The Fatal Flaws of Nuclear Power

Nuclear power has made headlines recently as a possible player in the energy future of the U.S., after decades of decline. But how do claims by industry and government champions stack up against the unsolved problems and dangers nuclear energy poses?

Cost

Despite its promise more than 50 years ago of energy "too cheap to meter," nuclear power continues to be dependent on taxpayer handouts to survive. From 1947 through 1999 the nuclear industry was given over $115 billion in direct taxpayer subsidies. Including Price Anderson limitations on nuclear liability, the federal subsidies reach $145.4 billion. To put this in perspective, federal government subsidies for wind and solar totaled $5.7 billion over the same period. The management of radioactive waste and the requirements for reactor decommissioning also require additional funds. Other aspects of nuclear power, such as the pollution from uranium mining, risks from nuclear weapons proliferation, dangers of reactor accidents, and the legacy of radioactive waste, are further hidden costs.

More Federal Subsidies

The high capital costs and long construction times of reactors make new reactors prohibitively expensive unless they are heavily subsidized by taxpayers. The Energy Policy Act of 2005 contains over $13 billion dollars in new subsidies and tax breaks, as well as other incentives, for the nuclear industry,[1] including:

- Reauthorization of the Price-Anderson Act, which limits industry liability in case of a severe accident; the rest of the tab would be picked up by taxpayers – possibly over $500 billion
- More than $1 billion for research and development of new reactor designs and reprocessing technologies
- Authorization of $2 billion in "risk insurance" to pay the industry for delays in construction and operation licensing for 6 new reactors, including delays due to the Nuclear Regulatory Commission or litigation.
- Authorization of more than $1.25 billion for the construction of a nuclear plant in Idaho
- Tax credits for electricity production, estimated to cost $5.7 billion by 2025[2]
- Unlimited loan guarantees to back up to 80% of the cost of construction in case of default

Even with these incentives, Standard & Poor's recently concluded that such subsidies "may not be enough to mitigate the risks associated with operating issues and high capital costs that could hinder credit quality."[3]

Why is Cost Important?

With the limited amount of money available to spend on tackling global climate change, we need to obtain the greatest reduction in carbon emissions per dollar spent. The high cost of nuclear power means that resources wasted on nuclear power take away from faster, cheaper, and cleaner solutions to climate change.

Waste

Nuclear power is not a clean energy source. In fact, it produces both low and high-level radioactive waste that remains dangerous for several hundred thousand years. Generated throughout all parts of the fuel cycle, this waste poses a serious danger to human health. Currently, over 2,000 metric tons of high-level radioactive waste and 12 million cubic feet of low level radioactive waste are produced annually by the 103 operating reactors in the United States.[4] **No country in the world has found a solution for this waste.** Building new nuclear plants would mean the production of much more of this dangerous waste with no where for it to go.

Uranium Tailings at Elliott Lake in Ontario 1995, Used with permission © Edward Burtynsky

Uranium Mining and Processing

Uranium must be mined and enriched to form fuel for nuclear reactors. Each of these procedures results in radioactive contamination of the environment and risks to public health. Most uranium mining in the U.S. takes place in Utah, Colorado, New Mexico, Arizona, and Wyoming – areas of the country that are suffering from its effects. Uranium is mined by physically removing uranium ore, or by extracting the uranium in a newer process known as in situ leaching. Conventional mining has caused dust and radon inhalation for workers – resulting in high rates of lung cancer and other respiratory diseases – and both types of mining have caused serious contamination of groundwater. When conventionally mined, uranium metal must be separated from the rock in a process called milling, which forms large radon-contaminated piles of material known as tailings. These tailings are often abandoned aboveground. Twelve million tons of tailings, for instance, are piled along the Colorado River near Moab, Utah, threatening communities downstream. In the case of in situ leaching, a solution is pumped into the ground to dissolve the uranium. When the mixture is returned to the surface, the uranium is separated and the remaining waste water evaporated in slurry pools. Following this separation, uranium is sent to a facility for enrichment – a process that concentrates the amount of fissile uranium. Enrichment produces toxic hydrogen fluoride gas and large amounts of depleted uranium. Depleted uranium poses a threat to public health and should be disposed of in a geologic repository.

