Peaceful Nuclear Explosions: Promises, Promises

Many arms control specialists have long been saying that programs for "peaceful nuclear explosions" (PNE's), either here or abroad, do not hold enough promise to compensate for the seemingly impossible difficulties they put in the way of achieving a comprehensive treaty to ban the testing of nuclear weapons. Now, two contract reports prepared for the Arms Control and Disarmament Agency (ACDA) indicate that, even if the U.S. government reinvigorates its now quiescent PNE program, commercial application of PNE's will not come before the 1990's, if indeed it ever comes.

One of the reports was done by the Gulf Universities Research Consortium (GURC) at Galveston, Texas, under a $113,000 ACDA contract. Principally, what GURC did was to examine the feasibility of what it regarded as the three most promising PNE applications, namely, detonating nuclear devices to (i) prepare oil shale for in situ retorting, (ii) stimulate the flow of natural gas in "tight" rock formations, and (iii) create storage caverns for natural gas and oil.

The other report was prepared by a panel chaired by Franklin A. Long, professor of science and society at Cornell University. The Long panel used the GURC study as the jumping-off point for its own brief analysis of the economic and technical feasibility of a wide variety of PNE applications. And, as in the case of the GURC report, its study encompassed only technical and economic factors, with political considerations left aside. Although it generally embraces the GURC report and its conclusions, the report of the Long panel is broader and in some respects more skeptical. Yet the panel was by no means dominated by individuals who might be suspected of an arms controller's bias against PNE's. The chairman and two other panel members have been closely identified with arms control issues, but the other five members of the group were specialists in petroleum engineering or marketing.

The Long panel points out that the United States has spent about $160 million on PNE experiments since the PNE program began in the late 1950's. Two-thirds of that amount has been spent on earth-moving or cratering experiments; most of the remaining third has gone for a series of tests to stimulate natural gas.

It was these gas-stimulation shots—Gas Buggy in New Mexico and Rulison and Rio Blanco in Colorado—that led to the first vigorous public opposition to PNE's in the United States. The opposition has been so intense that Colorado has amended its constitution to forbid such shots without approval of the electorate, and Congress in the current appropriations act has declared that no money shall be spent on "field testing of nuclear explosives in the recovery of oil and gas." The latter injunction was gratuitous, however, because interest in the PNE program has fallen to such a low level that the only money budgeted for it is about $1 million to study the effects of the Rio Blanco shot.

The Long panel report indicates that PNE applications are likely to come off second best when compared to alternative ways to achieve the same ends. For instance, after recalling the discouraging results of all the previous gas-stimulation shots, the panel noted GURC's finding that industry believes an alternative technique, massive hydraulic fracturing (MHF), holds more promise.

With respect to preparing oil shale for in situ retorting, the panel again compared the proposed PNE technique to the more conventional (though also unproved) technique known as the Garrett process. In each case, the aim is to create, within deeply buried beds of shale, tall "chimneys" of rubbled rock in which the retorting can occur. One problem in using PNE's lies in the danger of "blowing through" from one chimney to another if the chimneys are placed close enough together to permit recovery of even 25 percent of the shale oil.

The "most straightforward" and proven of the PNE uses, according to the panel, is that of creating storage cavities or caverns for oil or gas. But the panel concurred with GURC's view that the probability of such a PNE application by 1990 is small. The most convenient places to store oil and gas are those near populated areas, where use of PNE's would be unacceptable. Also, there are attractive alternatives to PNE-created storage cavities, such as abandoned coal or salt mines.

By far the most ambitious of the other PNE applications considered by the Long panel was the one now going under the name of Project Pacer. The Pacer concept (*Science*, 11 April), which represents a possible shortcut to fusion energy, would be expected to produce electricity and to breed fissionable material. Thermonuclear devices would be fired inside huge, partly water-filled cavities leached out of salt domes.

Through use of a heat exchanger, the radioactive steam from the cavity would be used to make secondary steam to operate the power turbines. At the same time, the primary steam would be "milked" of the uranium-233 or plutonium-239 it contains as a result of the thorium or uranium included in the explosive device. For a 2000-megawatt facility, two 50-kiloton devices would be denotated each day, or roughly 750 each year, all within the same cavity.

The panel did not dismiss Pacer as out of the question, but it pointed out that this project—now under consideration by the Energy Research and Development Administration (ERDA)—would face perhaps insuperable technical problems.

Originally, the GURC report, on which much of the Long panel report was based, was to have been a government document representing a consensus of view of all the interested agencies, chiefly ACDA and ERDA. As such, the report could have become one of the official documents of the Nonproliferation Treaty (NPT) review conference now going on in Geneva. But, as work on the report progressed, it seemed to officials such as Harold B. Curtis (now in ERDA's conservation program, but formerly chief of special studies in the old AEC's division of applied technology) that the report was reflecting an ACDA bias against PNE's. For instance, there was a feeling that, in the discussion of alternatives such as MHF, much was made of their advantages but very little was said of their drawbacks. Accordingly, what finally happened was that there was no inter-agency agreement about the said of their drawbacks. Accordingly, there was no inter-agency agreement about the report, and it was made public simply as a contract study.

Actually, neither the GURC nor the Long panel report comes across as an anti-PNE document, however much they may lay bare the PNE's disadvantages. Indeed, the Long panel recommends more economic analysis of PNE technology and, if the outcome of such analysis is encouraging, more research to perfect the technology. The report will be criticized by some arms controllers for not taking a hard line against PNE's. Besides complicating efforts to achieve a comprehensive test ban, the PNE issue militates against wider adherence to the NPT. Nations such as Brazil, Argentina, and India have used past promises of successful PNE's as justification for not signing the treaty.

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