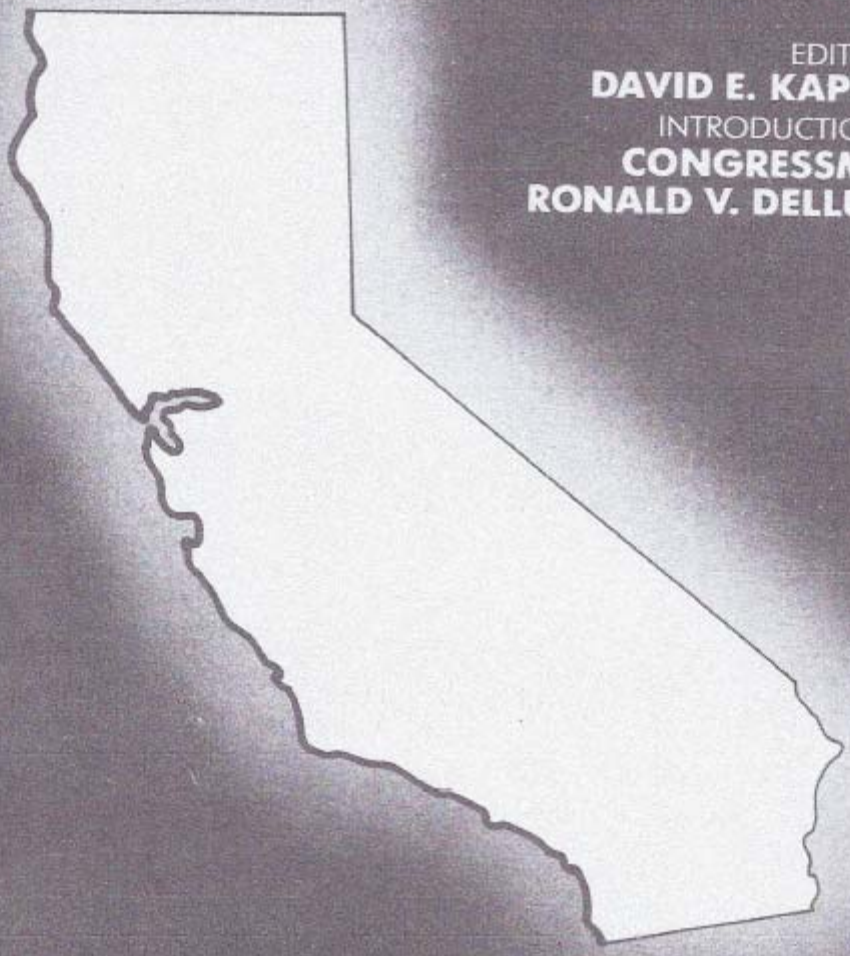
NUCLEAR CALIFORNIA

AN INVESTIGATIVE REPORT



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LIFE ALONG THE FAULTLINES

GLENN BARLOW

Californians are no strangers to earthquakes. Nearly everyone in the state can recall at least one small tremor and with it that eerie feeling of watching the light fixtures sway and the dishes rattle. Some less fortunate residents have been caught within the massive rumblings of quakes that devastated San Francisco, San Fernando, Long Beach and other areas of the state.

The seismic hazards faced by Californians have worsened, however, in recent decades. During the past 35 years, scores of facilities which handle radioactive materials have been built across the state. Dozens of nuclear reactors, plutonium laboratories and nuclear weapons depots now sit dangerously close to some of the most powerful earthquake faults in North America. Most of these facilities were constructed before fault zones were adequately mapped and understood. They serve as constant reminders that the next powerful earthquake may contaminate parts of California with lethal amounts of radiation.

It is this single factor, seismicity, that makes Nuclear California vastly different from Nuclear Tennessee or Nuclear New York. Approximately 90 percent of all earthquake activity in the continental United States occurs in California and western Nevada.

Nuclear facilities in California were sited and designed before the concept of plate tectonics was generally accepted. According to this theory, the surface of the earth is made up of gigantic crustal plates, which are moving gradually. Tension is released through earthquakes when the plates collide or slip past each other. The floor of the North Pacific Ocean is moving toward Alaska and sliding against the North American plate. This movement has created the San Andreas fault system, which stretches almost the entire length of California.

