Letters

Breeder Reactor Policy

While the articles by William D. Metz on European breeder reactors (Research News, 26 Dec., 30 Jan., 13 Feb.) constitute a generally informed and incisive piece of technical reporting, it seems worthwhile to qualify some points which are left ambiguous in an otherwise excellent series.

With respect to the enthusiasm of U.S. utilities for breeder reactors, utilities representing over 85 percent of the generating capacity of the United States have contributed to a series of breeder reactor development and construction projects, including the pioneering safety test reactor SEFOR, the Clinch River Project (over $250 million plus a plant engineering team), and half the funding for a $30 million design study of a prototype large breeder, a joint effort of the Electric Power Research Institute (EPRI) and the Energy Research and Development Administration (ERDA).

With respect to the U.S. policy of encouraging development of breeder technology by private industry, since 1970 development leadership has been centered in the Atomic Energy Commission (AEC)—now ERDA—which opted for a centralized federal program with the Fast Flux Test Facility as its cornerstone. World leadership in breeder reactor technology, development, design analysis, safety testing and analysis, and fuel has clearly resided in the United States, at least until recently. The designs of the French, British, Russian, and German prototypes embody many of the major design options and components that were being developed by the three competitive design teams in the United States in the late 1960's.

Nuclear power is highly attractive as a source of long-term, low-cost power from the standpoint of the consumer and the utilities. However, from the manufacturer's standpoint, many elements of industrial nuclear power have been rendered uncertain for some years to come by unresolved regulatory and environmental issues. Long-range planning and development on the scale required to launch a breeder reactor on a commercial basis has been essentially precluded in the United States since about 1971. The current ERDA-EPRI design study is founded on the expectation that the key questions of federal and regulatory policies will be resolved on a timely basis.

Reprocessing technology also has been subject to more procedural and financial than technical uncertainties. Except for the initial mechanical and dissolving steps, the chemical processes for mixed core and blanket breeder fuel are closely similar to the fuel reprocessing technologies which have been practiced successfully for large-scale production in government facilities for over 20 years in the United States, Russia, France, and Britain.

The questions raised about U.S. government policy on fabrication and reprocessing—scheduling large sums for pilot facilities—are appropriate, especially in view of the Europeans' policy, which is to build large-scale production facilities with similar costs and schedules. As the new management structure in ERDA takes hold, it is hoped that this issue will be resolved by assigning firm responsibility for production missions to "in-house" facilities or by assigning such work to industrial organizations who will accept responsibility for attaining regular production.

Short doubling times have been considered paramount objectives of breeder reactor development by the AEC and ERDA for two reasons, both of which are now largely inapplicable. The first is that designers have been forced to seek high breeding rates to offer some prospect of competitiveness with the low cost of fossil fuels and light water reactor fuel in the 1960's. This constraint has changed, since the cost of fossil fuels is now five to ten times higher than it was in the 1960's (and will be still higher in the 1980's). High breeding rates have also been considered important to ensure a sufficiently rapid buildup of the plutonium supply to permit installation of breeders at a high enough rate to supply a significant part of U.S. energy within, say, 25 years. It is now expected that sufficient plutonium will be produced from the light water reactors currently operating and under construction to feed breeders constructed at any credible rate until at least the year 2005. Short doubling time for reactor cores built in the 20th century is therefore not essential and may not be desirable if it requires giving up an appreciable element of reliability, safety, or convenience of operation of plant or fuel. The French have also given priority to convenience of operability over short doubling times. The concern about the effect of metal swelling in the core on the attainment of short doubling times is offset by the recent favorable results with low swelling materials. These results have been obtained in laboratories in the United States, Britain, France, and Russia.

Since the core region must be fully replaceable, the option of later core designs for higher breeding gain is not foreclosed. This approach also helps bridge the paralysis of policy on uranium resources. There are paradoxical arguments that we have hypothetical uranium *resources* which are too large to require early deployment of the breeder but that proven *reserves* are too small to support the growth of light water reactors.

There is no technical reason why the capital costs of breeders should be inherently higher than those of light water reactors, or why they might not be lower at a comparable stage of development. The overall costs of large light water reactor plants ordered since 1974 are now dominated by the costs of time and delay—nearly 55 percent is interest during construction plus escalation. Both the capital cost of the plant and the operating cost are increasingly being driven by one basic technological factor; the need to assure—and to continue to demonstrate and document—ever-increasing levels of assurance of primary pressure boundary integrity. This includes the pressure vessel, piping, and the associated pressure systems for emergency core cooling. In this context, the relatively modest cost escalation of the European breeder projects is highly encouraging relative to the escalation experienced by more conventional technologies as they approach significant application.

