December 1975, p. 964). So far Western Bloc members in Oregon have gathered enough signatures to qualify their initiative, but Massachusetts has failed. Only 22 states of the union possess the initiative mechanism. The ultimate goal of People's Lobby is to have a national initiative process adopted into the constitution by a constitutional amendment.

These ambitions will certainly be influenced by the fate of Californian nuclear safeguards initiative. The initiative is a fairly involved legal document but its basic requirements are as follows:

1) The federally imposed limitations on insurance liability for nuclear accidents must be removed within a year.

2) The effectiveness of all safety systems, including the emergency core cooling system, must be demonstrated by the testing in actual operation of substantially similar physical systems.

3) Radioactive wastes must be stored with no reasonable likelihood of escape.

4) Conditions 2) and 3) above must be demonstrated to the satisfaction of the state legislature, as expressed by a two-thirds vote in each house.

Opponents of the proposition are labeling it the "nuclear shutdown initiative" chiefly because Congress, they say, is not about to remove the insurance liability limits and second, the two-thirds rule is almost impossible to obtain. "Why, you can't get a Mother's Day resolution passed by a two-thirds vote in the legislature," former governor Edmund G. Brown told the Los Angeles *Times* recently. (Brown senior is a co-chairman of Citizens for Jobs and Energy; his son, the present governor, has not yet declared his position on the nuclear safeguards initiative).

Citizens for Jobs and Energy is supported by the state's major utilities and makers of nuclear hardware such as the Bechtel Corporation and Westinghouse. On the other side, Californians for Nuclear Safeguards is a coalition of environmental groups such as the Sierra Club and Friends of the Earth, together with Project Survival, a vigorous new group composed largely of activist middle-class housewives whose chief ideologue is guru-in-the-making E. F. Schumacher. Schumacher, economist author of the neo-Gandhian tract *Small Is Beautiful*, is a zealous opponent of nuclear power; his leading fan in California is Governor Jerry Brown.

Should the initiative be accepted in June, the industry's first move might well be to challenge its constitutionality in the courts, on the grounds that it usurps the right of the federal government to be the regulator of nuclear power. Yet judges might hesitate to nullify a law that has the specific support of several million voters. Whatever the final outcome, the initiative should prove an interesting experiment in direct democracy.—NICHOLAS WADE

Trident in Trouble: New Missile May Resemble Poseidon, After All

The $16.5 billion Trident submarine missile system has been having some problems lately, which may mean that it turns out to be similar to the existing Poseidon system instead of the revolutionary advance its advocates originally promised.

Some experts close to the project say that the Trident I missile, which is the first element of the system, may not attain its originally planned range of 4500 to 4800 nautical miles (n.m.), but may go only 4000 n.m. Other experts are doubtful that it will go more than 3600 n.m. The range of the Poseidon missile, now aboard U.S. strategic submarines, is from 2200 to 2800 n.m.

A second issue is what payload Trident I will carry at these ranges. There are reports that Trident I's maximum "throw weight" may be less than Poseidon's.

These problems with Trident I make the plans for Trident II—a missile that would go 6000 n.m.—even more questionable to the extent they look to the same technology.

The Navy, which is developing the Trident system, has declined to comment on these problems since virtually the entire subject is classified. Officials have, however, expressed confidence that Trident I will meet range and payload goals when it becomes operational in 1979. Nonetheless, from reports in the aviation press and talk in industry and scientific circles, there are signs that Trident I could be in trouble.

The Trident system was described to Congress in 1972, by John R. Foster, Jr., Director of Defense Research and Engineering, as involving "no diminution in capability" whatever from the existing Poseidon system. And Navy specifications for the missile, as recently as early 1974, stated that it should carry "essentially the same payload as Poseidon but go twice the range."

