Reprocessing nuclear fuel: for . . .

G. R. Bainbridge of the Energy Centre, Newcastle upon Tyne, gives his arguments for building an oxide fuel reprocessing plant in Britain

OVER the past 25 years British industry has worked towards an integrated nuclear fuel cycle for power generation. Progress continues favourably for the cycle in all main aspects:

- The centrifuge uranium-235 enriching plant at Capenhurst is progressively being commissioned.

- Consent has been given for the Central Electricity Generating Board (CEGB) and the South of Scotland Electricity Board (SSEB) to work towards the construction of advanced gas-cooled reactor (AGR) power stations at Heysham and Torness.

- Mr Justice Parker has reported on the BNFL application and it is likely that he has recommended the government to allow it probably at Dounreay.

- A UK Atomic Energy Authority (UKAEA) proposal to build a commercial fast reactor (CFR) power station, probably at Dounreay, should shortly be ready for consideration.

It is vital for national and international energy sufficiency to assure adequate reasonably-priced uranium and plutonium fuels to supplement diminishing coal, crude oil and natural gas resources; even fifty years hence it seems unlikely that other alternatives (fusion, sun, wind, waves, tides, geothermal) will be far enough developed to do this. The key to such sufficiency is used-fuel reprocessing of which Britain already has excellent large scale experience.

The United States, with almost 50% of known world low-cost uranium has a policy to defer reprocessing of used fuel rather than recover its 98% uranium and plutonium content. With great distances to transport fuel overland, no significant nuclear-fuel reprocessing industry, no CFRs and good prospects for exporting enriched uranium it may be a prudent commercial decision. Canada, with plenty of uranium and barely enough technical resources to build large-scale nuclear reactors can also get by, at least for the present without reprocessing. Both countries, however, may have severe and costly problems with deterioration of long-term stored radioactive fuel.

For Britain recycling fissile material from used AGR fuel can reduce the need for imported uranium by up to 35% or provide over 30% of extra heat from what is imported. A reprocessing plant for 1,000 tons per annum of used uranium oxide fuel can add 30 million tons of coal equivalent annually to resources, some of it to the benefit of overseas customers, with financial gain to Britain. The 1% plutonium product of the used fuel reprocessed at such a plant, blended in oxide form with about four times its own weight of uranium (not a bomb material), would provide the initial fuel of two large CFRs. At the same time the radioactive waste would have been reduced by a factor of about 50.

Confidence for peaceful co-existence between nations is an essential pre-requisite to reducing the number of nuclear weapons. Lack of such confidence in the late 1940s led the US, the USSR, Britain and France independently to produce bomb stockpiles using high enriched uranium from 'separation' plants and plutonium from elementary 'atomic piles'. Suspicion led China and India to follow. For none of those countries were commercial nuclear fuel reprocessing plants the primary developments.

More than 30 nations have the technical capability to produce nuclear bombs and more than 100 are in agreement about the need for a non-proliferation treaty aimed at controlling the spread of nuclear weapons. These countries are wiling to submit to International Atomic Energy safeguards.

At present no international sanctions are strong enough to prevent countries with modestly advanced technological capabilities from manufacturing highly destructive weapons. 'Friendly' political pressure and voluntary agreements between many nations have succeeded in reducing threat and counter-threat.

Trading is one sure way of easing international tensions. If the processors of used nuclear fuel, and their governments, assess that a country which has requested plutonium fuel will probably behave responsibly then properly supervised supply and use should be arranged whenever it is commercially practical. Britain has a long tradition in such trading.

Britain is a pioneer of nuclear wastes management. At present waste from nuclear fuel reprocessing is stored in liquid form in steel and concrete tanks and continually cooled. In the long term it would be safer to combine the valueless components of those wastes into inert solids. It has been suggested that the waste be chemically combined into glass and be stored within steel and concrete.

But it is first necessary to know what is valueless. History indicates that the wastes of earlier periods have found applications. So 'irretrievable' disposal could be inappropriate. Caverns in stable, dry and deep salt, clay and granite formations have been suggested for disposing of such wastes. The cost will depend on several factors: whether the depository is to be on land or below the sea, near or far from the processing plant, for retrieval or not. Other suggestions have been to place the solid blocks on or under the sea bed of the deep oceans.

For this latter option, the rate of disintegration of the blocks, the rate of mixing of their contents with the near surroundings, the migration of those surrounding solids and waters need to be better known.

International agreements will have to be reached on the disposal locations and procedures. This will take time and it will be wrong to reduce the options too hurriedly when adequate temporary arrangements are feasible.

A reprocessing plant for throughput of about 1,000 tons per annum will cost in excess of £500 million, including radioactive waste storage, some R & D expenditure (say 5% of the total) and a decade of operating costs (perhaps 25% of the total). That figure would be increased if extra cooling ponds capacity is needed and a decision is made to go forward with glassification for ultimate disposal. But the uranium alone in the 3,000 tons of used AGR fuel sent for reprocessing up to 1995 would be worth in the region of £200 million and the plutonium (say 30 tons) very much more. Introduction of a similar amount of overseas fuel processing business would completely recover the costs of the plant.

The plant costs are of the same order as those for one AGR power station and the reprocessing service from it is likely to provide for upwards of twenty such power stations. The uranium recovered could reduce imports of fresh uranium for them by 15% and the plutonium could fuel some 30 CFR power stations.

Apart from reducing the amount of radioactive wastes for disposal, there are advantages for the balance of payments and the ongoing nuclear power programme to be gained from reprocessing. □