INTERATOM AWARDED DESIGN CONTRACT FOR OMR-POWERED MERCHANT VESSEL

As agreement for the design and development of an Organic Reactor for propulsion of a nuclear-powered maritime tanker was reached recently between INTERATOM, the affiliate of Atomic International in Bethesda, West Germany, and Gesellschaft fuer Kernenergie in Schiffbau und Schiffahrt (Company for Atomic Powered Ship Development).

The German ship development company is composed of a group of private businesses and was formed last year in West Germany federal and state governments, who jointly provided funds for the development contract.

INTERATOM is a jointly-owned international company in the German nuclear field and was formed in December 1957 by Atomics International and DEMAAG AG, of West Germany, DEMAAG AG, with headquarters in Dussburg, is a leading European organization with wide experience in the design and manufacture of heavy machinery and equipment, and in the engineering and installations of chemical, steel, and similar plants.

Two And One-Half Year Study

The initial contract calls for a two and one-half year design and development period toward the construction of a prototype power plant which is planned as a fore-runner of larger reactors. The ship reactor design is for 10,000 shaft horsepower, capable of propelling tankers up to 40,000 deadweight tons.

Two Plans Considered

At present there are two plans being considered to build the prototype reactor after development work has been completed. One is to install the reactor under actual operating conditions on land near Hamburg, and the other is to construct the reactor aboard a ship of sufficient tonnage already capable of accommodating the Organic Reactor.

Many Advantages for Ship Propulsion

The Organic Reactor concept represents more than six years of intensive effort by Atomics International in developing it to where it is widely considered one of the safest and most economical systems.

The reactor produces the structural shielding weight—a prime factor in reactor costs. It consists of a simple system consisting of a heterogeneous reactor in which the fuel elements are surrounded by a high-boiling point liquid which serves as both the moderator and the heat-exchange medium.

The Organic Reactor is hydrocarbon-moderated, which results in compact core sizes requiring low structural material and shielding weight—a prime factor for tankers to increase shipping payloads. As a result of the low operating pressure, the Organic Reactor contains a minimum of stored energy, adding to its inherent safety.

Previous Marine Study By Al

Atomics International, in 1957, completed a design study of a 38,000-ton tanker for the Maritime Reactors Branch of the U.S. Atomic Energy Commission. In this study, a 70,000-horsepower reactor was to provide power for a 20,000-ton ship's main unit and all shipboard requirements. The scope of work on this project included the preparation of data on the ship's design and the nuclear power plant, as well as an economic analysis of the operation.

Additional Endorsement

Additional endorsement of the Organic Reactor for ship propulsion was made at the recent AEC-Maritime Administration Symposium on nuclear propulsion held last August in Washington, D.C. In the report of an AEC-sponsored 12-month study by an independent engineering organization on the "Economics of Nuclear and Conventional Merchant Ships," it was stated that the Organic Reactor was "the nuclear power plant with the least expected reactor system and least expensive propulsion system."
Organic Reactor Progress Impressive

Worldwide Interest Created By Reactor's Various Applications

The extensive strides made in developing the Organic Reactor as a safe, reliable, and economical system for both large and small nuclear power plants, for marine propulsion, and for process steam and process heat plants, continue to create worldwide interest in the concept.

Organic Reactor Highlights

In February, 1958, Dr. Chauncey Starr, General Manager of Atomics International, said the Joint Congressional Committee on Atomic Energy that the OMRE results were so promising that the Organic Reactor would become one of the very real contenders in producing economical power.

A month later, in March, 1958, a successful three-week test was conducted at the OMRE with bulk coolant temperature raised to 200°F, confirming thermal stability predictions on the organic fluid. The U.S. AEC reported the test to Congress as follows: "If radiation damage to the organic coolant proves not to be excessive, we have an additional reactor concept which can be exploited in full-scale plants with minimum development work."

Piqua OMR Plant

In May, 1948, the U.S. AEC announced that it had reached agreement on the basis of contractual arrangements with Atomics International and the City of Piqua, Ohio, for a demonstration OMR power plant. The project was to include research, development, fabrication, and construction of a 11400-kw Organic Reactor. The U.S. AEC also reported that the quoted price per kilowatt for the Piqua OMR was approximately less than actual or estimated capital cost of any known nuclear power plant of comparable size.

Steady Progress Reported

By June, 1958, the OMRE had completed its first extensive power run with a remarkable 85% on-line time. Operations at 305°F high bolling points confirmed that no significant heat-transfer loss occurred and that makeup requirements actually decreased.

