Uranium: Will There Be a Shortage or an Embarrassment of Enrichment?

Congress has taken the first step toward allowing private industry into the uranium enrichment business, long a government monopoly. The Joint Committee on Atomic Energy voted in favor of a bill, the Nuclear Fuel Assurance Act, allowing the Energy Research and Development Administration (ERDA) to negotiate contracts and government guarantees with industry groups under terms greatly modified from those originally sought by the Ford Administration. The result was a compromise in which the committee abandoned its opposition to, if not its misgivings about, government guarantees for private enrichment ventures, but tied its approval to the parallel expansion of government enrichment facilities at Portsmouth, Ohio. The prospect of so much additional enrichment capacity, however, raises the possibility that what was at one time expected to be an acute shortage is to be replaced by a glut. This possibility would appear to be enhanced by the continuing decline in the fortunes of nuclear power and by ERDA's own policies for operating the existing enrichment plants. In effect, ERDA is running its plants in a mode that not only is economically inefficient and contributes to perceived shortages and high prices for uranium, but also, paradoxically, results in the accumulation of a huge federal stockpile of enriched uranium.

According to its last official statement* on the matter in November, ERDA is planning to acquire a stockpile of as much as 14 million kilograms of enriched uranium worth between $10 billion and $15 billion by 1985. A stockpile of this size would equal nearly 5 years production from a large private enrichment plant. Officials at ERDA now disavow these figures, insisting that the stockpile, although substantial, will be smaller, and they justify it as a hedge against possible catastrophe at a government plant and as a backup should private enriching ventures encounter problems. But the economic justification for a large stockpile is, at least to some observers, extremely dubious.

In 1973 ERDA's predecessor, the Atomic Energy Commission (AEC), began requiring electric power companies to sign firm, long-term contracts for uranium enrichment. At that time optimism prevailed regarding the future growth of the nuclear industry, and there was a rush to buy from what was then virtually the only proved supplier of enrichment services. By mid-1974 the AEC had committed its entire capacity, including planned improvements to the three existing plants that by the mid-1980's will increase their present production by more than 50 percent. Actually, it appears that the AEC overcommitted itself by a wide margin, at least in part because its officials assumed that the plutonium generated in reactors would soon begin to be recycled as fuel, which would reduce the need for enriched uranium. Plutonium recycling has not yet come to pass, however, and still faces technical, economic, and regulatory hurdles of such magnitude that few expect it to play much of a role before 1988, if then. Optimism about nuclear growth has also suffered, with the result that most of ERDA's enrichment customers took advantage of an offer last year to revise their contracts without penalty. A few were cancelled, most were changed to delay delivery by an average of about 2 years. Despite the cancellations, ERDA remains committed to providing enriched uranium for the equivalent of 329 large, 1000-megawatt power plants, far more than its existing enrichment plants can economically supply.

To meet this commitment without building additional plants, which the Ford Administration has been resolutely opposed to, ERDA has adopted a novel approach—operating the plants uneconomically. This curious stratagem is possible because, although the mechanical features of an enrichment plant are fixed, the amount of uranium fed into it and extracted from it is not (see box), so that the amount of enriched uranium produced can be increased almost at will. The diseconomies come in the cost of the additional uranium that must be fed in to obtain a given amount of enriched product—essentially because more of the valuable fissile material (uranium-235) leaves the plant in the waste stream or tails. From ERDA's viewpoint, the advantage of making up its deficit by operating with a high tails assay is that the diseconomies are borne by its customers. Compared to operations at the economically optimum level—a concentration of about 0.20 percent uranium-235 in the tails—ERDA's announced plans would call for utilities to provide and pay for as much as 50 percent more uranium. ERDA's costs, primarily for the electricity to run the plants, would not rise.

Understandably, ERDA's customers are not entirely happy with this turn of affairs. This is especially true since the price of uranium is rising rapidly, in part because of anticipated shortages arising from ERDA's enrichment policy. Recent uranium prices have reached $45 per pound of U_3O_8, compared with highs of about $15 per pound in 1974 (the average price, however, now appears closer to $20 per pound). The utility point of view is clearly expressed in a recent report† on the nuclear fuel cycle by the Edison Electric Institute (EEI), a utility-sponsored organization. Among other recommendations, the report suggests that ERDA reconsider its plans for what EEI describes as "unreasonable demands for natural uranium supply from utilities as a possible offset for insufficient enrichment capacity." It finds that an additional enrichment plant of about 9 million separative work units, about the capacity each government plant will have when it is upgraded, will eventually be needed.

ERDA Stockpile Increasing

The EEI report reflects utility concern about the adequacy of enrichment capacity in the future, without which their expensive nuclear power plants might have to stand idle for lack of fuel. Actually, there is at present and will be for at least a few years to come an excess of enriching capacity, since the peak demand for enriched uranium under ERDA's existing contracts will not occur until the mid-1980's. In fiscal year 1975, for example, ERDA produced about 3 million kilograms of enriched uranium, but sold only 1.85 million kilograms to domestic and foreign customers. The remainder was added to its stockpile, which at the end of that year totaled 5 million kilograms—equivalent to almost a 4-year supply for U.S. nuclear power plants now in operation. Despite this reserve, ERDA plans to increase its stockpile still further.

An analysis of ERDA's stockpile policy by Vincent Taylor, an economist with the Los Angeles consulting firm Pan Heuristics, suggests that it is economically ir-

*Report of the Uranium Enrichment Conference, Oak Ridge, Tennessee, 11 November 1975, CONF-751134, available from the National Technical Information Service, Springfield, Va.

