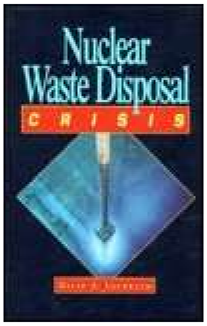
Enhancing ISFSI Security Against Insider and Intruder Sabotage

PennWell Corporation published my book, *Nuclear Waste Disposal Crisis*, in January 1996, focusing on



a safety problem a colleague and I had discovered involving spent fuel pools at the Susquehanna nuclear plant in Pennsylvania. The book discussed spent fuel pool and dry storage safety issues. The book helped me get hired by the Union of Concerned Scientists (UCS) in the fall of 1996 to direct their nuclear safety project. At UCS, my focus was on the safety and security of operating nuclear power reactors in the United States. I participated in public meetings with the NRC on security prior to 9/11. The NRC had discontinued its Operational Safeguards Response Evaluation (OSRE) program – the program it had used since 1991 to verify adequate security of nuclear power plants – in the summer of 1998, only to reinstate it after the Los Angeles Times published a very critical article. The OSRE program (now labeled Contingency Response) complements other elements of a plant's security plan as illustrated in the following graphic from the NRC's annual security report to the U.S. Congress for 2019:

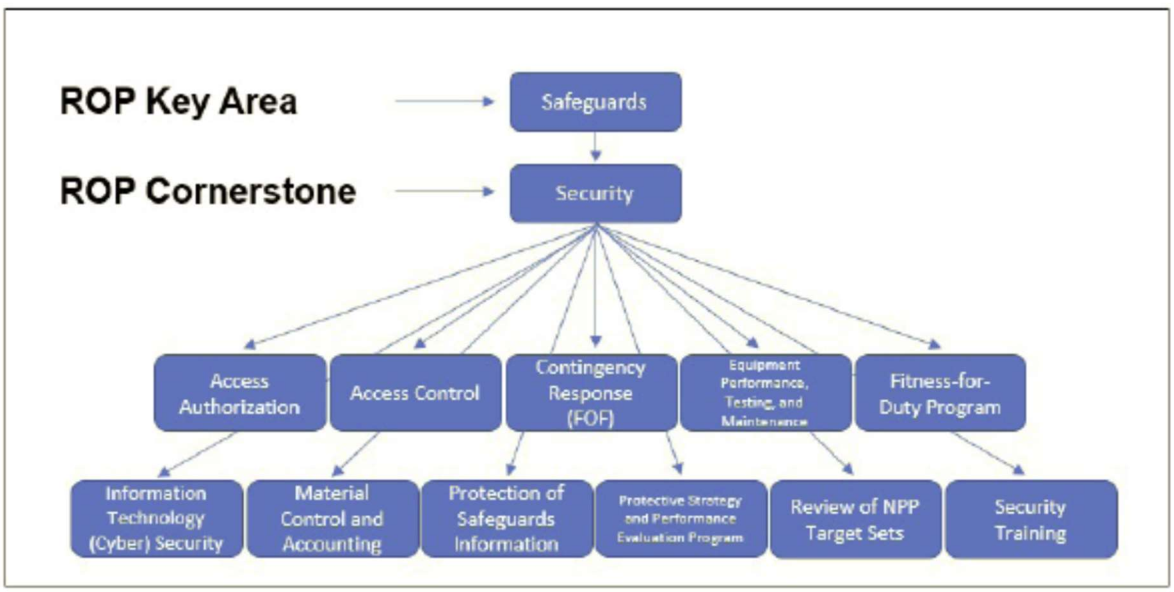


Figure 4 Inspectable Areas of the Security Cornerstone

My experience leads me to conclude that security of the dry casks within the Independent Spent Fuel Storage Installation (ISFSI) at Indian Point could be significantly enhanced by two measures: (1) two-person rule for entry into the ISFSI protected area, and (2) force-on-force testing under the Contingency Response program. The former protects against sabotage by insiders; the latter protects against sabotage by outsiders.

