

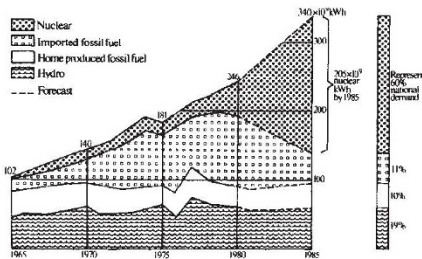
French nuclear power

Testing time for reactors

The problem with French nuclear power stations is that three-quarters of them are less than three years old, and suffering from teething problems, according to Electricité de France (EDF), which owns and runs them.

What is not clear is whether this should be a comforting or a disquieting thought. French nuclear power production is supposed to be increasing, but in September EDF produced only 6,700 GWh of electrical energy, compared with 8,200 GWh a few months previously. The net availability — the proportion of energy delivered to nominal capacity — fell to below 50 per cent in the summer, compared with a typical industry target of 70 per cent and a world average for pressurized water reactors (PWRs) (according to EDF) of 60 per cent. But, says EDF, PWRs more than three years old had the magic 70 per cent availability. It was the young ones — an independent design series of 20 or 50 — that were in trouble.

The accompanying figure reveals how much of the French nuclear power



programme is indeed young, coming on line during 1980–85. This is literally a testing time for French nuclear power. Of the 22 reactors now connected to the grid, only 6 were connected before 1980. Seven were connected that year, seven in 1981, and two have been connected this year. However, another 30 are under construction, due to come on line during 1983–89.

According to EDF, the problems amount to a combination of technical teething troubles and government safety regulations. There are three issues: a concentration of seven four-month shut-downs for obligatory inspections, after 18 months' operation, compared with four such shut-downs in 1981 and two planned for 1983; and two problems with faulty materials in the younger reactors.

One of these problems is outside the nuclear part of the reactor, in the steam "drier-superheater". This halted two reactors, Saint-Laurent B1 and B2, for a considerable period, but the problem is now thought to have been solved for these reactors and others in their production series.

The more awkward problem is the stress-corrosion cracking of inconel clips holding

guide tubes for the control rods within the reactor vessel. The problem was first noted in Japan in 1979, and since then the clips have undergone redesign in French reactors beginning construction. But most reactors coming on line in the past three years have the old clips, and there have been failures and shut-downs this year at Fessenheim 1, Bugey 2 and 4 and Gravelines 1. The clips are to be replaced on a series of 20 reactors, at a net cost, according to EDF, of about FF 1,300 million (£110 million).

But is this the end of the "teething" troubles — or will there be more to come, when the problem, like the clips and the

US defence

Townes in dissent on MX siting

Washington

Controversy continues about how and where the new MX missiles should be based. President Reagan is committed to give Congress a plan for basing the MX (short for "missile experimental") by 1 December and the Secretary of Defense, Mr Caspar Weinberger, has done his part by transmitting his recommendations to the White House, apparently on 1 November. But now his most prominent scientific adviser on the issue, Dr Charles Townes of the University of California at Berkeley, has taken the unusual step of expressing his personal doubts about the now-favourite plan — and the contents of his letter have been promptly leaked in the US press.

The question of how to deploy MX has been a long-standing conundrum. Out of about 30 alternative plans suggested by the military, the Carter Administration selected that called "Racetrack" in which missiles would have been moved from one launching point to another by means of underground tunnels. But by the time the plan was put forward, so many doubts had arisen that Congress never approved it.

The same fate may yet await the Reagan Administration, which has already failed to persuade Congress to authorize funds for deployment — without specifying how the missiles would be deployed. Townes was appointed head of a panel of scientists and defence experts to re-examine the MX problem when Mr Weinberger took office. The scheme now most favoured by the US Air Force and, it is rumoured, by Mr Weinberger is called "Dense Pack". MX missiles would be placed in fixed and hardened canisters in the ground so close together that incoming warheads would interfere with each other, the blast and other consequences of a nuclear explosion interfering with later arrivals.

The Air Force now says that 100 MX missiles separated by distances of about 2,000 feet would be close enough to ensure

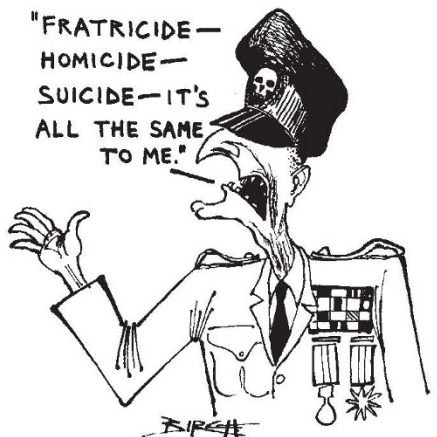
drier-superheaters, will be multiplied through a long production series leading to high replacement costs, and a degree of insecurity in future electricity supply, which is planned to reach 60 per cent nuclear by 1985?

However, this can be taken as an argument for building more nuclear reactors, not less, to provide a cushion of overcapacity, and it will no doubt be taken that way at the ministry of research and industry in the forthcoming argument over coal and nuclear power and falling energy demand forecasts (see *Nature* 11 November, p.100). In Britain, too, where the Central Electricity Generating Board is planning its first PWR at Sizewell, Suffolk, the French problems are seen in a positive light — as useful design lessons. **Robert Walgate**

interference (called "fratricide" in the new jargon). Hitherto, the Air Force has discarded Dense Pack on the grounds that missiles not destroyed in an attack would be unable to fly out in retaliation. The new development is that the Air Force says that missile silos can be hardened so that their missiles will survive even if over-pressures amount to 5,000 lb per square inch.

The nub of Townes's argument is that this "super-hardening" may not be feasible, that there are no clear limits on the time that would be needed for such a development or of its cost and that the Soviet Union might find a counter to Dense Pack sooner than the Air Force could install it.

Military considerations apart, Dense Pack has the political advantage that it would occupy an area of only 10–15 square miles. One of the objections to Racetrack from ranchers and environmentalists in western states was that huge tracts of land would be required.



The latest version of Dense Pack advocated by the Air Force is that the 100 MX missiles would be sited in a long thin column aligned north to south. This has the theoretical advantage that the optimum pattern of an attack on the missile field