Both the Trident I missile and its follow-on, the Trident II, are the justification for building a controversial new class of submarines, also called Trident. The first of these is already under construction, and the defense budget which Congress has just approved includes funds for work on an additional nine. The Navy plans to put a total of 160 Trident I's aboard ten of the Poseidon submarines and a total of 240 Trident I's aboard the ten new Trident submarines. Foes of the new submarine, in congressional debates over the project, have argued without success that all the Navy really needs to do is to backfit Trident I aboard the existing fleet of Poseidon submarines.

The Navy wants a new generation of long-range strategic missiles to increase the operating area of the submarines and, hence, lessen their chances of detection. Their present area is of approximately 3 million n.m.^{2}, embracing the Arctic, North Atlantic, and North Pacific oceans. If they carried missiles with a range of 4000 n.m. the submarines would have an operating area of no less than 15 million n.m.^{2} (see map); they could even train their missiles on the Soviet Union while sitting off the U.S. coastline.

The Soviet Union is widely reported to be unable to detect, let alone destroy, the 31 U.S. strategic submarines that are now on station at any given time in a single first strike. The submarines would be able to strike back at the Soviet Union with devastating force. For this reason, the submarine-based long-range missile—in its present and future forms—is considered the country's most stable deterrent against nuclear war.

But developments of the last year are raising anew some questions as to whether the new missile will be only a modest improvement over Poseidon. First, there have been problems with the new high-energy propellant, and there is some disagreement among experts as to whether these can be adequately solved. The Navy's prime con-

tractor on the project, Lockheed Missiles and Space Company, subcontracted the propellant work for all three stages to a joint venture of Hercules, Inc., and Thiokol Chemical Corporation. (The joint Hercules-Thiokol venture is rumored in the industry to have won the subcontract partly because of a calculation that their new propellant could push the 70,000-ton Trident I some 6000 n.m.—much farther than the Navy specifications.)

