

A Meltdown But No Melt-Through

Reports out of Moscow this week indicate that by drilling holes beneath the Chernobyl reactor to create a "cooling zone" for its white-hot reactor core, the Soviets averted a "China syndrome" — a runaway melting of nuclear fuel out of the bottom of the reactor, down through the concrete mat below, and on deep into the earth. "As for the assault on the reactor, we're working not only beside it, but under it. Our task is to fully neutralize it, to 'bury' it," said Yevgeny Velikhov, a vice-president of the Soviet Academy of Sciences, in an interview published May 8 in *Pravda*, the Communist Party paper. The ultimate goal is to entomb the Chernobyl facility's #4 reactor in concrete until its nuclear contamination decays to manageable levels. Soviet officials say the decay process could take several hundred years.

While the meltdown crisis may be stabilized, "it would be difficult for me to say the crisis is over," said Morris Rosen, the U.S. member of the International Atomic Energy Agency team that met with the Soviets last week. In a radio interview Monday, Rosen said that if the Soviets don't provide adequate cooling, heat being generated by the radioactive decay of reactor fuel could again bring that fuel to the melting point. "The eventual worry," he said, "is that if the melting starts again [the fuel could] work its way through the concrete block below the reactor core and eventually reach the ground."

Ironically, during the 1970s a China syndrome was commonly held to be the worst possible reactor accident. But one lesson of the Chernobyl event may be to dispel that assumption. Radioactive contamination of the environment might have been less widespread, and perhaps more manageable, some scientists now believe, if the Ukrainian reactor damaged in an explosion and fire three weeks ago had melted down in the classic China syndrome scenario instead of flinging its contamination primarily into the atmosphere.

"Anytime you've got radioactive material going up into the atmosphere, you have a much worse situation than when releases contaminate the ground and [water]," says Susan Niemczyk, a Washington, D.C.-based reactor safety analyst. While officials can cordon off contaminated soil and prohibit the drinking of contaminated water, they can't ask people not to breathe, she points out.

That's not to suggest that managing a melt-through would be easy. Niemczyk says that although she and other U.S. scientists have probably studied the melt-through problem as thoroughly as any, it



Arrow points to the severe structural damage sustained during an explosion at Chernobyl's #4 reactor.

has not been thoroughly enough. A 1980 study she conducted while working at Sandia National Laboratories in Albuquerque, N.M., concluded that neither the Nuclear Regulatory Commission (NRC) nor the national laboratories have the skills to contain core materials that have melted through the bottom of a reactor's concrete base mat, preventing them from contaminating groundwater and migrating through soil. Unless the needed expertise is developed, she half-jokingly recommended in a report to NRC, officials might consider "declaring such a site a national monument" and keeping people away from it — perhaps for hundreds of years.

In fact, several factors make Chernobyl-style plants more resistant to melt-through and more likely to vent contaminants into the atmosphere than their Western counterparts, according to discussions at an NRC briefing in Washington, D.C., last week. For example, though the Chernobyl reactor produced power

comparable to large U.S. plants, its fuel-holding core is more than 10-fold larger in cross section — 1,600 square feet instead of somewhat less than 144 square feet, according to Victor Stello, NRC's executive director for operations. As a result, Chernobyl's concrete mat beneath the reactor is also comparably larger, he says. The ability of the Chernobyl fuel to spread out and dissipate heat over a much larger concrete mat reduces the chance of a melt-through, noted Harold Lewis, a member of NRC's Advisory Committee on Reactor Safeguards.

Moreover, Stello said, while the Soviet reactor has been designed with some capacity for "containment" of potential accident emissions, "it isn't like any Western containment that you would see." Instead of surrounding within a reinforced structure all of the pipes carrying reactor-core coolant, a portion of each of the 1,700 tubes carrying coolant from the Chernobyl reactor core extends beyond the limited "containment" area. If any of these pipes ruptured outside of containment, radioactive materials would spew into the environment.