Waste from Reactors

Over 54,000 metric tons of irradiated fuel has accumulated at the sites of commercial nuclear reactors in the United States. There are several proposals to manage this highly radioactive waste, but none of them would satisfactorily deal with the material.

Yucca Mountain

The Yucca Mountain project continues to be mired in controversy and may very well never open. Numerous unresolved problems remain with the geologic and hydrologic suitability of the proposed site, and serious questions have been raised about its ability to contain highly radioactive waste for the time required. In December 2004, the Department of Energy (DOE) missed its stated license application deadline for the project. DOE currently has no estimate of when it will submit its application. In July 2004, the D.C. Circuit Court of Appeals found that the time limit set by the Environmental Protection Agency (EPA) during which radiation in the groundwater at the site boundary must meet federal drinking water standards was inadequate and illegal. In August 2005, the EPA released a revised standard for the site. The proposed standard, however, still fails to safeguard public health, and would be the least protective radiation standard in the world.

Scientific fraud is also a longstanding problem in the research on the site. In March 2005, DOE and the U.S. Geological Survey revealed emails showing that USGS scientists falsified data related to quality assurance and modeling of water infiltration at the site. Quality assurance (QA) is extremely important to good science, because QA procedures are established to ensure that the data are generated, documented, and reported correctly. The data in question deals with how rapidly water can travel through the mountain, corrode waste containers, and release the material into the environment. There have been other issues in the past with the movement of water through Yucca Mountain.[5]

Private Fuel Storage

Private Fuel Storage (PFS) is a consortium of eight commercial nuclear utilities seeking to open an aboveground “interim” storage site for 40,000 metric tons of irradiated fuel on Goshute land in Utah. After an eight year struggle, NRC granted the consortium a license in September 2005, but the license still requires the approval of the Bureau of Land Management and the Bureau of Indian Affairs. Three of the companies involved in the project have also recently withdrawn or decided to withhold funding from the consortium. If opened, PFS would not solve the waste problem, even temporarily. By transporting waste and storing it above ground in yet another part of the country, PFS will just make the existing waste problem worse. The “temporary” nature PFS is also questionable, because the project is completely dependent on the opening of Yucca Mountain. PFS raises serious environmental justice issues, because the lease with the Goshute Tribe on which PFS is based is mired in controversy and corruption.

Reprocessing, Fast Reactors, and Transmutation

Fast reactors, in combination with reprocessing and transmutation, have also been proposed by the Bush Administration as a way to deal with the waste produced by nuclear power. Specifically, fast neutron reactors – high temperature reactors that use separated plutonium and have an inert gas or liquid metal as a coolant – have been put forth as a way to reduce the radioactivity of the waste by converting long-lived radionuclides into shorter-lived radionuclides in a process known as transmutation. But fast neutron reactors have a terrible track record in safety and are incredibly expensive. These reactor designs also have many remaining technological problems, including the difficulties of using plutonium fuels in operating reactors, low rates of transmutation, unproven fuel fabrication systems, and dangers to workers making the fuel. Even if these problems were addressed, fast-neutron reactors would not eliminate the need for a repository.

Reprocessing, the chemical process of extracting uranium and plutonium from irradiated fuel after it is removed from a reactor, also has problems. Reprocessing technology, which is an essential component of the fast reactor cycle, is extremely expensive, poses a security threat, leads to environmental contamination, and also does not eliminate the need for a repository.

Security

Nuclear plants currently operate at 64 sites in 31 states. Considering the devastation that could result from a successful terrorist attack on a nuclear plant, ensuring their protection should be a priority in a post-September 11 environment. However, the U.S. Nuclear Regulatory Commission (NRC) and nuclear industry are leaving plants vulnerable.

What Could Happen?

The 9/11 Commission noted in June 2004 that al Qaeda's original plan for September 11 was to hijack 10 airplanes and crash two of them into nuclear plants.[6] A September 2004 study by Dr. Ed Lyman of the Union of Concerned Scientists, using the NRC's own analysis method, found that a worst-case accident or attack at the Indian Point nuclear plant 35 miles north of New York City could cause up to 43,700 immediate fatalities and up to 518,000 long-term cancer deaths. Such a release could cost up to $2.1 trillion, and would force the permanent relocation of 11.1 million people.[7]

The Indian Point Nuclear Plant, 24 miles north of New York City. (Google Maps)

Security Tests Still Inadequate

Between 1991 and 2001 almost half the plants tested failed to prevent mock attackers from simulating damage that would result in significant core damage and risk of meltdown – even though guards were defending against a group of only three attackers. After being suspended and revised following September 11, 2001, the new tests have less than double that number, according to *Time Magazine* and other sources. That's far fewer than the 19 we have already experienced.