At a nuclear conference in Rome, Italy, in June, Dr. S. Siegert, Technical Director of Atomics International, reported the completion of a study which indicated that an organic reactor can be designed to operate on a phenolamine fuel cycle using natural uranium feed.

In July, 1958, a letter by Dr. Starr to the United States Atomic Energy Commission which was published in the Congressional Hearings before the Joint Committee on Atomic Energy on the proposed EURATOM program, stated in part: "...at this time, the more than six months of unusually successful operation of the OMRE have demonstrated that the radiation stability of the terphenyls is better than was expected from previous 'in-pile', small-scale results."

By August, 1958, the Organic Reactor was included in the Euratom program as one of three "proven-type" reactors. Additional recognition was given in a major study to evaluate large-scale, organic-cooled reactors to determine the optimum size and design. Plant capacities up to 300,000 electrical kilowatts are being considered.

OMR-Powered Ship

In February, 1959, a design contract was announced for an OMR-powered marine tanker between INTERATOM, the affiliate of Atomics International in West Germany, and Gesellschaft fuer Kernenergie in Shipyard and Schiffsbaude (Company for Atomic Powered Ship Development).

Approved Piqua Site For OMR Plant

Also in February, 1959, John A. McCoy, Chairman of the U.S. AEC, announced that the Commission would proceed with the construction of an organic moderated and cooled reactor at the newly selected site in Piqua, Ohio, in view of the Commission's belief that the Organic Reactor Concept has promise for the achievement of economic nuclear power.

Organic Reactor Power Plants

In addition to the 11400-kilowatt OMR nuclear power plant for the City of Piqua, Ohio, for which the final design is being completed by Atomics International, designs for larger 150,000 electrical-kilowatt organic power plants have been made. Several proposals for this size plant are now being considered in Europe.

Process Steam Applications

Concurrently with these developments, Dr. Starr, in his address before the Royal Swedish Academy of Engineering Sciences in Stockholm on January 28, 1959, pointed out that a number of OMZ designs for European process steam applications had been examined by Atomics International. The OMRE has studied three reactor sizes of 25, 50, and 75 megawatts, primarily based on the Piqua-type design.

The cost of process steam from these plants varies with reactor power level for the three designs, ranging from around $2.00 per metric ton of steam for the 25 Mw reactor down to about $1.60 per metric ton for the 75 Mw reactor. This compares with $2.25 per metric ton for steam from conventional fuels in the European area.

In summary, Dr. Starr pointed out that the future market for industrial heat is certainly an expanding one. A number of locations offer good promise for economically-competitive nuclear heat to produce low temperature steam for industrial use, and Organic Reactor designs appear especially attractive for the production of such heat. "Technical and economic considerations of nuclear process heat applications demand further investigation and construction of prototype plants," Dr. Starr said.

Thus, the intensive effort made by Atomics Internation in developing the Organic Reactor concept promises a bright future potential for the system in its applications-for small and large nuclear power plants, nuclear-powered merchant ships, and for process steam and process heat plants.

IN THE CONTROL ROOM OF THE OMRE—left to right: Mr. Joseph Rogers, President of Interatom, Mr. Einar Modin, vice-president of EURATOM, Paul de Groote, Head of research and development division for ASEA (Sweden), and Mr. Harold Lander, vice-president of ASEA.

CONCEPTION OF 150,000-KW ORGANIC REACTOR PLANT OF THE TYPE CURRENTLY UNDER CONSIDERATION IN EUROPE.
11 Million Kw Hours Generated From Sodium Reactor Experiment

On January 29, 1959, the Sodium Reactor Experiment completed its eighth power generation run. The reactor has now accumulated a total of 1750 megawatt-days of operation, during which 10,925,000 kilowatt-hours of electric power have been generated. The turbine-generator has been "on the line" during 2,323 of these operating hours on the sodium pumps has been 13,000 hours.

Typical operating conditions for the reactor and steam generator are:

- Reactor sodium out: 90°F
- Reactor sodium in: 510°F
- Steam generator sodium out: 405°F
- Steam generator sodium in: 635°F
- Steam temperature: 770°F
- Steam pressure: 600 psig
- Electrical power: 5,000 Kw
- Gross thermal efficiency: 29%

The reactor has been found to have a fast response to power changes, and the negative temperature coefficient and a negative power coefficient. The resultant stability of the reactor is noteworthy. During a recent power run, integrating timers on the automatic control system showed that the rods were in motion only 3.5 minutes in 144 hours to maintain steady state full-power operation. The reactor can be completely shut down and restarted in 21½ minutes. More detailed studies indicate that even this high rate of change can be increased markedly.

