NUCLEAR WASTE DISPOSAL

Yucca Blowup Theory Bombs, Says Study

The theory was explosive, but in its biggest test yet, it has fizzled. Last year, an unpublished paper circulated at the Los Alamos National Laboratory raised the possibility that the planned nuclear waste repository at Yucca Mountain, Nevada, might erupt in massive nuclear explosions. The scenario, which held that leaking waste could concentrate in the surrounding rock to form a "supercritical mass," received heavy publicity (*Science*, 30 June 1995, p. 1836). But a review released last week by the nuclear engineering department at the University of California, Berkeley, says it is not credible.

The report concludes, says study leader William Kastenberg, "that at the Yucca Mountain site there don't appear to be any geochemical or geophysical mechanisms for these supercritical scenarios to happen." The Berkeley team could dismiss any danger from commercial spent fuel stored in the repository. It could not, however, utterly rule out some sort of chain reaction if the dump were to hold highly enriched uranium or plutonium from dismantled nuclear weapons. But the Berkeley study does suggest simple engineering fixes—as did a recent report by the Oak Ridge National Laboratory—that it says would effectively reduce the risk to zero.

An internal Los Alamos review of the theory, proposed by lab physicists Charles Bowman and Francesco Venneri, had already concluded that it was implausible. But as the controversy grew, lab administrators funded the new study, which involved virtually the entire nuclear engineering faculty at Berkeley, along with outside experts. "It's clear they've done a very thorough job," says John Browne, head of energy research at Los Alamos.

"When we finally looked at the potential transport mechanisms required" for concentrating different types of stored material, says nuclear engineer Per Peterson, "it was all quite improbable." Because uranium is highly soluble, says Kastenberg, "it will be flushed out of the system into the ground water without accumulating a critical mass." And the plausible transport mechanisms for plutonium are just too slow considering its relatively short half-life, 100,000 years. "The crux of the matter is, by the time you accumulate the necessary plutonium for an explosion—about 250 kilograms—most of it has decayed," says Kastenberg.

To err on the side of caution, the Berkeley researchers did calculate what would happen if the accumulation process somehow won out. "If [250 kilograms of plutonium] were to instantaneously configure itself into the most supercritical possible configuration ... which happens to be physically impossible," says Peterson, "the amount of energy released would still not be sufficient to generate any venting of radioactive material. Some sort of megaexplosion doesn't appear credible."

Bowman, however, says the study vindicates him because it doesn't eliminate any possibility of a nuclear event, and he welcomes the Berkeley group's discussion of possible safeguards. One possibility is filling the canisters and storage area with beads of depleted uranium, the leavings of the uranium enrichment process. As a group led by Charles Forsberg at Oak Ridge has recently pointed out, that would bring down the fraction of fissile material in the waste to a point where no nuclear reaction could ever get going. Moreover, says Forsberg, if ground water leaked into the storage area, the depleted uranium would quickly saturate it, making it unable to carry any of the enriched material.

Forsberg adds that the government has a "nontrivial problem" of disposing of the 400,000 tons of depleted uranium left over from the arms race. "If we're going to shove it down a hole," he says, "let's shove it down a hole where it does some good."

–Gary Taubes

ANIMAL RESEARCH

Care Guide Gives Labs More Freedom

BOSTON—If caretakers of the thousands of mice, rats, dogs, monkeys, and other creatures used each year for U.S. biomedical research have a Bible to steer them, it's the *Guide for the Care and Use of Laboratory Animals*. But just as scriptural interpretations shift with the centuries, animal-care practices change over time—and last week the creator of the guide, the U.S. National Research Council (NRC), handed down the word in new and revised form.

The revisions, the first since 1985, downplay rigid standards for space allotments per animal and cage construction and call instead for researchers to focus on enhancing animals' sense of "well-being"—for example, housing playful animals such as cats and chimpanzees in multilevel cages with plenty to distract them. About 400 researchers and administrators got their first look at the new guide in Boston on 14 and 15 March, at an annual animal-care conference,* and most welcomed the changes. "We need to be constantly moving ahead to alleviate and eliminate pain and distress [to lab animals] and to seek out alternatives" to their use, says Andrew Rowan, an environmental scientist at Tufts University's School of Veterinary Medicine. Many in the animal-welfare movement, however, object to this shift, saying the guide's new standards are subjective and difficult to enforce.

The guide has a lot of clout. First published in 1963, it's used as a reference source for humane animal care throughout the United States and in many other nations. Researchers supported by the National Institutes of Health (NIH) and other branches of the Public Health Service must demonstrate that they have implemented its standards when federal inspectors come to call—or risk losing their funding.

In previous editions, says Thomas Wolfle, director of the NRC's Institute of Laboratory Animal Resources (ILAR), those standards focused on "things we could readily observe: How big is this cage? Is the paint on the laboratory walls peeling? Are there puddles on the floor?" But after nearly 3 years of study, the ILAR committee appointed to update the guide decided to give institutional animal care committees more flexibility. According to its introduction, the guide "charges users of research animals with the responsibility of achieving specified outcomes but leaves it up to them how to accomplish these goals." This means, for example, that animal-care officials are urged to find innovative ways of encouraging species-specific behaviors, such as scent-marking among dogs, and can alter caging requirements to do so.

Animal welfare advocates, however, prefer more specific targets. Cathy Liss, executive director of the Washington, D.C.–based Animal Welfare Institute, says "You need some way to make sure that bottom-rung institutions—the ones that won't do anything more than they absolutely have to—will truly be providing for animals' well-being." Liss is also concerned about reductions in recommended cage sizes for some groups of animals. Cages for chimpanzees weighing 25 to 35 kilograms, for example, have shrunk from 4.9 cubic meters under the old guidelines to only 2.1 cubic meters under the new version.

Wolfle explains that the old guidelines for chimp cages made no distinction based on weight; relatively small, young chimps don't need the space of animals twice their weight. As for the subjective nature of the new guidelines, Wolfle agrees that "it's much easier to see right or wrong on a check sheet" of equipment, but in the new guide, the animal, not the equipment, is the final arbiter of proper care.

–Wade Roush

* "Animal Care and Use: Hot Zones, Gray Zones, and 'Go Slow' Zones." The revised guide will be available from the NIH Office of Protection from Research Risks in May.