Two-Person Rule

The existing security plan for Indian Point already contains elements intended to protect against sabotage by insiders. The Access Authorization program includes background checks designed to verify the trustworthiness of individuals before they begin working inside the security fence. The Access Control program restricts entry into vital areas of the plant to only persons authorized to enter. The Fitness-for-Duty (FFD) Program includes initial and random testing for drug and alcohol use seeking to protect against individuals working while impaired. The FFD Program also includes a Continuing Behavior Observation component in which supervisors monitor workers to detect unusual actions. Protection of Safeguards Information is the info complement to the Access Control program. It restricts access to security plan details to only those individuals authorized to see them. Collectively, these security plan elements lessen the likelihood that an insider attempts radiological sabotage.

The two-person rule would further reduce the risk of ISFSI sabotage by insiders. It would prevent one worker from entering the ISFSI protected area alone. The theory behind this rule is that, barring a conspiracy, each of the multiple workers would either deter the other(s) from attempting sabotage or intervene in a timely manner should it be attempted.

The NRC acknowledged the potential hazard posed by one worker with access to vital areas. In March 2009 following the issuance of its post-9/11 security regulation upgrades, the NRC issued Regulatory Guide 5.77 titled "Insider Mitigation Program." The NRC stated:

> *A trusted person with protected or vital area access, or access to digital computer and communications systems and networks from outside the protected area, can pose a significant threat to the safety and security of a nuclear power plant.* (page 3)

The virtue of the two-person rule has been recognized by the NRC and by Sandia National Laboratories. In May 2014, the NRC issued NUREG-2166 titled "Physical Security Best Practices for the Protection of Risk-Significant Radioactive Material." The NRC reported:

> *This best practices document provides guidance to a licensee or applicant regarding some best practices that should be used for the development and implementation of a physical protection program.* ***A best practice is a method or technique that has consistently shown results superior to those achieved by other means and that is used as a benchmark for completing a task.*** (page 1-1) [boldfacing added for emphasis]

The NRC explicitly addressed the two-person rule:

> *The licensee should implement an access control system that uses a two-person protocol to access sources. This technique provides some mitigation for a lone insider performing a malevolent act.* (page D-4)

More recently, the Sandia National Laboratories recommended the two-person rule. In August 2022, Sandia released SAND2022-12199 titled "Nuclear Power Plant Physical Protection Recommendation Document" which stated:

> *Vital areas (VA) are located within protected areas. NPPs* [nuclear power plants] *should have an approved access authorization list for access into a VA. This access authorization list should ensure individuals with unescorted access and a need to enter the VA to perform their job functions are the only individuals with access into a VA. This list should be evaluated be department management and security management frequently to ensure those that no longer require access are removed from the list.* ***NPPs should implement a two-person (line-of-sight) rule for all personnel that enter a VA.*** (page 39) [boldfacing added for emphasis]

On May 17, 2021, the emergency plan for Indian Point was submitted to the NRC. It stated:

> *A Security fence marks the perimeter of the Protected Area of the site. Access beyond the fence is restricted to badged employees or escorted visitors. Metal and bomb detectors are located at the Protected Area entrance. All buildings related to plant functions are within the Protected Area security fence. … The Independent Spent Fuel Storage Installation (ISFSI) is located within the Protected Area boundary for interim dry storage of spent fuel.* (page 2)

The ISFSI at Indian Point is a vital area within the Protected Area.

The NRC published its Safeguards Summary Event List (SSEL) for the first time in July 1992. Each SSEL described security incidents at NRC-licensed facilities. The initial SSEL described the May 7, 1979 discovery that 62 of 64 fuel assemblies at the Surry nuclear plant in Virginia had been damaged by sodium hydroxide poured onto them. The fuel assemblies were housed within a locked and alarmed building which could only be accessed by workers passing the background screening. Two persons were arrested on June 18, 1979, for the sabotage. They were convicted and sentenced to two years in prison. The men claimed to have sabotaged the fuel to call attention to what they termed "unsafe conditions and lax security."

The two-person rule, had it existed at Surry back in 1979, would not have prevented this fuel sabotage incident. The two-person rule is not 100 percent reliable. In fact, neither are any of the other elements in the security plan designed to protect against insider sabotage. If any one element was 100 percent reliable, no other elements would be necessary. Instead, multiple highly reliable elements combine to minimize the chance that all fail and the insider(s) sabotages the ISFSI.

