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Nuclear Power Plants: Vulnerability to Terrorist Attack

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Summary

Protection of nuclear power plants from land-based assaults, deliberate aircraft crashes, and other terrorist acts has been a heightened national priority since the attacks of September 11, 2001. The Nuclear Regulatory Commission has strengthened its regulations on nuclear reactor security, but critics contend that implementation by the industry has been too slow and that further measures are needed. Several bills to increase nuclear reactor security measures and requirements were introduced after the 9/11 attacks, along with provisions in an omnibus energy bill considered in the 108th Congress (H.R. 6). None of those measures were enacted, but further action on omnibus energy legislation is anticipated in the 109th Congress. This report will be updated as events warrant.

Nuclear power plants have long been recognized as potential targets of terrorist attacks, and critics have long questioned the adequacy of the measures required of nuclear plant operators to defend against such attacks. Following the September 11, 2001, attacks on the Pentagon and the World Trade Center, the Nuclear Regulatory Commission (NRC) began a "top-to-bottom" review of its security requirements. On February 25, 2002, the agency issued "interim compensatory security measures" to deal with the "generalized high-level threat environment" that continued to exist, and on January 7, 2003, it issued regulatory orders that tightened nuclear plant access. On April 29, 2003, NRC issued three orders to restrict security officer work hours, establish new security force training and qualification requirements, and increase the "design basis threat" that nuclear security forces must be able to defeat.

Security Regulations

Under the regulations in place prior to the September 11 attacks, all commercial nuclear power plants licensed by NRC must be protected by a series of physical barriers and a trained security force. The plant sites are divided into three zones: an "owner-controlled" buffer region, a "protected area," and a "vital area." Access to the protected area is restricted to a portion of plant employees and monitored visitors, with stringent

access barriers. The vital area is further restricted, with additional barriers and access requirements. The security force must comply with NRC requirements on pre-hiring investigations and training.[1]

Design Basis Threat. The severity of attacks to be prepared for are specified in the form of a "design basis threat" (DBT). One of NRC's April 2003 regulatory orders changed the DBT to "represent the largest reasonable threat against which a regulated private guard force should be expected to defend under existing law," according to the NRC announcement. The details of the revised DBT, which took effect October 29, 2004, were not released to the public. Contending that the new DBT still does not adequately represent the credible terrorist threat faced by nuclear power plants, eight state attorneys general urged NRC in January 2005 to open a new rulemaking on the issue.[2]

NRC requires each nuclear power plant to conduct periodic security exercises to test its ability to defend against the design basis threat. In these "force on force" exercises, monitored by NRC, an adversary force from outside the plant attempts to penetrate the plant's vital area and damage or destroy key safety components. Participants in the tightly controlled exercises carry weapons modified to fire only blanks and laser bursts to simulate bullets, and they wear laser sensors to indicate hits. Other weapons and explosives, as well as destruction or breaching of physical security barriers, may also be simulated. While one squad of the plant's guard force is participating in a force-on-force exercise, another squad is also on duty to maintain normal plant security. Plant defenders know that a mock attack will take place sometime during a specific period of several hours, but they do not know what the attack scenario will be. Multiple attack scenarios are conducted over several days of exercises.

Full implementation of the force-on-force program coincided with the effective date of the new DBT in late 2004. Standard procedures and other requirements have been developed for using the force-on-force exercises to evaluate plant security and as a basis for taking regulatory enforcement action. Many tradeoffs are necessary to make the exercises as realistic and consistent as possible without endangering participants or regular plant operations and security. Each plant is required to conduct NRC-monitored force-on-force exercises once every three years.

NRC required the nuclear industry to develop and train a "composite adversary force" comprising security officers from many plants to simulate terrorist attacks in the force-on-force exercises. However, in September 2004 testimony, the Government Accountability Office (GAO) criticized the industry's selection of a security company that guards about half of U.S. nuclear plants, Wackenhut, to also provide the adversary force. In addition to raising "questions about the force's independence," GAO noted that

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[1] General NRC requirements for nuclear power plant security can be found at 10 CFR 73.55.

[2] *EnergyWashington Week*. "Attorneys General Take NRC to Task on Nuclear Plant Security Flaws." January 31, 2005.

Wackenhut had been accused of cheating on previous force-on-force exercises by the Department of Energy.[3]

GAO contended in the same statement that nuclear plants' implementation of new security plans based on the new DBT was not receiving adequate NRC review — and that deficiencies might not be discovered for three years, after all plants have undergone force-on-force exercises. "NRC cannot yet provide assurances that its efforts will protect nuclear power plants against terrorist attacks as outlined in the new DBT," the statement said.

Emergency Response. After the 1979 accident at the Three Mile Island nuclear plant near Harrisburg, PA, Congress required that all nuclear power plants be covered by emergency plans. NRC requires that within an approximately 10-mile Emergency Planning Zone (EPZ) around each plant the operator must maintain warning sirens and regularly conduct evacuation exercises monitored by NRC and the Federal Emergency Management Agency (FEMA). In light of the increased possibility of terrorist attacks that, if successful, could result in release of radioactive material, critics have renewed calls for expanding the EPZ to include larger population centers.