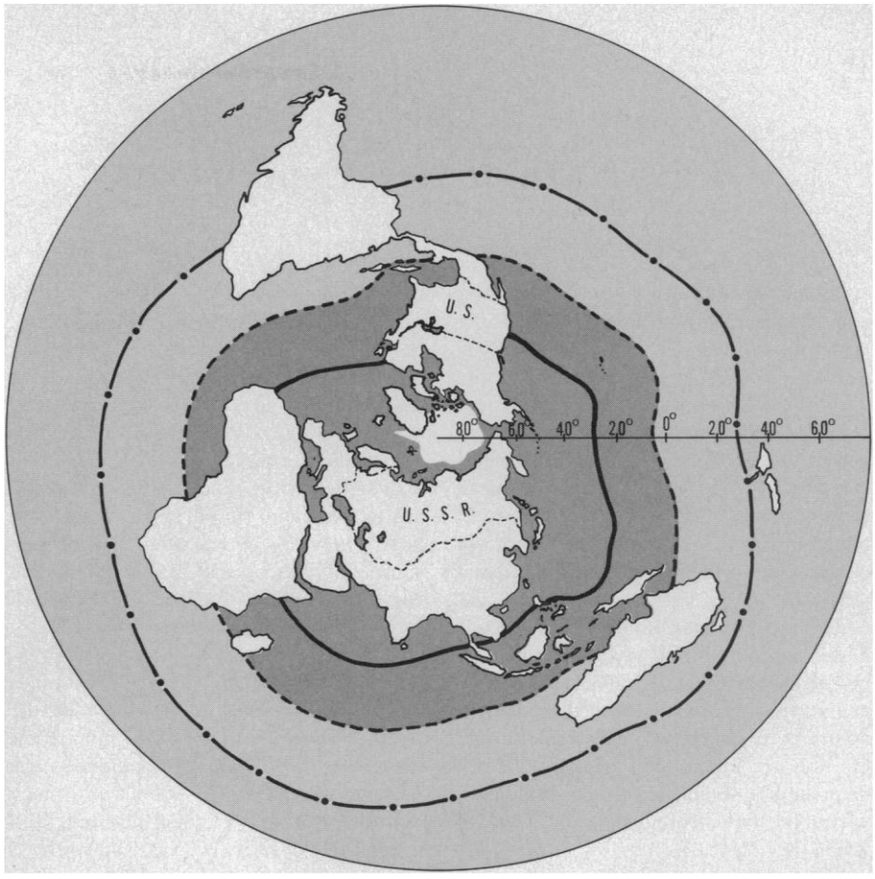
A Risky Fomulation

Nearly everyone admits that the Hercules-Thiokol propellant was "riskier" than other formulas proposed by competing companies. It consists of a mix of several kinds of nearly pure explosives. These must be made to bind together evenly and to cling uniformly to the fuel chambers and motor parts to produce a steady burn. Moreover, this highly sensitive mixture must be prevented from deteriorating into a less stable form—after years of storage in the missile—which might blow up spontaneously or explode on ignition.

The lifetime of most other strategic missiles, such as the Minuteman and the Poseidon, is said to be from 10 to 15 years; but some experts close to the Trident program have been predicting that, in its present formulation, the Trident fuel's deterioration may prevent it from having a lifetime of more than 5 years.

Two explosions have provided evidence that this "risky" formulation is proving difficult to develop. The first was at the Hercules plant in Bacchus, Utah, in May 1974; the second was at the Naval Weapons Center in China Lake, California, last June. After the first explosion, the Navy and Lockheed assembled a group of some 40 propellant experts from government laboratories and universities around the country to consult on the problem. Reliable sources report that, in the course of trying to resolve the problems, the proportion of the principal explosive, HMX oxides (a material used frequently in conventional bombs), has been reduced. The change has made the mixture more stable, but experts admit it has cost the missile several hundred miles in range. Other experts in the field predict it will go only 3600 n.m.

The significance of this range reduction is that, according to some people, the existing Poseidon missile can be redesigned to go 4000 n.m. as well. In its present form, Poseidon's final stage is not designed to make this longer trip. But, says Herbert Scoville, an arms control expert who has written on Poseidon and Trident, "You can redesign Poseidon to make it go 4000 nautical miles with one warhead, certainly, and possibly with more." Thus Trident's new, reduced range puts it more nearly in a class with Poseidon than the original plans had suggested.



Striking radius of a 2800 n.m.-range Poseidon missile is shown by solid line; 4000 n.m.-range by dashed line; and 6000 n.m.-range by broken line.

Intertwined with the question of its range is that of the Trident I's payload. A recent report in *Aviation Week and Space Technology*, which knowledgeable sources regard as accurate, said that Trident I will carry "eight 100-kiloton" nuclear warheads. In terms of throw weight this could represent a considerably smaller total payload than the 10 to 14 50-kiloton warheads carried by the Poseidon. (Informed sources say that, as the result of improvements in warhead design making for larger yield at a given weight, each of the new, 100-kiloton warheads planned for Trident will weigh only a little more than a 50-kiloton Poseidon warhead.)

Rumors are circulating in industry that Trident I's designers have had to sacrifice throw weight—make do with fewer warheads than originally planned—for Trident I to achieve the 4000-n.m. range. Experts familiar with range-payload tradeoffs—a common problem in missile design—calculate that if the missile were made to carry ten of the 50-kiloton warheads, its range would be reduced to 3800 n.m. If it had to carry 14 such warheads, its range might be reduced to as little as 3100 n.m.

There is, to be sure, in some industry circles and within the Navy, a body of opinion to the effect that the range problems of the missile—whose first full-scale flight test is scheduled for next year—will be solved. As one industry source said, "There are few things that time and money can't solve. And this program has plenty of both."

Nonetheless, the present rather dubious status of the missile raises questions about the need for pressing ahead with the new submarine and with the Trident II, on which design work is still at an early stage. Some indication, perhaps, of just how sensitive the future of the Trident program has become in Navy circles these days can be gleaned from the following Navy response to a reporter's question on plans for propellant technology in Trident II. "Since a purpose or mission for Trident II presently is not defined, it is not possible to determine what propellant will be used for Trident II. However, if there is a Trident II, the Navy will take advantage of applicable Trident I technology."

—DEBORAH SHAPLEY