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Irradiated Nuclear Fuel Risks at New Nuclear Darlington Neglected in OPG's EIS

1. Background and Context

The risks from nuclear power in general, and irradiated nuclear fuel in particular, have the potential to impact public health, safety, security, and the environment in major – even catastrophic -- ways. But they also impact our civil liberties, and the open form of democratic governance itself that our societies' hold dear, with its principles of public involvement in decision making, openness, transparency, and accountability from government agencies.

Ontario Power Generation Incorporated (OPG), in its *ENVIRONMENTAL IMPACT STATEMENT, NEW NUCLEAR – DARLINGTON, ENVIRONMENTAL ASSESSMENT (EIS)*,¹ has, in many ways, significantly neglected addressing such risks.

OPG proposes to generate vast quantities of additional irradiated nuclear fuel, from up to 4,800 Megawatts-electric worth of nuclear new build (as many as four atomic reactors) at its Darlington Nuclear site on the shoreline of Lake Ontario, just east of Toronto, over the course of 60 years. In addition to this large-scale irradiated nuclear fuel generation, OPG proposes to store the irradiated nuclear fuel on-site, in both waste pools (wet storage), as well as dry cask storage facilities. It proposes to ultimately ship off the irradiated nuclear fuel to a yet-to-be-identified deep geologic disposal facility.² Despite the many, and potentially catastrophic, inherent risks of all these activities associated with irradiated nuclear fuel, OPG devotes woefully inadequate treatment of them in its EIS.

OPG's proposal is further detailed in *NUCLEAR WASTE MANAGEMENT, TECHNICAL SUPPORT DOCUMENT, NEW NUCLEAR - DARLINGTON, ENVIRONMENTAL ASSESSMENT*,³ as well as in *MALFUNCTIONS, ACCIDENTS AND MALEVOLENT ACTS TECHNICAL SUPPORT DOCUMENT, NEW NUCLEAR-DARLINGTON, ENVIRONMENTAL ASSESSMENT*.⁴

However, these documents also fail to adequately address the very serious risks associated with the generation, on-site storage, shipment off-site, and long term management (isolation from the living environment for as long as they remain hazardous) of the very large quantities of irradiated nuclear fuel that would be generated by new atomic reactors operating at the Darlington Nuclear Site.

Thus, the EIS and Technical Support Documents (TSDs) cited above fail to fulfill the “Guidelines for the Preparation of the Environmental Impact Statement for Ontario Power Generation’s Darlington New Nuclear Power Plant Project.”

As recounted on Page 24 of the *EIS*’s APPENDIX A: FINAL EIS GUIDELINES, regarding irradiated nuclear fuel, OPG had been instructed to observe the following guidelines in the preparation of its *EIS*:

8.7 Waste and Used Fuel Management

In addition to the project-phase specific requirements for waste provided in the preceding subsections, the EIS must present the proponent’s proposed plan for the disposition of all radioactive and hazardous wastes and *used fuel*. The proponent’s activities related to the site preparation, construction, operation, decommissioning and abandonment of low and intermediate level waste management facilities, and *used fuel storage facilities*, must be described. Where this plan identifies that radioactive or hazardous wastes or *used fuel* are expected to be managed by an organization other than the proponent, *the EIS must describe at a conceptual level the methods that can be used to ensure that these materials are managed in a manner the (sic) protects health, safety and the environment.*

(emphasis added)

As will be described below, OPG’s EIS and the accompanying TSDs do not adequately address, even at a conceptual level, “the methods that can be used to ensure that these materials [irradiated nuclear fuel] are managed in a manner that protects health, safety and the environment” from the numerous radiological risks and hazards associated with irradiated nuclear fuel.

Additionally, the FINAL EIS GUIDELINES instructed OPG as follows:

8.8 Malfunctions, Accidents and Malevolent Acts

Information on accidents and malfunctions, including intentional malevolent acts are necessary to permit consideration of relevant environmental effects in the environmental assessment. A summary of information on malfunctions and accidents should be presented in this section of the EIS. A separate section of the EIS should provide more details regarding the information requirements relating to accidents, malfunctions and malevolent acts as per Section 12.0 of these guidelines.

And thus:

12. ACCIDENTS, MALFUNCTIONS AND MALEVOLENT ACTS

12.1 General Considerations

For the purposes of the assessment, accidents and malfunctions may be separated into three categories and defined as follows:

- *Nuclear accidents*, consisting of all accidents and malfunctions with radiological consequences. These accidents may be further subdivided into nuclear accidents directly involving the reactor core (such as serious damage to the reactor core), ***nuclear accidents involving other on-site nuclear power plant facilities that contain radiological substances (including the storage of spent fuel waste and radioactive waste handling facilities)***, and nuclear accidents related to the off-site transportation of low and intermediate-level radioactive wastes. Accidents that do not directly involve the reactor core include criticality events associated with the nuclear fuel.

[And]

12.4 Malevolent Acts

The EIS must address potential environmental effects that could result from intentional malevolent acts. While intentional malevolent acts are not accidents, ***the proponent must compare the environmental effects resulting from malevolent acts with the environmental effects identified for both accidents involving radiological substances (Section 12.2) and conventional accidents (Section 12.3). The EIS must describe the consequences of malevolent acts as either bounded by environmental effects of nuclear and conventional accidents described in the EIS, or where necessary identify where the consequences of the malevolent act are greater.***

(emphases added)

OPG, and its subcontractors responsible for the relevant TSDs undergirding the New Nuclear Darlington (NND) EIS, have ignored a plethora of information, that has long been publicly available, about the many risks associated with irradiated nuclear fuel, such as that which OPG proposes to generate and store at NND for many decades into the future.

Following, then, is a comprehensive, but far from exhaustive, listing of such resources that have been largely or entirely overlooked by OPG's team, with commentary on each item's relevance to the NND proposal now before us. The listing is arranged in the following sections:

2. An Overview of the Problem: Ongoing Risks Associated with Irradiated Nuclear Fuel
 - 2A. Risks Associated with On-Site Wet Pool Storage
 - 2B. Risks Associated with On-Site Dry Cask Storage
 - 2C. Risks Associated with Transportation
 - 2D. Risks of "De Facto Permanent" On-Site Storage
 - 2E. Risks of Diversion of Irradiated Nuclear Fuel for Use in Radiological Dispersal Devices

- 2F. Risks from Irradiated Nuclear Fuel to Civil Liberties and Democratic Norms
3. Some Proposed Solutions: Expert Recommendations to Address the Risks
4. Application to New Nuclear Darlington (NND) Project
5. Summary and Recommendations

Within each section and sub-section, entries most often flow in chronological order. However, from time to time, commentary is sometimes made on related subject matter that does not necessarily follow a rigid chronological order.

Before addressing the many risks associated with irradiated nuclear fuel below, it is important to point out that such risks do not go away simply by ignoring them. In fact, that would allow the risks to fester, increasing their probability of occurrence due to not defending against them. This could result in catastrophic consequences, such as large-scale release of hazardous radioactivity into the environment. Past efforts, by the various experts and environmental advocates listed below, serve to spotlight and address the many risks of irradiated nuclear fuel. They can and should help serve to inform and assist this current NND decision making proceeding.

2. An Overview of the Problem: Ongoing Risks Associated with Irradiated Nuclear Fuel

Following below, the many risks associated with the generation, storage, transport, and long term management of irradiated nuclear fuel will be addressed in greater detail. However, an overview of the irradiated nuclear fuel risks created by constructing and operating a nuclear power plant such as NND is in order.

Such risks have long been recognized. However, even after the terrorist attacks of September 11, 2001 against the United States, security risks to irradiated nuclear fuel storage pools and dry casks have persisted, despite the potential for catastrophic radioactivity releases to the environment that could result. For this reason, environmental advocates have also persisted, right up to the present day, to warn about these risks, and to urge nuclear utilities, safety regulators, and other decision makers to adequately address them. As the chronology below shows, environmental advocates' demands that security precautions to protect nuclear power plants – including irradiated nuclear fuel storage facilities – from terrorist attacks have been met with consistent resistance by NRC.

For instance, over a quarter century ago, on May 13, 1984, Great Lakes United (GLU) resolved that “Energy conservation programs be sustained, introduced or stepped up to stabilize or even reduce consumption levels, thereby reducing ecologically harmful emissions, and/or *ecological risks associated with storage and transportation of spent fuels from nuclear reactors.*” GLU advised that, rather than build new atomic reactors (as currently proposed at Darlington Nuclear Generating Station), “*We accelerate the decommissioning of problematic nuclear facilities...*”⁵

The very next year, Bennett Ramberg warned that the risk created by the possibility of nuclear power reactors being bombed by hostile forces had not been adequately recognized.⁶ Ramberg explained how the bombing, with conventional explosives, of a major nuclear power station, *or radioactive waste storage facility*, could contaminate thousands of square miles with hazardous radioactivity, consequently causing widespread damage to public health and the environment, as well as catastrophic property damage. Ramberg suggested ways to diminish the vulnerability of such facilities, through *physical safeguards* and legal restraints. While Ramberg's book focused on military conflicts between nation states, it nonetheless holds important insights regarding the potential for capable non-state actor terrorist attacks, as upon irradiated nuclear fuel storage pools, dry cask storage facilities, and off-site waste shipments.

Bringing home such theoretical discussions to hands-on, front line realities of security vulnerabilities, on February 3, 1999, Captain David N. Orrick (U.S. Navy, retired), Security Specialist at the U.S. Nuclear Regulatory Commission's (NRC) division of Nuclear Reactor Regulation (NRR), revealed in a "Differing Professional Opinion"⁷ that a full 47% of nuclear power plants in the U.S. subjected to mock attacks carried out under his leadership had failed the test. Orrick revealed that nearly half of U.S. atomic reactors had exhibited "significant weaknesses" in securing vital plant systems against radiological sabotage. Significantly, irradiated nuclear fuel storage pools and dry cask facilities are almost always held to a lesser standard of security protection than are the reactors themselves. Yet reactors were often the central focus of these mock terrorist attacks that showed "significant weaknesses" in even their security protections, meaning irradiated nuclear fuel storage facilities are likely even more vulnerable to attack.

Needless to say, the terrorist attacks of 9/11/2001 elevated awareness that not only accidents, but also attacks, could cause catastrophic radioactivity releases at nuclear power plants. Vulnerable facilities included irradiated nuclear fuel storage installations, be they "wet" or "dry." Even shipping containers in transit were recognized as at risk of disastrous radioactivity releases if successfully attacked, although this vulnerability had been raised prior to the 9/11 attacks as well. Such risks related to irradiated nuclear fuel stemming from the NND proposal need to be addressed in this EIS proceeding, nearly a decade after the "final warning" raised by the 9/11 attacks.

Such warnings were raised by environmental watchdogs beginning almost immediately after the 9/11 attacks. Within just a few weeks, the Committee to Bridge the Gap and Nuclear Control Institute held a joint press conference at the National Press Club in Washington D.C. to call attention to nuclear power plant vulnerabilities to terrorist attacks. They invited Bennett Ramberg, the author cited above, to share his now 16 (1985-2001) year old insights about such risks that still not been adequately addressed.

Shortly after the U.S. invasion of Afghanistan began in October, 2001, in the aftermath of the 9/11 attacks, writer Harvey Wasserman penned "AMERICA'S TERRORIST NUCLEAR THREAT TO ITSELF."⁸ In it, he warned what could have happened at Indian Point nuclear

power plant near New York City, had the 9/11 attackers targeted that site instead of the World Trade Center:

But today terrorist attacks could destroy those same critical cooling and control systems that are vital to not only the Unit Two and Three reactor cores, but to the *spent fuel pools* that sit on site. The assault would not require a large jet. The safety systems are extremely complex and virtually indefensible. One or more could be wiped out with a wide range of easily deployed small aircraft, ground-based weapons, truck bombs or even chemical/biological assaults aimed at the operating work force.

Wasserman also raised the specter of reprisal attacks because of the U.S. military intervention in Afghanistan, including against nuclear power plants. Such reprisal attacks were of enough concern to NRC and the U.S. Department of Energy (DOE) that they reacted, as discussed immediately below.

Violations of civil liberties and democratic norms of openness and transparency in governmental decision making were also soon in coming. Citing “security” risks, one month after the 9/11 attacks, NRC shut down its entire website, making information inaccessible to the public, even to atomic watchdog organizations actively engaged in NRC licensing proceedings. The atomic watchdogs responded with alarm on October 15, 2001, arguing that NRC’s action protected not the public from radiological risks, but rather the nuclear power industry from unwanted disclosures about radiological risks.⁹ This type of governmental secrecy, especially concerning matters as important as nuclear safety, security, etc., is antithetical to democratic norms, another realm of risks (including to civil liberties) that needs to be addressed in this NND proceeding. However, this has not been the case thus far. There has been a similar non-disclosure of several key aspects of the risk management related to irradiated nuclear fuel in the EIS and review process for the NND project.

Atomic watchdogs continued to beat the drum of warning. On October 22, 2001, Dave Kraft, Executive Director of Nuclear Energy Information Service (NEIS) in Chicago, Illinois, published “HERE TODAY, *THERE* TOMORROW: COMMERCIAL NUCLEAR REACTOR SITES AS TERRORIST TARGETS.”¹⁰ In this report, NEIS documented terrorist attack risks at nuclear power plant irradiated nuclear fuel storage pools and dry cask storage facilities. It also highlighted NRC’s indifference at best, or rather irresponsibility, dereliction of duty, and betrayal of the public trust, regarding the issue of “credible terrorist threat.”

While the Canadian Nuclear Safety Commission (CNSC) and NRC are, of course, independent agencies working under separate sovereign governments, it is still appropriate that important lessons can and should be drawn from NRC’s many failures over the years and decades. These lessons learned should be applied in this NND proceeding, lest the same mistakes be repeated in Canada. After all, a “successful” terrorist attack against an irradiated nuclear storage facility on either side of the Great Lakes, as at NND, would impact not only the host country, but also the neighboring country across the border. The need for such bi-national cooperation on security was driven home at the highest level when Canadian Prime Minister Stephen Harper and U.S. President Barack Obama issued a joint “Declaration on a Shared Vision

for Perimeter Security and Economic Competitiveness” at a summit meeting in Washington, D.C. on February 4, 2011.¹¹

Environmental organizations’ concern about nuclear power plant security risks was amplified in November 2001, when a coalition of dozens of groups published a “Mandate for Securing America’s Electricity Supply.”¹² Although addressed to U.S. governmental agencies, it nonetheless contains important demands that should be carefully considered in this NND proceeding, such as:

...Congress must mandate that utility-funded security operations be increased at existing nuclear reactors and maintained throughout plant life and the *on-site storage of irradiated nuclear fuel*. Current security at U.S. nuclear reactors is unacceptable. The NRC and the International Atomic Energy Agency have acknowledged that the containment buildings housing nuclear reactors are not designed to withstand an attack of the type and scale used against the World Trade Center and Pentagon. Since 1991, despite months of advanced warning and beefed up security forces, nearly half (47%) of U.S. nuclear power plants failed to repel small mock terrorist attacks conducted by the NRC. These exercises did not assess the full Design Basis Threat that NRC regulations require nuclear power plants to protect against. Moreover, these exercises failed to assess the ability of nuclear plants to defend against attacks by truck bomb, aerial, and water-borne assault, three likely scenarios that fall outside the current Design Basis Threat...

...All branches of government must ensure that the terrorist attacks do not result in the erosion of fundamental civil liberties. The hallmarks of our free society and our values are manifested and secured in the Bill of Rights. Therefore, it is essential that security programs and activities clearly differentiate between legitimate terrorist threats and the rights of the public to peacefully assemble, exercise free speech, organize and educate...”