With NRC endorsing it as a best practice and Sandia recommending it for all persons entering vital areas, the two-person rule[1] should be implemented at Indian Point for individuals entering the ISFSI protected area. This area is not a high-traffic area and implementing the two-person rule should not be much of a burden.

Force-on-Force (FOF) Testing

In its annual security report to the U.S. Congress for 2021, the NRC stated:

> *FOF inspections include both tabletop drills and performance based FOF inspection exercises. These FOF inspection exercises simulate combat between a mock adversary force and a licensee's security force. At an NPP, the mock adversary force attempts to reach and simulate damage to significant components of safety-related systems (referred to as "target sets") that protect the reactor's core or the spent fuel. Compromise of target sets could potentially cause a radioactive release to the environment. The licensee's security force, in turn, attempts to interdict the mock adversary force to prevent the adversary from reaching target sets, thus preventing such a release.* (page 7)
>
> *Pursuant to the FOF SDP, an effective exercise is one in which the licensee demonstrates effective implementation of its protective strategy in accordance with plans approved by the NRC and related implementation procedures, regulatory requirements, or other Commission requirements, such as orders or confirmatory action letters. …* ***An ineffective exercise is one in which the licensee did not demonstrate effective implementation of its protective strategy*** *in accordance with plans approved by the NRC and related implementation procedures, regulatory requirements, or other Commission requirements, such as orders or confirmatory action letters.* (page 9) [boldfacing added for emphasis]

The NRC initiated FOF testing in 1991 with the Operational Safeguards Response Evaluation program, The table below shows the results from the NRC's annual security reports to the U.S. Congress, beginning with the first one in September 2007:

Year	Number of FOF Inspections	Number of Ineffective Exercises	Success Rate

[1] Cameras might be employed as a virtual second person provided (a) the individual within the ISFSI protected area is on-camera at all times, and (b) an individual monitors the camera(s) for the duration of the entry.

2021	17	1	94.1%
2020	16	0	100.0%
2019	20	1	95.0%
2018	21	1	97.4%
2017	19	1	94.7%
2016	21	1	95.2%
2015	22	1	95.5%
2014	23	1	95.7%
2013	23	1	95.7%
2012	23	1	95.7%
2011	24	0	100.0%
2010	24	2	91.7%
2009	23	3	87.0%
2008	24	2	91.7%
2007	22	2	90.9%
2004-2006	44	0	100.0%
Totals:	366	18	95.1%

In nine of the past ten years, FOF testing revealed an ineffective protective strategy at a nuclear power plant. Overall, there were 18 "failures" out of the 366 FOF inspections conducted during this 18-year period. The 95.1% success rate is meaningful.

A 100% success rate would raise questions about the robustness of the testing program, merely like asking "Who's buried in Grant's tomb?" and accepting "dead people" as a correct answer.

The 4.9% "failure" rate reflects the robustness of the FOF tests. The "failures" also occurred during testing, allowing the identified vulnerabilities to be corrected before any real intruders arrive to exploit them.

The NRC notifies plant owners well in advance of the dates of the FOF tests. For example, the NRC notified the owner of the Nine Mile Point nuclear plant in New York on August 31, 2022, that it would conduct FOF tests between July 28th and September 1st and between September 25th and September 29th 2023.

Advance notice is necessary because the owner must arrange to provide two security guard forces during FOF tests – one force to participate in the tests using non-lethal laser equipment and a second force to protect the plant with real weapons. Avance notice has a silver lining – it removes virtually all excuses from an owner about a failed FOF test.

On June 23, 2005, the NRC Panel formed to assess a Differing Professional Opinion initiated by an NRC regarding how FOF results are evaluated reported:

> *The Panel recognizes that the FOF exercise is just one element that is considered when the effectiveness of a licensee's physical security program is evaluated.* ***However, FOF exercises are the only means by which the NRC can observe and evaluate a protective force's implementation of its defensive strategy. These exercises provide valuable insights into a protective force's ability to thwart adversaries that cannot be obtained by reviewing a licensee's security plan or conducting the Security Baseline Inspection Program.*** (pages 3-4) [boldfacing added for emphasis]

Being the only means to evaluate a protective strategy and gain valuable insights unattainable by reviewing the security plan or performing NRC's baseline inspections, it's unclear why the NRC would discontinue FOF testing once a nuclear plant permanently shuts down.

