BOON TO SOCIETY:

THE LMFBR

The world can reap tremendous benefits in terms of greatly increased energy resources from the liquid-metal fast breeder reactor (LMFBR). Here's a rundown based on the Westinghouse design prepared during the project definition phase of the LMFBR demonstration program of the U. S. AEC.

R. J. CREAGAN[1]

Westinghouse Electric Corp., East Pittsburgh, Pa.

Society on a worldwide basis will benefit from decisions now being made by industry and government with respect to development of the liquid-metal fast breeder reactor, which will be implemented in the 1970s in the U. S., England, Russia, France, Germany, and Japan.

How will society benefit? Stated simply, the LMFBR converts more of the heat it produces to electricity than water reactors because of its greater thermodynamic efficiency—40 percent compared with about 30 percent for the light-water reactor. It has a thermal discharge of 4800 Btu/kwh versus 6600 for the light-water reactor. This is approximately 30 percent less heat rejection to the environment for an LMFBR than for a water reactor. Since neither water nor LMFBR reactors will release noxious chemicals, thermal discharge is the principal difference in environmental effect between the two types of reactors. Other than heat rejections, the nuclear plant has essentially zero effect upon its environment, and thus is indeed a good neighbor and a benefit to society.

Seven LMFBRs are currently operable, six are under construction, and nine are in the planning stages. As an indication of the intensity of international efforts, the planned expenditures for LMFBR development programs for the various countries and their gross national products are listed in Table 1.

Another measure of LMFBR importance in the U. S. is project cash flow, which will be approximately $500 million for the first demonstration plant from 1972 through 1978. Later, about 3000 MWe of LMFBR capacity will be committed in the 1970s, which at $400 per kw is a billion dollars.

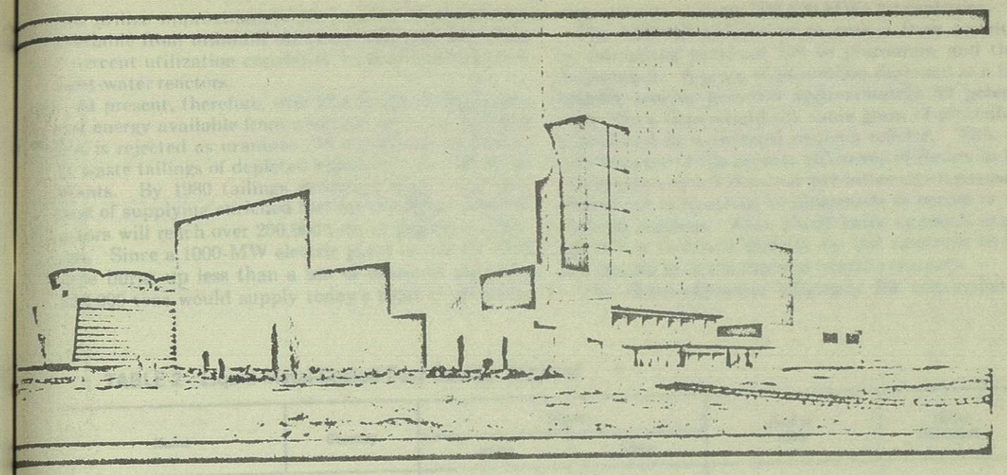
As evidence of U. S. LMFBR policy, President Nixon, in his June 4, 1971, energy message to Congress, stated that "our best hope today for meeting the nation's growing demand for economical, clean energy lies with the fast breeder reactor." The president further gave a commitment to complete successful demonstration of the LMFBR by 1980, and

[1] Manager, R&D Planning.

Based on a paper contributed by the ASME Aerospace Division.

TABLE 1 National Investments in LMFBR

	Country					
	U. S.	U.S.S.R.	France	U. K.	Japan	Germany
LMFBR/year ($ millions)	200	200	100	70	50	30
1972 GNP ($ billions)	1113	538	162	128	232	195
Percentage of GNP	0.018%	0.04%	0.06%	0.055%	0.02%	0.015%



later (Sept. 26, 1971) in a speech at Hanford, Wash., indicated that there should be two demonstration plants.

Financial benefits to society from the LMFBR might best be summarized by an AEC cost–benefit analysis which indicates benefits to the nation over a 34-year period of $21.5 billion, discounted at 7 percent to mid-1971. Other specific LMFBR benefits to society will be described in the sections that follow.

The Plans for LMFBR Plants

World status and plans for LMFBR power plants are given in Table 2,[2] which lists LMFBR projects that are operable (7), under construction (6), planned (9), and decommissioned (4), with country location, megawatts thermal and electric, and initial operation date. Table 2 also shows whether a loop or pool configuration is used.

Present plans for the U. S. LMFBR program in the 1970s consist of completion of the 400-MWt Fast Flux Test Facility (FFTF) on the AEC's Hanford Reservation in the state of Washington. It will not produce electric power but will reject heat to an air heat exchanger. Its development will provide base technology applicable to LMFBRs and associated industry experience needed in order to supply the components and systems for such a plant. The reactor will contain closed loops for advanced fuel tests, which will be isolated from process sodium in the main reactor coolant loop so that test failures will not harm the reactor.

In addition to FFTF, the highest priority U. S. LMFBR program for the 1970s is construction of the two demonstration plants mentioned by President Nixon.

The request for proposal for the first demonstration plant specified a power level between 800 and 950 MWt (approximately 350 MWe). Approximately $400,000,000 has been committed for development, design, construction, and testing of this project by the Atomic Energy Commission, the utility industry, and the future owner-operators, TVA and Commonwealth Edison.

Power output for the second demonstration breeder reactor has not yet been specified, but the unit will probably be larger, with authorization arranged after the first demonstration plant is committed for construction and funding. AEC authority under the project definition phase permits some work on a second plant. The ultimate objective of the cooperative government–utility–industry program is to develop a competitive, viable, and economic industry in the U. S.

In contrast to the lead which the U. S. had in water-reactor technology, we now have comparable technology in the sodium-reactor field with Russia, England, and France but are behind them in plant construction schedules.

Worldwide interest and investment is motivated by LMFBR ability to provide essentially limitless electric energy from fuel which can be imported easily and self-generated. The LMFBR does not place the country using it at a political or economic disadvantage with respect to another country by requiring a continuing supply of either large amounts of raw material or an isotope separation process, as is the case with enriched-uranium reactors.

Available Nuclear Energy

The most important long-term advantage of the breeder is the increase in available energy it provides from nuclear resources. The fact that such additional energy is required is indicated by Table 3, which shows the growth in energy requirements as the population of the U. S. increases and more power is consumed per person. A similar pattern will be followed throughout the world with a greater percentage increase in developing countries.

The LMFBR will provide more energy because it

[2] Figs. 1 and 2 and Tables 2 and 3 are from a statement of Milton Shaw of the AEC at FY 1973 authorization hearings before the Joint Committee on Atomic Energy, Feb. 22, 1972.