Just as old and new reactor and radioactive waste risks in upstate New York, on the south shore, impact Canadian citizens who live on Lake Ontario and the St. Lawrence River, so do old and new (as at NND) reactor and radioactive risks in Ontario impact U.S. citizens who live near Lake Ontario, and downstream along the St. Lawrence. These impacts extend to Native American Tribes and First Nations as well, which, under treaties signed by the U.S. and Canadian government, oblige the U.S. and Canadian governments to enter into government-to-government consultation with those Native American Tribes and First Nations about the decision to introduce such risks, as by giving the go-ahead to construct and operate NND.

Irradiated nuclear fuel security was part and parcel of the 130 group environmental coalition’s call for major changes in nuclear power plant security, and for replacing nuclear power with safer, more secure, sustainable options.¹³

Robert Alvarez confirmed the concerns of environmental advocates in the January/February 2002 edition of the *Bulletin of the Atomic Scientists*. Alvarez had formerly served, from 1993 to 1999, as Senior Policy Advisor to the Secretary and Deputy Assistant

Secretary for National Security and the Environment at DOE; since, he has served as Senior Scholar at the Institute for Policy Studies.¹⁴ In the article, entitled “What about the spent fuel?”, Alvarez warned about the risks of terrorist attack against what at many nuclear power plants is the single largest concentration and quantity of hazardous radioactivity: the densely-packed irradiated nuclear fuel storage pool.¹⁵ As such terrorism risks would apply at NND, they should be adequately addressed in this proceeding.

Despite the repeated warnings, a year after the 9/11 attacks, nuclear utilities and their regulators had still not addressed these risks. On the first anniversary of the attacks, the Project on Government Oversight (POGO) published a major report, “Nuclear Power Plant Security: Voices from Inside the Fences,” revealing scandalous, ongoing security vulnerabilities at U.S. atomic reactors.¹⁶ These included security guard forces being worked 70 to 80 hour work weeks, for months on end, with no let up. A major security vulnerability identified by POGO was that the “NRC Turns Blind Eye to Spent Fuel Pools.”¹⁷ At “Decommissioning Reactors: NRC’s Poor Stepchild,” POGO documented that decommissioned reactors’ irradiated nuclear fuel security is even more neglected by the regulatory agency than at operating reactors’ irradiated nuclear fuel storage facilities, despite equivalent risk levels.¹⁸ These security vulnerabilities revealed by POGO at U.S. reactors, even a full year after the 9/11 attacks, can provide insights to CNSC, CEAA, and other Canadian governmental decision makers vis-à-vis NND concerning what types of security vulnerabilities – including overworking security guards, ignoring risks at irradiated nuclear fuel wet and dry storage facilities, etc. – to watch out for in this current proceeding.

Echoing the revelations of POGO cited above, on October 20, 2002, the *New York Times* reported on overworked nuclear power plant security guards at the Palisades atomic reactor in Michigan, on the shoreline of Lake Michigan, as well as at the Indian Point reactors in New York.¹⁹ Again, such abuses of security guards, and other nuclear power plant workers, must be guarded against at NND, for the sake of safety and security, as well as the workers’ own well being and basic human rights. But the NND EIS and related TSDs do not adequately address such issues. There is too much at risk, such as the proposed irradiated nuclear fuel storage in pools and dry casks on the Lake Ontario shoreline, to ignore such vital issues.

In spite of the documented ongoing security vulnerabilities, and repeated calls by environmental advocates for upgrades, on December 18, 2002, NRC ruled that terrorist attacks were “remote and speculative” risks which could not easily be assigned a quantitative probability of occurrence.²⁰ It then effectively assigned terrorist attacks a quantitative probability of *zero*, by dismissing several concurrent – and all future -- environmental interventions raising contentions of terrorism risks in atomic reactor licensing proceedings. NRC also rejected a state government’s (Utah’s) terrorism risk contention in a large-scale dry cask storage facility licensing proceeding.²¹

However, Dr. Gordon Thompson responded the very next month²² to NRC’s ruling by stating:

[T]he terrorist attacks on the World Trade Center and the Pentagon on 11 September 2001 provided significant new information. These attacks conclusively demonstrated that the threat of highly-destructive acts of malice or insanity is a

clear and present danger, and that *no reasonable person can regard this threat as remote or speculative*. According to press reports, US authorities have obtained information suggesting that the hijackers of United Airlines flight 93, which crashed in Pennsylvania on 11 September 2001, were planning to hit a nuclear plant.

(Emphasis added. Dr. Gordon Thompson cited Nicholas Rufford, David Leppard and Paul Eddy, “Nuclear Mystery: Crashed plane's target may have been reactor,” *The Sunday Times* , London, U.K., 20 October 2001.)

And, as argued in NIRS’s own response to its sudden dismissal on more than a dozen security and terrorism related contentions in a license extension proceeding, NRC’s ruling seemed to have more to do with obscuring such radiological risks from the public and media, rather than addressing or dealing with those risks.²³ NRC’s ruling may have done a favor for the nuclear power industry, but at the expense of security. It also represented a blow to the very heart of democratic decision making, and certainly a betrayal of its supposed agency mission to protect public health, safety, the environment, and the common defense. It is commendable that risks of “malevolent acts” are to be considered in this NND proceeding, but it is vital that they be adequately addressed with maximum transparency. However, such requirements of open and accountable government decision making have not been fulfilled thus far.

In addition to environmental advocates, the U.S. Congress’s investigative arm has warned about such security risks.²⁴ In September 2003, the U.S. General Accounting Office (GAO) identified several areas of serious security weaknesses at nuclear power plants, despite the dramatically increased societal concern, and NRC’s own claims of a “top to bottom” security review, a full two years after the 9/11 attacks. Despite the passage of over four years since the February 1999 “Differing Professional Opinion” of Captain David N. Orrick (U.S. Navy, retired) cited above regarding force-on-force security tests at nuclear power plants, this GAO report confirmed Orrick’s revelations were still of concern. Such ongoing NRC security failures in the U.S. could be applied to great benefit in correcting errors before they happen at NND. The risks, as from irradiated nuclear fuel storage and transportation, are just too great to keep repeating the same mistakes at nuclear power plants across North America.

In a major official confirmation that nuclear power plants had indeed been considered as targets by terrorists for attack, on July 22, 2004, the long-awaited *9/11 Commission Report* was published. It documented, most significantly vis-à-vis nuclear power, that 9/11 ringleader, Mohammad Atta, during training flights in a small private plane he piloted in preparation for attacking the World Trade Center, had spotted a nuclear power plant located on the Hudson River. He had advocated that it be added to the list of sites to be attacked on 9/11, but was never given permission by his superiors in Al Qaeda to change the attack plan. This nuclear power plant, unnamed in the *9/11 Commission Report*, can only have been the twin reactors at Indian Point, New York, very close to New York City (as NND would be close to Toronto). As Wasserman had noted, above, if Atta had attacked Indian Point instead of the World Trade Center, the nightmare of 9/11 could have been orders of magnitude worse. The 9/11 Commission

also reported that Al Qaeda's original attack plan was to hijack not 4, but rather 10 airliners, and to crash 2 of them into nuclear facilities:

As originally envisioned, the 9/11 plot involved even more extensive attacks than those carried out on September 11. KSM maintains that his initial proposal involved hijacking ten planes to attack targets on both the East and West coasts of the United States. He claims that, in addition to the targets actually hit on 9/11, these hijacked planes were to be crashed into CIA and FBI headquarters, **unidentified nuclear power plants**, and the tallest buildings in California and Washington State. (emphasis added)²⁵

As cited above, the *London Sunday Times* reported on October 20, 2001, that there was evidence that the target for the fourth plane could very well have been a nuclear power plant. The infamous Three Mile Island nuclear power plant, with one remaining operating reactor as well as an irradiated nuclear fuel storage pool, was but a short flight time away. However, the jetliner instead crashed into the ground at Shanksville, Pennsylvania, due to a passenger revolt that stormed the hijackers in the cockpit.

To get some idea of the magnitude of the casualties and property damage that could result from a "successful" terrorist attack on a reactor that led to a catastrophic radioactivity release, consider the 1982 *CRAC-2* study, commissioned by NRC and carried out by Sandia National Lab.²⁶ Indian Point 2 could cause 46,000 "peak early fatalities;" 141,000 "peak early injuries;" 13,000 "peak cancer deaths;" and \$274 billion in property damages. But *CRAC-2* was based on 1970 U.S. Census data, so casualty figures would likely be much higher today due to population growth over the past 41 years. Also, when adjusted for inflation, \$274 billion in early 1980s U.S. currency would now equate to \$604 billion in property damages. Likewise, a large-scale radioactivity release from Indian Point 3's reactor could cause 50,000 "peak early fatalities;" 167,000 "peak early injuries;" 14,000 "peak cancer deaths;" and \$314 billion in property damages; again, casualties would now likely be higher due to population growth since 1970, and adjusted for inflation, property damages would now approach \$700 billion. A large-scale radioactivity release from Three Mile Island Unit 1, whether caused by reactor accident or attack, could cause 42,000 "peak early fatalities;" 50,000 "peak early injuries;" 26,000 "peak cancer deaths;" and \$102 billion in property damages; casualties would now likely need to be adjusted upwards due to population growth, and adjusted for inflation, property damages would be \$225 billion. As bad as the 9/11 attacks on New York City and Pennsylvania (as well as Virginia at the Pentagon) were, with close to 3,000 deaths, that disaster would be dwarfed by such a radioactive catastrophe.

Of course, Indian Point Units 2 and 3, and Three Mile Island Unit 1, account for reactor risks, but those nuclear power plants also have irradiated nuclear fuel storage pools on-site. They will also soon have dry cask storage, if they do not already.

Such reactor and irradiated nuclear fuel storage accident and attack risks would exist at NND, as well as at the old Darlington nuclear power plant reactors, of course. Given the scale of

potential casualties and property damage figures reported above from *CRAC-2*, such risks must be addressed in this current proceeding.

The very next day, environmental advocates responded to the serious revelations contained in the *9/11 Commission Report*. On July 23, 2004, California-based Committee to Bridge the Gap filed a Petition for Rulemaking to the NRC, calling on the agency to revise the Design Basis Threat for nuclear power stations, in order to contemplate and defend against realistic terrorist attack risks, and to require that nuclear power station operators protect the facilities from attack by aircraft.²⁷ It called for NRC to require that nuclear power plants construct “brick and mortar” (or, more precisely, steel “I” beam and steel mesh) physical fortifications around reactors, as well as other facilities of radiological risk such as irradiated nuclear fuel storage pools, in order to shield vulnerable systems, structures, and components against attack. The petition also sought to upgrade nuclear power plant site security response capabilities in order to be able to repel a coordinated attack by at least a minimum of 19 attackers – equivalent to the force size involved in the 9/11 attacks. But despite nationwide mobilization and concern,²⁸ NRC eventually declined the petition. CBG’s concept of physical fortifications to protect radiologically risky nuclear power plant systems – such as irradiated nuclear fuel storage pools – should be considered at NND in the course of this current proceeding.

In addition to environmental advocates, state governments called for NRC to act on the 9/11 Commission’s findings. Just a week after the publication of the *9/11 Commission Report*, on July 30, 2004, Jill Lipoti, Assistant Director for the Radiation Protection Program and Release Prevention Element at the State of New Jersey Division of Environmental Safety and Health (where she would later serve as director), wrote to the NRC expressing deep concern about the Oyster Creek nuclear power plant irradiated nuclear fuel storage pool’s ability to withstand the crash of an airliner.²⁹ Citing the January 2003 Alvarez *et al.* study³⁰ (which is further discussed in the next section below, under “wet storage” risks), she requested NRC to do a site specific study of the risks of the pool’s failure and a consequent catastrophic radioactivity release. Independent site specific studies of the risks of pool failure at NND should likewise be carried out. “Independent” would mean independent of CNSC and OPG, for their track records show that they will be unacceptably biased in favor of NND, despite such risks. This would require, of course, that a final decision be made on which reactor design would be built at NND, so that irradiated nuclear fuel storage pool and dry cask storage designs could also be determined and analyzed for security risks.

Another major “shoe to drop” in July 2004 was the “publication” of the classified version of the National Academy of Science’s report on the “Safety and Security of Commercial Spent Nuclear Fuel Storage.”³¹ The redacted, public version of this report was not released until April

6, 2005. The NAS report contained a number of very significant findings and recommendations, such as:

irradiated nuclear fuel storage facilities cannot be dismissed as targets for terrorist attacks;

an assessment of current security measures at U.S. irradiated nuclear fuel facilities should be performed by an organization of both NRC and the nuclear power industry;

under some conditions, a terrorist attack that partially or completely drained a spent fuel pool could lead to a propagating zirconium cladding fire and the release of large quantities of radioactive materials to the environment;

potential vulnerabilities of irradiated nuclear fuel storage pools to terrorist attacks are plant-design specific, so specific vulnerabilities can only be understood by examining the characteristics of irradiated nuclear fuel storage at each plant;

although NRC and independent analysts have made progress in understanding some vulnerabilities of irradiated nuclear fuel storage pools to certain terrorist attacks and the consequences of such attacks for releases of radioactivity to the environment, additional work on specific issues is needed urgently;

NRC should undertake additional best-estimate analyses to more fully understand the vulnerabilities and consequences of loss-of-pool-coolant events that could lead to a zirconium cladding fire, and, based on these analyses, NRC should take appropriate actions to address any significant vulnerabilities that are identified;

NRC should immediately ensure that power plant operators take prompt and effective measures to reduce the consequences of loss-of-pool-coolant events in irradiated nuclear fuel storage pools that could result in propagating zirconium cladding fires;

Additional steps can be taken to make dry casks less vulnerable to potential terrorist attacks, and NRC should consider using the results of the vulnerability analyses for possible upgrades of requirements in 10 CFR 72 [Title 10, Code of Federal Regulations, Part 72] for dry casks, specifically to improve their resistance to terrorist attacks;

Dry cask storage for older, cooler irradiated nuclear fuel has two inherent advantages over pool storage: (1) It is a passive system that relies on natural air circulation for cooling; and (2) it divides the inventory of irradiated nuclear fuel among a large number

of discrete dry cask storage containers; both factors make it more difficult to attack a large amount of irradiated nuclear fuel at one time, and also reduce the consequences of such attacks;

Depending on the outcome of plant-specific vulnerability analyses, NRC might determine that earlier movements of irradiated nuclear fuel from pools into dry cask storage would be prudent to reduce the potential consequences of terrorist attacks on pools at some commercial nuclear plants;

and NRC should improve the sharing of pertinent information on vulnerability and consequence analyses on spent fuel storage with nuclear power plant operators and dry cask storage system vendors on a timely basis.

Also following closely upon the heels of the publication of the *9/11 Commission Report*, on August 10, 2004, a national coalition of U.S. organizations, the Nuclear Security Coalition, petitioned NRC for emergency enforcement action on boiling water reactor (BWR) structural vulnerabilities to terrorism.³² Significantly, the Nuclear Security Coalition raised the red flag on irradiated nuclear fuel storage pools even more at risk of terrorist attack than the ones at Indian Point, the nuclear power plant eyed by Mohammad Atta for attack on 9/11. Indian Point's two operating reactors are Pressurized Water Reactors (PWRs), while 32 of the 104 licensed nuclear power stations in the U.S. – Boiling Water Reactors (BWRs) -- are designed and constructed so that irradiated fuel storage ponds are located literally on the roof of the reactor building in structures that a pre-9/11, 2001 NRC study³³ identified as vulnerable to aircraft penetration (this NRC report is also discussed below under the next section, on "Wet Storage" risks). The same NRC study identified that the resulting irradiated nuclear fuel fire, potentially involving hundreds of tons of irradiated nuclear fuel, would cause tens of thousands of latent cancer fatalities over a wide area, out to distances as far downwind as 500 miles away. The Nuclear Security Coalition's emergency enforcement petition urged NRC to address the structural vulnerabilities of these reactors' irradiated nuclear fuel storage pools, or else force their closure. While the EPR and AP1000 PWR designs, as well as the ACR1000 design, under consideration for NND are not BWRs, each designs' "wet" and "dry" storage facilities' security vulnerabilities should be subjected to a careful examination in this proceeding.

