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## **A Marshall plan, nuclear style**

*Civex is a chemical process for recycling plutonium that could be used to separate civilian fuel cycles from military production systems. Proposed originally by Dr Walter Marshall of the UK Atomic Energy Authority and launched by Dr Chauncey Starr, president of the US Electric Power Research Institute, it is to be submitted to the International Nuclear Fuel Cycle Evaluation study suggested by President Carter. But Walter Patterson, Friends of the Earth energy specialist has doubts about the package and explains why.*

Dr Walter Marshall, deputy chairman of the United Kingdom Atomic Energy Authority, has been publicly worried for more than a year about weapons implications of civil nuclear technology. On 24 February 1978, Dr Marshall devoted his Graham Young Memorial Lecture at the University of Glasgow to an analysis of "Nuclear Power and the Proliferation Issue", and unveiled a new package of proposals to cope with the problems he identified.

The lecture is, frankly, a strange document. In the Introduction Dr Marshall notes that "The growth of nuclear power throughout the world carries with it the possibility of proliferating nuclear weapons capability", and that "those scientists who have thought about it have realised that normal commercial grade plutonium could be used to make 'crude' weapons". However, he is curiously coy about his own attitude to the issue, preferring simply to acknowledge that there is "concern" about possible governmental or sub-governmental misuse of civil plutonium, and about the civil liberties implications of the control measures which might be required.

Yet he must himself take very seriously at least the force of such concern; otherwise it is not easy to see how he could bring himself to put forward a scheme as sweeping - indeed grandiose - as the one he then proceeds to sketch.

Even by nuclear standards the Marshall plan has few parallels for scope and time-scale. As eventually becomes clear, it entails virtual global agreement to embark collectively on a precarious technical adventure whose goal cannot be achieved before the mid-twenty-first century.

Dr Marshall's stated subject is "the need to control and limit the availability of plutonium". He opens with a startling aside: the production of 250kg of plutonium per gigawatt-year of thermal reactor operation is "in itself not a matter of direct and immediate concern". This statement is on the same footing as the observation by Mr Justice Parker in paragraph 17.6 of the Windscale inquiry report that any direct proliferative consequences of building the proposed new Windscale reprocessing plant "will not happen for ten years".

It is a recurrent characteristic of nuclear advocacy: at the outset there is no problem; thereafter there is no solution.

Dr Marshall also makes some characteristically asymmetrical assumptions about future energy developments. He assumes, for instance, that non-nuclear conservation and supply technologies will fail to satisfy, and that it will be possible to deal with his preferred nuclear programme producing a cumulative plutonium output of 20,000 tonnes by 2040, at which time annual production is upwards of 600 tonnes per year.

Dr Marshall's primary concern is the plutonium in spent fuel. Initially this plutonium is rendered, in his terminology, "inaccessible", by the radiation from the accompanying fission products. As the fission products decay, the plutonium becomes progressively more "extractable", and accessible.

However, his analysis is oddly abstract and idealised. He does not mention who owns or who controls the materials. He fails to distinguish clearly the very different types of access available to sub-national groups and national governments; as a result both his disaggregation of the problem, and the solutions he proposes, are incomplete and inconsistent.

Nevertheless the underlying theme of his approach is recognition of the shortcomings of existing "safeguards" which depend on inspections and materials accounting. He declares that the widespread storage of spent fuel as presently occurring is a basis for concern "because, in essence, every fuel storage facility, wherever it is placed, becomes a 'plutonium mine'. This means that each reactor cooling pond, each national fuel element store or each regional fuel element store becomes a 'plutonium mine' and the plutonium in that mine becomes steadily more accessible as time goes on. In effect a storage policy sets off a proliferation time clock. With this policy every nation with a nuclear power plant and spent fuel element storage facility has set up a target for plutonium diversion and has established an option to construct weapons in ways that are easier and easier to operate as the stored plutonium becomes associated with less less radioactivity".

This assertion is beyond dispute; and it should give pause to many who have hitherto refused to take the possibility seriously.

