Breeding in light water: The test begins

On Aug. 26, the light-water breeder reactor in Shippingport, Pa., went critical, and in so doing marked the beginning of commercial-scale tests for a potentially proliferation-proof reactor. Although this reactor won't solve problems of nuclear wastes or recycling of spent fuel, it does promise to greatly extend our dwindling nuclear-fuel supplies and will use a potentially safer fuel cycle.

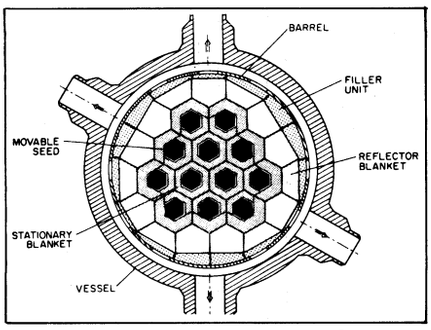
Each fissioning atom in a reactor core absorbs one neutron and ejects two or three more. Only one neutron is required to keep the chain reaction going; excess neutrons escape the reactor or are captured by nonfissile (nonfissionable) material in its core. In the light-water breeder, there must be enough excess neutrons to convert a rich blanket of nonfissile thorium into more uranium-233 fuel than is burned by fissioning. This constitutes breeding.

Calculations show that a light-water reactor fueled with U-235 will not breed; U-235 is the fuel burned by commercial reactors in the United States. However, the higher neutron release associated with fissioning U-233 indicates that that isotope can breed in light-water reactors.

The light-water component of its name refers to the regular hydrogen isotope present in water moderating its core or nuclear-assembly area. A moderator slows the speed or energy with which neutrons move through the core. Here it is also a coolant, carrying off heat generated by fission to generate electric power.

How important is the light-water breeder? Some type of breeder becomes essential as the nation exhausts its uranium supplies (and if a nuclear-power economy is agreed to). Also, as Westinghouse Electric Corp. showed in having to renege on its uranium-supply contracts last year, the age of inexpensive uranium is over. Economically recoverable U-235 is in tight supply, which is one reason why utilities here and elsewhere are so eager to get their hands on the Australian uranium offered last month for export. (Australia holds 20 percent to 25 percent of the noncommunist world's uranium reserves.) President Carter's preference for eliminating fuel recycling further heightens concern over uranium availability. And most energy supply estimates show an increasing reliance on nuclear power (together with coal) to ease the energy crunch during the next 50 years.

There are other types of breeders. In fact, most talk focuses on a more costly, controversial and complicated cousin, the liquid-metal fast-breeder reactor (LMFBR). Because plutonium will figure strongly in its fuel cycle and because Theodore Taylor has brought visibility to the relative ease with which thousands of nuclear sophisticates could fashion a crude but effective bomb with plutonium, nuclear-weapons proliferation has become a major obstacle to LMFBR endorsement. The LMFBR may also have several technical obstacles to overcome, but the proliferation issue could make that moot.



This core cross section shows configuration of rods containing seed, or fuel, and thorium blanket. Coolant flows alongside fuel. The reflector rods limit neutron losses.

The comparatively simpler light-water breeder offers the following potential advantages:

- It makes use of the abundant and currently unused thorium-U-233 fuel cycle instead of U-235 fuel.
- It should be possible to alter existing commercial power reactors to accept a light-water breeder core.
- Gamma-ray emissions from highly enriched U-233 fuel make it too hot to handle—radioactively speaking—which should deter potential sabateurs from diverting it for use in weapons. Studies underway will also examine the feasibility of denaturing its fuel—mixing it with nonfissile material—so that it will still burn but no longer be of weapons-grade purity; denaturing could also kill its ability to breed.
- It significantly reduces production of dangerous transuranic elements as byproduct wastes—among these is plutonium. However, the radioactive-waste total would be similar to that produced in current light-water reactors.

If the light-water breeder sounds so good, why haven't you heard of it before? Because of Admiral Hyman G. Rickover. The formidable Rickover runs a tight ship; no one talks about the naval nuclear program—of which the light-water breeder is an off-shoot—but Rickover. He oversees all naval nuclear research and development, and because he has never been one to tout technology in the public forum, the light-water breeder's development has passed almost unnoticed heretofore.

An unusual core geometry makes this reactor uniquely suited for breeding. In conventional light-water reactors, control rods act like sponges to soak up excess neutrons which could otherwise cause a runaway reaction. Changing positions of the rods controls the neutron flux, and therefore the power output. But all neutrons lost to the control rods' spongelike action in a conventional reactor are put to good use breeding fissile fuel in this breeder. Criticality is controlled by moving fuel, not control rods. The thorium blanket sponges up excess neutrons, but makes fuel in the process, something control rods didn't do.

Various physics tests will be performed in coming months before stepping up the reactor to full power—about 50 megawatts. President Carter has been invited to a dedication of the breeder, according to ERDA. Electricity produced in the reactor, owned by ERDA, during its three years of scheduled testing will enter the Duquesne Light Co. power grid. Duquesne and ERDA jointly own the Shippingport power plant. □

Soviet psychiatric practices criticized

Before they even stepped into the Hawaiian sun, the nine Russian delegates to last week's World Congress of Psychiatry could attest to Honolulu's heat. Although more than 1,500 scientific papers were presented at the meeting—the first such worldwide gathering of psychiatrists in six years—it was clear from the outset that this year's congress was to have but one overriding theme: The abuse of psychiatry for political purposes, particularly in the Soviet Union.

By conference time, months of public disclosures by Soviet emigrants documenting more than 200 cases of alleged use of psychiatric diagnoses to suppress healthy dissidents had reached a crescendo. And timed with the start of the meeting was the release of *Psychiatric Terror: How Soviet Psychiatry is Used to Suppress Dissent*, a voluminous review of many of these cases. Sidney Bloch, one of the book's authors, flew to Honolulu for the congress along with two purported victims of the Soviet mental health system—mathematician Leonid Plyushch, confined to a mental institution for two years after being prohibited from attending his own trial, and Marina Voikhanskaya, a psychiatrist who fled to England two years ago after criticizing the practices of her colleagues in Soviet mental hospitals.

The drama culminated close to midnight, Aug. 31, when the general assembly of the World Psychiatric Association (WPA) voted by secret ballot to condemn the Soviet Union for "the systematic