

Issue Brief: Vulnerability of U.S. Nuclear Power Plants to Terrorist Attack and Internal Sabotage

Introduction:

The Sept. 11 terrorist attacks on the World Trade Center and the Pentagon illustrated the deadly intentions and abilities of modern terrorist groups. These attacks also brought to surface long-standing concerns about the vulnerability of U.S. nuclear installations to possible terrorist attacks. The United States is home to 103 nuclear power plants located in 31 states, generating about 20% the nation's electricity. There are an additional 14 decommissioned plants, some of which still contain radioactive material. Some of these plants are located near large urban population centers. Experts consider U.S. nuclear reactors to be "high-value targets" for a terrorist determined to inflict large-scale death and destruction in the country.

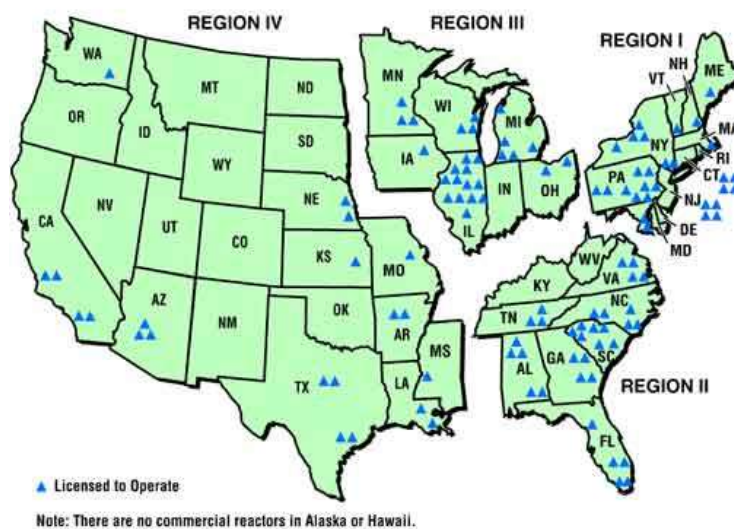
Since the September 11 attacks, the Federal Bureau of Investigation (FBI), the Nuclear Regulatory Commission (NRC) and other federal and state offices have received a number of threats or scares concerning U.S. nuclear power plants. The Air National Guard has been scrambled at least a couple of times to keep low-flying aircraft away from nuclear power plants, including the Vermont Yankee plant in Vermont and the Oconee plant in South Carolina.¹ On October 17, according to plant officials, the Three Mile Island nuclear power plant in Pennsylvania was put on the highest alert after receiving, as described by the plant officials, a "credible threat" against the installation.² A day earlier, the city of Baltimore, MD, was put on high alert due to a threat received against a nearby nuclear power plant.³ The NRC, which is the agency responsible for monitoring the safety of U.S. nuclear installations, has acknowledged receiving serious threats against U.S. nuclear power plants even before September 11. In 1999, for example, the NRC admitted to Congress that it had received a credible threat of a terrorist attack against a nuclear power facility.

US Nuclear Power Plants by Region

(Click map for larger version)

How Safe are U.S. Nuclear Power Plants?

Despite the recent media and public interest in the topic, concerns about the vulnerability of nuclear power plants against terrorist attack or sabotage are not new. As early as 1982, the Argonne National Laboratory, a Department of Energy (DOE) facility, conducted a study detailing the likely damage that a jetliner could inflict on the concrete containment walls protecting nuclear reactors. The study described possible scenarios where an accidental jetliner crash could compromise the safety of a nuclear power plant's primary containment wall and interior structure. The report estimated that even if just 1% of a jetliner's fuel ignited after impact, it would create an explosion equivalent to 1,000 pounds of dynamite inside a reactor building. An explosion of this magnitude impacting on a containment structure that has already been weakened by the crash of a high-speed jetliner crash could potentially compromise the integrity of the power plant. While the report refrained from providing detail, in these accident scenarios, about how and when radioactivity might be released, it stated that "the breaching of some of the plant's concrete barriers may often be tantamount to a release of radioactivity." The report further stressed that U.S. nuclear regulators might have underestimated the potential damage from such explosions.⁴



Following the 1993 World Trade Center (WTC) bombing and revelations that Ramzi Yousef, the convicted mastermind of this event, had also plotted similar attacks against nuclear power plants, the NRC put in place measures to protect the country's nuclear reactors from attack scenarios using land vehicles filled with explosives. Under enhanced security provisions, which according to the NRC have been in place since 1996, nuclear power plant security personnel received advanced training, anti-sabotage procedures were implemented, and new plant-monitoring devices were installed at many of the country's reactors. In 1998, the NRC completed enhanced security mechanisms for spent fuel rod storage facilities.