Another controversial issue regarding emergency response to a radioactive release from a nuclear power plant is the distribution of iodine pills. A significant component of an accidental or terrorist release from a nuclear reactor would be a radioactive form of iodine, which tends to concentrate in the thyroid gland of persons exposed to it. Taking a pill containing non-radioactive iodine before exposure would prevent absorption of the radioactive iodine. Emergency plans in many states include distribution of iodine pills to the population within the EPZ, which would protect from exposure to radioactive iodine, although giving no protection against other radioactive elements in the release. NRC in 2002 began providing iodine pills to states requesting them for populations within the 10-mile EPZ.

Nuclear Plant Vulnerability

Operating nuclear reactors contain large amounts of radioactive fission products which, if dispersed, could pose a direct radiation hazard, contaminate soil and vegetation, and be ingested by humans and animals. Human exposure at high enough levels can cause both short-term illness and death, and longer-term deaths by cancer and other diseases.

To prevent dispersal of radioactive material, nuclear fuel and its fission products are encased in metal cladding within a steel reactor vessel, which is inside a concrete "containment" structure. Residual heat from the radioactive fission products could melt the fuel-rod cladding even if the reactor were shut down. A major concern in operating a nuclear power plant, in addition to controlling the nuclear reaction, is assuring that the

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[3] Government Accountability Office. *Nuclear Regulatory Commission: Preliminary Observations on Efforts to Improve Security at Nuclear Power Plants.* Statement of Jim Wells, Director, Natural Resources and Environment, to the Subcommittee on National Security, Emerging Threats, and International Relations, House Committee on Government Reform. September 14, 2004. p. 14.

core does not lose its coolant and "melt down" from the heat produced by the radioactive fission products within the fuel rods. Therefore, even if plant operators shut down the reactor as they are supposed to during a terrorist attack, the threat of a radioactive release would not be eliminated.

Commercial reactor containment structures — made of steel-reinforced concrete several feet thick — are designed to prevent dispersal of most of a reactor's radioactive material in the event of a loss of coolant and meltdown. Without a breach in the containment, and without some source of dispersal energy such as a chemical explosion or fire, the radioactive fission products that escaped from the melting fuel cladding mostly would remain where they were. The two meltdown accidents that have taken place in power reactors, at Three Mile Island in 1979 and at Chernobyl in the Soviet Union in 1986, illustrate this phenomenon. Both resulted from a combination of operator error and design flaws. At Three Mile Island, loss of coolant caused the fuel to melt, but there was no fire or explosion, and the containment prevented the escape of substantial amounts of radioactivity. At Chernobyl, which had no containment, a hydrogen explosion and a fierce graphite fire caused a significant part of the radioactive core to be blown into the atmosphere, where it contaminated large areas of the surrounding countryside and was detected in smaller amounts literally around the world.

Vulnerability from Air Attack. Nuclear power plants were designed to withstand hurricanes, earthquakes, and other extreme events, but attacks by large airliners loaded with fuel, such as those that crashed into the World Trade Center and Pentagon, were not contemplated when design requirements were determined. A taped interview shown September 10, 2002, on Arab TV station al-Jazeera, which contains a statement that Al Qaeda initially planned to include a nuclear plant in its 2001 attack sites, intensified concern about aircraft crashes.

In light of the possibility that an air attack might penetrate the containment building of a nuclear plant, some interest groups have suggested that such an event could be followed by a meltdown and widespread radiation exposure. Nuclear industry spokespersons have countered by pointing out that relatively small, low-lying nuclear power plants are difficult targets for attack, and have argued that penetration of the containment is unlikely, and that even if such penetration occurred it probably would not reach the reactor vessel. They suggest that a sustained fire, such as that which melted the structures in the World Trade Center buildings, would be impossible unless an attacking plane penetrated the containment completely, including its fuel-bearing wings.

Recently completed NRC studies "confirm that the likelihood of both damaging the reactor core and releasing radioactivity that could affect public health and safety is low," according to NRC Chairman Nils Diaz. However, NRC is considering studies of additional measures to mitigate the effects of an aircraft crash.[4]

Spent Fuel Storage. Radioactive "spent" nuclear fuel — which is removed from the reactor core after it can no longer efficiently sustain a nuclear chain reaction — is stored in pools of water in the reactor building or in dry casks elsewhere on the plant

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[4] Letter from NRC Chairman Nils J. Diaz to Secretary of Homeland Security Tom Ridge, September 8, 2004.

grounds. Because both types of storage are located outside the reactor containment structure, particular concern has been raised about the vulnerability of spent fuel to attack by aircraft or other means.