The maximum earthquake on the San Andreas Fault could measure 8.5 on the Richter magnitude scale. This could release the power and fury equal to the explosion of 1500 Hiroshima-size atom bombs, according to the California Division of Mines and Geology. By comparison, the 1906 quake that almost destroyed San Francisco measured 8.2; the 1971 San Fernando quake measured 6.5. The Richter scale is logarithmic, so an increase of one number means a tenfold increase in the magnitude of the tremors, and a 30-fold increase in the amount of energy released.

Californians have been warned repeatedly by geologists and public officials of impending seismic disaster. A few of the more recent reports point to the increasing danger we all confront:

- The probability of a major earthquake in California is "well in excess" of 50 percent during the next 30 years, according to a 1980 report by the Federal Emergency Management Agency. The report also notes that local, state and federal agencies are not prepared to respond adequately to the emergency created by the quake.
- A report by the Institute of Governmental Studies of the University of California, Berkeley, using historic quake cycles and recent research, concludes that the probability is higher than 50 percent that a great earthquake will strike California during the 1980s and that it will probably affect major urban areas.
- After the devastating volcanic eruptions of Mount St. Helens in Washington in 1980, the President's National Security Council ordered the U.S. Geological Survey to develop scenarios of possible earthquakes that could severely affect California population centers. The USGS report noted that the probability of a major quake is highest in Southern California and is increasing each year.

The $180 Billion Risk

About halfway between San Diego and Los Angeles, right next to Interstate 5 on the Pacific Ocean, sit the three nuclear reactors of San Onofre. It is one of the world's largest nuclear plants, and it sits in one of the world's most dangerous fault zones. Within 100 miles of the plant live 12 million people — half the population of California. Within four miles of the plant is the Newport-Inglewood Fault, which federal geologists call the most hazardous fault in Southern California. In 1933 that fault slipped and generated the Long Beach earthquake, causing massive damage to areas within 40 miles of San Onofre.

What will happen if a major earthquake triggers an accidental meltdown at one of San Onofre's reactors? We don't know. No local, state or federal agency has ever analyzed the consequences of a simultaneous nuclear accident and severe earthquake. No government agency has ever worked out an emergency response plan for such a disaster.

During the last few years, federal and state agencies have busily drafted disaster plans to use when the next powerful earthquake strikes. In the aftermath of the Three Mile Island accident, they also began making separate plans for major nuclear accidents. But no one bothered to combine the two plans in California. Perhaps these government officials think it is too far-fetched. Perhaps they just don't want to cope with the bureaucratic and environmental nightmare of the ultimate peacetime disaster: an earthquake-

induced meltdown at a major nuclear power plant. To get an idea of the extent of damage from such an event at San Onofre, consider the following studies:

- A magnitude 7.5 quake on the Newport-Inglewood Fault, even without taking into account the presence of nearby San Onofre, would cause the heaviest damage of any comparable earthquake in California. According to a 1980 report by the Federal Emergency Management Agency, that quake could kill 23,000 people, injure thousands more and cause $70 billion in damages.
- A meltdown at San Onofre, according to a 1981 Nuclear Regulatory Commission report, could cause 130,000 early deaths and 300,000 latent cancers in people living within 50 miles of the accident. More than one million people would each be exposed to more than 25 rems of radiation. (The allowable dose under routine conditions is .025 rems per year.)
- Another study of a San Onofre meltdown, done by the California Office of Emergency Services in 1980, estimates that the accident could contaminate 16,000 square miles, require emergency health care for hundreds of thousands of radiation victims and force the mass evacuation of eight-to-ten million people. Furthermore, the study places an economic value on the apparent loss of Southern California: $180 billion.

Following the Three Mile Island accident, the President's Council on Environmental Quality attempted to determine what effects a massive release of radiation would have on the population surrounding the nuclear plant. The CEQ concluded that if TMI had melted down, the radiation could have produced thyroid tumors in children as far away as 100 miles. The council recommended that children and pregnant women be evacuated immediately following any nuclear accident, as they were in the Harrisburg, Pennsylvania, area during the partial meltdown at TMI.

