of extracting weapons material was roughly equal to or greater than that of doing so by independently processing long-stored fuel.

The fact that, in contrast to thermal reactors, fast breeder reactors were relatively insensitive to fission products in their fuel meant that it was possible to conceive of "a hypothetical idealised breeder fuel cycle which at all points has a plutonium-uranium mixture that does not exceed the 15 to 20% plutonium necessary for fresh fuel, that is only partially decontaminated from fission products, and is therefore highly inaccessible" Dr Starr said.

The net result of such a reprocessing system combined with a fast breeder reactor would be the creation of a diversion-proof nuclear power capacity that would effectively remove such nuclear power systems as a potential resource for weapons proliferation.

So far the new system, which is being submitted to the International Nuclear Fuel Cycle Evaluation Study (INFCE) set up last year at the suggestion of President Carter has received a cautiously optimistic welcome from the administration, keen to develop a politically-acceptable fast breeder nuclear reactor programme and reprocessing policy.

A spokesman for the US Secretary of Energy, Dr James R. Schlesinger, said that the concept described by the scientists would receive serious consideration because it fitted with the goals of the federal reactor research programme.

However, environmentalists still have their doubts. In a joint statement, two Washington-based environmentalists groups, New Directions and the Natural Resources Defense Council, criticised the new proposal for a failure to set high enough standards of safety, saying that the new technique could be used as a cover-up for the production of nuclear weapons.

The relative desirability of fast breeders over thermal reactors—even taking proliferation dangers into account—had been emphasised by Dr Marshall four days prior to the Washington meeting when he gave the Graham Young Memorial Lecture at Glasgow University in Scotland. Dr Marshall said that a policy of using thermal reactors alone in the once-through cycle was not a satisfactory non-proliferation policy since every fuel storage facility became, in essence, a 'plutonium mine'. Furthermore the net rate or production of plutonium by fast breeders was potentially lower than the production of plutonium as waste by thermal reactors.

David Dickson

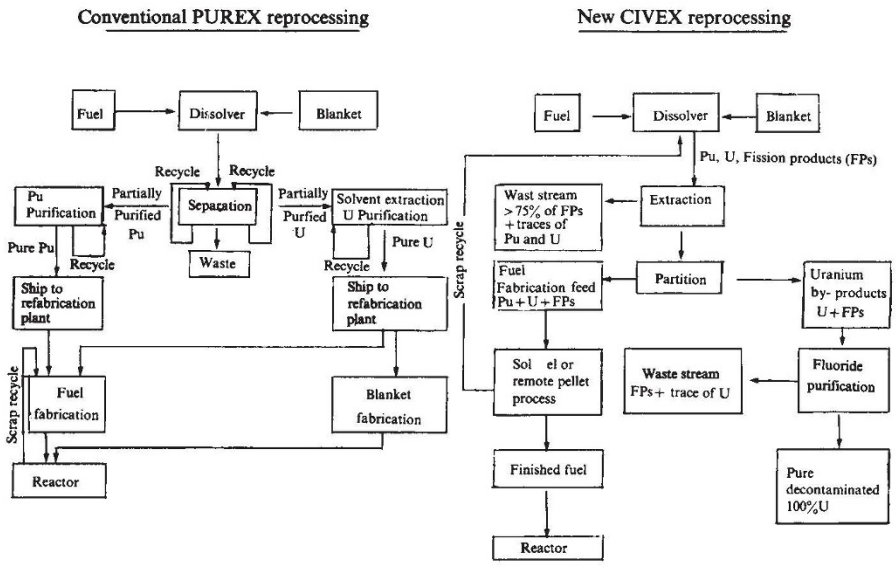
How 'CIVEX' and 'PUREX' differ

DETAILS of the new reprocessing system—described as 'CIVEX' to emphasise its civilian character and distinguish it from the conventional 'PUREX' reprocessing process—were described to the Washington conference by Dr Milton Levenson, Director of EPRI's nuclear power division.

According to Dr Levenson, seven criteria were necessary to help define a diversion-proof reprocessing system These were:

- No pure plutonium in storage
- No pure plutonium at any intermediate point
- No way to produce pure plutonium by simple process adjustment
- No way to produce pure plutonium without equipment modifications
- No way to carry out equipment modification with facilities and components normally on site
- No way to carry out the required equipment modifications without plant decontamination or entry into extremely high radiation fields
- Length of time required for successful diversion such that adequate time is available for national and/or international response.

Dr Levenson said that a number of steps in the conventional PUREX process violated at least one of these criteria. Such unacceptable steps included the shipment of pure plutonium from a reprocessing plant to a refabrication plant, the final plutonium purification cycles, and the provision for recycling material that was not highly purified.



The first steps of the solvent extraction operation prior to the scrubbing of fission products from the plutonium/uranium streams did meet the criteria, and would be retained in the CIVEX process. However, the process was new in two ways, Dr Levenson said.

Firstly the chemical steps used for uranium purification use a fluoride purification process which is effective for purifying uranium but not for plutonium. The excess uranium which is to be recycled for blanket fabrication is collected for subsequent purification by a fluoride volatility process using bromine trifluoride or low temperature fluoridation to produce UF_6 and subsequent purification by distillation or sorption-desorption.

Furthermore the plant equipment and layout would be such that there is no way to change the mode of operation to produce plutonium. In the PUREX process, whose objective is to make the purest possible uranium and plutonium, free of radioactive wastes, equipment is provided to permit the recycling and decontamination of any material carrying radioactive impurities. Such equipment is not present in the CIVEX plant, and concrete process cells are constructed of such a size as to make it impractical or impossible to install any.

Further modifications in the CIVEX design include the absence of a separate scrap recovery facility, and the fact that the primary product stream is taken directly through a remote fabrication operation, using the sol-gel method of making oxide or remote application of the more conventional oxide process through to finished fuel.