

Interim Storage Partners:
Transportation of the Inventory and the
Storage of Highly Radioactive Waste Materials.



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October 2018

¹ Image was taken from: <https://opinion.premiumtimesng.com/2016/05/23/172942/>

TABLE OF CONTENTS

ABSTRACT	4
THREAT ENVIRONMENT	6
Target Environment	6
Target Profile	8
Worldwide.....	9
Domestic	10
Attacks.....	13
Wastes as Targets	17
Symbolism.....	20
Dangerous Cargoes	22
Lessons Learned.....	24
ISP PARTNERSHIP.....	25
CONSEQUENCES	31
Radiological Impacts	31
Economic Impacts.....	34
Data	36
Direct.....	37
Indirect	38
Stigma	38
Social Consequences.....	40
Social Groups	41
Anomie/Social Ennui	42
Social Dislocation	42
Social-Psychological	43
Social Cohesion	43



Political Impacts.....	44
Jurisdiction	44
Presumption of Response	45
Political Consequences	46
Legal Aspects	47
Liability	49
Analytical Typology	51
Matrix Example	51
INFORMED CONSENT	53
T ₁ – Transportation	54
T ₂ – Terrorism (HIE).....	55
T ₃ - Tribal Lands.....	56
T ₄ - Trust.....	57
Implications	58
RECOMMENDATIONS.....	60
AUTHOR’S BIOGRAPHY.....	69



ABSTRACT

This report focuses on the radiological safety and security implications for the proposed Interim Storage Partners (ISP) Consolidated Interim Storage Facility (CISF) in Andrews County, Texas.² It analyzes the implications for nuclear waste transportation/storage policies regarding potential Human Initiated Events (HIE) against commercial spent nuclear fuel (SNF)³ and Greater than Class C (GTCC) highly radioactive waste shipments and their storage at the proposed facility in Andrews County.^{4,5}

This document focuses on the following topics in preparation for comment and intervention by the October 2018 deadlines. This report includes discussions that will inform potential testimony and acts as pre-testimony consultation on:

- Analysis of the potential threats to waste shipments/storage by a HIE on any of the end of the fuel cycle operations that would constitute the supply chain for a proposed CISF.

² See ISP statement regarding the Orano, USA (Orano) and Waste Control Specialists (WCS) partnership underlying this CISF proposal: <http://us.aveva.com/EN/home-4039/orano-iv-wcs-cisf.html>

³ Some people in the energy industry and government have started to use the term ‘used nuclear fuel’. This report will use the more well-known term of spent nuclear fuel for more universal understanding by those transit and termination communities that will be impacted by this proposed CISF in Andrews County, Texas.

⁴ The ISP Environment Report (USNRC Docket # 72-1050) focuses on SNF and greater than class C wastes from NPP operations. The former Yucca Mountain Project included high-level wastes (HLW) and suggested defense wastes may have been destined for Yucca Mountain as well. This listing of only two waste types for the facility in Texas (SNF and GTCC) was communicated by ISP, despite federal regulations (10 CFR, Section 72) which focus on “Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste.” The listing of high level wastes listed in 10 CFR, Section 72 creates ambiguity for the materials that will be transported and stored at the Texas facility. This is problematic since safety and security considerations might be different for these dissimilar types of wastes. The presentation herein assumes that the totality of materials that would have been transported and stored at Yucca Mountain is logically going to be stored at the Texas CISF since it is a stop gap storage solution until a long-term geologic repository can be sited.

⁵ One stakeholder has articulated various concerns about the potential ‘regional’ CISF’s being considered by the NRC in New Mexico (Holtec) and Texas (ISP). These issues include: 1) The transportation component of the EIS for any CISF application should take into account the policies of the WIEB HLRW Committee; 2) The transportation component of the EIS for any CISF application should fully evaluate all reasonable modes and routes; and 3) The transportation component of the EIS for any CISF application should consider all facets of a SNF/HLW (GTCC) transportation program that could influence the safety of the public and the environment. See July 27, 2018 letter to the NRC from the Western Interstate Energy Board (WIEB) High-Level Radioactive Waste (HLRW) Committee. Also note that the idea behind the use of interim storage was to be a regional idea, not one or two western US based facilities (per the WIEB webpage). This western based siting policy choice has severe implications for the state of Texas and the many transit communities the wastes travel through to reach this destination or the one nearby in New Mexico. The issue is regional inequity of the placement of CISF’s. The vast majority of reactors, and respective SNF and GTCC, are in the Eastern half of the United States. This regional radiological risk inequality is not just objectionable on its face, but it significantly exacerbates transport risks, given the distance that needs to be traveled. This inequality is in addition to any other issues that are present: tribal economic exploitation, environmental injustice, the yet to be determined suitability of the New Mexico/Texas CISF sites, the lack of consent-based siting, etc.

