Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions
issue brief

NUCLEAR REACTOR SECURITY DESIGN: 18TH CENTURY READY

BOSTON, MASSACHUSETTS

In 1775, lanterns hung in the steeple of the Old North Church told patriots how British invaders advanced: one if by land, two if by sea. Duly prepared, Americans defended Lexington and Concord from either ground or waterborne threat. In 2001, commercial jets hijacked shortly after taking off from Logan Airport struck the two towers at the World Trade Center in New York City.

Following the 9/11 tragedy, the Nuclear Regulatory Commission (NRC) conducted its infamous "top to bottom" review of measures protecting America's nuclear power plants from sabotage. Through a series of advisories, orders, and rulemaking, the NRC upgraded protective measures for existing nuclear power plants that would also apply to any new nuclear plants constructed in the United States.

But if new nuclear power reactors are built, the first two should be named Lexington and Concord. Such patriotic names are appropriate considering that the NRC's "upgraded" security measures would protect the facilities from ground or waterborne threats – but not from aerial hazards. For the NRC's upgraded security regulations – developed in response to the four hijacked aircraft producing the 9/11 tragedy – assume there is a zero percent chance that an aircraft would be intentionally crashed into a nuclear plant. The regulations assume that invaders might come by land and might come by sea, but never by air. The NRC's "upgraded" security regulations would protect 21st century nuclear facilities from 18th century threats. Paraphrasing the President, "NRC, you've done a heck of a job."

The 9/11 tragedy clearly proves a third lantern figuratively hangs in the Old North Church steeple. The NRC must see this light and require new nuclear reactor designs to be more resistant to 21st century threats. The NRC must transform from industry puppet into public guardian. The US Congress must make it happen. Americans deserve better than the NRC has provided.

BACKGROUND

In 1980, the NRC formed a panel to examine how to design nuclear reactors to be less vulnerable to sabotage. The 11-man panel consisted only of employees from reactor manufacturers (e.g., Westinghouse and General Electric), reactor designers (e.g. Bechtel and Sargent & Lundy) and reactor owners (e.g., Northern States Power and Commonwealth Edison). The panel took the Westinghouse Standard Nuclear Utility Power Plant (SNUPPs) design and evaluated various means of making that design less vulnerable to sabotage. Two SNUPPs reactors were built and today operate in the United States – the Wolf Creek nuclear plant in Kansas and the Callaway nuclear plant in Missouri.

The panel pursued two design objectives aimed at reducing sabotage risk: (1) decrease the number of pathways one could take to cause release of radioactivity materials, and (2) increase the number of steps one must take along the pathways. The panel assessed the various design options to determine their effectiveness in improving resistance to sabotage, their feasibility, and their impact on cost and

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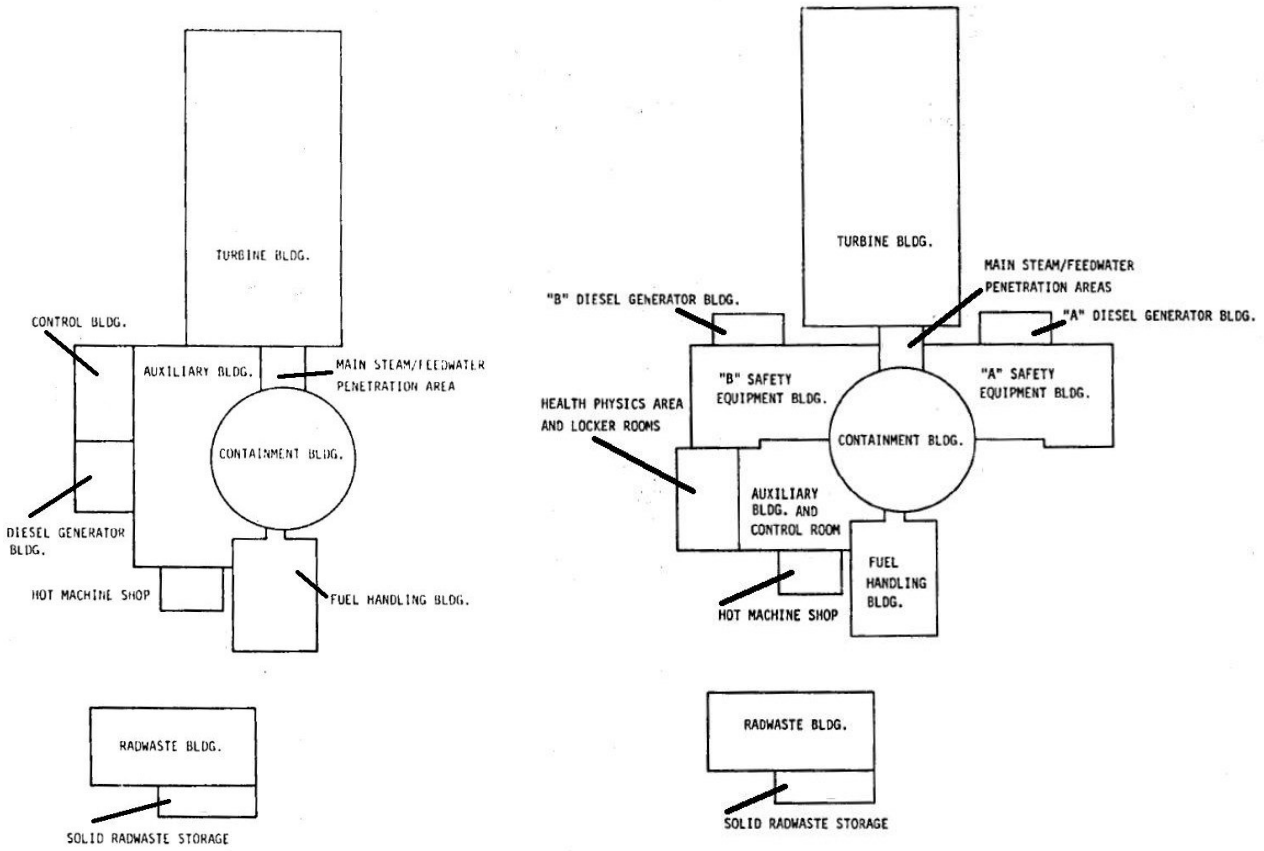
operations. The panel revised the SNUPPs design to incorporate the options deemed the highest security benefits with the fewest negative impacts.