Safety

A 2002 survey of the NRC's workforce, commissioned by the NRC's Office of the Inspector General (OIG) and conducted by an independent contractor, revealed troubling facts about employees' confidence in the agency's ability to be an effective regulator.[8] Many employees reported a concern that "NRC is becoming influenced by private industry and its power to regulate is diminishing." Meanwhile, only slightly more than half of NRC employees reported feeling that it is "safe to speak up in the NRC"—a finding that does not instill confidence in the NRC's ability to identify potential safety problems before they become serious.

At the Salem and Hope Creek nuclear plants in New Jersey, operated by PSEG Nuclear, serious mismanagement and a deficient safety culture in fact led to the deterioration of the physical condition of the plant - a situation brought to light by a whistleblower who had been fired from her job as a manager at the plant allegedly for voicing safety concerns. Three independent assessments of the situation confirmed the problems at the plant, and an NRC review found "weaknesses in corrective actions and management efforts to establish an environment where employees are consistently willing to raise safety concerns." The NRC also found a general sentiment among employees of the plants that PSEG had emphasized production over safety.[9]

Case Study: Davis-Besse

Mismanagement by FirstEnergy Nuclear Operating Company and lax oversight by the NRC allowed severe degradation of the nuclear reactor vessel head at the Davis-Besse nuclear plant in Oak Harbor, Ohio, to go unnoticed for years until it was finally discovered in March 2002 that a mere three-eighths of an inch of metal cladding was all that contained the essential coolant pressure boundary of the reactor vessel, a dire situation that could have easily led to a reactor breach, subsequent loss of coolant, and potential meltdown.

A December 2002 report by the NRC's Office of the Inspector General (OIG) found that the NRC's decision to allow the continued operation of Davis-Besse "was driven in large part by a desire to lessen the financial impact on [FirstEnergy Nuclear Operating Company] that would result from an early shutdown."

The hole in the head of the Davis-Besse reactor in Ohio.

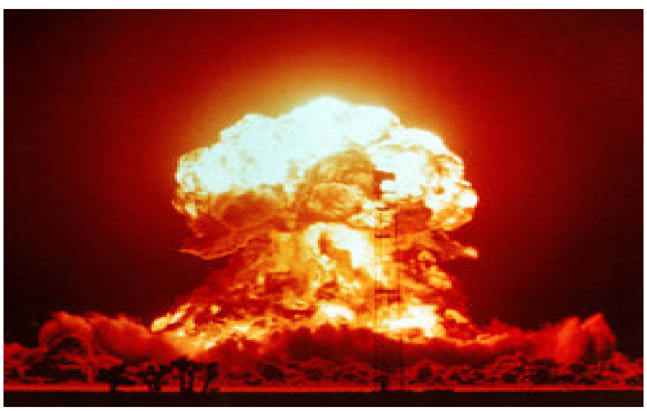
The OIG further concluded that the "NRC appears to have informally established an unreasonably high burden of requiring absolute proof of a safety problem, versus lack of reasonable assurance of maintaining public health and safety, before it will act to shut down a power plant."[10]

Case Study: Tritium Leaks and Ground Water Contamination

The nuclear industry has also recently come under fire for leaking tritium - a radioactive isotope of hydrogen - into the groundwater of areas surrounding nuclear plants. Leaks have been reported at the Braidwood, Byron, and Dresden reactors in Illinois, the Palo Verde reactors in Arizona, and the Indian Point nuclear plant near New York City. Even worse, nuclear energy companies have kept the discoveries of these leaks from the public, sometimes for several years. Tritium is a byproduct of nuclear generation and can enter the body through ingestion, absorption or inhalation. Long-term exposure can increase the risk of cancer, birth defects and genetic damage. In June 2005, the most recent study from National Academies of Science (NAS) reaffirmed that there is no level of radiation exposure that is harmless or beneficial, and that even the smallest dose of ionizing radiation is capable of contributing to the development of cancer. Tritium takes about 250 years to decay to negligible levels, and is very difficult to remove from water.

