# Ultimate Recycling: Nuclear Warheads

*A new warhead design might permit plutonium triggers from old nuclear weapons to be used in new ones—and that could spell doom for a controversial defense plant*

PHYSICISTS AT THE LAWRENCE LIVERMORE National Laboratory have quietly been developing a new approach to making nuclear warheads that could have a major impact on the federal government's troubled multibillion-dollar nuclear weapons program. The approach, which is now being tested, would do away with some of the costly processes involved in putting together the intricate components of thermonuclear explosives. But the Department of Energy (DOE), which oversees the sprawling nuclear weapons production effort and has been funding the Livermore work, is likely to find the idea a mixed blessing, for it could derail a controversial plan to reopen a bomb-making factory in Colorado that is currently undergoing a $1-billion repair program.

What the Livermore scientists have come up with may be the ultimate in recycling: A way to reuse intact plutonium triggers from old warheads—now being retired from the nuclear stockpile in record numbers—in the thousands of new weapons slated for production in coming years. The idea may appear unremarkable, but it represents a complete departure from the decades-old practice of making fresh plutonium cores for each new type of warhead—a practice akin to custom-designing spark plugs for every model and size of automobile engine. Indeed, because warheads have traditionally been designed as a complete unit, little thought has been given before to making their parts interchangeable, and some weapons designers were initially skeptical that the idea would work.

Recent tests have demonstrated, however, that what one physicist calls a "revolutionary new...design" will permit the use of recycled plutonium triggers, or "pits" as they are known, in several of the five different types of warheads that the Pentagon wants to build. Filled with the radioactive gas tritium and encased in chemical high explosive, the hollow plutonium pit sets off a nuclear chain reaction when it is compressed during detonation.

Livermore began working on the idea after the nation's sole factory for plutonium triggers at Rocky Flats, Colorado, was temporarily closed in 1989 because of safety and environmental problems. Now the new approach is proving so successful that it might eventually make the factory redundant. And that possibility could pose a political problem for DOE, which is planning to reopen Rocky Flats this year—even before it can meet federally mandated safety and environmental standards. Congress faces a tough dilemma: It must either keep funding a possibly outdated production line, perhaps wasting huge sums and allowing some hazards to persist, or delay its reopening until the Livermore design is fully tested.

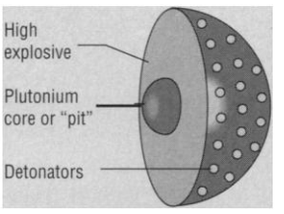
John S. Foster Jr., a member of the Defense Science Board and former Livermore director, is among those who favor considering a delay in reopening the plant "pending verification of the practicality" of complete recycling. He and others, including a senior DOE official, say this might be done within 1 year. "You wouldn't want to reopen it and then shut it again" because plutonium triggers can be recycled, Foster said.

There is, however, considerable military pressure to reopen Rocky Flats this year. Closing the plant caused the supply of plutonium triggers to dry up last July, and no new U.S. nuclear warheads have been made since. This already has created a shortage of roughly 450 new warheads, according to top-secret nuclear production plans signed last year by President Bush and inadvertently disclosed in a recently declassified congressional hearing text. "We...need an operating Rocky Flats facility as soon as possible," said Robert Barker, the assistant to the secretary of defense for atomic energy, in March testimony to a House appropriations subcommittee. Without Rocky Flats, "it may be impossible for the U.S. to implement its planned nuclear modernization and recommended nuclear safety programs," Air Force General Lee Butler, commander of the Strategic Air Command, told the Senate Armed Services Committee that month.