Extensive physics experiments using both the "classical" and the oscillator techniques have established the accuracy of the methods used to calculate the reactor parameters. Power oscillator tests have permitted the establishment of fuel-rod parameters such as control rod calibrations, temperature coefficients and power coefficients to very close tolerances. The latter technique promises to offer considerable saving of time in the initial startup of new nuclear power plants.

Sodium Purity

Through fuel transfers, experiments, maintenance and modifications, requiring penetrations into sodium containment vessels, oxide from any air which entered has been readily removed by cold traps and hot traps. In the initial sodium filling of the reactor systems, only 20 parts per million of oxides were measured in the sodium prior to any effort to remove them. During reactor operation, the oxides in the primary sodium system can be maintained well below 10 parts per million by continuous operations of the hot traps. The tightness of the piping and vessel system is evidenced by the fact that the oxide concentration of the sodium remained below 5 parts per million during a one week period in which neither the hot trap nor the cold trap was operated.

Fuel Elements

In addition to power generation, maximum utilization of the reactor has been made in experimental work to establish and promote the technology of this reactor concept. One of the primary experiments has been with reactor fuel materials and fuel geometries. These tests are being conducted on many types of fuels simultaneously. One of the fuel elements recently examined which had a power history of 600 MWd/T average and 1000 MWD/T at the maximum flux region of the element had suffered no dimensional changes in the rods.

During the experimental fuels program, more than 1,000 core elements transfers have been effected without incident with the fuel handling cask and have at all times maintained an inert atmosphere in the cask and in the reactor when their atmospheres were mutually connected. It is of interest that the use of sodium as a coolant permits selection from among a wide variety of fuel element materials, since sodium is compatible with most metals.

Proven Concept

The sodium graphite reactor concept has been proven by operation of the SRE in conjunction with the standard steam turbine electrical generating plant of the Southern California Edison Company. New methods and modifications now planned will further improve the reactor steam conditions which have been attained to compare even more favorably with those of the most modern utility plants.

Since sodium has a low vapor pressure at the temperature achieved in modern steam plants, a costly pressure vessel and thick-walled piping are not required in the construction of the plant.
L-77 LABORATORY REACTOR FOR UNIVERSITY OF WYOMING

First Reactor Purchase For State

An Atomics International L-77 Laboratory Reactor has been purchased by the University of Wyoming at Laramie, Wyoming, and is now in operation.

The L-77 is the first nuclear reactor to be installed in the State of Wyoming and will be used in graduate study programs in reactor engineering and technology, radiation chemistry, and reactor physics. The reactor will also be used to produce radioactive isotopes for research in the Schools of Agriculture, Pharmacy, Arts and Sciences, the College of Engineering, and the Natural Resources Research Institute.

Safe, Easy Operation

Dr. Carl A. Cinnamon, professor of physics at the University, stated that "The reactor will benefit Wyoming by helping the State keep abreast of the times in this new adjunct to education. We are delighted," he added, "with the ease of operation of this reactor, its inherent safety features, and its design capability of going to higher power at very little additional expense."

Dr. Cinnamon and Richard Coo, assistant professor of Mechanical Engineering at the university, received instruction and checkout with an L-77 Laboratory Reactor in operation at Atomics International's facilities. Both are licensed to operate the reactor at the university.

INTERATOM Moves to New Provisional Headquarters

INTERATOM, the affiliate of Atomics International in West Germany, moved to new provisional offices in Bensberg near Cologne on December 15, 1958.

The new provisional offices are located in the picturesque Castle of Bensberg about a mile from the site in the thickly wooded hills east of the historical city of Cologne where INTERATOM's permanent headquarters are planned. The town of Bensberg is embedded in the forests of the mountainous region east of the Rhine river.

INTERATOM Intemationale Atomreaktorbau GmbH, designs and manufactures nuclear power and research reactors and related products, and promotes sales abroad and subcontracting activities. INTERATOM was formed in December 1957 by Atomics International and DEMAG AG of West Germany.

INTERATOM'S NEW PROVISIONAL HEADQUARTERS at Bensberg, near Cologne in West Germany. Permanent offices are planned on a site nearby.

FRENCH RADIATION SAFETY STUDY GROUP on visit to Atomics International's facilities, prepares for discussion in room in which At's L-77 Laboratory Reactor is in operation.