In the 20th century, the prime significance of a breeder—even with modest breeding gain—*is its total independence from future supply or costs of uranium and isotope separation.*

One view of the basic significance of the overseas progress on the breeder is worth stating explicitly. Seven developed nations (six in Europe plus Japan) are aggressively developing and starting to deploy the breeder. They see it as the only reasonably technically assured source of energy which is not dependent upon large domestic fuel resources and which is not interruptible by the changing winds of foreign relations. In each of these countries, the immediate realities of deprivation, both of energy and of

the resources that depend on energy, have been experienced recently and much more intensely than at any time in the history of the United States. With most Americans lacking in any personal experience with the realities of deprivation, this country luxuriates in debate, searching for near-zero hypothetical risks to man and environment from nuclear and fossil energy, while the far greater real risks of inaction grow and multiply.

The European determination and progress on the breeder highlights the importance of maintaining our momentum with this energy option so that it may be available if the great hopes for conservation and for other, more speculative, technologies are not fully realized in this century.

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Notes

1. This commentary represents our personal views and does not necessarily reflect the views of EPRI or of electric utilities.

Marihuana Effects

Thomas H. Maugh II, in his article "Marihuana: New support for immune and reproductive hazards" (Research News, 28 Nov. 1975, p. 865), includes an account of our work which, unfortunately, is a mixture of information from two different sets of experiments (*1*). He states that we "observed a variety of abnormalities in the sperm of men who have smoked cannabis for many years. These abnormalities include changes in lipid concentrations, protrusions of chromatids from the nucleus, and marked changes in the balance of acidic and basic amino acids in the histone proteins that encapsulate the sperm DNA. The significance of these changes is unclear, however, as Stefanis has found no ill effects definitely associated with them." Our only finding from the sperm study was a low, arginine-rich protein (protamine) content in sperm nuclei, indicative of deviant maturation (*2*). Reproductivity of these donors seemed not to be affected. As stated in our article (*1*), "this would be consistent with our finding that despite the low protamine content, the sperm heads of the users display the normal species-specific shape which is an indicator of normal condensation and reproductive capacity" (*3*).

The other findings, incorrectly described by Maugh, were actually abnormalities in peripheral blood cells of chronic cannabis users, and they include the following: low membrane phospholipids, protrusions of heterochromatin from the nucleus, and changes in the normal complement of histones and nuclear acidic proteins. Since these findings were not associated with overt blood pathology, they may represent compensatory changes resulting from a primary effect of cannabis.

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2. B. L. Gledhill, M. P. Gledhill, R. Rigler, Jr., N. R. Ringertz, *Exp. Cell Res.* **41**, 652 (1966).
3. J. MacLeod and R. Z. Gold, *Fertil. Steril.* **2**, 394 (1951).

"Extation"

There is a need for a single word to describe the status of a species whose population has been reduced to such a low level that it can no longer function as a significant part of its normal ecosystem [as in the case of the California condor (*Gymnogyps californianus*), the whooping crane (*Grus americana*), and the black-footed ferret (*Mustela nigripes*)] or to the point where there is considerable doubt whether the species remains extant [the status of the ivory-billed woodpecker (*Campephilus principalis*), the Eskimo curlew (*Numenius borealis*), and the Caribbean monk seal (*Monachus tropicalis*)]. The use of an adverb—nearly, probably, almost, perhaps—or phrase to modify the adjective "extinct" may merely mask our ignorance, implies an irreversible state, is wordier than necessary, and is probably conceptually incorrect. Extinction, like pregnancy and uniqueness, is not subject to degree. Further, such terms are basically numerical and only by inference convey any biological information.

I propose the word "extaille" (pronounced ex-tail) to fill the need expressed above. Extaille is based on the Middle English adjective "taille," meaning cut, trimmed, or limited. As a noun it can refer to what is left over after cutting and trimming. It is the root of the word "tailor" and of "tailings" (from a mine). The prefix "ex" brings the root into consonance with other words that describe the biological status of a species—"extant" and "extinct"—and further suggests a remnant "from" a formerly more abundant popu-

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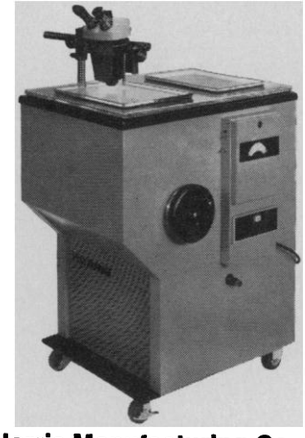

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