Robert Avery, a reactor scientist at Argonne (Ill.) National Laboratory, believes the *initiation* of the Chernobyl accident might also be attributable to "poor design. We're beginning to look at that now." In particular, he considers that the use of so many independent, pressurized pipes and valves not only is "overly complicated" but also increases the chances that one of them will fail.

— J. Raloff

Will U.S. be first to tax Nobel Prize?

To journalists it's known as the "Pulitzer Prize rule," to scientists it's the "Nobel Prize rule." It's a provision in the U.S. tax code that excludes from taxable income certain cash awards recognizing achievement in fields such as charity, the arts and science. But a little-noted provision of the proposed tax reform legislation now wending its way through Congress would drop that exclusion and tax as income all money from prizes and awards other than scholarships or academic fellowship grants.

U.S. tax law already treats most monetary prizes and awards as income. However, winnings are not taxed when the award is for special achievements, was not applied for by the recipient and will not require that the winner "render substantial services as a condition of receiving it." Among awards that fall into this special exemption category are the Nobel Prize, the Pulitzer Prize, the Mac-

Arthur Foundation Fellowship Award, the Lasker Award and the General Motors' Kettering, Mott and Sloan cancer-research prizes.

The proposed elimination of exemptions for certain awards has already brought sharp criticism from the Stockholm-based Nobel Foundation. "The tax reform bill would make the United States the first and only country in the world to tax Nobel Prizes," notes Nancy Abramowitz of Arnold & Porter in Washington, D.C., a firm representing the Nobel Foundation in the United States. A statement by her firm, outlining the Nobel Foundation's position, charges that the proposed tax change could set a disturbing precedent: "U.S. taxation of Nobel Prizes could be used as an excuse by certain foreign governments to tax away the prizes, or otherwise punish dissident laureates."

Says John Corbally, president of the

John D. and Catherine T. MacArthur Foundation in Chicago, "Everybody is going to have to do something if we're going to get hold of the deficit. But in general, this would seem to me to be such a small source of funds . . . that I'm not sure it's among the important things that need to be done."

In fact, the intent of the tax reform package is for it to be "revenue neutral" — that is, to bring in only as much money as before, according to Betty Scott Boom, a staff member of the Senate Finance Committee. If individuals pay less tax per dollar earned — one goal of the reform — the "lost" revenues will have to be made up elsewhere. As a result, the Senate committee has recommended doing away with many existing deductions, including the one for these prizes. But removing exemptions on awards like the Nobel will not make much of a dent, Boom concedes. Over five years it is expected to bring in less than \$50 million.

The MacArthur award, potentially the largest of those that would lose their exempted status, seeks to stimulate further innovative activity in persons who have already demonstrated exceptional creativity by freeing them from some fiscal constraints that their income, or their need to earn an income, might place on them. MacArthur Fellowships vary from \$128,000 to \$300,000, paid out over five years, depending on the age of the recipient; recipients over age 65 at the time of the award receive the most money. But if these prizes were taxed, Corbally told *SCIENCE NEWS*, the MacArthur Foundation would have to evaluate whether the tax burden on the winner countered the intent of the award. And if it did, he says, the foundation "certainly would consider" increasing its awards to offset the effect of the tax.

The Nobel Foundation is considering a similar move. Compensating U.S. winners for their tax burden could, according to the foundation's position statement, "significantly increase the cost to the Nobel Foundation," since 102 of its awards over the past 25 years — some 40 percent — have gone to U.S. citizens.

The Reagan administration's reasoning in initially proposing to tax these prizes was not only to simplify tax law but also to take advantage of the fact that receipt of a monetary award would increase a citizen's ability to pay taxes in much the same way that winning a lottery would. According to an analysis by the Joint Committee on Taxation, however, one could tighten existing laws and still maintain an exclusion for certain expressly earmarked awards, like the Nobel. However, the tax reform package has already passed through the House without any changes to this provision. An alternative tax reform proposal drafted and passed by the Senate Finance Committee last week would also tax these prizes. — *J. Raloff*

A potpourri of earth activity

The northeastern section of the "ring of fire" — an area encircling the Pacific Ocean that is renown for seismic and volcanic rumblings — has kept scientists on their toes during the last several weeks. Following the March 27 eruption of the Augustine volcano, its first in 10 years, three other Alaskan volcanoes either erupted or threatened to erupt throughout April and May. And two of the strongest earthquakes to hit California in two years jolted the San Francisco Bay area at the end of March.

