CONF-800943--7

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THE ROLE OF THE CONSOLIDATED FUEL REPROCESSING PROGRAM IN THE UNITED STATES BREEDER REACTOR PROGRAM

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To be presented at the American Nuclear Society Topical Meeting, "Fuel Cycles for the Eighties," to be held September 29-October 2, 1980, Gatlinburg, Tennessee.

*Operated by Union Carbide Corporation for the U.S. Department of Energy.

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Introduction: Historical Perspective on Breeder Development

For over two decades, the United States has been developing Liquid-Metal Fast Breeder Reactors as ensurance for the time when uranium supplies are no longer adequate to fuel present light-water reactors. Although most of the effort has been devoted to reactor systems, a limited R&D program to develop the fuel cycle has been carried out over the past five to ten years. The limited program was considered adequate until the past few years because it appeared that breeder recycle would be a straightforward evolution from an emerging commercial LWR recycle industry. A more comprehensive program to develop and demonstrate breeder reprocessing and recycle has been devised and implement over the past four years as a follow-on to the initial stated U.S. policy[1] to carry forward a program that would include major pilot plant demonstration.

*Research sponsored by the Division of Nuclear Power Development, U.S. Department of Energy under contract W-7405-eng-26 with the Union Carbide Corporation.

Impact of INFCE and NASAP — Present U.S. Nuclear Strategy

It is not possible to give a clear and unambiguous description of the present U.S. nuclear strategy at this time because of the ongoing controversy surrounding the pace of breeder development and whether to build the Clinch River Reactor; the still-emerging effects of Three-Mile Island; and the negotiating effort underway, but still not completed, to summarize worldwide nuclear positions and strategies via the International Nuclear Fuel Cycle Evaluation (INFCE). Nevertheless, some fundamental positions and directions seem to have been clarified in conjunction with the two-year series of studies conducted as part of the INFCE and the companion domestic NASAP. The studies confirmed the merits of the conventional U-Pu cycle, but failed to find significant resource utilization, proliferation resistance, or any economic advantages for the Th-^{233}U cycle. Continuing trends toward decreases in energy consumption and electric power usage appear to diminish the need for nuclear power and to put off the time when breeders are needed; at the same time, most of the industrialized world see no alternates to nuclear power in the next 50 years — and that period seems to include the time when breeders must be brought on-line as uranium supplies diminish. At present, the need for the plutonium recycle in thermal reactors is not generally supported. Instead, plutonium is seen as most needed for breeder fuel. Opposing views on the future use of breeders can be summarized as follows: Those who see no need for near-term programs to develop and demonstrate breeders believe the incentives or needs for

commercial breeders cannot emerge before the period 2010-2020. The breeder advocates, on the other hand, see the need for near-term positive steps to build demonstration reactors and fuel cycle plants for operation and testing in the 1990s so that commercial systems could be initiated around the turn of the century.

Recycle — An Absolute for Breeder Systems

While present U.S. policy precludes the commercial reprocessing of LWR fuels and the recycle of plutonium, the policy does encompass the need to continue a program to develop the technology for reprocessing breeder fuels. Some questions have again risen this year as to the pace of the entire breeder program, including recycle, and the answers are evolving. This paper and the other companion papers at this meeting which describe several aspects of the Consolidated Fuel Reprocessing Program take a longer-range perspective on the total program. Whether the program is implemented in the general time frame described is dependent on future government actions dedicated to carrying out a systematic program that would permit breeders to be commercialized early in the next century.

The Reprocessing R&D Strategy

The U.S. reprocessing R&D strategy is a comprehensive, phased program evolving from flowsheet development, which includes small-scale hot-cell

tests through bench-scale and prototype equipment development for critical processes, a cold prototype Integrated Equipment Test (IET) now under construction, and hot demonstration in a pilot-plant-scale Hot Experimental Facility (HEF) concurrent with the operation of the first demonstration breeder reactor.[2] These phases are described in more detail in three companion papers at this conference. Reprocessing is to be done with the coprocessing option of the Purex flowsheet, following a chop-leach head-end step. Treatment of off-gas streams to retain the gaseous fission products is planned in a remotely operated and maintained facility which would significantly reduce worker exposure.

Role of the IET Facility

The IET facility will provide a test bed for a comprehensive development program for the remote technology needed. In this facility, over the next three to five years, complex mechanical head-end equipment will be operated in an integrated mode for the first time. The equipment is at the same scale or capacity as the future HEF (0.5 ton/day) which is about one-tenth commercial scale.

Role of the HEF

When the first breeder demonstration reactor is operated, it is essential that capability exist to reprocess and recycle the spent

fuel; therefore, plans are developing rapidly for a major pilot-scale facility to perform that task. The HEF is now in the final stages of conceptual design, although, of course, neither the breeder demo nor the HEF has yet been authorized by Congress. The HEF will use a facility concept derived from the remote canyon concepts of U.S. production plants but with a significant degree of sophistication of the remote technology. The concept, termed Romotex, is described in another paper. In addition to the concurrent reclamation and recycle of the demo reactor fuel, the objectives of the HEF include the demonstration of (1) efficient chemical recovery flowsheets, (2) low emissions to give the equivalent of 1 mR/year fence post dose from full-scale plants, (3) low worker exposures, (4) acceptable waste handling techniques, (5) upgraded and acceptable safeguards, (6) significant progress toward satisfying regulatory and licensing requirements, and (7) attributes which improve the proliferation resistance of reprocessing plants.

References

1. International Atomic Energy Agency (IAEA) Advisory Group Meeting on LMFBR Fuel Reprocessing, May 17-21, 1976, Leningrad, USSR.

2. W. D. Burch and W. S. Groenier, "Fast Reactor Fuel Reprocessing Development in the United States - An Overview," Fast Reactor Fuel Reprocessing Conference, May 15-18, 1979, Dounreay, Scotland.