

NUCLEAR REACTORS

Britain's Power Dilemma

THE miners, Arabs and power workers between them made life so bad for Britain's power industries last week that a meeting of the Nuclear Power Advisory Board, which was to take another step along the troubled road to choosing Britain's next reactor type, had to be cancelled. Everyone had too much on their plates already.

An announcement is expected early next year from Mr Peter Walker, Secretary of State for Trade and Industry, on which type of reactor Britain is to build next.

The Nuclear Power Advisory Board has already had presentations from the chief parties interested in the choice and has learnt from the Central Electricity Generating Board that it wants to buy light water reactors from the United States—preferably Pressurized Water Reactors (PWRs) from Westinghouse.

The board argues that the light water reactors are cheaper and more proven than anything else available. The alternatives are fourfold. Britain could build more Advanced Gas Cooled Reactors. Five of these are being built. All of them are late, and the first is not due to produce full power until 1975.

Two of the other possibilities require development. These are the Steam Generating Heavy Water Reactor, a 100 MW prototype of which has been performing well at Winfrith in Dorset since 1967, and the High Temperature Reactor. But the board argues that it is too late to build SGHWR. It offers too little export or development potential, is more expensive than the PWR, a development programme would be required with all its attendant risks and substantial quantities of heavy water would be needed. The High Temperature Reactor also suffers from the need for a development programme. A 30 MW prototype has been operating since 1963, but 30 MW is a far cry from the 1,200 MW size that interests the CEBG. The board is relatively enthusiastic about the design, however, and would like to see a commercial plant built. But it does not want to use the HTR for the large scale programme it is envisaging—six to eight stations on order by 1980. It would rather see the design developed more slowly.

The final possibility is that another Magnox station could be built. In spite of corrosion problems, Magnox stations have performed well and last year produced some of the cheapest electricity. With some redesign work to remove corrosion problems more Magnox stations could be a reliable bet. But the board believes the cost to be prohibitive, perhaps £600 million a station as against about £400 million for a more modern design.

The argument is not quite as simple as the CEBG would have everyone believe. For a start it is unfortunate, to say the least, that the empty order books of the nuclear industry, the government's commitment to reach a decision soon and the CEBG's belief that it will need more nuclear stations by the end of the decade have all combined to force a decision now rather than in eighteen months or two years time, when it will be seen whether at least one of the Advanced Gas Cooled Reactors, costing between them rather more than £1,000 million, works. Equally the CEBG's calculations studiously ignore the question of foreign exchange. With a trade gap running at £289 million in a single month, the government cannot be eager to spend more money abroad than it has to. And a first PWR would be bought lock and stock, if not barrel, from the United States. As the CEBG sees it, Britain's GEC-dominated National Nuclear Corporation would provide the emergency core cooling system, the containment and the chemical engineering of the new station, but the remainder of the nuclear steam supply system would come from abroad.

And the question of safety remains to be answered. The United States Atomic Energy Commission has spent the past two years arguing in public and private about the effectiveness of the Emergency Core Cooling System (ECCS) that is a key part of the PWRs' defence system against a bad nuclear accident. Theoretically the ECCS douses the reactor core in water within seconds of, for example, a broken pipe or blocked pump cutting off the normal cooling water supply to the core. Without water, a dry core heats to 1,800° C within a minute, at which point the fuel and zirconium fuel cans being to melt. An hour after the loss of cooling water the core has flowed to the bottom of the reactor vessel accompanied by steam explosions which, combined with gas pressure, could split the reactor vessel, releasing fission products. A few hours after that, the molten core would have eaten through the reactor vessel and the concrete foundations.

The ECCS is designed to prevent this happening. But no practical test of the system has been made, and an AEC facility known as the Loss of Fluid Test Facility will not be ready to run the crucial experiments on what does actually happen to a dry core until 1975. Theoretical calculations suggested that the emergency core cooling system would prevent these events. But other sums produced different answers, and a small scale test on a simulated reactor core suggested that in the event of 30 to 100% of the cooling water leaving the reactor, only 10% of the emergency cooling water would reach the core. The Loss of Fluid Test should confirm

or quell these doubts. But the answers will not be available by January when Mr Walker has to make his decision.