In September, 2004, three years after the 9/11 attacks, the U.S. General Accounting Office (GAO) testified before a U.S. congressional hearing that NRC's oversight of revised Design Basis Threat requirements for atomic reactor security had significant weaknesses, especially its ability to validate that nuclear power plants were in compliance with existing security regulations.³⁴ Its blistering testimony concluded:

While its efforts to date have enhanced security, NRC is not yet in a

position to provide an independent determination that each plant has taken reasonable and appropriate steps to protect against the new DBT. According to NRC officials, the facilities' new security plans are on schedule to be implemented by October 2004. However, NRC's review of the plans, which are not available to the general public for security reasons, has primarily been a paper review and is not detailed enough for NRC to determine if the plans would protect the facility against the threat presented in the DBT. For example, the plans GAO reviewed are largely based on a template and often do not include important site-specific information, such as where responding guards are stationed, how the responders would deploy to their defensive positions, and how long deployment would take. In addition, NRC officials are generally not visiting the facilities to obtain site-specific information and assess the plans in terms of each facility's layout. NRC is largely relying on force-on-force exercises it conducts to test the plans, but these exercises will not be conducted at all facilities for 3 years. NRC's oversight of plants' security could also be improved. However, NRC does not plan to make some improvements in its inspection program that GAO previously recommended and still believes are needed. For example, NRC is not following up to verify that all violations of security requirements have been corrected or taking steps to make "lessons learned" from inspections available to other NRC regional offices and nuclear power plants. Moreover, if NRC needs to revise its DBT further as the terrorist threat is better defined, it will need longer to make and test all the necessary enhancements. The Department of Energy, for example, is currently reviewing the DBT for its nuclear facilities.

Significantly, post-9/11, NRC only increased the Design Basis Threat (DBT) attack force from three to five individuals. As mentioned in Committee to Bridge the Gap's July 2004 petition for rulemaking cited above, NRC's DBT should require that nuclear power plants be capable of repelling an attack at least as large as the actual attack of 9/11 – 19 attackers working in coordination. Such "lessons learned" from weaknesses in NRC's enforcement of security regulations as contained in this 2004 GAO report should be applied in this NND proceeding.

On the eve of the third anniversary of the 9/11 attacks, HBO (Home Box Office Television) debuted *Indian Point: Imagining the Unimaginable*. The film was directed and co-produced by Rory Kennedy, and features Robert Kennedy, Jr., Chief Prosecuting Attorney of Riverkeeper. It takes a "what if" look at the potentially catastrophic consequences of a large-scale radioactivity release from the Indian Point Energy Center, a three-unit nuclear-power plant station, located just 35 miles (56 kilometers) north of midtown Manhattan, New York City, New York. Although Indian Point 1 has long been shut down, Indian Points 2 and 3 are still operating. However, all irradiated nuclear fuel generated at the site remains stored there, mostly still in "wet" pools, but also in a growing number of dry casks. NND, for its part, would be located less than 50 miles (80 kilometers) from "midtown" Toronto, Ontario. The questions asked and

warnings issued about Indian Point in this film should be applied to NND as well, given its proximity to a major metropolitan area, not to mention its location on the shoreline of Lake Ontario, drinking water supply for millions in the U.S., Canada, and numerous Native American Tribes and First Nations.

Later that same year, Dr. Edwin S. Lyman, Senior Scientist at Union of Concerned Scientists (UCS), prepared a report about safety and security risks at the Indian Point nuclear power plant as an expert witness on behalf of environmental intervenors against the 20 year license extension sought by Entergy Nuclear Corp. from NRC.³⁵ At page 16, Dr. Lyman stresses that intentional acts of malice represent a class of “accidents” that should not be considered using probabilistic modeling:

Accident probabilities are not relevant for scenarios that are intentionally caused by sabotage. Severe releases resulting from the simultaneous failure of multiple safety systems, while very unlikely if left up to chance, are precisely the outcomes sought by terrorists seeking to maximize the impact of their attack. Thus the most unlikely accident sequences may well be the most likely sabotage sequences.

Dr. Lyman’s report about Indian Point’s terrorism risks so close to New York City could and should be used to shed light on the terrorism risks at NND (as well as the old atomic reactors at Darlington Nuclear Generating Station as well), so close to Toronto, on the shore of such a major drinking water source as Lake Ontario.

In early 2005, a list of airports within 10 miles of nuclear power plants in the U.S. was compiled.³⁶ This was done in order to call attention to nuclear power plants’ vulnerability to explosives-laden private airplanes, from general aviation airports, being used as suicide “cruise missiles” against nuclear power plants, including against irradiated nuclear fuel storage pools or their vital safety systems such as cooling water pumps and heat exchangers, and the electricity supply that runs them. Despite enhanced screening of passengers at commercial airports by the U.S. federal government’s Transportation Security Administration, this particular attack risk had yet to be addressed. Likewise, security risks from large size cargo airplanes had also not been adequately addressed, several long years after the 9/11 attacks. Proximity to airports of all types, as well as vulnerability to attacks launched by aircraft of all types, including explosives-laden general aviation aircraft, should be carefully addressed at NND.

On June 29, 2005, NRC staff issued a draft “proposed director’s decision,” which largely to entirely denied the Nuclear Security Coalition’s petition of August, 2004.³⁷ On November 7, 2005, NRC staff finalized its denial of the Nuclear Security Coalition’s petition.³⁸ This NRC rejection of carefully documented public concerns further eroded public confidence in the regulator, continuing an unbroken, years-long pattern of such denials. Not to be deterred, however, the Nuclear Security Coalition immediately issued a statement the very next day, condemning the NRC staff’s denial of the petition, and immediately filed an appeal of the decision with NRC Commissioners.³⁹

On the very same day, NRC staff instead introduced its own proposal to “upgrade” its security regulations’ Design Basis Threat.⁴⁰ But on February 22, 2006, NIRS filed “Comments on Proposed Rulemaking to Modify the Design Basis Threat for Nuclear Facilities and Request that the Agency Withdraw RIN-3150-AH60,” including comments on the vulnerability of irradiated nuclear fuel storage pools to terrorist attack.⁴¹ As its introduction stated:

NIRS is concerned that the proposed rule as written reflects the Commission’s misguided efforts to contain the real cost of security at US nuclear power stations. The present joint Commission and industry plan to codify the Design Basis Threat is made at potentially great expense to the public health, safety and security by maintaining an unrealistically low level security bar around nuclear power stations which has already been surpassed by the tragically consequential al-Qaeda attacks on domestic soil.

We urge that the Commission withdraw the proposed rule (RIN-3150-AH60) as written, re-evaluate and complete an analysis of the twelve factors as published in the Federal Register notice incorporating the lessons learned from and since the September 11th attacks and reissue an appropriately upgraded DBT rule for public comment.

On April 4, 2006, GAO again testified before Congress on nuclear power plant security vulnerabilities going unaddressed by NRC.⁴² This time, it was revealed that NRC had weakened security regulations after having been pressured to do so by nuclear power industry lobbyists. As GAO reported:

Key elements of the revised DBT, such as the number of attackers, generally correspond to the NRC threat assessment staff’s original recommendations, but other important elements do not. For example, the NRC staff made changes to some recommendations after obtaining feedback from stakeholders, including the nuclear industry, which objected to certain proposed changes, such as the inclusion of certain weapons. NRC officials said the changes resulted from further analysis of intelligence information. Nevertheless, GAO found that the process used to obtain stakeholder feedback created the appearance that changes were made based on what the industry considered reasonable and feasible to defend against rather than on what an assessment of the terrorist threat called for.

GAO also reported:

It is too early, however, to conclude that all sites are capable of defending against the DBT because, as of March 30, 2006, NRC had conducted force-on-force inspections at 27, or less than half, of the 65 nuclear power plant sites.

And that:

...in observing three inspections and discussing the program with NRC, GAO noted potential issues in the inspections that warrant NRC's continued attention. For example, a lapse in the protection of information about the planned scenario for a mock attack GAO observed may have given the plant's security officers knowledge that allowed them to perform better than they otherwise would have.

For the sake of security, safety, public health, and environmental protection, such economic and political sway wielded over lawmakers and regulators by the powerful nuclear power industry should be vigilantly guarded against at NND.

In May 2007, *Esquire* magazine revealed a major security breach at the Palisades nuclear power plant in southwest Michigan on the Lake Michigan shoreline. NIRS immediately called for a congressional investigation of the grave incident.⁴³ U.S. Representative Ed Markey (Democrat-Massachusetts) launched just that, firing questions about the incident at NRC Chairman Dale Klein.⁴⁴ Chairman Klein's initial, and even final, responses to Congressman Markey's inquiry essentially downplayed the security significance of the breach, indicating a lack of NRC interest in learning or applying lessons from the incident. The lessons *not learned* included major failures within both the nuclear power industry and NRC regarding vetting procedures for security related personnel, another matter that should be addressed in this NND proceeding.

Another major NRC security breach was reported by ABC News on July 11, 2007.⁴⁵ At least one section of NRC was shown to be asleep at the switch when it came to the security implications of licensing. A GAO sting operation revealed that NRC unthinkingly rubberstamped radioactive sealed source licenses – which could easily enable even a “lone wolf” terrorist to obtain materials needed to construct a large-scale radiological dispersal device. Although not directly related to nuclear power plant risks, the GAO sting nonetheless revealed gaping vulnerabilities to the dissemination of “dirty bomb” ingredients. Such overlooked security “cracks” in CNSC and other Canadian regulations should be plugged, as well, if they exist, a subject ripe for being addressed in this proceeding in regards to the irradiated nuclear fuel that would be generated at NND.

Yet another major security breach was revealed on September 25, 2007. After a three-month investigation, WCBS-TV in New York City broadcast “Asleep at the Switch,” exposing a stunning breakdown of security at multiple atomic reactors, including videotape of security guards sleeping on the job at the Peach Bottom nuclear power plant in Pennsylvania.⁴⁶ Peach Bottom's owner, Exelon Nuclear Corp., fired Wackenhut, which ran the site's security operations over the incident. However, as of 2011, NRC still employs Wackenhut as the security contractor at its headquarters building in Rockville, Maryland. WCBS says it also found instances of security guards sleeping at Indian Point nuclear power plant near New York City.

On October 10, 2007, the Project on Government Oversight (POGO) again shed light, just as it had in 2002, on *why* Peach Bottom's security guards were asleep on duty – they were still being worked to the point of exhaustion by Exelon and Wackenhut, a truth that NRC's lackluster investigation failed to publicly reveal.⁴⁷ Thus, over five years since POGO had first revealed the scandal of nuclear power plant security guard forces being worked to the point of exhaustion (see endnotes 16-18), this very same security vulnerability persisted at U.S. atomic reactors. Such repeated security mistakes must be guarded against at NND, starting with the conduct of this proceeding.

On December 17, 2007, Greenpeace USA, and supporting coalition of environmental groups, submitted public comments to NRC regarding the agency's proposed regulation that would require some – but not all – new atomic reactor designs to withstand aircraft crashes.⁴⁸ As expressed by Greenpeace, “if the NRC is going to license reactors in a post 9-11 America, the government should require that any new reactors be designed to withstand the known terrorist threat.” Certainly, NND's proposed reactor designs – the AP1000, the EPR, and the ACR1000 – should all be required to withstand aircraft crashes before they can be built and operated.

On July 8, 2009, Beyond Nuclear's Paul Gunter posted “Virtual Reconnaissance and the security threats from nuclear plants.”⁴⁹ In it, he quoted Scott Portzline of Three Mile Island Alert, who warned the U.S. Department of Homeland Security on May 13, 2009:

There now exists a very serious compromise of security at our nation's nuclear power plants. Due to the very high quality of satellite images, terrorists and saboteurs can see far too much detail, which gives specific advantages to an attacking force. Some of the defensive positions of nuclear plant guards are now revealed due to the elevated level of clarity and resolution. Furthermore, these images reveal pathways, stairways and potential staging areas giving terrorists the ability to plan the quickest or best route to the specific targeted buildings.

Such threats included satellite images of the Oyster Creek nuclear power plant's dry cask storage facility in New Jersey readily accessible to anyone on the internet.

Regarding nuclear power's adverse impacts on our civil liberties and democratic norms, Gunter observed:

By necessity and by its very nature, nuclear power is becoming a more secretive operation, incompatible with an open democratic society. The public is already denied its due process to openly challenge nuclear power plant operating licensing proceedings that involve issues over inadequate site security and vulnerable on-site nuclear waste storage. The continued operation, timeless presence and potential expansion of nuclear power poses an increasing threat not only to public

health and safety and to national security but to the civil liberties of an open society.

The level of detail now widely available in an exponentially growing information age spotlights the concerns that Mr. Portzline has raised to federal officials. Federal action to blur the detail of virtual images of existing nuclear power plant sites is needed. However, such action in and of itself does not address the growing threat that this particular energy technology will continue to pose now and into the distant future. It does make potentially malicious reconnaissance much less easy to perform by remote and anonymous adversaries. Such suppressive action does, however, highlight and amplify a concern for our civil liberties and forces the question what other information forums must be obscured or denied the public and what other freedoms must be lost to protect us from the threat posed by nuclear power?

Despite the passage of over eight years since the 9/11 attacks, the NRC was still considering security upgrades, as at dry cask storage facilities against explosives designed to breach armored vehicles. However, it is unclear when or even if such security upgrades will be required.⁵⁰

A security lapse at Vermont Yankee in February, 2010, revealed that – nearly 15 years after Timothy McVeigh destroyed the Alfred P. Murrah Federal Building in Oklahoma City with a massive truck bomb, killing 168 people and injuring 450 more in what was, until 9/11, the deadliest act of terrorism on U.S. soil -- atomic reactors could still be vulnerable to such attacks through as simple a mistake as failing to inspect entering delivery trucks.⁵¹

In March 2010, the Associated Press reported that a suspected al-Qaeda member, Sharif Mobley, had worked at six U.S. nuclear power plant sites comprising a total of ten atomic reactors.⁵² Charles Faddis, a former officer at the Central Intelligence Agency and the author of *Willful Neglect: The Dangerous Illusion of Homeland Security*, penned an op-ed in the *New York Times* on May 5, 2010 entitled “Al Qaeda’s Nuclear Plant.”⁵³ In it, Faddis warned:

...Since his arrest by Yemeni security forces in March, American law enforcement officials have taken pains to emphasize that Mr. Mobley’s low security clearance makes it unlikely that he passed crucial details about American nuclear-plant security to Al Qaeda.

But it doesn’t take top-level clearance to know how to set off a nuclear meltdown. All it takes is information on perimeter security — information Mr. Mobley possesses about every plant where he worked...

...And it turns out that damaging a reactor's cooling system is a lot easier than getting to the core. You don't have to obtain access to the nuclear fuel, get into the control room or penetrate the containment shell. Most of the critical components of the cooling system, including pumps and water intake pipes, sit unprotected outside. If you can get a car bomb or a team with demolition charges near these components, you can shut off the cooling water to the reactor, and physics will take care of the rest.

Even low-level employees at a nuclear plant would have the information necessary to pull off such an attack, like the number of guards, their weapons and procedures at entry gates — even someone as low-level as Sharif Mobley.

We don't yet know what kind of plant-security information, if any, Mr. Mobley passed on to Al Qaeda. But we do know that the organization has been interested in attacking American nuclear plants for years; it even considered including a plant on its Sept. 11 target list.