But Southern California is not Harrisburg. To evacuate children and pregnant women from the Los Angeles basin under any circumstances is difficult enough to envision, but if San Onofre melted down during an earthquake, the task would become utterly impossible. The quake would probably damage freeways, airports and other routes of escape. Just as the mountain ranges around L.A. trap smog particles, they could also trap clouds of radiation. If the mountain passes were blocked by landslides or other earthquake damage, they would also trap the people trying to escape. Routes to the south would be blocked by the intense radiation emitting from San Onofre.

It was 1963 when the NRC first approved construction of the San Onofre Nuclear Generating Station. Despite the obvious seismic hazards at the site, the NRC waited until 1980 before requiring the plant owners to conduct a

thorough seismic investigation. Even before then, however, data began coming in that San Onofre could not withstand a powerful quake from the Newport-Inglewood Fault.

San Onofre's owners, Southern California Edison and San Diego Gas & Electric, were startled in 1975 when the NRC temporarily closed the plant because of seismic hazards. After the structure was strengthened, the reactor was reopened. Meanwhile, construction continued on two additional reactors, and the entire plant was designed to withstand an earthquake of magnitude 6.5.

More bad news for the utilities arrived on December 31, 1980, however, when the NRC issued a new report on earthquake hazards at the site. The report confirmed the existence of an entirely new zone of faults lying directly offshore and beneath the reactors and upgraded the maximum possible jolt from the Newport-Inglewood Fault to 7.0 on the Richter scale. One month later, a new USGS report stated that the Newport-Inglewood could generate a quake with a magnitude of 7.5, an ominous departure from earlier estimates. The San Onofre reactors were never designed to withstand a 7.5 earthquake. Within seconds such a quake could destroy the cooling pipes that bring water to the radioactive core, creating a meltdown which could permanently contaminate Southern California.

PG&E's Seismic Sojourn

Although San Onofre provides the most dramatic example of a combined nuclear and seismic disaster, there are numerous other radioactive sites that lie dangerously close to active earthquake faults. In fact, California nuclear plants have a history of delays, shutdowns and modifications — all because of seismic hazards. Take, for example, the case of Pacific Gas & Electric.

Nuclear License Number One in the United States went in 1957 to a test rector named Vallecitos near Pleasanton in Alameda County. PG&E helped General Electric build the Vallecitos Nuclear Center, hoping it would give the utility a lead in the then-emerging field of nuclear power generation. But, in October 1977, the NRC ordered the shutdown of the largest reactor at Vallecitos. The reason: new geologic evidence showing that Vallecitos could experience earthquakes and ground motions similar to those during the 1971 San Fernando quake. The surface of the ground could rupture as much as eight feet directly beneath the reactor.

General Electric still owns that test reactor and three others at Vallecitos, operates a plutonium lab and handles frequent shipments of highly radioactive spent fuel. Despite the threat of a powerful earthquake, GE is appealing to the NRC to reopen the test reactor.

PG&E went on to other projects after completing Vallecitos. In 1958 the utility began developing a site for a major nuclear plant at Bodega Bay in Sonoma County. Attorney David Pesonen, a longtime critic of nuclear power in California, proved to the Atomic Energy Commission (the NRC's predecessor) that the site was next to the nation's deadliest fault, the San Andreas. The AEC recommended against the license and PG&E pulled out.

Pesonen took on PG&E again in 1968, when the utility sought permission to build a plant one mile north of Point Arena in Mendocino County. Once more, earthquake hazards were documented, and PG&E abandoned the site by 1972.

PG&E experienced similar seismic problems with a proposed site at Davenport, north of Santa Cruz. And the utility's first commercial nuclear plant, built at Humboldt Bay near Eureka in 1963, shut down temporarily in 1977 for refueling, and never reopened because of earthquake dangers.

PG&E's final bout with seismic safety may be the Diablo Canyon nuclear plant, located 200 miles northwest of Los Angeles, near San Luis Obispo. The license to construct these two giant reactors was issued by the AEC in 1966, when the nearest major fault was believed to be 20 miles inland. In 1971, however, a pair of oil geologists named Hoskins and Griffiths discovered an offshore fault that passes less than three miles from the reactors. It was named the Hosgri Fault after its discoverers.

