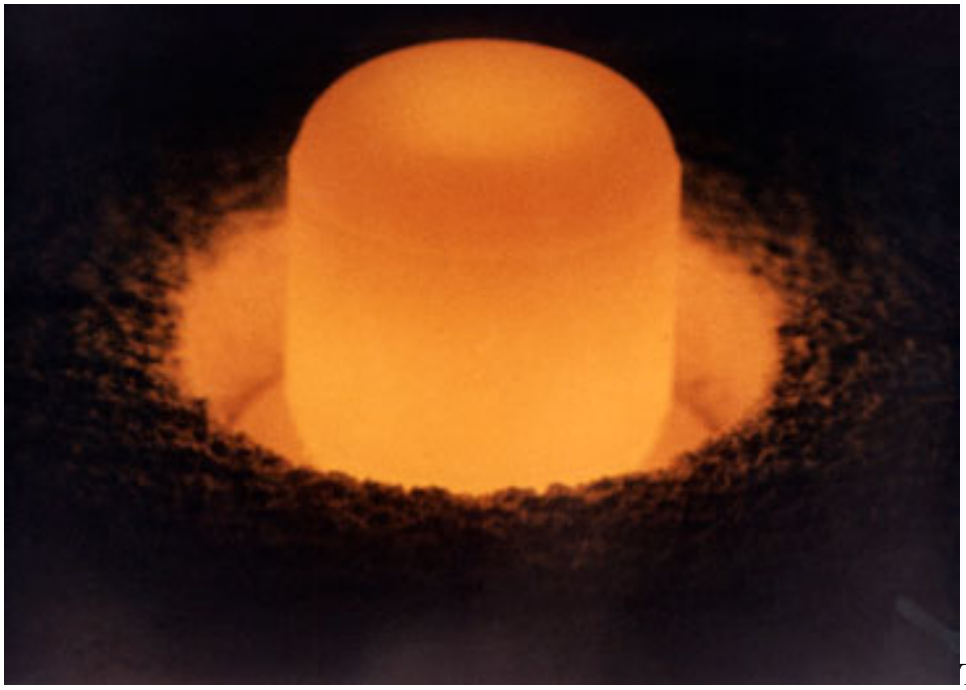
How to Rid the World of the "Element from Hell"

By David Biello | May 9, 2012 |



The vast majority of the radioactive plutonium on the planet is man-made—roughly 500 metric tons, or enough to make 100,000 nuclear weapons by the calculations of the International Panel on Fissile Materials. Much of it is the legacy of the nuclear arms race between the U.S. and Russia in the latter decades of the 20th century but, more and more, it is also the legacy of nuclear power.

Now a team of scientists—physicists Frank von Hippel and Richard Garwin along with environmental scientists Rodney Ewing and Allison Macfarlane—suggest that burying plutonium is the only reasonable solution to this problematic stockpile in a comment to be published in *Nature* on May 10. (*Scientific American* is part of Nature Publishing Group.) They also recommend the U.K., which is presently debating what to do with its nearly 100 metric tons of plutonium, should lead the way by studying how to immobilize the "element from hell" in ceramic pucks that can then be buried in deep caverns or even deeper boreholes.

There are other alternatives. The U.K. actually appears to be leaning toward following the example of France and Japan in their attempts to use the plutonium in so-called mixed oxide nuclear fuel, or MOX. This alternative fuel gets its name because it bears fuel pellets made by combining oxides of uranium and plutionium, a fact that also makes MOX more expensive and harder to handle. By one French estimate from 2000 recycling plutonium in this way adds $750 million to the annual cost of electricity generation in France compared with fuel rods manufactured from uranium freshly dug out of the ground and enriched. The U.S. is spending $13 billion to turn 34 metric tons of its plutonium stockpile into MOX at a facility in South Carolina. And the U.K. failed in its prior attempt to produce MOX fuel at Sellafield, which

shut down last year after spending $2.3 billion in its abortive attempt.

Another option is to use the plutonium as fuel directly in so-called fast reactors, which employ neutrons to initiate fission that are whizzing about much faster than in current nuclear reactor technologies. That high-speed neutron action necessitates cooling such reactors with something a little more difficult to deal with than water, such as liquid sodium (which burns on contact with air or water). And that has meant maintenance problems have plagued the world's fast reactors, such as Monju in Japan or Superphénix in France, although both Russia and the U.S. have each had some successes.

In the end such fast reactors don't so much solve the plutonium problem as delay it: A hole in the ground to hide the radioactive stuff would still be required. So why not just take the cheap route and immobilize it, then bury it, asks the team of scientists? That may be because finding a place to bury it has proved politically radioactive—from Japan to the U.S. Here, Yucca Mountain in Nevada is no closer to being a solution for nuclear waste today than in the 1980s when it was first designated as a final resting place for U.S. radioactive residue. A recent blue ribbon commission recommended starting over from scratch (although the Waste Isolation Pilot Plant in New Mexico has fared better). Nor has the U.S. adequately prepared for tearing down its aging nuclear reactors and dealing with the radioactive waste left behind, according to an April Government Accountability Office report. The problem with treating plutonium "unambiguously as the dangerous weapons material that it is," as the scientists put it, is that few want to pay to have it buried, even very deeply, anywhere near their backyards.

Image: Courtesy of U.S. Department of Energy