

## Nuclear Reactors and Eastern Earthquakes

To the dismay of the utilities affected, the Nuclear Regulatory Commission (NRC) on 13 March ordered the immediate shutdown of five commercial power reactors in the eastern United States for fear of a critical failure in the reactor's cooling systems in the event of an earthquake. What led to the NRC action was the recent discovery, by one of the utilities, that a computer model used when the plants were designed years ago understated the stresses that part of the piping in the coolant systems might have to withstand. The shutdown, which surprised many people in light of the fact that the eastern United States is not usually thought of as an earthquake-prone area, has touched off a debate in Congress and elsewhere over whether the NRC acted wisely.

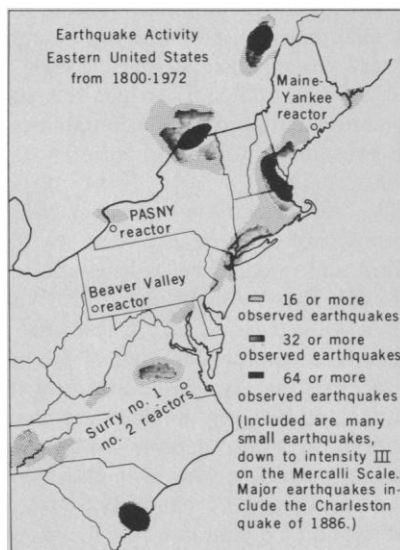
The units affected by the shutdown order are in Maine, New York, Pennsylvania, and Virginia. One of the Virginia Electric and Power Company's Surry units No. 1 and No. 2 on the James River southeast of Richmond was already closed for repair of its steam generators and the other was to be closed later this year for the same reason. The shutdown could lead to a substantial rise in electric rates locally and to an increase in oil imports of tens of thousands of barrels a day for a period of months.

The closings were ordered after Duquesne Light Company informed the NRC that the stress-resistance characteristics of certain pipes in its Beaver Valley unit No. 1 near Shippingport, Pennsylvania, did not check out against the computer model currently in use. This was so because a model used prior to 1972 by the Stone and Webster Engineering Company, designer of the Beaver Valley unit (and the other four reactors as well), contained a simple error wherein some stresses were combined in such a way as to be offsetting rather than additive.

For the NRC the gut issue was, and is, How significant was the mistake in terms of the actual risk to public safety? The answer must turn in part on the expected frequency and severity of earthquakes in the East.

For every earthquake experienced

in the eastern United States there are ten in southern California, and the eastern quakes generally are of small magnitude. Nevertheless, according to the U.S. Geological Survey, more than 3500 earthquakes (most of intensity ratings of 3 to 5 on the Modified Mercalli scale) have been reported in the eastern half of the country since 1700 and a few (such as the 1886 quake at Charleston, South Carolina, and the 1755 quake near Cape



Map by Holly Bishop

Ann, Massachusetts) have been quite large.

In general, eastern earthquakes remain poorly understood and are even harder to predict than earthquakes in the West.

Taking the best information at hand, the NRC has put the probability of a major earthquake—at least 7 on the Modified Mercalli scale—giving the plants a severe shaking during their lifetimes at between 1 in 1000 to 1 in 10,000 per year. Even this would be a "safe shutdown earthquake" which the reactors would be expected to survive. The likelihood of a Modified Mercalli scale 6 earthquake, through which a properly designed and built plant would be capable of continuing to operate, is put at between 1 in 100 to 1 in 500 per year, which, to take the high side, is a 40 percent probability for a plant with a 40-year life.

According to NRC engineers, the ground acceleration from a magnitude 6 earthquake could, when amplified through the reactor building and piping systems, result in dangerous stresses on certain pipes, including some that are connected to the main

coolant loop as well as to some in the emergency core cooling system. These stresses would in some instances be twice what the pipes were designed to withstand without deformation and possible rupture.

Harold R. Denton, the NRC's director of reactor regulation, has said, "I had no option [to shutting down the reactors]. The finding I made was that the level of protection provided by these plants was not adequate." But Stone and Webster, together with the utilities involved and some members of Congress, believe that the NRC has overreacted. William Swiger, vice president of Stone and Webster, told *Science* that both the frequency of eastern earthquakes and their possible effects on the reactors had, in his opinion, been much overstated. He pointed to repeated instances of fossil-fuel plants designed by Stone and Webster and other companies riding out earthquakes in California without damage to their piping.

In Swiger's view, instead of ordering the immediate shutdown, the NRC should have called on the utilities to bring all piping within currently acceptable stress limits during the next scheduled refueling shutdown. Meanwhile, modeling analysis and engineering planning to that end could go forward. Nobody knows how long the five reactors will be down, but it could be anywhere from weeks to months.

## Interagency Group Cautious on Nuclear Waste Disposal

Within the next month, President Carter is expected to announce what the government's policy will be for the management of nuclear wastes. To this end, the Interagency Review Group (IRG) set up by the White House in March 1978 to look at the waste problem has now submitted a report that sets forth the consensus view of the officials who represented the 14 participating agencies.

As a result of some of the outside comment on the IRG's interim report of last October (*Science*, 6 October 1978), the final report is somewhat more cautious and technically conservative in its assessment of the state of the art for nuclear waste disposal.