Proliferation

Nuclear power also increases the risks the nuclear weapons proliferation. As more reactors are built around the world, nuclear material becomes more vulnerable to theft and diversion. Power reactors have also historically led directly to nuclear weapons programs in many countries.



Explosion of U.S. nuclear bomb in 1953 at the Nevada Test Site, DOE image.

Sensitive nuclear technology such as uranium enrichment and spent nuclear fuel reprocessing are ostensibly employed to create fuel in power reactors, they may be easily adjusted or redirected to produce weapons-grade fissile material. Moreover, power reactors themselves produce plutonium, which may be used in bombs. In practice, there is no way to segregate nuclear technologies employed for "peaceful" purposes from technologies that may be employed in weapons—the former may be, and have been, transformed into the latter.

Climate Change

The vast majority of public interest and environmental groups are adamantly opposed to nuclear power because it creates dangerous waste, brings unnecessary risks, and cannot rescue us from climate change. Over 300 national, state, and local organizations have endorsed a statement clearly outlining their reasons for continuing to oppose to nuclear power as a solution to climate change,[11] while not a single environmental group is advocating for more nuclear plants. Nuclear power is too slow, expensive, and inflexible a technology to address climate change, and would entail the building of thousands of new nuclear reactors. These reactors would result in intensified proliferation, waste, and safety problems. These reactors would also drain investment away from renewable technologies. According to a new analysis by Public Citizen based on the work of governments, universities and other organizations in the United States, Europe and Japan, it is technically and economically feasible for a diverse mix of existing renewable technologies to completely meet U.S. energy needs over the coming decades.[12] Clean, safe renewable energy sources – such as wind, solar, advanced hydroelectric and some types of biomass and geothermal energy – can reliably generate as much energy as conventional fuels without significant carbon emissions, destructive mining or the production of radioactive waste.

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[1] <http://www.citizen.org/cmep/energy_enviro_nuclear/electricity/energybill/2005/articles.cfm?ID=13779>.
[2] *Analysis of Five Selected Tax Provisions of the Conference Energy Bill of 2003*, Energy Information Administration, February 2004, p. 3; <http://tonto.eia.doe.gov/FTPROOT/service/ sroiaf(2004)01.pdf>.
[3] Standard and Poor's, Credit Aspects of North American And European Nuclear Power, January 9, 2006
[4] According to data provided by the three low-level commercial waste facility operators, they accepted 12 million cubic feet of low-level waste in 2003. When reactor licenses expire in the next twenty to thirty years, decommissioning (cleaning up closed reactor sites) is expected to vastly increase the amount of low-level waste needing disposal.
[5] In 1996, a team of researchers from Sandia National Laboratory doing work on water infiltration at Yucca Mountain detected chlorine-36 (a radioactive isotope of chlorine not found significantly in nature) at repository depth. After further investigation, the team determined that the Cl-36 had likely come from the atmospheric atomic bomb tests over the Pacific, and thus indicated that water had entered and moved through the rock at Yucca Mountain in the last fifty years.
[6] *The 9/11 Commission Report: Final Report of the National Commission on Terrorist Attacks Upon the United States*, p. 154; <http://www.gpoaccess. gov/911/>.
[7] Dr. Edwin S. Lyman, "Chernobyl on the Hudson? The Health and Economic Impacts of a Terrorist Attack at the Indian Point Nuclear Plant," Riverkeeper, Inc., September 2004.
[8] U.S. Nuclear Regulatory Commission, Office of the Inspector General, "OIG 2002 Survey of NRC's Safety Culture and Climate," OIG-03-A-03, Dec. 11, 2002.
[9] Hubert J. Miller, U.S. Nuclear Regulatory Commission, letter to E. J. Ferland, Public Service Enterprise Group, July 30, 2004.
[10] U.S. Nuclear Regulatory Commission, Office of the Inspector General, "Event Inquiry: NRC's Regulation of Davis-Besse Regarding Damage to the Reactor Vessel Head," Case No. 02-03S, Dec. 30, 2002.
[11] <http://www.citizen.org/documents/GroupNuclearStmt.pdf>.
[12] Public Citizen, "Renewable Energy is Capable of Meeting Our Needs", April 2006, http://www.citizen.org/documents/RenewableEnergy.pdf .