For now, we have no choice but to assume that Mr. Mobley did in fact pass on details about plant security, and we need to take immediate steps to head off any possible terrorist attack. Defensive schemes at the plants where Mr. Mobley worked need to be significantly changed so that his information is no longer of value to any potential attacker. Guard procedures, for example, must be altered. Where such changes cannot adequately compensate for the potential risk Mr. Mobley presents, then defenses need to be strengthened. Security perimeters need to be widened. And more barriers must be put in place against car bombs.

Once we have dealt with the plants where Mr. Mobley worked, we need to institute similar procedures at the remainder of the nuclear plants in the United States, because the unfortunate truth is that the defensive schemes at these sites are essentially all alike.

For too long we've assumed that a nuclear plant is safe as long as its reactor is protected. Sharif Mobley knew better. Now, chances are, so does Al Qaeda.

Electronic warfare attacks on safety systems vital for keeping irradiated nuclear fuel cool and isolated from the environment, as in "wet" storage, is now another risk that must be addressed, as at NND. A September 26, 2010 article in the New York Times revealed that the

Stuxnet worm, most likely developed by a government intelligence agency, had potentially disrupted operations not only at an Iranian uranium enrichment facility, but also at an Iranian nuclear power plant.⁵⁴

Thus, media reports have revealed ongoing nuclear power plant security vulnerabilities for nearly a decade now after the 9/11 attacks, right up to the present day. These exposés have repeatedly moved environmental advocates to take action, to call for security upgrades, only to be rebuffed by nuclear regulators, under pressure from the nuclear industry itself. Official government reports, as by GAO, have not moved NRC to adequately correct such failures. This begs the question, what exactly, short of a catastrophic radioactivity release caused by a “successful” terrorist attack, will it take for the nuclear power industry and its regulators to adequately address known security vulnerabilities, as at irradiated nuclear fuel storage facilities? This NND proceeding must address these critical issues.

2A. Risks Associated with On-Site Wet Pool Storage

In January 2001, the U.S. Nuclear Regulatory Commission (NRC) published its final draft of “Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants,” (NUREG-1738).⁵⁵ Although this report focused on accidental heavy load drops into waste storage pools at decommissioned nuclear power plants, the risk consequences of a pool drain down are equally applicable to pool drain downs due to terrorist attacks at operating nuclear power plants. NRC reported that “the consequences of a zirconium fire could be serious,” that the loss of cooling water in a waste storage pool could lead to around 25,000, or more, latent fatal cancers downwind, with deaths occurring as far as 500 miles away. Its Appendix 2D, “STRUCTURAL INTEGRITY OF SPENT FUEL POOL STRUCTURES SUBJECT TO AIRCRAFT CRASHES,” focuses on the consequence of an accidental aircraft crash on an irradiated nuclear fuel storage pool.⁵⁶ Deliberate attack is not considered. However, this section of the report -- as does the report’s Section 3.5.2 -- notes that the 32 General Electric Mark 1 and 2 Boiling Water Reactors “do not appear to have any significant structures that would reduce the likelihood of penetration” of the irradiated fuel pool by an aircraft. The study characterizes a “large aircraft” as weighing just 12,000 pounds, 6 tons. But the takeoff weight of the large jumbo commercial aircraft that hit the World Trade Center was on the order of 150 tons. Its APPENDIX 4, “CONSEQUENCE ASSESSMENT FROM ZIRCONIUM FIRE,” focuses on the radioactive inventory releases and human health consequences of a zirconium fire in a irradiated nuclear fuel storage pool. Due to the appendix on aircraft crashes in particular, this report was withdrawn from public access by NRC following the 9/11 terrorist attacks. It was later returned, with the caveat that NRC would not publicize its existence. The risks of sudden pool drain downs, whether due to accidents or attacks, should be addressed in this proceeding. To not do so would be to ignore a major safety and security risk at NND.

In reference to the risks of heavy load drop accidents leading to rapid pool drain downs, such an accident nearly occurred on the Lake Michigan shoreline, at Palisades nuclear power

plant in Covert, Michigan, in October 2005. For several months, because the nuclear utility and NRC did not disclose the incident, it remained unknown to the public and even elected officials. NRC claimed that this near-disaster was “not a reportable event.” After submitting a Freedom of Information Act (FOIA) request, the author was able to document what had happened and why.⁵⁷ Palisades had come precariously close to dropping a 107 ton, fully loaded transfer cask back into the pool. This risked breaching the pool floor, and suddenly draining away the cooling water supply. As described by the NRC study immediately above, that could have led within a short period of time to a catastrophic radioactive waste inferno. Given similar close calls at Prairie Island nuclear power plant in Minnesota (another long duration dangle of a fully loaded cask above the pool, in the 1990s) and at Vermont Yankee (a fully loaded cask drop that came precariously close to striking the loading platform floor, in more recent years), the potential for such an incident at the NND is certainly a credible risk. OPG must address the risk of heavy load drops into irradiated nuclear fuel storage pools in this proceeding.

In January 2003, Alvarez *et al.* reported that a terrorist attack successfully draining the cooling water from an irradiated nuclear fuel storage pool could cause a catastrophic radioactivity release that would dwarf the Chernobyl nuclear disaster in scope.⁵⁸ Alvarez *et al.* summed up the potential consequences:

A 1997 study done for the NRC estimated the median consequences of a spent-fuel fire at a pressurized water reactor that released 8 to 80 mega-curies of cesium-137. The consequences included 54,000-143,000 extra cancer deaths, 2,000-7,000 square kilometers of agricultural land condemned, and economic costs due to evacuation of US\$117-566 billion. It is obvious that all practical measures must be taken to prevent the occurrence of such an event. In short, "The long-term land-contamination consequences of such an event could be significantly worse than those from Chernobyl," they concluded.

The Alvarez *et al.* report made abundantly clear, to an ever widening audience, that irradiated nuclear fuel storage pools represent one of the worst security vulnerabilities in the U.S. If not given adequate consideration in the NND proceeding, the same could be true for decades to come in Canada. It would, of course, be much easier, much less expensive, and much less time consuming to design safeguards and fortifications into the initial design of NND's irradiated nuclear fuel storage pool(s), rather than attempt to retrofit the facilities later. In the U.S., irradiated nuclear fuel requires pool storage for at least five years. However, the OPG and related NND TSDs actually state that pool risks, for any particular stored irradiated nuclear fuel, would persist at NND for a full decade before transfer to dry storage. Of course, *the only safe, sound solution known for forever deadly irradiated nuclear fuel is to not generate it in the first place.* That is our preferred alternative to NND.

Similarly, in May, 2006, Dr. Gordon Thompson prepared a report, “Risks of Pool Storage of Spent Fuel at Pilgrim Nuclear Power Station [near Boston] and Vermont Yankee.”⁵⁹ that perhaps could also be used as a model to investigate terrorism risks at NND (as well as at the old reactors and their irradiated nuclear fuel storage pools at Darlington Nuclear Generating Station).

And then in May, 2008, Dr. Gordon Thompson published “Scope of the EIS for New Nuclear Power Plants at the Bruce Site in Ontario.”⁶⁰ In it, he very clearly articulated the serious safety and security risks associated with both pool storage and dry cask storage of irradiated nuclear fuel. For example, he provided clear, concise accountings of how much radioactivity would be where at new nuclear power plants. At page 27, he used the Indian Point nuclear power plant very near New York City – as Darlington is near Toronto – to make comparisons of radioactivity content of reactor cores, pools, and dry casks. He uses Cesium-137 content to make these comparisons.

Thompson reports that each pool at Indian Point contains 2,500,000 TeraBecquerels (TBq) of Cesium-137. He reports that each Indian Point PWR core contains 420,000 TBq of Cesium-137. The Chernobyl nuclear catastrophe, by way of comparison, released “only” 90,000 TBq of Cesium-137 into the environment, and yet devastated vast regions with such radioactivity contamination. CNSC defines a “Large Release” as exceeding 100 TBq of Cesium-137. As Thompson states, “an environmental assessment for these [new] plants must consider the potential for an atmospheric release containing hundreds of thousands of TBq of Cesium-137.” Certainly the pools at NND represent huge radiological risks. This must be addressed in the NND EIS proceeding going forward.

Providing yet more valuable perspectives on various radiological risks of concern, Thompson also cites a 2007 study by Cousins and Reichmuth, sponsored by Defence Research and Development Canada, about a radiological dispersal device (RDD) or “dirty bomb” open air attack at the CN Tower in downtown Toronto.⁶¹ The study assumes a “mere” 37 TBq release from the RDD attack, yet calculates that from a cleanup standard of 500 mrem per year, “the estimated economic impact would be \$28 billion, whereas for a cleanup standard of 15 mrem per year the impact would be \$250 billion.” It should be noted that a 500 mrem/year “clean up standard” would pose quite significant risks for human health for persons inhabiting such a contaminated area; a 15 mrem/year “clean up standard” would itself still pose increased risk to human health. Thus, a “successful” terrorist attack upon an irradiated nuclear fuel storage pool at NND, unleashing “hundreds of thousands of TBq of cesium-137,” (or even millions of TBq, since Thompson 2003 and 2008, NRC staff 2001, and Alvarez *et al.* 2003 have documented that up to 100% of the volatile Cesium-137 could be released into the environment from a zirconium cladding fire in an irradiated nuclear fuel pool) could be a continental-scale catastrophe.

Yet another risk associated with “wet” pool storage of irradiated nuclear fuel, especially over extended time periods, is leakage from the pools due to corrosion holes and/or cracks in pool walls and/or floors; other age-related degradation; seepage of tritium through concrete structures and steel liners on pool walls and floors; and even clogged drains. Several commercial

reactors in the United States – Connecticut Yankee, Indian Point (New York), Salem (New Jersey), and Plant Hatch (Georgia) -- have discovered such leaks, sometimes only many years after their commencement, resulting in large amounts of radioactively contaminated water leaking into groundwater and downstream surface waters. The author has prepared a three-page backgrounder on the history of pool leaks in the U.S.⁶² In addition to the pool leaks at U.S. commercial reactors, pool leaks have also occurred at a U.S. Department of Energy research reactor waste storage pool on Long Island, New York, as well as at a private industry irradiated nuclear fuel services facility in Virginia, as documented in the backgrounder cited.

Pool leaks risk radioactive contamination of drinking and agricultural irrigation water supplies, as well as of the food chain. Such food chain contamination introduces the risk of bio-magnification/bio-accumulation, as in fisheries, crops irrigated with such contaminated water, and/or livestock (including their meat and/or dairy products) fed those contaminated crops, and/or given contaminated water to drink. Bio-magnification/bio-accumulation can thus reverse the dilution of radioactivity in the environment, which is especially risky for the health of those at the top of the food chain, including humans. The U.S.-Canadian International Joint Commission's (IJC) Nuclear Task Force has published a report on the realities and risks of bio-magnification/bio-accumulation of radioactivity released by nuclear power plants, specifically in the Great Lakes ecosystem. It is entitled *REPORT ON BIOACCUMULATION OF ELEMENTS TO ACCOMPANY THE INVENTORY OF RADIONUCLIDES IN THE GREAT LAKES BASIN*.⁶³

Other operational risks of irradiated nuclear fuel storage pools must also be addressed at NND. As but one example, on January 21, 2010, NRC cited Palisades nuclear power plant in southwest Michigan on the Lake Michigan shoreline for a boration violation in its irradiated nuclear fuel storage pool.⁶⁴

2B. Risks Associated with On-Site Dry Cask Storage

At least as early as June 1998, it was known that dry casks were vulnerable to attacks, such as by TOW anti-tank missiles. This was revealed by a test conducted upon a German CASTOR storage/transport cask at the U.S. Army's Aberdeen Proving Ground in Aberdeen, Maryland, U.S.A.⁶⁵ This revelation was of deep security significance, for each and every fully loaded irradiated nuclear fuel dry cask in the United States contains over 200 times the long-lasting radioactivity released by the Hiroshima atomic bomb. Thus, dry casks containing 24 pressurized water reactor (PWR) irradiated nuclear fuel assemblies contain about 240 times the long-lasting radioactivity released at Hiroshima. Casks containing 32 PWR assemblies hold 320 times the long-lasting radioactivity released at Hiroshima.⁶⁶

Thus, a successful explosive and incendiary attack upon fully loaded dry casks could unleash a disastrous amount of radioactivity onto the winds and waters, to harm humans and the environment downwind and downstream out to great distances, depending on how far it is blown by the wind or carried by the water. In considering the security risks associated with irradiated nuclear fuel – including in this NND proceeding -- adequate attention must be paid to the risks posed by remotely fired weaponry, especially high explosives and shaped charges designed to penetrate much thicker armor than is present on irradiated nuclear fuel storage containers.

Dr. Gordon Thompson's 2008 report cited above⁶⁷ provides some helpful perspective on dry cask security risks. He reports that the Cesium-137 content of a typical dry cask is 500 times larger than the "Large Release" level defined by CNSC, thus 50,000 TBq of Cesium-137. Thus, if 1/500th of the Cesium-137 content of a typical dry cask were to escape into the environment, due to accident or attack, it would represent a "Large Release," as defined by CNSC. Thus, accidents or attacks involving dry casks at NND also deserve careful examination in this proceeding going forward. The release of hundreds (or thousands, or even tens of thousands -- again, considering the potential for 100% release of Cesium-137) of TBq from a dry cask after a "successful" terrorist attack could spell unprecedented radiological disaster downwind and downstream from NND. It is obvious that such potentially disastrous risks must be carefully examined and adequately addressed to prevent them from ever happening.

Documentation of dry cask risks over the past decade or longer deserve mentioning.

On November 9, 1999, the author delivered the following statement⁶⁸ about dry cask storage of irradiated nuclear fuel to the NRC Commissioners at a meeting about enhancing public stakeholder confidence and participation in NRC decision making:

Take the precedent-setting dry cask storage at Palisades nuclear plant in Michigan – a good example of the NRC serving as the lubricant for the nuclear power industry, at the expense of genuine public involvement. NRC's first ever generic licensing of dry cask storage has made it impossible for the public to intervene to protect public health, public safety, and the environment. Adjudicatory public hearings are denied. Environmental Impact Statements are circumvented. Thus blocked by NRC, the public was forced to file for an injunction in federal court against the loading of the casks at Palisades in 1993. To avert the injunction, Consumers Power Company and NRC officials perjured themselves before the judge, promising that if problems developed, casks could and would be promptly and safely unloaded by simply reversing the loading procedure. The fourth cask loaded in the summer of 1994 proved defective. Forced to acknowledge serious technical obstacles that prevent safe unloading, Consumers Energy has still not unloaded that cask, more than 15 years later. The Court of Appeals decision instructed the concerned citizens to address their concerns to the NRC via the 2.206 petition process. But the NRC routinely rejects these petitions, and is not required to respond to them in a timely fashion. The NRC sat on the Palisades dry cask petition for 18 months before finally rejecting it. All the while, Consumers

Power proceeded to load 9 more casks, despite the unresolved concerns. Once the petition was rejected, concerned citizens were left with no further recourse. The illusion of public involvement via this petition process has grown rather thin.

The NRC's rubber stamping of [Consumers Energy's] secretive, yet-to-be-demonstrated unloading procedure at Palisades, and NRC's servile handling of the suspicious dry cask storage office fire following the hydrogen burns in June, 1999, has further driven home the lesson that the NRC and Consumers Energy are unaccountable to the public. The token public meetings conducted answered no questions, raised troubling new ones and served merely to intensify public concern and outrage about the suspicious and disconcerting goings-on at Palisades.

Similarly, the author again presented testimony, on behalf of NIRS, on February 23, 2000, at an NRC Commissioners meeting, about the many risks of dry cask storage.⁶⁹ The risks cited included: circumvention of public participation; the lack of a clearly established, safe unloading procedure; major quality assurance violations in both the design and fabrication of dry casks; cracks, corrosion, and even explosions in fully loaded dry casks deployed on the shoreline of the Great Lakes. Such risks of dry cask storage should be addressed in this NND proceeding.

