state & society

Study finds no proliferation–proof nuclear fuel cycle

The International Nuclear Fuel Cycle Evaluation, which concluded its two-year study earlier this year, and a US study along the same lines, seem to have ended once and for all the myth that nuclear weapons and nuclear energy have nothing to do with one another. INFCE was set up at the instigation of the Carter Administration in 1977 to explore ways we can minimize proliferation of nuclear weapons resulting from the development of nuclear energy, and some consider it a major defeat for US international nuclear policy.

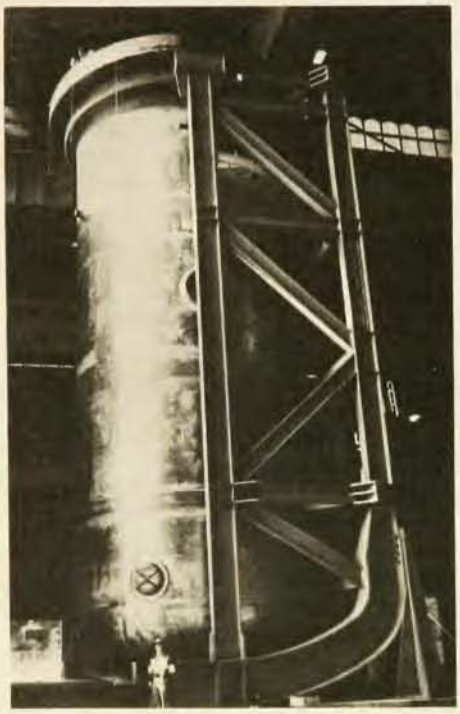
Carter hoped that INFCE would convince the international nuclear community to restrict severely any activity or technology that would involve the production of weapons-usable plutonium, such as the breeder reactor or reactor fuel reprocessing, and come up instead with a proliferation–proof technical alernative. That did not happen. But the 66-nation group did reach broad agreement that there are proliferation risks associated with nuclear power as well as measures that can be taken to make such risks more tolerable and manageable.

The study was divided into eight working groups, each with responsibility for a specified aspect of the fuel cycle. In all, 519 experts from 46 countries and five international organizations participated in the working groups. They produced more than 20 000 pages of documents over the two years of the study. A technical coordinating committee was also set up, composed of the 22 co-chairmen of the working groups, to coordinate the study from the technical point of view.

The INFCE reports do not contain policy recommendations, because INFCE was intended as a nonpolitical technical and analytic study rather than as a negotiation. They do define the problems, however, and provide suggestions that include technical, legal and institutional measures. INFCE also analyzed the special needs of developing countries.

Among the major conclusions of INFCE:

- There is no hope of developing a thorium fuel cycle for nuclear reactors that could be available on a commercial basis until well after the year 2000.
- Sensitive nuclear facilities, such as reprocessing plants and enrichment plants, that provide direct access to weapons-usable materials, should be limited to a few countries.
- Reprocessing is not, as some had contended, necessary for the permanent disposal of nuclear wastes, and the reprocessing of fuel for use in non-breeder reactors is at best marginal economically.
- Reprocessing looks particularly unattractive economically for developing countries with small nuclear power programs.
- Breeder reactors, in routine operation are less environmentally hazardous than are light water reactors and are most appropriate in industrialized nations with large nuclear power grids.
- Effective international safeguards are an essential feature of the nuclear power industry and should receive substantial attention.



Clinch River Breeder Reactor vessel has been completed but the Carter administration wants to abandon the project. The recently completed INFCE report said that breeder reactors in routine operation are less environmentally hazardous than light-water reactors.

INFCE examined the economics of what it considered to be the three major fuel cycle options: fast breeder cycles, thorium–uranium fuel cycles and other advanced reactor systems and concluded that "no one fuel cycle can be said to have an economic advantage in all cases." There are conceivable circumstances under which each of the three cycles considered may have an economic advantage over the others.

A parallel study to INFCE was performed by the Department of Energy and completed about the same time as the international review. The DOE's Non-proliferation Alternative Systems Assessment Program, which focussed primarily on evaluating the proliferation resistance of alternative nuclear systems,but also considered other factors that influence national decisions on the acquisition or expansion of nuclear power programs. It drew many conclusions similar to those of INFCE, but went a step further and put forth recommendations for the US nuclear research, development and demonstration programs. Both NASAP and INFCE set a high priority on improvement of light water reactors. Both groups also agreed that, although there is no technical "fix" to the problem of proliferation, the relative risks of proliferation resulting from fuel cycles can be reduced by applying certain technical and institutional measures, and recommended continued research in areas such as co-conversion and co-processing.

Even on the issue of the breeder reactor, the US and the international groups were in close agreement, arguing for further breeder research. But they disagreed as to when the breeder might first become a necessity. INFCE assumed a fairly high rate of growth in nuclear generating capacity. By the year 2000, INFCE concluded, the non-communist world could be generating as much as 1200 GW from nuclear reactors, compared with today's capacity of about 125 GW. Based on INFCE's long-term uranium supply assessment, they concluded that the uranium industry would be able to achieve

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annual supply levels adequate only for the requirements up to the year 2000, assuming the highest growth projections. NASAP estimated that uranium supply will satisfy demand in the US at least until 2010 without resorting to the breeder. During that two-year interval, forecasts of future world energy demand dropped sharply, and many countries revised downward their plans for installing nuclear power.