The CEBG is of course aware of these problems. It has looked at the calculations at its nuclear laboratories at Cheltenham and concluded that the light water reactors are safe enough. But its conclusion is not going unchallenged. The Friends of the Earth have just launched a campaign on energy and its conservation. Their sister organisation in the United States has been at the forefront of the campaign against light water reactors. Last week a spokesman for the British end of the organisation said that "it is a little difficult to explain" how the CEBG has managed to satisfy itself about the safety of light water reactors while the Atomic Energy Commission is still sorting out the problem.

Aside from the safety matter, it is not at all certain that building PWRs will be as easy as the board maintains. Its interest lies in 2,400 MW stations consisting of two 1,200 MW sets. The largest PWR built and operating to date is 1,050 MW. And in spite of talk about buying proven designs, no reactor comes off the shelf. British industry will have to learn to build PWRs just as it has had to learn to build AGRs or would have to learn to build commercial HTRs or SGHWRs. Walt Patterson, a nuclear physicist who works with Friends of the Earth, says "the whole AGR fiasco is entirely conceivable as a re-run with light water reactors". Additionally the complaint is common within the industry and the United Kingdom Atomic Energy Authority that the CEBG cannot resist fiddling with power station designs.

A final question worth asking is why the government, the Atomic Energy Authority, the generating boards and the industry have the current problem to solve at all.

The CEBG seems happy to consign the AGR to oblivion. Yet it is the

Forthcoming Natures

NEXT week, *Nature* will contain a thirty-two page supplement reviewing science in Australasia.

Nature for Friday, December 14, will be a Christmas issue. In addition to the regular features there will be several pages of specially commissioned articles, chess problems and a quiz.

The two Friday issues of December 21 and 28 will be combined in one large edition that will be published December 21. *Nature Physical Science* and *Nature New Biology* will likewise be published in double issues on December 17 and December 19 respectively.

board that ordered the reactor in the first place, commissioned three separate designs and agreed to build these before a full prototype was constructed. (The Windscale AGR, well though it has run, is a far simpler machine than the commercial stations, built more for fuel testing than as a proper prototype.) The stations were all approved without detailed design work being undertaken.

It is a similar mess that everyone is trying to avoid this time. The choice is not an easy one. As Sir John Hill, Chairman of the Atomic Energy Authority, said at the Royal Society symposium on energy last week "all reactor systems have some problems". He also pointed out that "every time there is a major change of design there will be difficulties". It is possible that light water reactors will prove the final choice. But the CEGB should admit that the case is not as clear cut as it claims.

AUTOMOBILE POLLUTION

GM Breaks Ranks

by our Washington Correspondent
MOTOR manufacturers have recently failed in a last ditch attempt to keep exhaust catalysts off cars sold next year. For months, executives from the car industry have been badgering Congressmen and Senators, trying to win yet another delay in implementing the stringent exhaust emission controls specified by the Clean Air Act, and the matter finally came to a head early this month when the Senate Public Works Committee held a couple of days of hearings on automobile pollution. Spokesmen for the industry warmed over a number of old arguments, seized upon all kinds of real or imaginary fears, and invoked threats of economic and social disaster if the Clean Air Act is not soon modified. But the chief outcome seems to be a huge split in their own ranks.

They were arguing, essentially, for emission controls to be frozen at their present levels for the next two years, and for some rather more stringent controls to be imposed in 1977. Such a delay would put off the need to fit exhaust catalysts, since the present regulations can be met with engine modifications, and the clear intention is to use the breathing space to work to put off that fateful day entirely.

That, at least, is the position taken by representatives of Ford and Chrysler, who were unstinting in their criticisms of the catalyst. But witnesses from the other member of the big three, General Motors, broke ranks and came out with some extraordinary statements in support of the device. But they, too, want the controls relaxed, although only by a small amount.