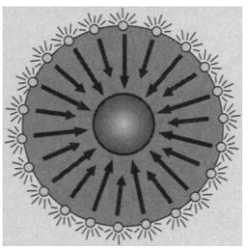
Why move rapidly now that the Cold War has ended? Officials say the new warheads are required to modernize some of the 19,000 nuclear explosives currently in the U.S. arsenal. The modernization plan would provide new war-fighting capabilities and the ability to target Soviet sites with weapons that explode with greater force than some of those in the current arsenal. But the rush to reopen the plant has sparked intense controversy on both national security and environmental grounds. Senator Timothy E. Wirth (D–CO) said at a recent Armed Services Committee hearing on DOE's budget request that it has caused "a great deal of alarm to people in the Denver metropolitan area" who are already upset by the plant's history of neglecting environmental and safety rules. "What's the need, what's the rush?" Wirth asked. Activist groups such as the Union of Concerned Scientists (UCS) and Friends of the Earth have also argued that the reopening should be delayed or canceled. "There is no national security requirement for [new] nuclear weapons that would warrant the risks to worker public health and safety that have been shown to

## PLUTONIUM PITS

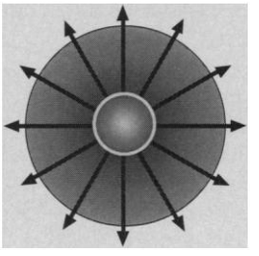
The plutonium core or "pit" of a nuclear weapon acts as its trigger. The pits are produced one by one in a complicated procedure that involves casting or rolling small discs of plutonium, then machining, heat-treating, and shaping them on a lathe.




NORMAL FIRING



When all detonators on a warhead fire simultaneously, the inward-traveling detonating wave uniformly compresses the plutonium pit.



With its high density, the plutonium pit becomes supercritical, releasing huge amounts of energy from the nuclear chain reaction.

Source: Natural Resources Defense Council/The Washington Post

be present at Rocky Flats," said Hampshire College physics and science policy professor Allan Krass in a recent report for the UCS.

One House panel has already recommended that DOE's strategy for reopening Rocky Flats be reviewed. At the urging of Representative David Skaggs (D–CO), who represents the Rocky Flats area, the Appropriations subcommittee on defense voted on 16 March to advise DOE to wait for the report of an independent panel looking into alternate production sites before resuming plutonium processing for the manufacture of new pits. But DOE objects strongly, and nothing in the provision would bar DOE from manufacturing new pits with stockpiled plutonium. The issue will be debated further in Congress, and the new Livermore studies may play an important role in deciding the outcome.

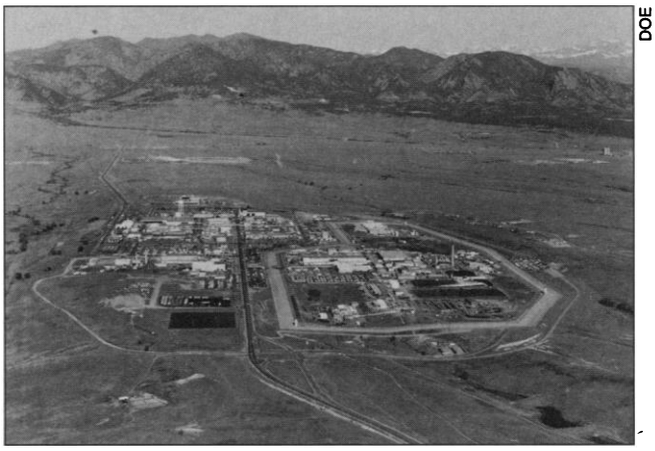
Congress wasn't generally aware of the new thinking about warhead manufacture until the design work on pit recycling was disclosed by John H. Nuckolls, director of the Livermore lab, in March testimony before a closed hearing of the House Armed Services Committee panel on defense nuclear facilities. "Extensive reuse of major nuclear components from retired weapons could profoundly affect the design and size of the future nuclear weapons complex," he said. Nuckolls has declined to answer questions about his testimony.

Officials say that in normal periods, the machinery at Rocky Flats produces several pits each day after an 8-week-long operation that includes the recasting or rolling of purified plutonium disks, known as "buttons," to form twin hemispheres. Each hemisphere is then subjected to lathing, heat-treating, cleaning, and testing in a building the size of two football fields. The entire process is extremely inefficient, wasting the equivalent of one-third of the plutonium contained in the finished pits.