Most of the existing NRC security regulations, critics claim, are intended to protect against internal fuel damage from a small group of well-armed intruders aided by one insider; a lone insider; or a 4-wheel-drive land vehicle bomb.⁵ Despite the enhanced safety mechanisms imposed by the NRC under the Operational Safeguards Response Evaluation

program, U.S. nuclear reactors remain vulnerable to terrorist attack or insider sabotage. The NRC's own tests have illustrated that safety firewalls at many U.S. nuclear power plants are penetrable by outside intruders as well as disgruntled employees on the inside. Since 1991, despite months of advanced warning and beefed up security, some 47% of U.S. nuclear power plants failed to repel small mock terrorist attacks conducted by the NRC.⁶

Immediately after the September 11 attacks, the NRC stated that American nuclear power plants could withstand the crash of a commercial jetliner like those used against the WTC and the Pentagon. Within days of this assertion, however, the agency spokesmen found themselves backpedaling and stating that before Sept. 11 the NRC had not considered and prepared for the danger of an aerial attack on U.S. nuclear reactors involving large commercial planes loaded with jet fuel. The agency had no serious contingency plans for such attack because, as the NRC spokesman Victor Dricks stated, "it was never considered credible that suicidal terrorists would hijack a large commercial airliner and deliberately crash it into a nuclear power plant."⁷

The International Atomic Energy Agency (IAEA) has also confirmed that current nuclear power plants are structurally vulnerable against the September 11 attack scenario that destroyed the World Trade Center Buildings. According to IAEA Spokesman David Kyd, "[Nuclear] Reactors have the most robust engineering of any buildings in the civil sector - only missile silos and nuclear bunkers are built to be tougher. They are designed to be earthquake-proof, and our experiences in California and Japan have shown them to be so. They are also built to withstand impacts, but not that of a wide-bodied passenger jet full of fuel. A deliberate hit of that sort is something that was never in any scenario at the design stage. These are vulnerable targets and the consequences of a direct hit could be catastrophic." In an interview with CNN's Moneyline program, Kyd asserted that successful use of a large passenger airliner to attack a nuclear power plant is a rather unlikely scenario. In the course of the same interview however, Kyd acknowledged that, if such an attack were successfully conducted, "the containment could be breached and the cooling system of the reactor could be impaired to the point where radioactivity might well be set free."⁸

According to experts, if a large airliner were to hit a nuclear power plant's containment structure, the jet engines could penetrate the structure, leading to the introduction within the building of jet fuel and most likely a severe explosion and fire similar to those witnessed at the WTC and the Pentagon on September 11. Nuclear power plants are not well equipped to deal with severe fires, known as "common-mode failures." Such accidents could actually cause various safety systems to fail simultaneously, leading to a loss of coolant that cannot be mitigated and ultimately resulting in a meltdown of the nuclear fuel.⁹

According to Robert Alvarez, a Senior Policy Adviser to the Energy Secretary between 1993 and 1999, while an attack or internal sabotage in any part of a nuclear reactor could pose significant danger to human health and the environment, perhaps the most significant radiological consequences from acts of malice would come from commercial reactor spent fuel pools.¹⁰ Spent fuel pools at many U.S. nuclear reactors contain, on the average, about five times more radioactivity than in the reactor core and constitute collectively the largest concentration of radioactivity on the planet. With the exception of a handful of nuclear power stations where the spent fuel is stored in dry-casks, the vast preponderance of commercial spent fuel is stored in water. In these pools, there are some 40,000 tons of highly radioactive spent fuel in about 137,000 spent fuel rods. Many rods, in compacted storage, are only about 9 inches apart -- one inch more than fuel rod spacing in a reactor core. For safety reasons, most of the spent fuel pools at commercial nuclear reactors were never meant to hold this much-spent fuel. To get around this problem, the NRC has required many plant operators to install complicated equipment to maintain water chemistry and temperature and to prevent criticalities. All of these "engineering work-arounds," argues Dr. Alvarez, add to the fragility of the storage system at the country's nuclear power plants.

The spent fuel pools at commercial reactors are mostly encased in what the nuclear industry describes as "steel super-structures," otherwise known as corrugated buildings. The structures protecting commercial spent fuel pools are not as well built as primary containment structures designed to protect reactor cores and are unlikely to withstand a plane crash or a ground-launched missile. If a pool and its equipment are damaged and develop leaks as a result of an attack or internal sabotage, the fuel-cladding could undergo an exothermic reaction and spontaneously catch fire when the water level in the pool drops half-way, exposing the rods. This is a scenario roughly comparable to what took place after the explosion at the Chernobyl nuclear power plant in Ukraine on 26 April 1986, the worst nuclear reactor accident ever recorded.¹¹

The human, environmental, and economic cost of a successful terrorist attack or internal sabotage could potentially be as devastating as, if not worse than, the nuclear nightmare witnessed at Chernobyl in 1986. While the true extent of the human and environmental damage caused by the accidental meltdown of the Chernobyl plant's core in Ukraine is yet to be assessed, the initial experience provides a glimpse of what is at stake. According to one report:

"The accident at the Chernobyl plant led to the deaths of 30 power plant employees and firemen within a few weeks, mostly from acute radiation effects, and to the evacuation of over 100 000 people from surrounding areas. Large parts of Belarus and Ukraine, plus parts of the Russian Federation, were contaminated and approximately five million people still live in areas of these countries with levels of Cs ground deposition of more than 37 kBq/[m.sup.2]. Other countries in the Northern Hemisphere -principally in northern and eastern Europe - were also affected by radioactive releases from the plant, although generally to a much lower extent than in the former Soviet Union. The most notable finding from health studies following the Chernobyl accident has been the excess of thyroid cancer among those exposed in

