

Reprocessing (1): Barnwell, USA

An inevitability forestalled

Colin Norman, recently at Barnwell, reports on the reprocessing debate in the United States

AMONG the more controversial problems awaiting the attention of the Carter Administration next year will be whether to allow an extraordinary nuclear facility, built like a concrete fortress in the middle of a South Carolina pine forest, to start operating. Constructed by private industry at a cost so far of some \$250 million, the facility could become either a key component in the nuclear power programme in the United States, or a massively expensive white elephant.

Designed as the first full-scale commercial plant to reprocess spent nuclear fuel from power reactors, the facility is already falling victim to rising concerns about the proliferation of nuclear weapons, and its fate will probably hang on a complex series of regulatory, political and diplomatic decisions expected to be taken next year. But, even if the Carter Administration does decide to allow the plant to begin work, its troubles won't be entirely over. Before it can operate at full capacity, additional facilities to solidify highly radioactive wastes from the plant and to convert plutonium nitrate to plutonium oxide will be required. They could cost as much as \$500 million, a sum which private industry says it is unwilling to risk without government assistance.

When plans for the plant were drawn up in the 1960s, it looked like a sure-fire commercial proposition. Opposition to nuclear power had scarcely begun to surface, prospects for burgeoning growth in the nuclear industry looked good and reprocessing was generally regarded as inevitable. Three industrial concerns—the Allied Chemical Company (50%), Gulf Oil (25%) and Royal Dutch Shell (25%)—therefore decided to form a partnership, called Allied General Nuclear Services (AGNS), and sink about \$100 million into the venture. They expected to have the facility in operation by about 1974.

Enticing idea

The plant is designed to reprocess fuel continuously from about 50 commercial power reactors, extracting plutonium and uranium from highly radioactive spent fuel rods and recycling the materials as new reactor fuel. The idea looked enticing.

Light water reactors now in use in the United States and in most other

countries are fuelled with uranium in which the concentration of the fissile isotope uranium-235 has been enriched from its natural level of about 0.7% to about 3%. While the reactor is operating, small quantities of fissile plutonium are formed along with other highly radioactive products and when the fuel rods are removed from the reactor, they contain roughly 1% plutonium and 1% unused uranium-235—more than half the original amount of fissile material. If those elements could be extracted and recycled as reactor fuel, savings in fuel costs could be substantial, and the need to mine and enrich uranium would be greatly reduced.

Another incentive for commercial concerns to get into the reprocessing business was the expectation that large numbers of breeder reactors would be in operation by the end of the century. Since breeder reactors produce large quantities of plutonium, a plutonium extraction industry is essential to the economics of their operation. Small wonder, therefore, that Allied, Gulf and Shell decided to get into the reprocessing business.

They were not alone when they designed the plant in the 1960s. A small-scale reprocessing facility was already in operation at West Valley, New York, and another was on the drawing board for a site at Morris, Illinois. In addition, plutonium had been extracted from spent fuel from military reactors ever since the Manhattan Project in the early 1940s—a fact that gave would-be commercial reprocessors confidence that the process would work successfully. So far, however, the nascent reprocessing industry has been beset by disasters.

The West Valley plant, designed to handle about one ton of irradiated fuel per day, was operated from 1966 to 1972, when it was closed for modification and expansion. Since then, the estimated costs of modifying the plant have skyrocketed, uncertainties have arisen about how the wastes should be handled, and the amount of time required to complete the construction work has stretched to ten years. Consequently, the plant's operator, a consortium known as Nuclear Fuel Services, announced last year that the plant would be scrapped.

The second facility, constructed in the early 1970s by the General Electric Company at Morris, was an even

greater disaster. General Electric sank about \$64 million into the plant, but a number of problems with remote handling of radioactive material were encountered during testing and in 1974, the company decided to cut its losses and abandon the venture.

The AGNS facility is therefore the only plant remotely close to operating, though the Exxon Nuclear Company has applied for a licence to construct a similar-sized plant at Oak Ridge, Tennessee, in the mid-1980s. The facility, located near Barnwell, South Carolina, is generally acknowledged to be vastly superior technically to the West Valley and Morris plants; it is, however, facing a determined challenge from nuclear critics and arms control advocates, who argue that it would usher in a new and more dangerous nuclear age—the so-called plutonium economy. Opposition to the facility has, in fact, already caused long delays and is partly responsible for the cost escalation from the original estimate of \$100 million to the present cost of \$250 million.

Massive construction

Built to reprocess about 1,500 tons of irradiated fuel per year—the output from some 50 reactors—the facility is certainly impressive. A massive concrete construction, lined throughout with stainless steel, it is designed to operate by remote control. Irradiated fuel rods will be shipped to the plant in heavily shielded casks, and they will be stored in the facility in huge water pools. From there, they will be transferred to a giant hydraulic shearing device, which will chop the rods into two-inch sections, and the pieces will be plunged into a bath of hot, concentrated nitric acid.

The acid bath will dissolve uranium, plutonium and other radioactive elements from the fuel rods, leaving behind the stainless steel cladding, which will be removed and stored pending final burial. Plutonium and uranium will be removed from the nitric acid solution by a relatively straightforward solvent extraction process, and the plutonium and uranium salts will be separated from each other electrolytically. The waste solution will be concentrated and transferred to huge, double-walled stainless steel tanks for temporary storage.

A facility for converting uranyl nitrate from the separation plant to uranium hexafluoride has been built by AGNS at the Barnwell site, the idea being to ship the fluoride directly to an enrichment plant at Oak Ridge, Tennessee. As for the plutonium, the plan is to convert it eventually to plutonium oxide for fabrication into reactor fuel consisting of a mixture of plutonium oxide and enriched uranium

oxide. At present, however, no plutonium conversion facility has been built at Barnwell, and the element will therefore probably be stored temporarily as plutonium nitrate solution in titanium tanks.