Recycling intact pits would essentially eliminate all of these operations. But it would require careful tests to ensure that other weapons components could function properly with a pit that may differ from an original design. Some of these tests, including at least one underground nuclear explosion costing tens of millions of dollars, have already occurred, while others are still in the early planning stages, several weapons officials said.

The plan nearest to completion involves recycling cores from retired W68 Navy Poseidon submarine missile warheads in new W89 warheads for short-range missiles carried by Air Force strategic bombers. Nuckolls said in March that non-nuclear tests of the W89 warhead have produced "favorable" results. He also told a Senate Armed Services subcommittee this month that a recent underground nuclear explosion of the redesigned W89 with a recycled pit had "exceeded our expectations" and "probably ensured" the weapon could be delivered on time.

The Energy Department has identified the W89 as one of three types of weapons slated to receive new pits beginning later this year. The others are the W88 warhead for Trident submarine missiles and the B61-6 and B-61-7 bombs for strategic and tactical aircraft. But Nuckolls testified that recycled pits could also be used in the W88, possibly within 2 to 3 years, and other nuclear weapons scientists said on condition of anonymity that both Livermore and the Los Alamos National Laboratory are studying the feasibility of using recycled pits in the B61. Those who oppose delaying the Rocky Flats reopening say that the United States cannot safely wait any longer to put the W88s on six new Trident submarines and the new B60s on various aircraft, even though these systems can carry older, less powerful warheads in the meantime.



DOE

**Obsolete?** *Pit recycling may put Rocky Flats out of business.*

The chief scientific challenge is ensuring that the recycled plutonium trigger, which provokes a bomb's so-called primary fission explosion, will have sufficient force to cause a secondary or thermonuclear (fusion) reaction, several weapons scientists said. The trigger for the W68 warhead—the principal candidate for recycling because thousands are being retired as Poseidon submarines are replaced by Tridents—has a relatively thin or light "pit" compared to some other modern weapons that use a larger quantity of plutonium. It thus must be carefully analyzed for compatibility with higher-yield thermonuclear designs, such as bomber weapons or the W88. It also is somewhat larger than pits that were custom-designed for the W88, W89, and W80 sea-launched cruise missile warheads. "It's like taking an 8-cylinder engine and putting it in a Honda," said one weapons designer.

Nuclear weapons scientists have eschewed such tests in the past because they prefer to design every warhead "from the ground up," another designer said. This approach is good for business at the weapons labs—it entails more work and a higher budget—and it also allows the military to forgo many technical compromises in creating weapons precisely tailored to fulfill wartime targeting plans. Although a few warhead designs have been flight-tested on more than one type of missile or airplane, most have not; as a result, any warhead redesign made necessary by pit recycling will likely force costly new flight tests.

Some scientists have complained that recycling of older nuclear cores might inhibit use of new safety features designed to reduce the likelihood of an accidental release of radioactive materials. Such features might include use of high explosive material that is relatively insensitive to the stress of accidents; it might also include a container for the plutonium pit to reduce risks that the carcinogenic material might be dispersed in a fire. However, Nuckolls said without elaboration about the new Air Force W89 warhead that "we are including all the modern safety features... [while] using pits which were not originally designed for this purpose."

Rocky Flats officials have also noted that older pits have higher intrinsic radiation due to buildup of americium, a decay product of plutonium, complicating weapons manufacturing. But Richard A. Claytor, assistant secretary of energy for defense programs, told the House Appropriations Committee that "reasonable steps can be taken to minimize this increased radiation" by adding extra lead shielding to production equipment.

A detailed report on Rocky Flats by Congressional Research Service analysts, who had access to classified defense data, recently concluded that fabrication of the pits is the only Rocky Flats function that could not be performed elsewhere in the weapons complex. The analysts said a delay of up to a year or more in reopening the plant "would appear to have only modest consequences for [nuclear weapons] safety and national security." The $1-billion question is whether Congress will agree. ■ **R. JEFFREY SMITH**

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