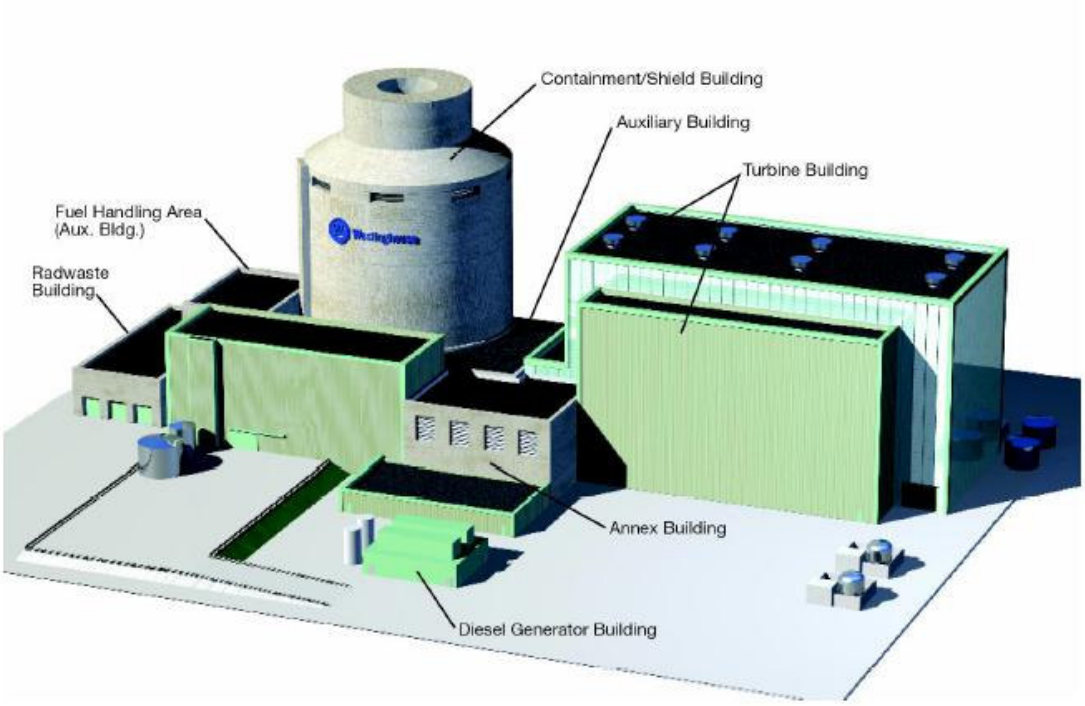


The diagram on the left shows the original SNUPPs design. The revised SNUPPs design is on the right. Some of the panel's revisions are evident between the two diagrams such as relocating the control room into a significantly more robust structure, splitting the emergency diesel generator room into separate rooms, and relocating the safety equipment powered from the emergency diesel generators into separate areas, too. Some of the panel's revisions are not evident because they are at the system-level instead of the structural level. The panel did not have suicidal aircraft crashes in mind, but many of the design improvements have the added benefit of reducing reactor risk from aerial threats. For example, relocating the control room into a significantly more robust structure lessens the likelihood that a suicidal aircraft will disable the control room and its occupants.