Also, as the report makes clear,

there continue to be differences among members of the IRG about some important questions regarding how fast the government should move to the establishment of intermediate and full-scale waste repositories. The various agencies will soon submit to the White House their individual recommendations on these questions.

Although other waste disposal concepts will be considered over the long term, the IRG has concluded that only the mined repository in deep geologic formations is achievable in the near term, which is to say through the mid-1990's. It concedes, however, that even in the case of mined repositories the degree of assurance about containing the wastes diminishes after a few thousand years and not even conservative engineering practices and multiple barriers can eliminate the need for a "societal judgment" as to the acceptable risk.

The report acknowledges that some members of the IRG, which was chaired by John M. Deutch of the Department of Energy (DOE), remain concerned that the report gives "insufficient attention to gaps and uncertainties in our current technical understanding."

Such cautionary language in the report reflects not only the voluminous outside comment received on the interim document but also the pulling and hauling that has gone on among the IRG members, especially those from DOE, the Department of the Interior, the White House Office of Science and Technology Policy (OSTP), and the Council on Environmental Quality (CEQ). DOE and CEQ have been at odds over whether further growth of nuclear power should be allowed in the absence of a convincing solution to the waste disposal problem. Moreover, some IRG members feel that the report fails to analyze adequately how "differences in future nuclear growth might heighten or reduce waste management difficulties."

At a press conference, John Deutch indicated that the IRG member agencies, in their individual recommendations to President Carter, will address questions of program timing on which the IRG failed to achieve consensus, including the following:

- Should the government proceed to establish the first repository for commercial high-level waste after only a limited review of alternative sites

(chiefly in salt) or should it await the characterization of a much broader range of geologic environments? With the latter course, the opening of the first repository—not likely before the 1990's in any case—might be delayed several years longer.

- Should the government move to the early establishment of a repository for transuranic (TRU) military wastes and, perhaps along with it, an intermediate-scale facility (ISF) for up to 1000 spent fuel assemblies from commercial power reactors? In this connection, the IRG report stops short of addressing the pending issue of whether to proceed with the controversial Waste Isolation Pilot Plant (WIPP) project, considered for a site near Carlsbad, New Mexico. Many proponents of nuclear power seem to regard the WIPP-ISF projects as their best bet for an early demonstration of the feasibility of permanent disposal of radioactive wastes.

### Possible Postponement for Troublesome Ethics Law

If Representative George Danielson (D-Calif.), chairman of a House Judiciary Subcommittee, has his way, the effective date of a new ethics law which has caused several high-ranking government scientists and science administrators to talk of resigning will be postponed from 1 July to next January.

Even under the law now in effect, an official who leaves federal service can never represent private parties before the government on issues he was formerly personally and substantially involved with. For 1 year he cannot represent such parties even on issues that fell within his general official purview. Now, under the new law (*Science*, 9 March), this period of abstinence would be extended to 2 years and would apply not only to representing parties before the government but even to counseling them on matters for which the official was formerly responsible.

Some officials have said that this law is so stringent that it might leave them virtually unemployable. Danielson will begin hearings soon on his postponement measure and promises to look into the new law's undesirable side effects.

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ers. Potentially the most important factor in his defeat was his refusal to organize early and promote himself aggressively among his colleagues. "Preyer doesn't enjoy hard campaigning," says an associate.

Waxman in contrast is younger, more liberal, a shrewd political strategist, and more aggressively ambitious. In person, he is soft-spoken and, like Preyer, an attorney who selects his words carefully. But his thoughtful manner cloaks a firm commitment to ideals. His approach to Congress is shared increasingly by the youngest members: "I'm not against seniority per se, but it has produced an awful lot of mediocre chairmen," Waxman says. "My opposition doubted my commitment to Congress and thought I would be a destabilizing influence." Then, half admitting it as truth, he adds, "My commitment is not to Congress as an institution, but to the issues that this institution deals with."

Until now, those issues have been the ones that interested Waxman's constituents, and no one has ever accused him of neglecting the folks back home. Waxman has one of the oldest, most liberal, most securely Democratic districts in the nation; because it covers west Los Angeles and includes most of Hollywood, it is also one of the wealthiest districts. Optimistically, Waxman pledged that his first priority after election to Congress would be the enactment of comprehensive national health insurance. He has been extremely critical of the auto industry for its failure to meet anti-pollution requirements of the Clean Air Act, and he has been critical of television's "family viewing hour" as a restriction of the literary license of television writers. Many of his constituents are Jewish, as is Waxman, and he has sharply criticized arms sales to the Middle East, as well as the Arab boycott. But if the real question is which came first—the liberal views of Waxman or those of his constituents—the evidence is reasonably clear: Waxman was president of California's Young Democrats and working hard in civil rights years before his first congressional campaign.

When Waxman decided to challenge Preyer for the post of subcommittee chairman, the first thing he did was strike an alliance with the members who thought as he did—young liberals with a decidedly interventionist and consumerist bent, people like James Scheuer and Richard Ottinger of New York, James Florio and Andrew Maguire of New Jersey, Toby Moffett of Connecticut, and Edward Markey of Massachusetts. Prey-

Luther J. Carter