Termination would be justified only if intruders could not possibly conduct radiological sabotage of the spent fuel in an ISFSI. But a long and lengthening list of studies issued by the Sandia National Laboratories indicates radiological sabotage of dry casks is possible.

In November 2013, Sandia reported:

> *In particular, the transport and storage of radioactive materials is of particular concern to the public, especially with regard to potential sabotage acts that might be undertaken by terror groups to cause injuries, panic, and/or economic consequences to a nation. For many such postulated attacks, no breach in the robust cask or storage module containment is expected to occur. However,* ***there exists evidence that some hypothetical attack modes can penetrate and cause a release of radioactive material.*** (page 1) [boldfacing added for emphasis]

In January 2013, Sandia reported the potential radiation dose consequences from dry cask sabotage:

> *The resulting dose consequences from releases of spent nuclear fuel (SNF) residing in a dry storage casks are examined parametrically. The dose consequences are characterized by developing dose versus distance curves using simplified bounding assumptions. The dispersion calculations are performed using the MELCOR Accident Consequence Code System (MACCS2) code. Constant weather and generic system parameters were chosen to ensure that the results in this report are comparable with each other and to determine the relative impact on dose of each variable. Actual analyses of site releases would need to accommodate local weather and geographic data. These calculations assume a range of fuel burnups, release fractions (RFs), three exposure scenarios (2 hrs and evacuate, 2 hrs and shelter, and 24 hrs exposure), two meteorological conditions (D-4 and F-2), and three release heights (ground level – 1 meter (m), 10 m, and 100 m).* (page iii)

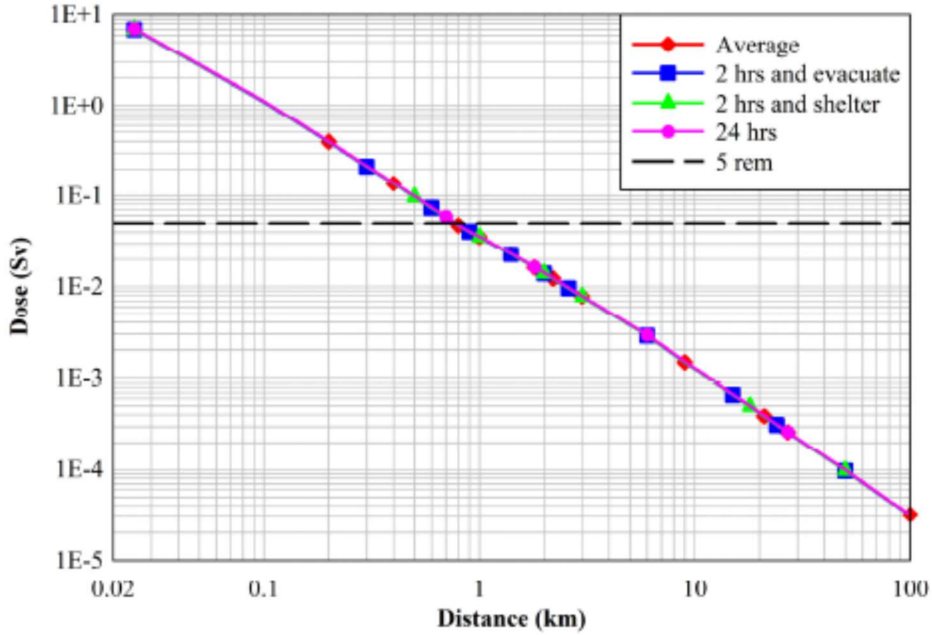


Figure 3.4 Dose as a function of distance for four exposure scenarios assuming ground release of 0.1% from a single 5 year old PWR 17×17 fuel assembly with 45 GWd/MTHM in D-4 meteorological conditions.

The ground-level release of one-tenth of one percent of the radiological contents of a single spent fuel assembly can cause a radiation dose of nearly 5 rem one kilometer away. That's a hazard at least a kilometer from being benign.