The attached table shows the panel's assessment scorecard for the many design options it considered to reduce the impact of sabotage. Note that the panel determined ALL of the design options to be feasible, most of which improved sabotage resistance, and more than half do so with low to moderate impact. In other words, the proposed security design improvements were not far-fetched, pie-in-the-sky ruminations, but rather practical ways to make reactor designs more resistant to sabotage. The NRC published the results of the panel's efforts in an 800-plus page report (NUREG/CR-1345, Volumes 1 and 2) in January 1981. Following 9/11, the NRC removed this report from the public arena. As we show below, it had apparently been removed from the NRC's consciousness prior to 9/11.

PROBLEM

Beginning in the mid-1990s, the NRC certified a handful of advanced reactor designs and is currently reviewing another handful of advanced reactor designs for possible certification. If new reactors are built in the United States, they will likely be from among these certified designs. But in developing and certifying these designs, it's as if neither the NRC nor the industry were aware of the results of their extensive study a quarter of a century earlier. The "advanced" reactor designs do not incorporate the security design improvements deemed feasible and low-impact by the industry panel back in 1980. Consider the proposed AP-1000 design, the evolutionary next step from the SNUPPs design examined by that panel. The AP-1000 design features numerous changes intended to make the reactor safer and more economical, but possesses little to better protect the reactor from aerial hazards.



The emergency diesel generators remain collocated in a single building. The associated safety equipment remains collocated in a single auxiliary building. The control room remains located in a relatively non-robust structure. And so on. The AP-1000 design graphic is little more than a color, 3-D version of the original SNUPPs design, with most of the vulnerabilities the 1980 panel tried to fix.

SOLUTION

In the mid-1990s, the NRC had scant justification for approving advanced reactor designs lacking improved security design features. After all, the NRC spent considerable money on the industry panel work that culminated in 1981's report NUREG/CR-1345. More than five years after the 9/11 tragedy, the NRC has no justification for even contemplating issuing a license for a reactor designed to merely protect the American public from 18th century threats. Sadly, the majority of the NRC Commissioners voted to omit consideration of intentional aircraft crashes from design reviews and licensing and is on record as being more concerned about the bottom lines of private companies than about American bottoms. The US Congress must not allow this Commission to sell out the American public by setting the stage for a nuclear Katrina. Any future nuclear reactors built and operated in the United States must be designed to protect Americans from sabotage threats from the land, the sea, **and the air**. The NRC simply cannot continue to pretend that the Wright brothers did not invent the aircraft. It must recognize that aircraft might be used to threaten nuclear facilities in American backyards.

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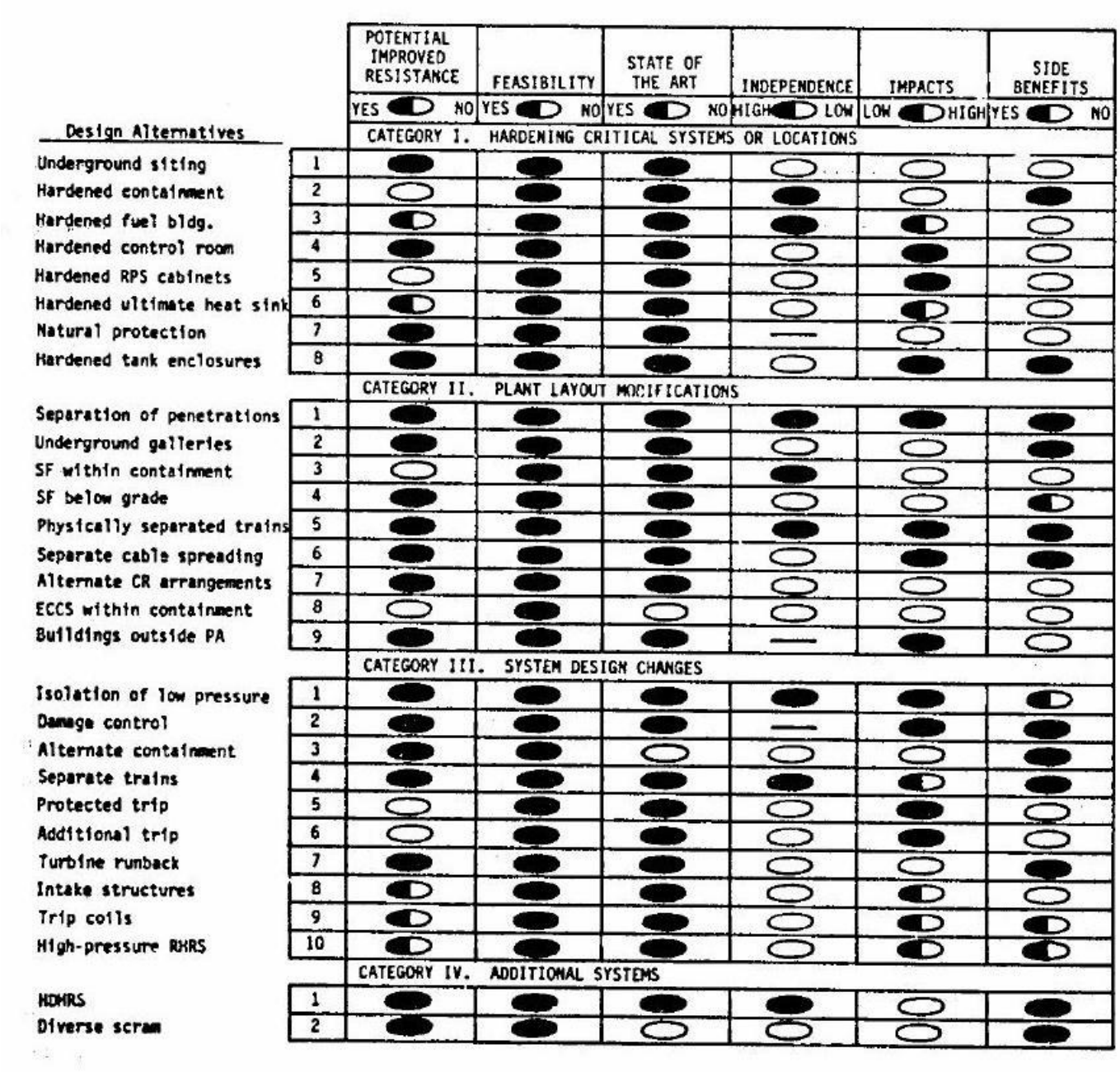
ATTACHMENT