Furthermore, it could be generalised immediately - although Dr Marshall does not do so. A nation with a store of fresh plutonium-based fuel has precisely similar problems and options. Even if the fresh fuel has been lightly irradiated - a "technical fix" accepted without hesitation by Mr Justice Parker, although it remains entirely hypothetical - such fuel would lose its activity even more rapidly in storage.

Dr Marshall concludes that "The emphasis for non-proliferation must be placed on the retrieval of fuel elements so we know unambiguously where the plutonium is and so that the number of sites in the world where we must rely on 'human organisation' is limited".

On this point Dr Marshall and Friends of the Earth are agreed, although FOE would stress the political difficulty of achieving any such objective. However, Dr Marshall then insists that it is desirable to embark on a whole new phase of nuclear activities, involving large numbers of fast reactors in many places, and a novel and untried concept for reprocessing and refabricating fast reactor fuel.

The premise behind this new phase is Dr Marshall's concern that otherwise we shall not know what to do with the accumulated plutonium. Dr Marshall proposes that we define a new role for the fast reactor. Instead of a fast "breeder" reactor, he suggests that we should think of it as a fast "incinerator" reactor, for burning up all the plutonium lying about. He claims that in this way it would be possible to decrease the net plutonium inventory.

However, studies by the US Nuclear Regulatory Commission, the American Physical Society and others suggest that process losses in recycling, plus the buildup of higher actinides, some decaying to plutonium, would considerably reduce any "incineration" advantage of such recycling.

In the meantime the Marshall proposals would entail a major international trade in plutonium materials, exchanging a doubtful long-term benefit for an immediate hazard. If it is in due course decided to terminate the programme the accumulated plutonium inventory will still require some form of ultimate disposal. Very little work has thus far been done on ultimate disposal; in the US the official view is that spent fuel itself - contrary to Dr Marshall's opinion - will eventually be suitable for direct ultimate disposal in a form which will not lend itself to "plutonium mining" at any future time. Whether this is so or not, the option ought surely to be preserved while research continues.

Dr Marshall's Harwell team, however, are still concentrating on reprocessing. Conceding the inadequacy of "light irradiation" as a radiological safeguard, the Harwell team have devised a process they call Civex - to distinguish it from the Purex process now used at Windscale and elsewhere.

In the Civex process the product stream is an intricate co-precipitate of mixed oxides of uranium, plutonium and fission products, whose radioactivity level is still high enough to make the plutonium "inaccessible". Given the difficulties already experienced with more conventional reprocessing flow-sheets, and the write-off of US General Electric's advanced Midwest Fuel Recovery Plant, it would be a brave investor who would put much money on Civex.

Dr Marshall, having declined to justify his assumptions about the future of energy use and supply, makes some remarkable assertions: ". . . a more detailed examination of the economics of the fast reactor fuel cycle would show that, once established, there would be strong economic pressures to adjust the balance between plutonium produced and plutonium incinerated in such a way that the net production (or destruction) would match that required by the energy demands of society". Could this detailed examination be published, perhaps?

Dr Marshall finishes by acknowledging the difficulty of the "interim period" before Civex and fast incinerator reactors have taken over.

It is, as he says, an interim period of several decades. Dr Marshall puts forward a programme for immediate implementation, and at once makes a quite inexplicable sidestep: "First a small number of very large reprocessing plants should be set up . . ." - using conventional Purex technology, whose proliferative implications he has already by implication decried. The proposal is understandable in terms of

organisational if not international politics; Dr Marshall's chairman, Sir John Hill, is also chairman of BNFL, and BNFL is not very happy about the suggestion that their proposed new Purex plant is a proliferation hazard.

The remainder of Dr Marshall's programme is predictable, a call for all the steps previously outlined to be undertaken. No timetable is given, but it must extend well into the twenty-first century; and the scale of international agreement required, even for the return of spent fuel, is unhappily at the outer limits of political plausibility, especially as it affects those countries whose nuclear ambitions already raise doubts.

Dr Marshall concludes by claiming that "The logic of these proposals is simple". Unfortunately, political and economic reality is not. On the evidence he himself presents, Dr Marshall has good reason to worry. But he appears to be worrying about the wrong problem. In view of his influence and his responsibility, that should worry the rest of us.

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