The Palisades' episode described above raises several issues relevant to irradiated nuclear fuel storage at NND. For example, safe unloading procedures must be fully worked out before dry casks are loaded in the first place.⁷⁰

Similarly, seismic risks to dry cask storage must not only be analyzed, but seismic safety regulations must actually be enforced. This is another safety violation that has been occurring at Palisades nuclear power plant since the very beginning of construction of its first dry cask storage concrete pad in 1992.⁷¹

Environmental advocates' (and even their state government allies, such as the Attorney General of the State of Michigan, Frank Kelly, who argued on behalf of the environmental coalition in the federal courts against the loading of Palisades' dry casks) challenges to significant violations of safety regulations have thus been rebuffed by NRC not once, but twice, at Palisades: first during the 1992 to 1997 timeframe regarding the safety of loading dry storage casks in the first place despite the lack of a clearly established, safe unloading procedure; and then again in the 2006 to 2007 time frame, this time regarding earthquake risks.

Thus, another hard "lesson learned" at Palisades, that should be applied in this NND proceeding, is the importance of safety regulations actually being enforced by federal agencies and courts of law. If not, then democratic institutions can easily be eroded, just as can public confidence in the regulatory process and rule of law itself. Such damage to our cherished democratic governance principles can be done when the public's good faith efforts, including rigorous documentation of safety risks and regulatory violations, fall on deaf ears at nuclear regulatory agencies, and are arbitrarily and capriciously brushed aside by the powerful nuclear

power establishment in order to meet its own agenda, such as a loading schedule for dry casks (or a building schedule for new reactors and their irradiated nuclear fuel storage pools), putting public health, safety, security, and the environment – as well as hard won democratic institutions -- at grave risk in the process.

On September 13, 2002, the author testified before the CNSC security risks to Bruce nuclear power plant proposed installation of as many as 2,000 dry casks for irradiated nuclear fuel storage. The author also cited the lack of adequate notification or involvement of U.S. citizens or elected representatives in the decision making process, despite the Great Lakes being a shared resource between the two countries.⁷² Similar concerns apply at must be addressed at NND. On the same day, the author issued a media release on these issues.⁷³

On October 17, 2002, both of the State of Michigan's U.S. Senators, Carl Levin and Debbie Stabenow, wrote a letter to U.S. Secretary of State Colin Powell expressing concern about Bruce nuclear power plant's proposal to install 2,000 dry casks on the Lake Huron shoreline, just 50 miles east of Michigan. At the top of their list of concerns was the casks' vulnerability to terrorist attack.

It should be noted that environmental advocates' proposal for "hardened on-site storage" is aimed at addressing, at least on an interim basis, such security risks at dry cask storage installations, as well as regarding irradiated nuclear fuel storage pools. See Section 3 below.

On July 15, 2004, the author published a white paper on the risks of dry cask storage of irradiated nuclear fuel entitled "Get the Facts on High-Level Atomic Waste Storage Casks!"⁷⁴ Again, such hard won lessons learned from mistakes in the U.S. with the design, manufacture, and use of dry casks should be applied at NND to avoid pitfalls detrimental to safety, security, and protection of the environment and public health.

On July 22, 2004, the author published a "Summary of Oscar Shirani's Allegations of Quality Assurance Violations Against Holtec Storage/Transport Casks."⁷⁵ Although specific to a particular cask model not currently under explicit consideration for use at NND, these documented revelations showed serious flaws in NRC's enforcement of quality assurance (QA) regulations, and thus safety and security regulations. Shirani stated, about the Holtec casks licensed by NRC for transport at high speeds on the railways of the U.S., that he questioned the structural integrity of the Holtecs *sitting still*, given their widespread violations of safety significant quality assurance regulations! In fact, NRC Midwest (Region III) dry cask storage inspector, Dr. Ross Landsman, fully supported Commonwealth Edison/Exelon Nuclear whistleblower Shirani's allegations about the serious quality assurance violations associated with the design and manufacture of Holtec dual-use storage and transport casks.⁷⁶ CNSC should guard against such serious violations of nuclear safety regulations, such as QA on design and manufacture of dry casks used at NND. (It deserves mentioning the VSC-24, Ventilated Storage Casks, used at Palisades and other U.S. reactors, also suffered serious QA violations; so much so, that they are no long in production, although dozens of these defective casks remain deployed, fully loaded with irradiated nuclear fuel, on the shores of Lake Michigan.)

On June 2, 2006, San Luis Obispo Mothers for Peace, and the Santa Lucia Chapter of the Sierra Club, represented by attorney Diane Curran, won a major victory when the 9th Circuit Federal Court of Appeals ruled that NRC must perform an environmental assessment of the terrorism risks associated with dry cask storage at the Diablo Canyon nuclear power plant in California.⁷⁷ For years, the NRC had tried to claim that the threat of terrorism on a nuclear facility is so remote that such issues need not be considered.

However, NRC's ultimate, court-ordered Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) were little improvement on past behavior. For one thing, the secrecy surrounding their references, calculations, and reasoning is unacceptable in a society dedicated to open, transparent, democratic norms of governance. If the EA is accurate, that any terrorism risks amount to a FONSI, then what is the harm in making the documentation transparent and accessible? Obviously, NRC's FONSI does not match its secretive behavior. Such secrecy must be guarded against at NND, lest it erode democratic institutions such as the public's right to know, government accountability, and public participation in decision making that affects its health, safety, security, environment, and civil liberties.

On July 1, 2008, San Luis Obispo Mothers for Peace again "faced off" against NRC staff at an extremely rare appeals hearing held before the NRC Commissioners themselves. The hearing challenged NRC staff's absurdly brief EA and FONSI regarding terrorism risks at Diablo Canyon's dry cask storage facility. Mothers for Peace described the experience in a media release.⁷⁸ Attorney, Diane Curran, assisted by expert witness, Dr. Gordon Thompson, asserted that the NRC staff's extreme secrecy was not only illegal, but constituted poor policy. Curran argued that the NRC must publicly disclose the broad outlines of its environmental assessment of an attack on Diablo Canyon in order to ensure the agency's accountability to the public. The legal dispute continues today.

2C. Risks Associated with Transportation

Given that GLU had the foresight to recognize the significance of "ecological risks associated with...transportation of spent fuels from nuclear reactors" 27 years ago (see endnote 1),⁷⁹ such risks represent a most glaring omission from the NND EIS.

In fact, there are many risks involved with transporting highly radioactive wastes, be it by truck, train, or boat. Perhaps the single best "repository," as it were, for documentation and insights on the many risks of shipping irradiated nuclear fuel is found at the "Nuclear Waste Transportation and Maps" subsection of the State of Nevada Agency for Nuclear Project's website.⁸⁰ There, 15 years of research findings by Fred Dilger Ph.D., James D. Ballard Ph.D., and Robert J. Halstead – technical consultants and expert witnesses for the State of Nevada – can be found. Halstead has long warned of the security risks associated with highly radioactive waste

shipments through major metropolitan areas. They have also shed light on the high risks stemming from severe accident scenarios, such as high speed collisions, especially into immovable objects such as bridge abutments; long-duration, high-temperature fires; and underwater submersion. Ballard, a terrorism expert, has testified in U.S. federal court on such matters. And each of them has testified before U.S. federal agencies on such matters. The preparers and reviewers of the NND proposal would do well to address high-level radioactive waste transport risks by reviewing the work of Dilger, Ballard, and Halstead.

In June 1999 the State of Nevada filed a "Petition for Rulemaking" to the NRC, charging that safeguards against terrorist attacks on high-level radioactive waste shipments were woefully inadequate or non-existent. Nine state governments and the Western Governors Association endorsed the petition.⁸¹ Again, as mentioned previously, such security risks related to irradiated nuclear fuel transportation should be addressed in this NND proceeding. To exclude such risks from the NND EIS is to improperly segment them off, lumping them into vague future proceedings – when in fact those risks would be entirely created by the irradiated nuclear fuel's generation at NND, and should be addressed at this time, not at some future date.

As cited by the 2006 NAS study mentioned below, in early September, 2001, a number of presentations were made at the Packaging and Transportation of Radioactive Materials (PATRAM) conference held in Chicago, Illinois that could shed important light on this NND proceeding.⁸²

For example, Robert Halstead, radioactive waste transportation consultant to the State of Nevada, gave presentations about the risks of terrorist attacks on irradiated nuclear fuel shipments. Made just a few days before the 9/11 attacks, these were quite prescient. Such Halstead – as well as Dilger and Ballard -- studies are posted at the State of Nevada Agency for Nuclear Projects website cited above.

At another 2001 PATRAM, F. Lange, G. Pretzsch, E. Hormann, and W. Koch addressed "Experiments to Quantify Potential Releases and Consequences from Sabotage Attack on Spent Fuel Casks," further validating the significance of terrorist risks to irradiated nuclear fuel shipments.

In addition, a 2001 PATRAM presentation by Areva of France, about widespread and severe external radioactivity contamination incidents involving hundreds of irradiated nuclear fuel shipments bound for its La Hague reprocessing center, also can provide "hard won lessons learned" for application at NND. The World Information Service on Energy (WISE)-Paris has provided coverage of this infamous radioactive waste contamination scandal.⁸³

Again, such security and contamination risks, as brought to light at PATRAM in 2001, should help to illuminate this NND proceeding on the important issue of irradiated nuclear fuel transportation.

DOE itself confirmed the reality of security risks to irradiated nuclear fuel shipments in October 2001. In response to heightened security risks stemming from the potential for reprisal attacks within the U.S. homeland due to the launching of military action in Afghanistan, DOE postponed a large rail shipment of irradiated nuclear fuel.⁸⁴ Such high level government responses to terrorism risks to radioactive waste shipments in the U.S. clearly show that such terrorism risks to radioactive waste shipments in Canada deserve careful treatment in the NND proceeding. This is especially so if such radioactive waste shipments would be water-borne on the Great Lakes, for that raises cross border impact issues. But so would a “successful” terrorist attack on an irradiated nuclear fuel truck or train shipment in certain parts of Canada, if the wind were blowing towards the U.S. Severe accidents, such as high speed crashes into immovable objects (like bridge abutments), crushing loads, or high-temperature, long-lasting fires, could also breach shipping casks and release disastrous amounts of hazardous radioactivity.

On November 17, 2001, the Gorleben International Peace Team, upon which the author served, issued the following findings⁸⁵ on its observations of human rights impacts associated with the transport and centralized interim storage of irradiated nuclear fuel and high-level radioactive waste that had just taken place in Germany amidst police state tactics to force the shipment through large-scale anti-nuclear protests:

1. Nuclear Energy and Radioactive Waste Inevitably Lead to Human Rights Violations
2. Police Anonymity and Lack of Accountability
3. Use of Excessive, Violent Police Force versus Non-Violent Sit-In Demonstrators
4. Police Playing Politics and Criminalising Demonstrators
5. Suspension of Citizens’ Constitutional Protections in order to Serve the Interests of the Atomic Industry

The serious injury of French anti-nuclear protestors at the hands of police during irradiated nuclear fuel shipments from La Hague to Gorleben in late 2010 show that such civil and human rights abuses have not been corrected over the course of the past decade.⁸⁶

Another useful tool that OPG, CNSC, CEEA, etc. could use to address irradiated nuclear fuel transportation risks at NND – as they should do -- is a report by the National Research Council of the National Academies of Science entitled “Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States,” published in 2006 by the National Academies Press in Washington, D.C. This study also identified significant safety, security, and even social acceptance issues that must be resolved before any large-scale transportation program for irradiated nuclear fuel can be launched onto the continents roads, rails, and/or waterways.

As summarized in Public Citizen’s analysis of the study entitled “Challenging Prerequisites for Safe Transport of Irradiated Nuclear Fuel Identified in NAS Study,”⁸⁷ the NAS reported that more research is needed in such areas as: full-scale crash testing of transport packages under severe accident conditions; a study of security issues; and a study of very-long-duration fires.

Also, NAS reported that DOE may not be up to the task, and that: it should avoid an extended truck transportation program, and should not begin large-scale transport of irradiated nuclear fuel until measures for mostly rail shipments are in place; it should make public its preferred routes for transporting irradiated nuclear fuel as soon as possible to support state, tribal, and local planning, especially for emergency response; DOE should fully implement its decision to use dedicated trains before beginning the large-scale shipment of waste; it should negotiate with nuclear utilities to ship older fuel first, and if the negotiations are not successful, Congress should consider a legislative requirement; and it should immediately carry out its emergency responder preparedness responsibilities required under federal law (the Nuclear Waste Policy Act, as Amended), including technical assistance and funding to states and tribes.

NAS also recommended that DOE, as well as the Department of Homeland Security, the Department of Transportation, and NRC should develop consistent and reasonable criteria for protecting sensitive information about irradiated nuclear fuel shipments and commit to publicly sharing and providing timely access to information that does not require protection. It stressed the importance of these various federal agencies remaining involved in the program, “in strict adherence to [safety] regulations.” It also stressed the importance of involving state and tribal governments, especially in route selection as well as emergency preparedness. Finally, NAS recognized the legitimacy of public concerns about the safety and security risks of irradiated nuclear fuel shipments.

2D. Risks of “De Facto Permanent” On-Site Storage

Although irradiated nuclear fuel in motion is particularly risky, it is also risky sitting still, especially over long time periods. As the GLU resolution 26 years ago found, “...the transportation of nuclear waste *and its storage* in the Great Lakes Basin present serious risks of spillage and irreversible contamination of surface and ground waters...”.⁸⁸ While the resolution was mostly focused on opposing geologic repositories for irradiated nuclear fuel and high-level radioactive waste targeted at sites in the Great Lakes Basin by both the DOE and Atomic Energy of Canada, Ltd. (AECL), it must be pointed out that “serious risks of spillage and irreversible contamination of surface and ground waters” increase over time, so long as so-called “interim” storage of irradiated nuclear fuel continues on-site at nuclear power plants. Such long-term storage has already gone on for several decades on the shorelines of the Great Lakes at certain sites. How many decades must pass before “interim” storage can begin to be regarded as *de facto* permanent storage?

But one example of many that could be cited, the Big Rock Point atomic reactor in northern Michigan, on the shoreline of Lake Michigan, has stored irradiated nuclear fuel on-site for 45 years now. Big Rock Point commenced operations in 1962 – four years before the Douglas Point atomic reactor on the Bruce Peninsula – and was permanently shut down in 1997. For 35 years, then, irradiated nuclear fuel was first stored in Big Rock Point’s waste storage pool. Then, with the pool’s dismantlement as part of the 1997 to 2006 decommissioning of the plant, the irradiated nuclear fuel has been transferred to dry casks not far from the Lake Michigan shore. With the Obama administration’s 2010 cancellation of the Yucca Mountain Project in Nevada, Big Rock Point’s irradiated nuclear fuel will now likely reside on-site for

many decades to come. In fact, the U.S. Nuclear Regulatory Commission (NRC) estimates that “interim” storage at Big Rock Point could go on for 120 years, if not longer. Given the uncertainties that still dog the concept of “geological disposal,” despite decades of industry support, and private and publicly funded research, the same could quite likely become the case with the irradiated nuclear fuel that would be generated by the proposed new reactors at Darlington Nuclear Generating Station.