The length of the Hosgri Fault has become a point of much debate because geologists agree that the longer a fault is, the greater the potential magnitude of a quake on the fault. Some believe that the Hosgri is part of a lengthy fault zone that branches off from the San Andreas offshore from San Francisco and continues along the coast south to just northwest of Santa Barbara. If the fault zone is indeed that long, it could produce a quake of magnitude 8.0. Federal geologists estimate that this could generate ground motions at Diablo Canyon as much as three times greater than the reactors were designed to withstand. The NRC, however, decided in 1976 to accept the theory that the fault zone is fragmented and shorter, making it capable of only a 7.5 magnitude quake.

The Second Line of Disaster

The big commercial nuclear reactors, like those at San Onofre, might be sufficiently remote from the epicenter of the coming major quake to avoid meltdown. However, there are enough other nuclear facilities sprinkled throughout the state to ensure that one of them will probably be in the zone of heavy damage. In every densely populated region in California, there are medical, industrial and research laboratories which handle large amounts of radioactive materials. The State of California licenses more than 1800 of these

facilities, the NRC more than 200. The list includes 18 research reactors at universities and corporations around the state.

Not included in this list are military reactors or the many stockpiles of nuclear weapons in California. The military, on the basis of "national security," refuses to reveal information on the large amounts of radioactive materials it handles in seismically active areas. While the Navy, for example, claims that it uses "state-of-the-art" building standards at its nuclear facilities, there is no way for a civilian to check this — there are no public hearings, no expert testimony and no appeals when the Navy decides to expand its nuclear arsenals. The Navy, in fact, has never done an environmental impact statement on the potential for a nuclear accident at one of its facilities.

All of the Navy bases in California were sited before they began handling large quantities of radioactive materials. Little or no thought was given to the effects of a major earthquake on nuclear weapons or submarine reactors. This is perhaps best illustrated at the Seal Beach nuclear weapons arsenal, located about 25 miles south of downtown Los Angeles, and built directly atop the Newport-Inglewood Fault. If that fault slips again, as it did in the 1933 Long Beach earthquake, hundreds of pounds of weapons-grade plutonium could be dispersed throughout metropolitan L.A.

Other naval facilities present similar hazards. The Concord Naval Weapons Station, 30 miles northeast of San Francisco, stores nuclear weapons near active fault zones in densely populated East Bay suburbs. The North Island Naval Weapons Station stores nuclear bombs on top of the Rose Canyon Fault Zone, within a mile of downtown San Diego. And the Mare Island Naval Shipyard, near San Francisco, which unloads radioactive waste from submarine reactors, sits atop two fault zones that generated the fierce Mare Island Earthquake of 1898.

In the Livermore Valley, 30 miles east of Berkeley, the Lawrence Livermore Laboratory is located above 13 active faults capable of causing ground motions at the lab, according to a draft environmental impact statement. The lab designs nuclear weapons for the Navy and other branches of the military, handles up to 495 pounds of plutonium at one time and operates a small research reactor (see Chapter 13).

There are further dangers offshore. During the 1940s, '50s and '60s, government and corporate radiation labs in California dumped radioactive waste into the Pacific offshore from San Francisco, Santa Barbara, Los Angeles, San Diego and Mendocino. All of these dump sites are located on complex, active earthquake fault zones. More recently, in 1980, the Navy revealed plans to dump old nuclear reactors from submarines and other vessels off the Mendocino coast. This site is possibly the most active offshore fault zone in California; earthquakes occur there frequently, including a powerful magnitude 7.0 in 1980.

Shake and Bake?

The prospect of a massive earthquake splitting apart a nuclear plant is precisely the kind of problem we wish would disappear. Unfortunately, it won't. We have government scientists telling us that a major earthquake will strike California within 10 years; we have a state covered with nuclear facilities that straddle the most powerful fault lines; and we have regulatory agencies that seem incapable not only of responding to such a disaster, but of even examining what damage might result.

California's shaky history makes it increasingly vulnerable to a major nuclear accident. What will it take to convince federal or state agencies to shut down or at least upgrade the nuclear facilities already located near the state's active fault lines? An accident worse than Three Mile Island? Considering the state's seismic history, such a disaster may not be long in coming.