The primary concern is whether terrorists could breach the thick concrete walls of a spent fuel pool and drain the cooling water, which could cause the spent fuel to overheat and catch fire. Critics of the nuclear industry have pointed to NRC studies that have found such fires possible, although unlikely. NRC contends that critics have overestimated the likely consequences of a spent fuel fire and underestimated the ability of plant operators to cool the spent fuel in a damaged pool.[5] Spent fuel stored in dry casks does not rely on water for cooling, but concerns have been raised that terrorists could attempt to breach the casks and release radioactive material into the air. Spent fuel pools and dry cask storage facilities are subject to NRC security requirements.

Regulatory and Legislative Proposals

Critics of NRC's security measures have demanded both short-term regulatory changes and legislative reforms.

A fundamental concern was the nature of the DBT, which critics contended should be increased to include a number of separate, coordinated attacks. Critics also contended that nearly half of the plants tested in NRC-monitored mock attacks before 9/11 failed to repel even the small forces specified in the original DBT, a charge that industry sources vigorously denied. Critics also pointed out that licensees are required to employ only a minimum of five security personnel on duty per plant, which they argue is not enough for the job.[6] Nuclear spokespersons responded that the actual security force for the nation's 65 nuclear plant sites numbers more than 5,000, an average of about 75 per site (covering multiple shifts). Nuclear plant security forces are also supposed to be aided by local law enforcement officers if an attack occurs.

In February 2002, NRC implemented what it called "interim compensatory security measures," including requirements for increased patrols, augmented security forces and capabilities, additional security posts, installation of additional physical barriers, vehicle checks at greater stand-off distances, enhanced coordination with law enforcement and military authorities, and more restrictive site access controls for all personnel. The further orders issued April 29, 2003, expanded on the earlier measures, including revising the DBT, which critics continue to describe as inadequate.

Because of the growing emphasis on security, NRC established the Office of Nuclear Security and Incident Response on April 7, 2002. The office centralizes security oversight of all NRC-regulated facilities, coordinates with law enforcement and intelligence agencies, and handles emergency planning activities. Force-on-force

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[5] NRC Fact Sheet. *NRC Review of Paper on Reducing Hazards From Stored Spent Nuclear Fuel.* August 2003.

[6] 10 CFR 73.55 (h)(3) states: "The total number of guards, and armed, trained personnel immediately available at the facility to fulfill these response requirements shall nominally be ten (10), unless specifically required otherwise on a case by case basis by the Commission; however, this number may not be reduced to less than five (5) guards."

exercises are an example of the office's responsibilities. On June 17, 2003, NRC established the position of Deputy Executive Director for Homeland Protection and Preparedness, whose purview includes the Office of Nuclear Security and Incident Response.

Legislation. After the 9/11 attacks, several bills were introduced dealing with security in nuclear power plants in the 107th Congress, although none became law.

H.R. 3382, introduced by Representative Markey, would have created a federal force within the NRC to replace the private guards at nuclear power plants. The bill also would have required emergency planning exercises within a 50-mile radius around each nuclear plant and stockpiling of iodine pills for populations within 200 miles of nuclear plants.

Senator Reid's Nuclear Security Act (S. 1746) as originally introduced contained many provisions similar to those in H.R. 3382. However, Senator Reid later introduced a substitute version of the bill, which was approved by the Senate Environment and Public Works Committee on July 25, 2002 (S.Rept. 107-335). The substitute bill would have appointed a task force to review security at U.S. nuclear power plants, required the President to establish a federal team to coordinate protection of air, water, and ground access to nuclear power plants, and would have given statutory authority to NRC's Office of Nuclear Security and Incident Response. The reported bill also included NRC proposals to authorize guards at NRC-regulated facilities to carry and use a variety of firearms despite restrictions in some states.

In the 108th Congress, Senator Reid introduced the Nuclear Security Act of 2003 (S. 131) containing measures similar to the version of S. 1746 reported out of committee in the previous Congress, including the authorization for employees of NRC licensees to carry weapons. Senator Daschle included similar provisions in his Comprehensive Homeland Security Act of 2003 (S. 6). The authorization for NRC licensees to carry weapons is included in the energy omnibus bill (H.R. 6) reported out of conference and approved by the House in November 2003 (Title VI, Subtitle D). Subtitle D would also require a presidential report on nuclear facility threats, force-on-force exercises, training of National Guard and law enforcement personnel in responding to nuclear plant security threats, and fingerprinting of nuclear plant employees. The H.R. 6 conference report was blocked by a Senate filibuster.

On May 15, 2003, the Senate Environment and Public Works Committee reported out an amended version of the Nuclear Infrastructure Security Act of 2003, S. 1043, but the measure did not see floor action. As reported, the bill would have required NRC to revise the DBT through a formal rulemaking procedure, which would allow public comment on the proposed revision. In updating the DBT on April 29, 2003, NRC did not release details of the new requirements or comment on the process by which it reached its decision.

The 109th Congress is expected to continue working on omnibus energy legislation, which could include nuclear security provisions similar to previous proposals.