One interesting approach to breeder deployment has been put forth by IBM physicist Richard Garwin. He says that we can greatly reduce the hazard of proliferation associated with the breeder reactor by delaying its deployment and designing reactors that produce less weapons-usable plutonium. Nuclear power experts have traditionally encouraged early deployment of the breeder and development of high breeding ratios (the ratio of isotopes consumed to isotopes produced) in order to generate enough plutonium to fuel succeeding generations of breeders. But Garwin's calculations show that by fueling not only the first generation but each deployed liquid-metal fast breeder reactor initially with U^{235} rather than with reprocessed plutonium, we can sustain a reactor for more than 2000 years of operation at 1000 MW(e), even if there were no excess plutonium production in the mature LMFBR (that is, a breeder ratio of one). According to Garwin, his proposal to start the reactor operating with enriched uranium would allow a large, rapid deployment of breeders when they are economically desirable without the necessity of premature commercial breeder operation or plutonium separation. An available uranium resource of 3.5 million short tons of U_3O_8 would fuel 1000 LMFBR's for more than 2000 years even if their breeding performance were far worse than has already been demonstrated, he says.

Garwin's approach to breeder deployment has several nonproliferation advantages: We would not need to separate plutonium now to fuel future breeders. Nor would we need to deploy first-generation breeders now, when they are not economically competitive with either LWR or fossil plants. Finally, opting for lower breeding ratios can eliminate the production of excess Pu that could be diverted for weapons uses.

The emphasis of breeder research should therefore shift from trying to raise the breeder ratio to modifying the design of the LMFBR to make it cheaper, safer and reduce the uranium investment required to fuel a new LMFBR, Garwin says.

Garwin's proposal will have a hard time winning acceptance. Both the INFCE and the NASAP studies recognized that breeder deployment decisions will be made for reasons of energy security as well as for economic considerations, and that different countries will reach different conclusions as to the timing and need for the breeder. —MEJ

House group cuts DOE 1980 funds

In its attempt to reduce Federal expenditures the House Appropriations Committee has cut the Department of Energy's Fiscal Year 1980 appropriation for physics research by $19 million. While considering DOE's 1980 supplemental request and proposed rescissions, an appropriations subcommittee decided to make the additional cuts in the energy research budget. The action was unusual in several respects: For one, it was made halfway through the fiscal year, when some of the money involved had already been promised to national laboratories and universities. Also, the Committee was unusually specific in its proposed cuts, at times getting down to the project level. Such specifics are usually left to the Committee on Science and Technology.

The Appropriations Committee reduced the high-energy physics budget by $8 million, $4 million of which is to be removed from Brookhaven's Isabelle construction project budget until 1 October. This will result in a slower construction schedule, Edward Frieman, Director of Energy Research, told PHYSICS TODAY, and raise the total cost of the project by $5 million. Heavy-ion physics is reduced $1 million. Another $1 million is to be gained by deferring the construction of the National Superconducting Cyclotron at Michigan State University. And $2 million is to come out of the magnetic fusion program. The Committee recommended that DOE make this cut by stretching out the development and construction schedule of the Elmo Bumpy Torus proof-of-principle project.

Following the Committee's action DOE appealed the rescissions (repeal of funds) to the Senate Appropriations Committee, but as of this writing, the Senate is not expected to disagree with the cuts.

The cutbacks could have some severe effects if they are made law, according to DOE, including staff layoffs and equipment shutdowns. Ronald Young, with DOE's Office of Energy Research, told us that, as an example, SLAC may have to extend its regularly scheduled maintenance shutdown to the end of the fiscal year in September. Frieman said universities will be hardest hit by the cuts, because the national labs are working under contracts that cannot easily be broken. —MEJ

Cornell synchrotron seeks beam proposals

Proposals for experiments to be conducted at the Cornell High Energy Synchrotron Source (CHESS) facility, are now being considered. At present, three beam lines are fully operational and can supply radiation to four experimental stations. Intense polarized radiation in the hard x-ray energy range (a few keV and above) is available at these stations, and the characteristic energy of the radiation lies in a range of up to 35 keV. Proposals that would exploit this feature of the facility will receive preference. CHESS will provide the capability to facilitate studies in EXAFS, x-ray topography, small-angle scattering, Compton scattering, deep level spectroscopy and x-ray crystallography, but experiments need not be limited to these areas. Details on the current instrumentation and available facilities can be obtained from the director, B. W. Batterman, telephone (607) 256-5161.

Beam time will be allocated according to the recommendations of a review panel and the expected schedule of operation of the CESR storage ring. Proposals should be submitted by 15 August to Proposal Secretary, CHESS, Clark Hall, Cornell University, Ithaca, New York 14853.

Langenberg named NSF deputy director

Richard C. Atkinson has resigned as director of the National Science Foundation and is now chancellor of the University of California at San Diego. Atkinson had been NSF director since 1977 and served for two years before

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