In 1984, NRC first issued its Nuclear Waste Confidence Rule. Given the Orwellian nature of the decision, that kick off year was most appropriate. At that time, 27 years ago, NRC expressed “confidence” (hence the name) that one or more deep geologic repositories would open, somewhere in the U.S., by the 2007 to 2009 timeframe. However, by 1990, NRC decided to revise its “confidence,” ruling that “at least one” repository would open by 2025. In just six years, NRC’s “confidence” for an opening date for the first repository had slipped by as much as 18 years! In December, 2010, however, NRC’s “confidence” had slipped even further. NRC now states that it has “confidence” that within 120 years of the beginning of an atomic reactor’s operation, a “final resting place” for its irradiated nuclear fuel will be available. Specifically, NRC now states that irradiated nuclear fuel may be stored on-site at a reactor for 60 years of operations, and 60 years post reactor shut down. Returning to our previous example, 120 years of on-site storage at Big Rock Point would not expire until 71 years from now (1962 to 2082). However, the NRC Commissioners have directed NRC staff to investigate the potential for storing irradiated nuclear fuel at reactor sites for *centuries longer* than the already approved 120 year span. A century, let alone *centuries*, does not fit with most people’s understanding of what the words “temporary” or “interim” mean! Thus, NRC’s Nuclear Waste Confidence Rule may be more aptly described as a Nuclear Waste Confidence *Game*. A con game is any elaborate swindling operation in which advantage is taken of the confidence the victim (in this case the public) reposes in the swindler (in this case, the NRC). However, signaling that enough is enough, on February 16, 2011, the Attorneys General of the States of New York, Connecticut and Vermont filed a lawsuit against NRC over its Nuclear Waste Confidence Rule.⁸⁹

As shown by the Yucca Mountain dumpsite’s cancellation, OPG should not be allowed to simply assume that a deep geologic repository will open by 2035 in Canada to which NND’s irradiated nuclear fuel can be shipped. Such wishful thinking has no place in an EIS intended to protect public health, safety, security, and the environment against radiological risks. The website of the State of Nevada Agency for Nuclear Projects⁹⁰ is, again, the best single “repository” of documentation on the tortured history of the Yucca Mountain dumpsite proposal. This saga ended, after a 30 year ordeal, with the proposal’s termination by President Obama and DOE Secretary Chu in February 2010 when its annual budget request was zeroed out.

The Yucca dumpsite had served as the U.S. nuclear establishment’s illusion of a solution for the high-level radioactive waste problem for over a quarter century. It had already cost more than \$10 billion (although DOE’s latest estimate for the overall price tag of the project, if it had gone ahead, had risen to a whopping \$96.2 billion). The dumpsite’s opening had been regarded by many as a done deal just a couple years ago. But the scientific unsuitability of the site finally caught up with, and overtook, the raw political power play that had kept the wayward project on life support for decades. If the Yucca Mountain dumpsite can suffer such a sudden reversal, then OPG’s assumption that a Canadian “deep geologic repository” will open in as little as 24 years

from now is most inappropriate. Such a belief is much more an article of faith, than it is an established fact which could appropriately be included in an EIS and serve as the basis for decision making.

To emphasize the point yet further, Yucca was not even the U.S.'s first cancelled high-level radioactive waste dumpsite. The U.S. Atomic Energy Commission thought it had a winner in a salt formation at Lyons, Kansas in the late 1960s/early 1970s. But the AEC was forced to beat a hasty retreat when the Kansas Geological Society revealed that the site was literally full of holes: mineral extraction activity in the immediate vicinity had already ruined the site for use as a geologic repository for irradiated nuclear fuel "disposal."⁹¹ Numerous other countries have also had to long postpone, or outright cancel, opening dates for their first "deep geologic repositories," including the U.K., France, Germany, and Japan. OPG should not be allowed to assume that its NND irradiated nuclear fuel will simply begin to be transported away to someplace else in 2035.

OPG's reliance on the Nuclear Waste Management Organization (NWMO) for repository performance by 2035 is also most inappropriate. After all, OPG largely dominates NWMO. The conflict of interest is blatant. NWMO has also taken over management of the Bruce Deep Geological Repository (DGR) proposal just a kilometer or less from the shore of Lake Huron. While the OPG/NWMO DGR is "only" supposed to be for burial of so-called "low" and "intermediate" level radioactive wastes from 20 reactors across Ontario (including from Darlington Nuclear Generating Station), NWMO's takeover of the project raises the specter that *high*-level radioactive wastes may also be targeted for burial at the Bruce Nuclear Generating Station. As with the Yucca Mountain Project, geological – not to mention geographical -- unsuitability and uncertainty can present many an unexpected "show stopper" for proposed repositories. In fact, that has been the rule, not the exception, worldwide. Widespread resistance to such a radioactive waste repository on the shoreline of the Great Lakes can almost be guaranteed.

Again, lessons learned from such experiences in the U.S. can and should be applied at NND. For example, before Yucca Mountain's cancellation as a dumpsite, another policy reversal in the U.S. led to the piling up of irradiated nuclear fuel at the reactors that generated it in the first place. The U.S. had at first allowed for commercial irradiated nuclear fuel reprocessing from 1966 to 1976. It then prohibited it, first under the Republican Ford administration, beginning in October 1976. By April, 1977, the Democratic Carter administration had strengthened the ban on commercial irradiated nuclear fuel reprocessing. This bi-partisan agreement to ban reprocessing came in response to India's use of U.S. "atoms for peace" reprocessing technology, combined with a Canadian research reactor, to detonate its first nuclear explosive device in 1974. The policy change resulted in irradiated fuel piling up at reactor sites, first in pools, then in dry casks. It should serve as a cautionary tale for NND. OPG should not be allowed to "assume" that a deep geologic disposal site, or even a centralized interim storage site, for irradiated nuclear fuel will "magically" open by 2035. Such widely held illusions have been dispelled in the U.S., as at Yucca Mountain.

By the way, neither OPG/NWMO, nor the Canadian federal government, should consider reprocessing as an option for Canada's irradiated nuclear fuel. Besides the nuclear weapons

proliferation risks, plutonium extraction is also astronomically expensive for taxpayers and/or ratepayers; devastates the environment wherever it is carried out with radioactive contamination, with consequences for public health; and does not do away with the need for a long term management plan for high-level radioactive waste; on the contrary, it complicates long term isolation from the environment.

2E. Risks of Diversion of Irradiated Nuclear Fuel for Use in Radiological Dispersal Devices

An April 2005 GAO report⁹² showed that, far from securing and safeguarding irradiated nuclear fuel, NRC and multiple nuclear utilities (at Vermont Yankee, Millstone, and Humboldt Bay nuclear power plants) had actually *lost* irradiated nuclear fuel. Although it could not be conclusively proven, it was ultimately *assumed* that the irradiated nuclear fuel missing at Humboldt Bay had been pulverized on the bottom of the storage pool under the weight of a cask, while the missing irradiated fuel at Vermont Yankee and Millstone had been mistakenly shipped off and disposed of as “low” level radioactive waste, likely at the Barnwell, South Carolina, by dumping it in an unlined, leaking, shallow ditch. This GAO revelation points to the real risks of irradiated nuclear fuel theft leading to the proliferation of terrorist “dirty bombs.” NAS’s 2004/2005 report⁹³ findings and recommendations on this issue should be reconsidered in light of this GAO report, as should the downplaying and even dismissal of such risks at NDD in the current EIS and TSDs.

2F. Risks from Irradiated Nuclear Fuel to Civil Liberties and Democratic Norms

In addition to, and in direct connection with, the many radiological risks associated with irradiated nuclear fuel storage on-site at atomic power plants, as well as in transport, risks to civil liberties would likely be created by the construction and operation of NDD. Such risks created by NND must be given the attention they deserve in this proceeding as well. Infringements on civil liberties and negative impacts on democratic norms, due to the radiological and even nuclear weapons proliferation risks inherent in radioactive waste and nuclear power technologies, have been mentioned above. A couple additional, recent examples will further make the point.

Pennsylvania’s Office of Homeland Security has recently compared environmental activists with Al Qaeda terrorists.⁹⁴ This is quite ironic, since the vast majority of environmental activists, in addition to their dedication to protect life and its natural support systems, are often devoted to non-violent social change. More than once since the 9/11 attacks, non-violent anti-nuclear activists specifically have been singled out as potential security risks to atomic reactors and associated facilities (which would include irradiated nuclear fuel storage). This is especially ironic, given that anti-nuclear activists are dedicated to abolishing and isolating radiological risks, not unleashing them into the environment.

Another ironic example of nuclear power’s discord with democratic norms took place at an NRC environmental scoping hearing regarding the 20 year license extension proposal at

Davis-Besse nuclear power plant near Toledo. The “public” meeting was held at the Camp Perry military base. Concerned citizens and environmental advocates wishing to make public comments were required to government issued identification, and open their car trunk and other personal possessions to inspection by military guards.⁹⁵

3. Some Proposed Solutions: Expert Recommendations to Address the Risks

In April, 2002 the Institute for Energy and Environmental Research (IEER) coined the phrase “hardened on-site storage,” calling for it to be implemented as a necessary security upgrade at all nuclear power plants in the U.S. The concept was first articulated by IEER’s President, Dr. Arjun Makhijani, at a Citizens Awareness Network (CAN) symposium on high-level radioactive waste risks held at Wesleyan College in Middletown, Connecticut, U.S.A. This was followed on June 4, 2002 by an IEER media announcement, and attached “IEER Nuclear Waste Management Plan,” further explicating Hardened On-Site Storage (HOSS).⁹⁶ Dr. Makhijani argued that on-site storage of irradiated nuclear fuel had to be made more secure, in order to deter the likelihood that terrorists would choose to attack it to cause catastrophic radioactivity releases.

In January 2003, Dr. Gordon Thompson of the Institute for Resource and Security Studies (IRSS), commissioned by the Citizens Awareness Network (CAN), published the report “Robust Storage of Spent Nuclear Fuel: A Neglected Issue of Homeland Security.”⁹⁷ In this comprehensive report, which includes a graphic diagram depicting “robust” dry cask storage, Dr. Thompson argued that terrorists might even choose to detonate a nuclear weapon at a nuclear power plant in order to maximize the catastrophic radiological releases associated with vulnerable on-site stored irradiated nuclear fuel, in pools and/or dry casks. If terrorists wanted to maximize a “dirty bomb” attack, after all, why not do so by vaporizing an irradiated nuclear fuel storage pool, and/or concentrated, open air dry cask storage facility? Therefore, his proposed Design Basis Threat, against which robust dry cask storage should be measured, involved the detonation of a 10 kiloton nuclear explosive. His proposed “Robust Storage” would fortify and disperse the irradiated nuclear fuel stored on site, preventing a catastrophic radioactivity release even in the event of such a large-scale terrorist attack as an atomic weapon detonation, although undoubtedly some dry casks would still be breached or utterly destroyed by such a blast.

Thompson’s January 2003 report put significant “skin on the bones” of the hardened on-site storage (HOSS) concept first articulated by Dr. Arjun Makhijani at the CAN event at Wesleyan College, Middletown, Connecticut in April, 2002. Growing numbers of environmental groups across the country began to rally around the concept of HOSS as an alternative to such bad ideas as the Yucca Mountain dumpsite, the Skull Valley “parking lot dump,” reprocessing, or current vulnerable pool and dry cask storage.

The executive summary of Thompson's January 2003 report is attached to this submission as Appendix B.

In addition, on April 19, 2003, Dr. Gordon Thompson published a memo⁹⁸ describing an expert panel upon which he served at Gorleben, Lower Saxony, West Germany in 1979. The panel of independent scientists and technical experts – on which he served as the chair of the subgroup on hazards analysis -- debated irradiated nuclear fuel and high-level radioactive waste storage security and safety issues with representatives from industry and government regulatory agencies before state-level decision makers (during the height of the Three Mile Island meltdown, ironically), including the Governor of the State of Lower Saxony and several of his cabinet members. As described by Dr. Thompson:

On 16 May 1979 the governor announced that the Gorleben center would not be licensed as proposed. One of the unacceptable design features was the use of high-density spent-fuel pools. War risk was a major factor influencing this decision. Following this decision, Germany adopted a design for independent spent-fuel-storage installations (ISFSIs) in which spent fuel is stored dry in thick-walled casks housed in a building designed to resist antitank missiles. An ISFSI of this type now exists at Gorleben.

In the memo, Dr. Thompson asserts that the Gorleben decision making model is relevant to current day decision making on irradiated nuclear fuel storage policy in such places as the U.S. and Canada, stating that:

Key features of the model are: (a) independent scientists are provided with the time, payment and support that they need to develop carefully-considered findings; (b) lawyers and public-relations personnel are excluded; and (c) independent scientists debate government and industry scientists in front of decision makers. Much of the debate can be held publicly, as demonstrated by a forthcoming paper in the journal *Science and Global Security*. Sensitive issues can be debated in private sessions, using the same general model.

Thus, Thompson's "Gorleben 1979" memo's "lessons learned" should also be applied in the current NND proceeding.

On September 7, 2006, to mark the fifth commemoration of the 9/11 terrorist attacks, U.S. Representative Ed Markey (Democrat from Massachusetts) joined with the Nuclear Security Coalition in issuing a media release calling for hardened on-site storage of irradiated nuclear fuel.⁹⁹ Also on that day, the Nuclear Security Coalition delivered to every single one of the 535 Members of the U.S. Congress a letter calling upon them to support hardened on-site storage.¹⁰⁰ In its delivery to congressional offices, the Nuclear Security Coalition included a 14 minute presentation, prepared by the C-10 (Citizens Within the 10 Mile Radius of Seabrook Nuclear Power Plant) Research and Education Foundation and Citizens Awareness Network (CAN), entitled "Nuclear Spent Fuel and Homeland Security: The Case for Hardened Storage."¹⁰¹ Likewise, HOSS should be implemented at NND, as a "continental" or

“international” homeland security measure (as opposed to “national” security, since Lake Ontario and the St. Lawrence River is jointly shared between the U.S. and Canada, as well as many Native American Tribes and First Nations).

On September 13, 2006, over 150 national, regional, and grassroots environmental groups – with at least one group from each of the 50 states across the U.S. -- signed a “Statement of Principles for Safeguarding Nuclear Waste at Reactors.”¹⁰² The Statement, unveiled at a congressional hearing, outlined the basic principles of hardened on-site storage, and called upon Congress to require this needed national security upgrade at nuclear power plant sites across the country. An updated version of the Statement of Principles, published in March 2010 -- emphasizing opposition to reprocessing of irradiated nuclear fuel -- garnered even more nationwide support, with over 170 signatory organizations.¹⁰³

Key principles for safeguarding irradiated nuclear fuel on-site at reactors as an interim measure include:

- Requiring a low-density, open-frame layout for irradiated nuclear fuel storage pools;

- Establishing hardened on-site storage;

- Protecting irradiated nuclear fuel storage pools;

- Requiring periodic review of HOSS facilities and irradiated nuclear fuel storage pools;

- Dedicating funding to local and state governments to independently monitor the sites;

- And finally, prohibiting reprocessing.

“The Principles for Safeguarding Nuclear Waste at Reactors,” as well as the list of over 170 signatory organizations, is attached to this submission as Appendix C.

4. Application to New Nuclear Darlington (NND) Project

The applicability of these identified problems and solutions associated with the risks of irradiated nuclear fuel storage connected to the NND proposal are mentioned frequently in the sections above in the particular context of each point being discussed.

But to summarize, the Darlington Nuclear Generating Station, which already has four aged atomic reactors, and now proposes to build as many as four additional reactors on the same site, would thus constitute a more concentrated target for radiological terrorist attack than most nuclear power plants in the entire world. Far fewer atomic reactors at a single nuclear power

plant site are the norm in the U.S. (no site in the U.S. has more than three still operating reactors). If four new atomic reactors are constructed and operated at the Darlington Nuclear site under the NND proposal, the “radioactive bull’s eye” would simply grow even larger than it currently is. The irradiated nuclear fuel storage pools at the NND would eventually represent the greatest concentration of hazardous radioactivity on the site, just as the pools at the old Darlington Nuclear Generating Station do now. In terms of volatile, biologically hazardous, and long-lasting (300 to 600 years of hazard) Cesium-137, and other dangerous and deadly radioactive poisons, the irradiated nuclear fuel pools and un-hardened dry cask storage facilities would be vulnerable to potentially catastrophic radiological terrorist attack. Such concentrated radiological risks would be a tempting target for terrorists bent on unleashing a “dirty bomb” of catastrophic proportions, less than 50 miles (85 kilometers) from Canada’s largest metropolitan area.