†*Nuclear Fuels Supply*, Edison Electric Institute, 90 Park Avenue, New York, 1976.

rational. Carrying charges for a stockpile worth $10 billion to $15 billion, for example, would amount to more than $1 billion a year—a cost indirectly levied on the utilities that pay for the extra uranium. By operating the enrichment plants in such a way as to build the stockpile, Taylor finds, ERDA will increase uranium needs by 1982 to some 67,000 tons of U_3O_8 over what would be required if the plants were operated at their most economic level. This, he concludes, may be more than the uranium mining industry can supply and will in any case help to keep uranium prices artificially high, at considerable cost to the utilities and, ultimately, their customers. A more reasonable policy, he suggests, is for ERDA to operate its plants at their optimum level, drawing on its stockpiles of enriched and unenriched uranium to lower uranium prices and to keep mining requirements at a feasible level. When and if enrichment demands actually exceed ERDA's capacity, Taylor believes, it will be time enough to operate the plants uneconomically. In the long run, he says, it may be cheaper to build additional capacity than to stockpile on the scale contemplated by ERDA.

The question of how much enrichment capacity will eventually be needed depends on the growth rate of the nuclear industry. As recently as 1974, the AEC was forecasting 250 gigawatts of nuclear generating capacity ready to operate in the United States by 1985, and 1090 Gw by the year 2000. In congressional testimony in early 1975, ERDA officials lowered these forecasts to 185 and 800 Gw, respectively. The most recent ERDA "working estimates" are for 160 Gw in 1985 and 625 Gw by the end of the century, and it is not clear that the wave of plant cancellations and deferments has run its course. Even these estimates, however, do not appear to be fully reflected as yet in the enrichment picture. ERDA is basing its plans on its current contracts, which call for supplying enriched uranium to domestic power plants with capacities totaling 208 Gw by about 1985. This would seem to suggest either that a lot of utilities are going to take delivery of enriched uranium for which they have no immediate use, or that as much as 25 percent of the existing contracts will have to be delayed.

Last week's action by the Joint Committee thus has aspects of Alice in Nuclearland. In holding the Nuclear Fuel Assurance Act hostage to the committee's long-cherished proposals to build what is in essence a fourth government enrichment plant, it may well be setting the stage for an embarrassment of riches in the mid-1980's and the commercial failure or postponement of more efficient, second-generation plants based on centrifuge technology. Three such plants have been proposed by private groups for the latter half of the 1980's.

In any case, the immediate beneficiary of the legislation would seem to be a consortium known as Uranium Enrichment Associates (UEA), led by Bechtel Corporation, who plan to build a $3.4 billion plant based on the proved but comparatively inefficient gaseous diffusion process. The plant is to be located in Dothan, Alabama. The bill, which must still pass both houses of Congress, provides that ERDA engineers will supervise construction and that the government will guarantee the plant's successful operation through its first year; domestic investors in the plant are to have their money refunded in the event of its failure, but foreign investors, who will put up 60 percent of the cost, will not be covered.

If approved, the UEA plant will probably siphon off some of ERDA's enrichment customers, under a new contract provision that allows them either to cancel outright if they sign up with a private U.S. venture or to switch part of their business away from ERDA and renegotiate the remainder on favorable terms. How much a fourth government plant, if it is in fact built, would undercut these arrangements by removing any vestige of a need for ERDA to operate its plants inefficiently is not clear. At present, $12 million for preliminary planning of the new government facility has already been appropriated for fiscal year 1976, and $230 million more for fiscal year 1977 has been authorized by the Joint Committee but not yet by the Congress as a whole.

Officials at ERDA, asked about the Joint Committee's action and its implications, declined to comment until they have had a chance to study the amended bill. But they did question whether ERDA has the technical resources—both in manpower and in the Oak Ridge manufacturing facility that makes the key barrier devices for the gaseous diffusion plants—to carry out its supervisory role in the construction of the UEA plant and build a new government plant at the same time. The size of the stockpile and the operating policies for the existing plants also are being reviewed, with new plans due early this summer.

What is not yet evident, however, is a coherent rationale for maintaining a large stockpile or for operating the enrichment plants inefficiently. A glut of enriching capacity, if it comes, can perhaps be blamed on Congress. But uranium will without question eventually be in short supply, and the nuclear power industry is already experiencing financial trouble. It would seem difficult, then, to defend enrichment policies that exacerbate both problems.—ALLEN L. HAMMOND

SWU's and All That

Natural uranium contains only about 0.7 percent ^{235}U, the fissionable isotope, and this concentration must be increased to about 3.2 percent for use as fuel in light water reactors. The gaseous diffusion plants that accomplish this have a capacity measured in separative work units, or SWU's, and the three existing government plants are expected to produce about 13 or 14 million SWU's during fiscal year 1976. It is a peculiarity of the enriching process, however, that the amount of enriched uranium produced per SWU is not a constant but depends on how much uranium is fed to the plant. At higher rates of feed, more ^{235}U atoms are present and a given amount of separative work produces more enriched uranium. But more ^{235}U atoms also pass through the plant into the waste stream, or tails. Thus operating with a concentration of 0.2 percent ^{235}U in the tails, a gaseous diffusion plant produces about 200 grams of enriched uranium per SWU, and this increases to about 300 grams per SWU at a tails concentration of 0.3 percent; the catch is that operating at the higher tails assay requires 20 percent more uranium, and the feed requirement goes up sharply as the tails assay increases.

To make things more complicated, ERDA distinguishes between two sets of tails for its plants—those at which the plants actually operate, and transaction tails, which are a contractual specification of how much uranium utility customers must provide to obtain a given amount of enrichment work. The two are in general not the same. By manipulating both the contractual and the operating tails, ERDA can increase or decrease its stockpiles of feed and of enriched uranium.—A.L.H.