In any case, Russell Train, Admini-

strator of the Environmental Protection Agency, said that he is not prepared to recommend relaxing or delaying the standards, and the committee shows no sign of taking the initiative itself. Thus, as John J. Riccardo, president of Chrysler put it, since "action must be taken now, or it will be too late", exhaust catalysts will be fitted to cars sold next year.

It was a last ditch attempt by Ford and Chrysler because the Environmental Protection Agency has already given them the maximum amount of time available to meet the standards, and the only possible way to delay things further would be for Congress to modify the Clean Air Act. The act requires that 1975 model cars emit 90% less carbon monoxide and oxides of nitrogen than 1970 models, and that 1976 models emit 90% less oxides of nitrogen than 1971 models. Earlier this year, however, the motor manufacturers persuaded the Environmental Protection Agency to give them an extra year to meet the standards. But part of the EPA's bargain included a provision which requires that all 1975 model cars sold in California must meet strict emission controls—and that will need the use of exhaust catalysts on those cars. The rationale was to force catalysts to be introduced in California next year—1975 model cars will be unveiled in the Autumn of 1974—and nationwide a year later.

Ford and Chrysler executives argued, as they have done for the past two years, that the catalyst is inherently bad technology, and that they would like to use better devices, such as the stratified charge engine, if only they had the time to do it. But, if they are forced to clean up car emissions immediately, they have no alternative to sinking their money into exhaust catalysts at the expense of developing the other technologies.

Six months ago, that was also the complaint put out by General Motors, but at the hearings earlier this month, Edward N. Cole, the company's president, said bluntly that there is no need to modify the interim regulations set for California in 1975, and that the conventional engine equipped with catalytic converters will be the best method of cleaning up automobile pollution. Cole also said that GM cars will be able to meet the 1975 interim standards, and that catalysts will be fitted not only to cars sold in California, but to others as well.

The effect of the split in Detroit's previously united front had the effect of undermining many of the arguments put up for delaying the standards, and environmentalist witnesses at the hearings had little difficulty in playing off one statement from the car manufacturers against another. But it is

perhaps worth noting, in any case, that only a few months ago, when spokesmen for all three manufacturers were arguing for a year's delay in the 1975 standards, that they all painted pictures of economic disruption and wholesale closures if they were forced to introduce catalysts on all their cars next year. Now, however, not only is General Motors planning to introduce catalysts nationwide next year, but Ford is also planning to fit them to all their California cars and 65% of their others. Environmentalists have been quick to ask what happened to the dire forecasts.

As for the latest round in the battle, the arguments for delaying the standards have revolved around three chief questions—are the standards stricter than necessary simply to protect public health? Will the catalysts lead to another serious health problem, namely, the production of sulphuric acid from sulphur in petrol? And, finally, will they contribute to the energy crisis by decreasing engine efficiency? In each case, Ford and Chrysler argued that it would be sensible to delay implementing the standards until those questions have been answered. Clearly, if catalysts are installed next year and it subsequently turns out that they are not needed, several hundred million dollars will have been wasted.

The question of the standards being stricter than necessary is one on which the manufacturers are almost united, and they have also received direct and indirect support from the National Academy of Sciences for their arguments. In September, for example, Dr Arthur Stern, chairman of an NAS committee which has been looking into auto pollution, said that he believes the standards are three times stricter than necessary. That statement has, of course, been seized by the manufacturers and bandied about in committee rooms and Congressmen's offices ever since, but they are looking to the academy to provide even more support for their case next year. The academy has been given a contract by the Senate Public Works Committee to conduct a massive study of the health effects of pollutants, and the car manufacturers are convinced that when it reports next year, the academy will vindicate their own findings that the standards are much too strict.

In any case, the manufacturers have been arguing with some conviction that the 1975 interim standards should be delayed until the academy has produced its report, since, by next summer, catalysts will already be clamped to car exhausts and it will be too late to turn back if the study finds that they are not in fact needed. But the EPA, in the person of Mr Train, testified that relaxation of automobile controls next year would not only take the steam out of the