Plutonium politics

A number of environmental and anti-nuclear groups, led by the Natural Resources Defense Council (NRDC), began to worry in the early 1970s about the consequences of pushing ahead with a programme to extract and recycle plutonium on a large scale. They argued that plutonium could be stolen from the nuclear industry by individuals or terrorist groups and fashioned into crude atomic weapons, and they also challenged the federal government's exposure standards for plutonium, arguing that they are much too lax. So far, they have achieved considerable success in their assaults on the programme.

In 1974, the Atomic Energy Commission, which was then responsible for licensing nuclear facilities, announced that it would publish an environmental impact statement on the potential consequences of a large scale plutonium recycling industry before deciding whether to give the Barnwell plant a licence to begin operating. The statement was published in August, 1974, and it recommended giving a green light to plutonium recycle.

A few months later, however, the Atomic Energy Commission was scrapped and its licensing functions were transferred to the Nuclear Regulatory Commission (NRC). The new regulatory environment hasn't helped the Barnwell plant. In January last year, the NRC announced that it would re-examine the AEC's impact statement, and publish an expanded version of its own. NRC also announced that it would subject the matter to an exhaustive public hearing before making any decision on reprocessing and recycling.

The first part of NRC's impact statement, dealing with health and safety questions, was published a few weeks ago, and the second part, covering the more sensitive issues of safeguards and cost-benefit analysis, is expected to be published early next year. The promised public hearings have begun, and they are expected to continue for most of next year. NRC officials say that they hope to reach a final decision on whether reprocessing and recycle should be allowed by January 1978, which means that even if Barnwell gets a green light, it would not be started up until 1979.

In the meantime, however, the regulatory process has been overtaken to some extent by political developments. The explosion by India of an atomic

device constructed from plutonium extracted from an imported nuclear reactor in 1974 set loose a major debate in the United States about the nation's responsibilities to try to curb the spread of nuclear weapons. Throughout the past year, US officials have been urging the adoption of strict international controls on nuclear exports and they have been arguing for a complete moratorium on the sale of reprocessing and uranium enrichment technology to nations which do not have nuclear weapons. Concerns about proliferation have, in turn, led to a re-examination of the United States' own plans for reprocessing, and the matter even played a prominent role in the Presidential election.

In a speech delivered at a United Nations meeting last May, President-elect Jimmy Carter announced that he had reservations about pressing ahead with plutonium recycle in the United States while the State Department is trying to persuade other nations not to follow the same path. In November, Carter was more specific. He said he would "seek to withhold authority for domestic commercial reprocessing until the need for, the economics, and the safety of this technology is clearly demonstrated. If we should ever decide to go forward with commercial reprocessing, it should be on a multinational basis". A few days before the election, President Ford came out with a similar statement. The nuclear industry in the United States should no longer assume that reprocessing will be "a necessary and inevitable step in the nuclear fuel cycle", he said, and he announced that he would permit reprocessing and plutonium recycle "only if they are found to be consistent with our international objectives".

Mixed reaction

Those statements were greeted with satisfaction by opponents of the Barnwell plant. Nuclear critics and arms control advocates had long been arguing that a decision by the United States to forego reprocessing, at least for the time being, would send a clear message abroad that the United States is serious about its non-proliferation objectives. Needless to say, the nuclear industry doesn't agree.

Dr J. A. Buckham, manager of the Barnwell plant, said in an interview last week that "almost all of the stated objections of opponents of reprocessing are best served by the very opposite of what they advocate". He argued that the best way to persuade non-nuclear countries against embarking on reprocessing is to ensure that reprocessing services are available for all, perhaps on a multinational basis. "The failure to start up this plant (Barnwell) will not persuade the rest of the world not

to reprocess", he said, and added that the plant is so well safeguarded that it would not add to the proliferation problem at all.

Buckham also noted that reprocessing and plutonium cycle would stretch out uranium reserves and to help reduce reliance on fossil fuels. In other words, it is a key to the long-term prospects of the nuclear industry, which is one reason why nuclear critics are so opposed to the operation.

It should be noted that neither Ford nor Carter entirely ruled out the possibility of operating the Barnwell plant. Carter suggested that it could be turned into a multinational reprocessing facility, and both argued that the economics and safety of reprocessing should be proven before embarking on a full-scale reprocessing industry. The nuclear industry argues that the best way to prove the technology would be to operate the Barnwell plant as a demonstration facility, with government assistance. That possibility was under intense consideration in the Ford Administration last year, and it hasn't been entirely ruled out.

Operation of the plant would, however, require considerable capital expenditure. At present, it has capacity to store plutonium nitrate from about 18 months' production. A plant to convert the material to plutonium oxide would therefore be required soon after the facility is put into operation. Similarly, there is only temporary storage capacity for about one year's worth of radioactive wastes, and a solidification plant is required. Those plants could cost as much as \$500 million.

In view of the uncertainties surrounding the future for reprocessing, AGNS is unwilling to make that large an investment, and it has asked the Energy Research and Development Administration (ERDA) to build the ancillary facilities. The company said that it would be prepared to buy the facilities from the federal government once they were licensed and the plant was in full operation. ERDA officials have indicated that though federal assistance would not be forthcoming immediately, the possibility has not been ruled out entirely.

The future for reprocessing in the United States is therefore uncertain. Nuclear critics, such as Arthur Tamplin of NRDC, are convinced that the Barnwell plant can be stopped, while AGNS officials predict that they will receive a favourable decision from NRC. The matter is likely to be decided eventually by Congress—particularly if federal assistance is required—and it should be noted that the climate for nuclear power there is likely to change next year with the pending demise of the Joint Committee on Atomic Energy. □