Facilities at Harbors and Docks for Nuclear Powered Ships."

H. A. Ohlgren

May 17, 1956

Rough Drafts of Eleven Letters for Consideration for Transmittal to Firms Submitting Proposals for Construction or Study Contracts.

H. A. Ohlgren

June 25, 1956

Rough Draft of a Paper - "Trends on the Nuclear Propulsion of Merchant Ships."

July, 1956

Background Information and Special Charts on Installed Costs of Conventional and Nuclear Land-Based Power Plants.

H. A. Ohlgren

Minutes on Current Basis of Weekly Technical Meetings of Faculty and Staff Groups.

Trip Reports on Current Basis of Travel Undertaken for Completion of Contract Business.