In August 2004, Sandia National issued a classified report titled "Response of the HI-STORM Spent Nuclear Fuel Storage Cask to a Large Explosive Charge Blast (U)."

The NRC inserted the following text on a page inserted in front of the Sandia study:

> *The Nuclear Regulatory Commission does not support many of the assumptions and/or information contained in this report. This report cannot be used independently to develop any conclusions regarding security or protective measures. This report should not be shared with industry and should not be released to anyone outside the agency.* (prefacing page)

A heavily redacted version of the report was downloaded from ADAMS, the NRC's online library. The unredacted portions of the report stated:

> *The U.S. Nuclear Regulatory Commission (NRC) contracted Sandia National Laboratories to conduct the following study to evaluate the response of a Holtec HI-STORM 100 Cask System to a large blast sabotage event. The amount of explosive and standoff distance is representative of a scenario of a small truck parked directly adjacent to the cask. The scenario parameters for this event were defined by NRC design basis threat criteria and by NRC staff. … This loading simulates a truck delivery of the explosive, parked adjacent to the cask.* (page 8)

> *The HI-STORM storage cask included a 24-element MPC fuel basket assembly as a representative canister filled with spent nuclear fuel rods. For this large storage cask, evaluation of site constraints concluded that the nearest reasonable placement of explosive would be 0.3 m*

> *(1 ft) from the vertical surface of the cask (0.3 m (1 ft) from the surface of the charge to the surface of the cask).* (page 16)
>
> *Consequences of insults to the HI-STORM cask by the explosive charge are reported in this section. The charge configuration is limited to a bare TNT charge in close proximity to the cask.* (page 21) [the consequences were redacted in their entirety]

Had Sandia's testing demonstrated that the HI-STORM cask was impervious to TNT explosions, there would be no valid reason for the NRC to issue a disclaimer and to redact so much information. After all, information that something is not and cannot be a hazard never needs withholding.

In May 2004, Sandia reported:

> *Even in very severe accidents, casks used for spent nuclear fuel transport in the public domain are extremely resistant to releasing any of their contents. However, in some sabotage attack scenarios, aerosolized particles originating from disrupted fuel pellet materials could be released. A primary sabotage scenario considered is that of an attacker firing an armor-piercing weapon into a cask containing spent fuel assemblies, with the intent of trying to disperse some of the radioactive fuel contents, in order to cause harm to the public.* ***Airborne aerosol materials have the potential to cause radiological consequences if released to the environment.*** (page 11) [boldfacing added for emphasis]

In November 1988, Sandia reported:

> *This report presents experimental data and calculations to assess the potential hazard from a hostile attack upon a dry metal cask utilized for above-ground, spent-fuel storage. A high explosive device (HED) was directed at a simulated section of a large, dry-storage cask for on-site storage of 5-yr or older spent fuel. This section (test article) consisted of steel plates, representing the metal storage cask wall, followed by nine compartments, each containing depleted fuel assemblies. The fuel assembly compartments were representative of basket/fuel compartments found in the cavities of full-size storage casks.* ***The HED penetrated five of the nine fuel assembly compartments, producing progressively smaller holes and damage as it proceeded into the test article.*** (page 4) [boldfacing added for emphasis]

If the NRC were to conduct FOF tests of ISFSI security, the target sets would be easily identified – if the canister within a protective cask remains intact, no appreciable amounts of radiation are released. Canister integrity is therefore the answer key for a FOF test. If retained, the test shows an effective protective strategy. If lost, an ineffective strategy is revealed.

FOF testing of the ISFSI would also require identification of the Design Basis Threat (DBT) and Adversary Characteristics Document (ACD), both non-publicly available. The DBT and ACD define what weapons and tactics the mock intruders can employ during a FOF test. Presumably, the research conducted by Sandia on dry cask vulnerabilities used weapons within the DBT/ACD arsenal; otherwise, why waste the resources.

The NRC should either conduct FOF tests of ISFSI security or explain why ISFSIs are invulnerable to attack by outsiders. The FOF test frequency for operating reactors is once every three years. Because the hazard level of ISFSIs is lower than for operating reactors, the ISFSI FOF tests could be conducted at longer intervals. But never seems too long an interval.

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