Design Alternatives		POTENTIAL IMPROVED RESISTANCE (YES ◐ NO)	FEASIBILITY (YES ◐ NO)	STATE OF THE ART (YES ◐ NO)	INDEPENDENCE (HIGH ◐ LOW)	IMPACTS (LOW ◐ HIGH)	SIDE BENEFITS (YES ◐ NO)
CATEGORY I. HARDENING CRITICAL SYSTEMS OR LOCATIONS							
Underground siting	1	●	●	●	○	○	○
Hardened containment	2	○	●	●	●	○	●
Hardened fuel bldg.	3	◐	●	●	●	◐	○
Hardened control room	4	●	●	●	○	●	○
Hardened RPS cabinets	5	○	●	●	○	●	○
Hardened ultimate heat sink	6	◐	●	●	○	◐	○
Natural protection	7	●	●	●	—	○	○
Hardened tank enclosures	8	●	●	●	○	●	●
CATEGORY II. PLANT LAYOUT MODIFICATIONS							
Separation of penetrations	1	●	●	●	●	●	●
Underground galleries	2	●	●	●	○	○	●
SF within containment	3	○	●	●	●	○	○
SF below grade	4	●	●	●	○	○	◐
Physically separated trains	5	●	●	●	●	●	●
Separate cable spreading	6	●	●	●	○	●	●
Alternate CR arrangements	7	●	●	●	○	○	○
ECCS within containment	8	○	●	○	○	○	○
Buildings outside PA	9	●	●	●	—	●	○
CATEGORY III. SYSTEM DESIGN CHANGES							
Isolation of low pressure	1	●	●	●	●	●	◐
Damage control	2	●	●	●	—	●	●
Alternate containment	3	●	●	○	○	○	●
Separate trains	4	●	●	●	●	◐	●
Protected trip	5	○	●	●	○	●	○
Additional trip	6	○	●	●	○	●	○
Turbine runback	7	●	●	●	○	○	●
Intake structures	8	◐	●	●	○	◐	○
Trip coils	9	◐	●	●	○	◐	◐
High-pressure RHRS	10	◐	●	●	○	◐	◐
CATEGORY IV. ADDITIONAL SYSTEMS							
HDHRS	1	●	●	●	●	○	●
Diverse scram	2	●	●	○	○	○	●

CR	control room
ECCS	emergency core cooling systems
HDHRS	hardened decay heat removal system
PA	protected area (i.e., inside the security fence)
RHRS	residual heat removal system, an emergency system for cooling the reactor core
RPS	reactor protection system, an array of sensors monitoring reactor and plant parameter and associated circuits that automatically initiate protective measures when adverse conditions are detected)
SF	spent fuel pool
Train	a collection of pumps, piping, valves, and associated controls for performing a safety function like cooling the reactor core