For such reasons, both the “wet” and “dry” irradiated nuclear fuel storage facilities at NND (that is, pools and dry casks) must be designed, constructed, and operated to the highest standards of safety, security, environmental, and public health protection.

As the U.S. and Canada share the North American continent, especially along the Great Lakes and St. Lawrence River, the urgent call for hardened on-site storage (HOSS) south of the border, applies to the same need north of the border. After all, the Great Lakes and St. Lawrence form the drinking water supply for 40 million residents of both countries, not only U.S. and Canadian citizens, but also members of numerous sovereign Native American Tribes and First Nations.

HOSS should be carefully considered in this proceeding moving forward, and actually implemented at NND if the proposal goes ahead, as a safer and more protective (of public health and the environment, as well as the common defense, safety, and security) alternative than what is currently proposed in the OPG EIS and related TSDs. It is certainly cost-beneficial, when one considers the potentially catastrophic consequences that could unfold if terrorists “successfully” attack a fuel pool, or the disastrous consequences that could be unleashed onto the winds and waves if dry storage casks are “successfully” attacked.

These many risks identified above – whether risks to safety, security, public health, the environment, the common defense, civil liberties, or democratic norms of open, transparent, participatory, and accountable governance – all apply to NND, and should be given the most careful consideration, in this proceeding from here forward. Principles for Safeguarding Nuclear Waste, and Hardened On-Site Storage, should be implemented in earnest.

5. Summary and Recommendations

HOSS should be required at NND as a vital measure, albeit interim, for continental and Great Lakes Basin international security. This is most appropriate and timely, considering Prime Minister Harper and President Obama’s recent summit on border security. Nuclear power plants,

and especially their on-site stored highly radioactive wastes, are perhaps the most potentially catastrophic terrorist target on our shared border. They must be safeguarded against accident, secured against attack, and built well (or very likely even replaced someday with another, new hardened dry cask storage container) to protect against leaks into the environment over the long period of time that they will undoubtedly remain stored, once generated, on the Great Lakes shores.

However, securing the borders against radiological risks at nuclear power plants such as NND must be accomplished without sacrificing our civil liberties, or our democratic norms of open, transparent, participatory, and accountable governance. If nuclear power and radioactive waste are incompatible with our most cherished principles, then nuclear power must be abolished, and radioactive waste no longer generated. After all, efficiency and renewables such as solar and wind power can provide all the electricity we need, even as we phase out fossil fuels from our economy at the same time as we phase out nuclear power. Such a transition to carbon-free, nuclear-free energy could be accomplished affordably, for the same percentage of our Gross Domestic Product as we currently spend on expensive fossil fuel imports and nuclear power, and it could be accomplished with any further technological breakthroughs. All that is required to accomplish such a transition as early as 2040 is the political and societal will to do so.¹⁰⁴ After all, carbon-free and nuclear-free energy would not generate forever deadly¹⁰⁵ irradiated nuclear fuel that must be secured against terrorist attack at every stage of their on-site storage, transport, and long-term management.

END NOTES

¹ NK054-REP-07730-00029; Submitted To: Ontario Power Generation Inc.; Prepared By: SENES Consultants Limited, In Association With: MMM Group Limited; September 2009, posted online at http://www.ceaa.gc.ca/050/documents_staticpost/cearef_29525/0103/statement.pdf.

² As geologic disposal has yet to be proven safe, sound, or feasible anywhere in the world, a more conservative attitude is one of long term management, and isolation from the living environment, of the extremely long-lived, hazardous irradiated nuclear fuel. “Disposal” of this forever deadly man-made material has proven vexing and unworkable for nearly 70 years now, ever since Enrico Fermi first split the atom on December 2, 1942.

³ NK054-REP-07730-00027, Rev 000, Prepared by Nuclear Waste Management Division, Ontario Power Generation, Inc., August 2009.

⁴ NK054-REP-07730-00027, Rev 000, Submitted To: Ontario Power Generation Inc., Prepared by SENES Consultants Limited, September 2009.

⁵ Posted online at <http://www.glu.org/en/system/files/private/Energy-Development-and-Distribution-May-84.pdf>. GLU is a U.S.-Canadian-Native American-First Nations coalition, comprised of scores of groups, devoted to protecting and preserving the Great Lakes, 20% of the world's surface fresh water, drinking water supply for 40 million people, and life blood of one of the world's largest single regional economies.

⁶ Bennett Ramberg, "Nuclear Power Plants as Weapons For the Enemy: An Unrecognized Military Peril," University of California Press, 1985.

⁷ Posted online at <http://www.nirs.org/reactorwatch/security/osrenrdocument.pdf>.

⁸ Wasserman's article, "America's Nuclear Terrorist Threat to Itself," is posted online at <http://www.nirs.org/reactorwatch/security/wassermannukeseurity.htm>. He is also the author of numerous books, including: *The Energy War: Reports From the Front* (Independent Publishers Group, 1979); *Killing our Own: the Disaster of America's Experience with Atomic Radiation* (with Norman Solomon, Robert Alvarez and Elenor Walters, Delacorte Press, 1982); *The Last Energy War: the Battle over Utility Deregulation* (Open Media, 2000); *Harvesting Wind Energy as a Cash Crop: a Guide to Local-Owned Wind Power* (with Dan Juhl, Danmar.us, 2002); and most recently *Solartopia!: Our Green-Powered Earth AD 2030* (Harveywasserman.com, 2006). He also serves as Senior Advisor to Greenpeace U.S.A. as well as Nuclear Information and Resource Service (NIRS).

⁹ The Nuclear Information and Resource Service (NIRS) media release is posted online at <http://www.nirs.org/press/10-12-2001/1>. The environmental coalition's letter to the NRC chairman is posted online at <http://www.nirs.org/reactorwatch/security/nrcltrmeserveinfoblackout011015.htm>.

¹⁰ Posted online at <http://www.nirs.org/reactorwatch/security/neisterroristpaper.htm>.

¹¹ See Canadian Prime Minister Stephen Harper's Feb. 4, 2011 media release "PM and U.S. President Obama announce shared vision for perimeter security and economic competitiveness between Canada and the United States: Leaders also create bilateral Regulatory Cooperation Council (RCC) to reduce red tape for businesses" posted online at <http://www.pm.gc.ca/eng/media.asp?category=1&featureId=6&pageId=26&id=3931>. See also the White House Office of the Press Secretary's "Joint Statement by President Obama and Prime Minister Harper of Canada on Regulatory Cooperation" posted online at <http://www.whitehouse.gov/the-press-office/2011/02/04/joint-statement-president-obama-and-prime-minister-harper-canada-regul-0>. The relevance of this U.S.-Canadian summit to NND is underscored by the two leaders' announcement of the creation of a U.S.-Canada Regulatory Cooperation Council (RCC), as well as reception of the Second Report to Leaders on the U.S.-Canada Clean Energy Dialogue (CED). This would all seem to indicate that NRC and CNSC will likely interface more and more as time goes on such issue as nuclear power plant and irradiated nuclear fuel storage facility security, most especially along the shared border.

¹² The full text of the mandate is posted at <http://www.nirs.org/reactorwatch/security/mandateforsecuringamerica.htm>.

¹³ The November 1, 2001 coalition media release is posted online at <http://www.nirs.org/press/11-01-2001/1>.

¹⁴ See the biography of Robert Alvarez posted online at <http://www.ips-dc.org/staff/bob>.

¹⁵ This article is posted online at <http://www.nirs.org/radwaste/atreactorstorage/alvarezarticle2002.pdf>.

¹⁶ The full report is posted online at <http://www.pogo.org/pogo-files/reports/nuclear-security-safety/voices-from-inside-the-fences/>.

¹⁷ Posted online at http://www.pogo.org/pogo-files/reports/nuclear-security-safety/voices-from-inside-the-fences/#NRC_Turns_Blind_Eye_to_Spent_Fuel_Pools.

¹⁸ This chapter is posted online at http://www.pogo.org/pogo-files/reports/nuclear-security-safety/voices-from-inside-the-fences/#Decommissioning_Reactors_NRCs_Poor_Stepc.

¹⁹ The article is posted online at <http://www.nytimes.com/2002/10/20/us/guards-at-nuclear-plants-feel-swamped-by-overtime-deluge-in-the-wake-of-9-11.html?src=pm>.

²⁰ The NRC ruling is posted online at <http://www.nirs.org/reactorwatch/security/secnrcorder12172002pfs.pdf>.

²¹ The Private Fuel Storage, Limited Liability Corporation proposal to store 4,000 dry casks, containing 40,000 metric tons of irradiated nuclear fuel, in an open air, surface "parking lot" type

facility at the tiny Skull Valley Goshutes Indian Reservation just west of Salt Lake City. In addition to the security vulnerability of concentrating so much irradiated nuclear fuel in one outdoor location, 437 environmental and social justice organizations implored NRC to not license the facility due to environmental justice considerations. See the coalition's letter posted online at <http://www.nirs.org/radwaste/scullvalley/skullvalleygoshutesgroupltr772005.pdf>.

²² Dr. Gordon Thompson, Institute for Resource and Security Studies (IRSS), "Robust Storage of Spent Nuclear Fuel: A Neglected Issue of Homeland Security," January 2003, posted online at <http://www.nirs.org/reactorwatch/security/sechossrpt012003.pdf>; the report's executive summary is posted online at <http://www.nirs.org/reactorwatch/security/sechosses012003.pdf>.

²³ "NRC Denies Licensing Contentions on the Risk of Sabotage At U.S. Nuclear Facilities," *Nuclear Monitor* newsletter, January 2003, posted online at <http://www.nirs.org/reactorwatch/security/secnmart01142003nrcnixcontentions.pdf>.

²⁴ GAO's report is entitled "NUCLEAR REGULATORY COMMISSION: Oversight of Security at Commercial Nuclear Power Plants Needs to Be Strengthened," and is posted online at <http://www.nirs.org/reactorwatch/security/secgao2003nrcsecurityneedsstrength.pdf>.

²⁵ *The 9/11 Commission Report: Final Report of the National Commission on Terrorist Attacks Upon the United States*, "Outline of the 9/11 Plot," Staff Statement No. 16, pp.12 – 13, posted online at http://www.9-11commission.gov/staff_statements/staff_statement_16.pdf.

²⁶ *Calculation of Reactor Accident Consequences (CRAC-2)*, NRC and Sandia National Lab, 1982. A chart showing *CRAC-2's* casualty and property damage consequences, reactor by reactor, for large-scale radioactivity releases due to a major accident, is posted online at <http://www.beyondnuclear.org/storage/CRAC%202%20chart.pdf> (note, this chart was prepared by the author, based on the results reported in *CRAC-2*).

²⁷ The petition for rulemaking, PRM-73-12, is posted online at <http://www.nirs.org/reactorwatch/security/secbcpetitionrule2004.pdf>.

²⁸ See the NIRS action alert posted online at <http://www.nirs.org/alerts/11-16-2004/1>.

²⁹ Lipoti's letter is posted online at <http://www.nirs.org/reactorwatch/security/secnjdepltrnrc2004oysterck.pdf>.

³⁰ Robert Alvarez, Jan Beyea, Klaus Janberg, Jungmin Kang, Ed Lyman, Allison Macfarlane, Gordon Thompson, and Frank N. von Hippel, "Reducing the hazards from stored spent power-reactor fuel in the United States" *Science & Global Security*, Vol. 11, No. 1, 2003, January 2003. This article is posted online at http://www.princeton.edu/%7Eglobsec/publications/pdf/11_1Alvarez.pdf. *Science & Global Security* is published by the Program on Science and Global Security (SGS), based at Princeton University's Woodrow Wilson School of Public and International Affairs in New Jersey, U.S.A.

SGS has carried out research and policy analysis and education and training in nuclear arms control and nonproliferation for more than three decades.

³¹ Additional information on the NAS report “Safety and Security of Commercial Spent Nuclear Fuel Storage” (issued in classified form in July 2004, and a redacted public version on April 6, 2006) can be found in Appendix A attached to this submission.

³² The petition is posted online at <http://www.nirs.org/reactorwatch/security/bwrfuelpool2206petition08102004.pdf>. Its annex, including comprehensive background information, is posted online at <http://www.nirs.org/reactorwatch/security/bwrfuelpool2206annex08102004.pdf>. The list of “U.S. Commercial Reactors with Elevated Irradiated Fuel Storage Ponds,” as well as the list of signatory organizations to the emergency enforcement petition, is posted online at <http://www.nirs.org/reactorwatch/security/bwrfuelpoolreactorlist08102004.pdf>.

³³ In January 2001, NRC published its final draft of “Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants,” (NUREG-1738). The October 2000 draft of this report is posted online at <http://www.nirs.org/reactorwatch/security/secnrcsfstudy102000.pdf>. Although this report focused on accidental heavy load drops into waste storage pools at decommissioned nuclear power plants, the risk consequences of a pool drain down are equally applicable to terrorist attacks at operating nuclear power plants. NRC reported that “the consequences of a zirconium fire could be serious,” that the loss of cooling water in a waste storage pool could lead to around 25,000, or more, latent fatal cancers downwind, with deaths occurring as far as 500 miles away. The report’s Appendix 2D, “STRUCTURAL INTEGRITY OF SPENT FUEL POOL STRUCTURES SUBJECT TO AIRCRAFT CRASHES,” is posted online at <http://www.nirs.org/reactorwatch/security/secnrcsfstudy2000aircraft.pdf>.

³⁴ This GAO testimony is posted online at <http://www.nirs.org/reactorwatch/security/secgao2004nrcpreliminaryobv.pdf>.

³⁵ Edwin S. Lyman, Ph.D., *Chernobyl on the Hudson? The Health and Economic Impacts of a Terrorist Attack at the Indian Point Nuclear Plant*, Union of Concerned Scientists, September, 2004, available on the internet at: http://www.ucsusa.org/nuclear_power/nuclear_power_risk/sabotage_and_attacks_on_reactors/impacts-of-a-terrorist-attack.html.]

³⁶ The list of airports within 10 miles of U.S. nuclear power plants is posted online at <http://www.nirs.org/reactorwatch/security/securityairports10milesfnukes.pdf>.

³⁷ NRC staff’s “proposed director’s decision” is posted online at <http://www.nirs.org/reactorwatch/security/bwrnsc2206propdd06292005ml0512500100.pdf>.

³⁸ This final NRC staff denial is posted online at <http://www.nirs.org/reactorwatch/security/gebwr2206sfpvulnerabilityresponsetocommentsproposeddecision11082005.pdf>.

³⁹ This statement and announcement of its appeal are posted online at <http://www.nirs.org/reactorwatch/security/nscresponsercrejectsbnrpetition.pdf>.

⁴⁰ November 7, 2005 Notice of Proposed Rulemaking (RIN-3150-AH60), to amend the Design Basis Threat regulations for nuclear power plants and nuclear materials facilities, posted in the Federal Register, Volume 70, Number 214, Page 67380-67388.

⁴¹ NIRS's comments are posted online at <http://www.nirs.org/reactorwatch/security/security02222006dbtprmnirscomts.pdf>.

⁴² NUCLEAR POWER: Plants Have Upgraded Security, but the Nuclear Regulatory Commission Needs to Improve Its Process for Revising the Design Basis Threat, Statement of Jim Wells, Director Natural Resources and Environment, GAO, Testimony Before the Subcommittee on National Security, Emerging Threats, and International Relations, House Committee on Government Reform, April 6, 2006, posted online at <http://www.nirs.org/reactorwatch/security/sec04042006gaorpt.pdf>.

⁴³ The NIRS media release is posted online at <http://www.nirs.org/press/05-15-2007/1>.

⁴⁴ See the letter posted online at http://markey.house.gov/index.php?option=com_content&task=view&id=2836.