Then, last week, a magnitude 7.7 earthquake and a series of smaller tremors rocked the Aleutian Islands in Alaska. Not to be left out, Mt. St. Helens in Washington is now in the midst of a dome-building eruption, and out on the Pacific plate, Hawaii's Kilauea volcano last week spewed fountains of lava 800 feet in the air to mark the 45th major peak of activity in its three-year-long eruption.

Most of these events are related to the subduction, or plunging, of oceanic plates under the North American plate. The abrupt movement between two plates is what causes earthquakes, and the melting of descending ocean plates causes rising plumes of molten rocks to fire up volcanoes. While the process that generates most of these events is the same, scientists say it's probably just a coincidence that so many quakes and volcanoes have occurred at about the same time.

However, some researchers are wondering if these events, especially those in Alaska, are precursors of bigger things to come. Others have speculated that in general volcanoes and eruptions are triggered by far-reaching forces generated either by the movement of mantle material inside the earth or by the gravitational tugs, called tidal forces, of the sun and moon. Scientists have also suggested that these events can be triggered by a seasonal rise or fall in seawater along a continental shelf.

While seismologists may not understand its ultimate cause, the May 7 Alaskan earthquake, centered near Adak Island, was not unexpected. Carl Kisslinger and his co-workers at the University of Colorado in Boulder announced early last year that there was a great likelihood of a large earthquake occurring in the Adak seismic zone before October 1985.

They based their prediction on the past behavior of the zone: For three years prior to a magnitude 7.1 earthquake in 1971, the number of small quakes had decreased dramatically. Since September 1982 Kisslinger's group has noted another period of pro-

nounced seismic quiescence.

"Based on the data that are now coming in, it looks pretty clear that [the May 7 event] is the earthquake we've been expecting," says Kisslinger. "The preliminary data indicate that it ruptured the region of most profound quiescence."

Still, because there have been so few large earthquakes since their seismic network was erected, the researchers cannot be certain that seismic quiescence is a precursor of Adak earthquakes. The idea would be given a considerable boost, however, if the rate of small quake activity returned to its pre-September 1982 values by the end of this summer.

The Adak quake did not rupture one of the three seismic "gaps" that seismologists, using another approach to earthquake prediction, had pegged as being most ripe for even larger quakes (*SN*: 2/15/86, p. 104). Scientists still expect large quakes in these gaps.

Like the Adak quake, the eruption of the Augustine volcano was foreseen by researchers. The prediction was made primarily on the basis of seismic rumblings at the volcano. Juergen Kienle at the Geophysical Institute at the University of Alaska in Fairbanks and his colleagues alerted authorities of impending activity 9 days and then 10 hours before the volcano erupted, disrupting air traffic with plumes of ash extending up to 47,000 feet high.

The volcano's last explosive burst occurred on March 31. According to Betsy Yount at the U.S. Geological Survey in Anchorage, there was dome building and a slow-moving lava flow at the volcano from April 24 through April 28, but it has been essentially quiet since. Yount says Augustine has a history of erupting sporadically over a period of months, so chances are there will be more eruptions.

Augustine has been joined by the Pavlof volcano, which spewed out ash plumes up to 53,000 feet high in mid-April. The Akutan and Herbert volcanoes also have shown signs of restlessness.

Meanwhile, from April 15 through May 1, weak explosive bursts of gas, ash and rocks rattled Mt. St. Helens for the first time in two years. Increased seismicity and tilt at the volcano during the first week in May led geophysicists to issue an advisory on May 8 for an eruption, possibly an explosive one, within a few days or a week. At press time, it appeared that a dome-building eruption was in progress, but because of poor observing weather, scientists could not say whether the magma had reached the surface yet. — *S. Weisburd*