

European Space Agency

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Shuttle. West Germany is providing over half of the \$400 million in research and development costs. ESA will give NASA the first Spacelab and the US agency will probably purchase later units. The research effort at least for the first Spacelab flight will be a joint US-Europe venture—including the possibility of a European crew member, the first western European to fly into space. A second and somewhat larger project is Ariane, a launcher (of Atlas-Centaur size) to put satellites into synchronous orbit.

Several satellites are nearly ready or planned under ESA auspices. Celestial Observatory Satellite-B, scheduled for launch this month from California, carries instruments capable of detecting gamma rays with energies above 20 MeV. For 1976, there is GEOS, which will continue studies of the Earth's magnetosphere begun by earlier satellites. Also planned for that year is the International Ultraviolet Explorer, a joint venture with NASA and the UK Science Research Council. For 1977 there is the three-satellite International Sun Earth Explorer Project, also in partnership with NASA. EXOSAT, planned for 1979 will measure locations of x-ray sources using lunar occultation.

Plutonium recycling

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breeder reactors of the 1980's, the interim waste problem becomes less serious."

Frank von Hippel (Princeton) agreed that it is economically close to breakeven and this is one reason why the plutonium-recycle industry has developed so slowly. He told us: "I would speculate that ultimately, the government might have to take over that part of the fuel cycle. The idea originally was that recovered uranium and plutonium would more than pay for the process, but this is coming into question now. There is no great incentive with the price of uranium what it is." Recycling of nuclear wastes would add only about 20-30% to the available fuel supply—a far cry from the 50-fold increase in fuel-use efficiency expected for breeder reactors.

In any event, many power plants are filling up their spent-fuel storage pools. Taylor outlined for us the options the utilities have:

- ▶ They can hope for relaxation of safety criteria thereby allowing more spent-fuel rods to be placed into the same volume (this, Taylor says, is not likely to happen).
- ▶ They can look for offsite storage capacity that now exists, either in some-

Plutonium storage and recycling facilities

There are three plutonium recycling plants in the United States where utilities could send spent fuel rods should their own storage capacities fill up. None of these plants is recycling plutonium at the moment, but their storage areas are nonetheless potentially usable.

1. General Electric has invested in a small plant in Morris, Illinois, but there have been design difficulties and it probably will not be able to recycle plutonium.
2. At Barnwell, South Carolina, Allied Chemical and Gulf General Atomic have nearly completed construction of a facility that is more likely to be operable, although now it is likely to be caught in the NRC freeze.
3. The Nuclear Fuel Services Plant in West Valley, New York, has been shut

down since 1972 because radiation doses to workers were exceeding permissible levels. An improved and expanded version of the plant is scheduled to open in 1979.

The storage capacity of these three plants, however, is relatively small compared with the rate at which light-water reactors are discharging spent fuel rods. It is expected by 1977 that storage capacity for 1170 metric tons of waste will be available—storage for 50 tons that was available as of March 1975 and 1120 tons that is expected to open up. For 1975, 1976 and 1977, projected spent-fuel discharges are 698, 1101 and 1402 tons, respectively. For more details, see *LWR Spent Fuel Disposition Capabilities, 1975-1984*, US ERDA report #25, March 1975.

one else's reactor storage pool or in one of three other limited storage places (see box).

▶ They could possibly use temporary storage facilities that can be built, but it would take about three years for one to be ready for operation.

▶ They might make use of the hot storage facilities at Hanford, Washington and/or Savannah, Georgia; there has been serious consideration to reactivate these installations.

According to Taylor, it is not clear which, if any of these routes will be taken.

Effects on the breeder. According to the people we spoke to, plutonium recycling during the coming several years is not crucial to breeder-reactor development, although as Taylor put it, "The longer plutonium recycling is held off, the more it delays the time when more-or-less routine operating experience with plutonium fuel has been developed. And, of course, an NRC decision not to allow recycling, depending on how long the freeze lasts, could have a severe impact on the breeder, perhaps to exclude it altogether." He further mentioned the financial considerations involved: "At some point industry will have to consider fairly heavy investments in gearing up for the breeder and they may not want to make those investments if there is any danger that the safety and safeguards requirements will cause them not to want to go the breeder route at all."

Safeguards alternatives. Perhaps the most pressing problem with plutonium is its possible diversion by thieves. The recycling process is the first place in the commercial fuel cycle where plutonium is isolated and available for diversion, but there are several measures that can be taken. The first solution is not to process the spent fuel at all and perhaps bury it when it has cooled down. Second, a more on-line and accurate fuel-assay system is useful to tell quickly of

a discrepancy in the amount of plutonium in the system.

A third possibility is more secure physical barriers: fences, alarms, heavy containers, and guard and reserve forces. Taylor commented about this: "In principle you could make a trade-off between physical barriers and guards. I think, generally, people are tending to want to rely on equipment and as little as possible on guards who have the authority to shoot at people."

Another safeguard Taylor told us about is the use of a hot isotope such as cobalt-60 mixed in with the plutonium to "spike" it—that is, make it too hot for a thief to handle. He noted, of course, that it is also too hot for authorized workers and the public. —RAS

in brief

A *Consumers Guide to Instrumental Scientific Equipment*, including the names of knowledgeable users to contact for each of the 2000 items listed, is available for \$1.50 from the US Government Printing Office, Washington, D.C. 20402.

A bimonthly newsletter, *Atomic Data for Fusion*, published by the Holifield National Laboratory and NBS has appeared. Inquiries should be addressed to C. Barnett, Holifield National Lab, PO Box Y, Bldg. 9201-2, Oak Ridge, Tenn. 37830

Wave Electronics, a new bimonthly journal published by Elsevier, will cover the field of wave interactions used for communication purposes. Subscriptions are available for \$48.50 from Elsevier Publishing Co, PO Box 211, Amsterdam, The Netherlands.

Energy Review, a bimonthly edited by A. I. Berman, is available for \$18.00 a year from Energy Review, 200 West 57 Street, Suite 708, New York, N.Y. 10019. □