⁴⁵ See <http://blogs.abcnews.com/theblotter/2007/07/goa-stings-nucl.html>.

⁴⁶ A still photo from "Asleep at the Switch" is posted online at <http://www.nirs.org/reactorwatch/security/securityhome.htm>.

⁴⁷ POGO's media release is posted online at <http://www.nirs.org/reactorwatch/security/pogoonpbottomsecurity101007.pdf>.

⁴⁸ Greenpeace USA's comments are posted online at <http://www.nirs.org/reactorwatch/security/gpcommentsaircraft.pdf>.

⁴⁹ Posted online at <http://www.beyondnuclear.org/security/2009/7/8/virtual-reconnaissance-and-the-security-threats-from-nuclear.html>.

⁵⁰ See, for example, "Is public at risk if nuclear plants are attacked? NRC is considering toughening security regulations," by CHUCK CRUMBO, *The State* (South Carolina), Sunday, Jan. 31, 2010, posted online at http://www.beyondnuclear.org/storage/Reactor_Security_TheState_Jan2010.pdf.

⁵¹ “Ice truck enters VY with no inspection,” by Bob Audette, *Brattleboro Reformer*, Feb. 8, 2010.

⁵² See <http://www.beyondnuclear.org/security/2010/3/12/suspected-al-qaeda-member-worked-at-6-us-reactor-sites.html>.

⁵³ Posted online at http://www.nytimes.com/2010/05/06/opinion/06Faddis.html?_r=1.

⁵⁴ “A Silent Attack, but Not a Subtle One,” by John Markoff, *New York Times*, Sept. 26, 2010, posted online at http://www.nytimes.com/2010/09/27/technology/27virus.html?_r=1.

⁵⁵ The October 2000 draft of this report is posted online at <http://www.nirs.org/reactorwatch/security/secnrcsfstudy102000.pdf>.

⁵⁶ Posted online at <http://www.nirs.org/reactorwatch/security/secnrcsfstudy2000aircraft.pdf>.

⁵⁷ For further information on this incident, see <http://www.nirs.org/reactorwatch/licensing/caskdanglesummaryreport4406.pdf>, the April 4, 2006 “Summary Report on High-Level Atomic Waste Mishap at Palisades Nuclear Reactor Risks Radioactive Inferno with Casualty Potential of Thousands of Deaths Downwind, Based Upon U.S. Nuclear Regulatory Commission Freedom of Information Act (FOIA) Response Documents.”

⁵⁸ Robert Alvarez, Jan Beyea, Klaus Janberg, Jungmin Kang, Ed Lyman, Allison Macfarlane, Gordon Thompson, and Frank N. von Hippel published “Reducing the hazards from stored spent power-reactor fuel in the United States” in *Science & Global Security*, Vol. 11, No. 1, 2003, p. 6. This article is posted online at http://www.princeton.edu/%7Eglobsec/publications/pdf/11_1Alvarez.pdf. *Science & Global Security* is published by the Program on Science and Global Security (SGS), based at Princeton University’s Woodrow Wilson School of Public and International Affairs in New Jersey, U.S.A. SGS has carried out research and policy analysis and education and training in nuclear arms control and nonproliferation for more than three decades.

⁵⁹ A Report for the Massachusetts Attorney General by IRSS, May 2006, NRC Electronic Library, Adams Accession Number ML061630088.

⁶⁰ Dr. Gordon Thompson, “Scope of the EIS for New Nuclear Power Plants at the Bruce Site in Ontario: Assessment of Accidents and Malfunctions,” Prepared under the sponsorship of Greenpeace Canada, Institute for Resource and Security Studies, Cambridge, Massachusetts, May 2008.

⁶¹ Tom Cousins and Barbara Reichmuth, “Preliminary Analysis of the Economic Impact of Selected RDD Events in Canada,” presentation at the CRTI Summer Symposium 2007,

Gatineau, Quebec, 11 – 14 June 2007. CRTI is the CBRNE Research and Technology Initiative, a program of Defence Research and Development Canada. The conference proceedings (available from CRTI) list the presentation as CRTI 05-0043RD, entitled “Economic Impact of Radiological Terrorist Events.”

⁶² The author’s August 2010 backgrounder “Epidemic of Radioactivity Leaks from U.S. Nuclear Plants Includes Irradiated Fuel Pools” is posted online at <http://www.beyondnuclear.org/storage/pool%20leaks%20fact%20sheet.pdf>. A leak from the Hatch nuclear power plant in Georgia will be added to a forthcoming update to the backgrounder.

⁶³ The *REPORT ON BIOACCUMULATION OF ELEMENTS TO ACCOMPANY THE INVENTORY OF RADIONUCLIDES IN THE GREAT LAKES BASIN* is posted online at <http://www.ijc.org/rel/boards/nuclear/bio/index.html>. The December 1997 *INVENTORY OF RADIONUCLIDES FOR THE GREAT LAKES* itself is posted online at <http://www.ijc.org/php/publications/html/invrep/index.html>. In addition, the *Nuclear Task Force Chapter of the 1995-97 Priorities and Progress Under the Great Lakes Water Quality Agreement* is posted online at <http://www.ijc.org/rel/boards/nuclear/pr9597.html>.

⁶⁴ Beyond Nuclear’s media release on the incident is posted online at <http://www.beyondnuclear.org/nuclear-reactors-whatsnew/2010/1/21/nrc-issues-notice-of-violation-to-entergy-nuclear-palisades.html>.

⁶⁵ See Nuclear Information and Resource Service (NIRS) backgrounder entitled “Armor Piercing Missile Perforates High-Level Radioactive Waste Storage/Transport Cask In U.S. Army Aberdeen Proving Ground Test,” posted online at <http://www.nirs.org/factsheets/nirsfctshdrycaskvulnerable.pdf>.

⁶⁶ These figures have calculated by Dr. Marvin Resnikoff of Radioactive Waste Management Associates in New York, New York, and were communicated to the author in a private communication via telephone several years ago. Dr. Resnikoff is assured that his figures are conservative, for they only account for the five radioactive isotopes of cesium, which are particularly volatile, but not the scores of additional radionuclides present in the irradiated nuclear fuel, many of which are biologically hazardous.

⁶⁷ Dr. Gordon Thompson, “Scope of the EIS for New Nuclear Power Plants at the Bruce Site in Ontario: Assessment of Accidents and Malfunctions,” Prepared under the sponsorship of Greenpeace Canada, Institute for Resource and Security Studies, Cambridge, Massachusetts, May 2008.

⁶⁸ The full statement is posted online at <http://www.nirs.org/radwaste/atreactorstorage/statement1999.htm>.

⁶⁹ The full statement is posted online at

<http://www.nirs.org/radwaste/atreactorstorage/nrccommissionersmeetingdrycask61101.pdf>.

⁷⁰ See <http://www.nirs.org/reactorwatch/licensing/sinclairltr020697.pdf> for the February 6, 1997 letter from Dr. Mary Sinclair, Ph.D., co-chair of Don't Waste Michigan, to the five NRC Commissioners, highlighting possible perjury – as well as clearly established incompetence – by NRC staff when it assured a federal judge that dry storage casks could be safely unloaded at Palisades.

⁷¹ A February 17, 1994 letter from Dr. Ross Landsman, NRC Region III dry cask storage inspector, to NRC Chairman Ivan Selin, warned about the risk at Palisades that an earthquake could result in high-level radioactive waste storage casks falling into Lake Michigan or being buried in loose sand. The letter is posted online at <http://www.nirs.org/reactorwatch/licensing/021794rosslandsmanltrnrcchairmanselin.pdf>. Dr. Landsman wrote “Actually, its (sic) the consequences that might occur from an earthquake that I’m concerned about. The casks can either fall into Lake Michigan or be buried; in the loose sand because of liquefaction...It is apparent to me that NMSS doesn’t realize the catastrophic consequences of their continued reliance on their current ideology.” Underwater submersion could lead to inadvertent nuclear chain reactions in the fissile materials still present in the wastes; burial under sand could cause the wastes to dangerously overheat.

In April 2006, NIRS’s and its environmental coalition’s 10 CFR 2.206 (Title 10, Code of Federal Regulations, Part 2.206) emergency enforcement petition to the NRC Executive Director for Operations, and supporting declaration by Dr. Ross Landsman, warned that Palisades' dry cask storage pads violate NRC earthquake safety regulations. With no safe place to store its high-level radioactive wastes, intervenors argued that Palisades should be denied a 20 year license extension, and should be forced to shut down. See <http://www.nirs.org/reactorwatch/licensing/2.206.pdf> and <http://www.nirs.org/reactorwatch/licensing/landsmandec.pdf>.

On February 2, 2007 NIRS responded to NRC staff’s recommendation that its enforcement petition be rejected. See <http://www.nirs.org/reactorwatch/licensing/020207finalcomments.pdf>.

On June 27, 2007, the NRC staff only partially granted, but largely rejected, consideration of NIRS’s 10 CFR 2.206 emergency enforcement petition. See <http://www.nirs.org/reactorwatch/licensing/2206reviewltr.pdf>.

On June 28, 2007, NIRS issued a media release, “Citizen Groups Appeal to Federal Court against Palisades Nuclear Plant: Charge High-Level Radioactive Waste Storage Violates Safety Regulations.” See <http://www.nirs.org/press/06-28-2007/1>.

On August 2, 2007, NRC moved to dismiss the NIRS/environmental coalition lawsuit before the D.C. Circuit Court of Appeals. See <http://www.nirs.org/reactorwatch/licensing/finalmotiontodismiss080207.pdf>.

On August 17, 2007, NIRS and the environmental coalition defended their appeal to the U.S. Circuit Court for the District of Columbia against the NRC motion to dismiss. See <http://www.nirs.org/reactorwatch/licensing/respsdmsreally.pdf>.

Finally, on August 23, 2007, NIRS issued a media release regarding its defense of the coalition federal court appeal. See <http://www.nirs.org/press/08-23-2007/2>.

In the end, the Court of Appeals ruled in favor of NRC, against the environmental coalition's appeal. Thus, the dry cask storage facilities at Palisades remain vulnerable to earthquakes, in violation of NRC safety regulations.

⁷² Kamps' testimony is posted online at <http://www.nirs.org/radwaste/atreactorstorage/submissiontocnsconwwmfatbruce.pdf>.

⁷³ The media release is posted online at <http://www.nirs.org/radwaste/atreactorstorage/psottawa91302.pdf>.

⁷⁴ This backgrounder is posted online at <http://www.nirs.org/radwaste/atreactorstorage/drycaskfactsheet07152004.pdf>.

⁷⁵ Posted online at <http://www.nirs.org/radwaste//atreactorstorage/shiranialeg04.htm>.

⁷⁶ Landsman's memo to his superiors at NRC is posted online at http://www.nirs.org/radwaste/atreactorstorage/nrc_holtec.pdf.

⁷⁷ The court ruling is posted online at <http://www.nirs.org/reactorwatch/security/9thcirdec.pdf>.

⁷⁸ Posted online at <http://www.nirs.org/radwaste/atreactorstorage/mfpnrhearing7108.pdf>.

⁷⁹ Posted online at <http://www.glu.org/en/system/files/private/Energy-Development-and-Distribution-May-84.pdf>. GLU is a U.S.-Canadian-Native American-First Nations coalition, comprised of scores of groups, devoted to protecting and preserving the Great Lakes, 20% of the world's surface fresh water, drinking water supply for 40 million people, and life blood of one of the world's largest single regional economies.

⁸⁰ See <http://www.state.nv.us/nucwaste/trans.htm>.

⁸¹ Background information is posted online at <http://www.state.nv.us/nucwaste/news/fr13se99-30.htm>.

⁸² Thirteenth International Symposium on Packaging and Transportation of Radioactive Materials PATRAM. September 2-7, 2001. Chicago, Illinois.

⁸³ Published in its "Plutonium Investigation" Number 6-7, May-June 1998, which can be found online at http://www.beyondnuclear.org/storage/no6_7.pdf.

⁸⁴ An October 25, 2001 Nuclear Information and Resource Service media release about DOE's decision is posted online at: <http://www.nirs.org/press/10-25-2001/1>.

⁸⁵ See <http://www.nirs.org/radwaste/hlwtransport/giptpoints1117.htm>. The Gorleben International Peace Team also issued a media release on November 17, 2001 media release documenting the civil and human rights abuses during the German irradiated nuclear fuel shipments: <http://www.nirs.org/press/11-17-2001/1>.

⁸⁶ See <http://www.beyondnuclear.org/civil-liberties/2010/11/9/anti-nuclear-protestors-seriously-injured-by-french-police-d.html>.

⁸⁷ Posted online at <http://www.citizen.org/documents/NASTransportstudy.pdf>.

⁸⁸ Passed on May 19, 1985, posted online at <http://www.glu.org/en/system/files/private/Nuclear-Waste-May-85.pdf>.

⁸⁹ "3 States Challenge Federal Policy on Storing Nuclear Waste," Matt Wald, *New York Times*, Feb. 15, 2011, posted online at http://www.nytimes.com/2011/02/16/nyregion/16nuke.html?_r=2&scp=2&sq=nuclear&st=cse.

⁹⁰ www.state.nv.us/nucwaste

⁹¹ See the history of the aborted Lyons, Kansas dumpsite in Donald L. Barlett and James B. Steele's *Forevermore: Nuclear Waste in America*, with information posted online at <http://www.barlettandsteele.com/books/forevermore.php>.

⁹² The report, entitled "NUCLEAR REGULATORY COMMISSION: NRC Needs to Do More to Ensure that Power Plants Are Effectively Controlling Spent Nuclear Fuel," is posted online at <http://www.nirs.org/radwaste/atreactorstorage/gao04112005nrclostnwaste.pdf>.

⁹³ See Appendix A attached to this submission for additional information.

⁹⁴ See a news article on this at <http://www.beyondnuclear.org/civil-liberties/2010/11/8/pennsylvanias-office-of-homeland-security-compares-environe.html>.

⁹⁵ See news coverage at <http://www.beyondnuclear.org/civil-liberties/2010/11/4/like-to-comment-on-reactor-safety-and-environmental-impacts.html>.

⁹⁶ The release and plan is posted online at <http://www.ieer.org/comments/waste/yuccaalt.html>.

⁹⁷ The full report is posted online at <http://www.nirs.org/reactorwatch/security/sechossrpt012003.pdf>. The report's executive summary is posted online at <http://www.nirs.org/reactorwatch/security/sechosses012003.pdf>.

⁹⁸ The memo is posted online at <http://www.nirs.org/reactorwatch/security/gordongorlebenmemo41803.htm>.

⁹⁹ The media release is posted online at <http://www.nirs.org/press/09-07-2006/1>.

¹⁰⁰ The letter is posted online at <http://www.nirs.org/reactorwatch/security/hoss09072006nsccong.pdf>.

¹⁰¹ The presentation is posted online at http://www.c-10.org/spent_fuel.html.

¹⁰² The Statement of Principles is posted online at: <http://www.citizen.org/documents/PrinciplesSafeguardingIrradiatedFuel.pdf>.

¹⁰³ It is posted at <http://216.250.243.12/ieer/pdfs/HOSS%20PRINCIPLES%203%2023%202010x.pdf>.

¹⁰⁴ See, for example, Dr. Arjun Makhijani's 2007 book Carbon-Free and Nuclear-Free: A Roadmap for U.S. Energy Policy, IEER Press, posted online at <http://www.ieer.org/carbonfree/index.html>.

¹⁰⁵ The U.S. Environmental Protection Agency (EPA), in its court ordered re-write of its Yucca Mountain Project radiation release regulations, now recognizes a one million year hazard associated with irradiated nuclear fuel and high-level radioactive waste. However, such a mind boggling time span still does not comprehend such hazardous radioactive isotopes as Iodine-129, which has a 15.7 million year half life, and thus at least 157 million years of hazard.