- The unique nature of the ISP organization *vis-à-vis* waste transport/storage and potential issues directly associated with said relationships.
- Preliminary appraisal of the consequence assessment methodology necessary for such actions and as a valid concern prior to the advent of any shipment campaign for these highly radioactive materials and that also apply to storage operations.
- Preliminary assessment of the informed consent process from the various communities (local, tribal, state and state-regional groups) that would be involved in consenting for the proposed Texas CISF facility.⁶

⁶ In response to the BRC findings some movement was made on consent for siting of waste facilities. When the DOE sought public comments on informed consent based siting processes during the public comments/hearings, one comment was telling. The Institute for Energy and Environmental Research (IEER) said “Informed consent is all the more necessary in regard to an issue as fraught as nuclear waste, including spent fuel (which contains the vast majority of radioactivity in all nuclear waste)... What should be the standard of informed consent in regard to matters involving security for eons (given the plutonium-239 content of spent fuel) and involving health risks for even longer, given that the half-lives of some fission products, like iodine-129 and cesium-135 are in the millions of years? Informed consent can never be in the abstract: it is the obligation of the DOE to inform the public exactly what is involved. The DOE has fallen very far short of what is needed in its discussion of ‘Integrated Waste Management.’ Since the DOE is seeking comment on what a “consent-based siting process” should consist of, IEER is setting forth some minimal requirements.” See <https://ieer.org/resource/repository/comments-doe-consent-based-siting-nuclear-waste-2016/>. The status of the DOE as title holder/funder for the transportation efforts and the CISF is unclear currently given the legality of their involvement and the recommendations by non-partisan review boards suggesting the DOE exclusion from the whole storage process after decades of mismanagement, poor planning and the failure of siting the Yucca Mountain facility. These recommendations are understandable given the lack of progress after over three decades of geologic repository siting by the DOE and after huge expenditures, scandals at this agency and on-going failure to accomplish this task.

THREAT ENVIRONMENT

This report will start with a discussion on the risks the shipments and storage facility might face given the threat environment of contemporary society and recognizing the upheaval in worldwide political affairs. This discussion chooses to not address specific tactics or weapons that could be deployed against shipments or the storage facility in the name of safety and security for the corridor communities and workers that would be employed in transit activities or at the CISF.

Target Environment

The potential of HIE attacks against the radioactive wastes that are in-transit to the proposed CISF, be it by rail, highway or barge, and when they are eventually within the confines of the storage facility are analyzed herein. This evaluation starts with a discussion on the risk profile for attacks against waste shipments and storage facilities. These potential attack risks are discussed as HIE: human initiated events like sabotage, accidents, protests and terrorism on waste transportation systems and storage facilities.^{7, 8}

The point of such an examination is to establish the target rich environment that is the nuclear industry and how prevalent the facilities are as potential and recognizable targets. It also helps establish that HIE risks are present, that HIE represent a robust articulation of potentials for the end of the fuel cycle operations necessary to stock the proposed facility and that these events represent a range of potentials far exceeding the very limited vision of risks set forth in a traditional design basis threat (DBT)⁹ normally

⁷ Human Initiated Events (HIE) were defined by the author's 2002 United States Senate testimony but were articulated at other events prior to this date. See J. D. Ballard testimony for the Committee on Energy and Natural Resources, *United States Senate*, One-Hundredth Seventh Congress. This testimony is available at <http://www.yuccamountain.org/leg/ballard052202.html>.

⁸ Specific accident scenarios that threaten the cargoes are beyond design basis events (BDBE) and could be exacerbated by human error or interference. Exemplar events include the Fukushima disaster (March 2011) and the Baltimore Tunnel Fire (July 2001). Fukushima was amplified by many errors of commission and omission. The aftereffects of the Fukushima disaster are discussed in more detail herein and referenced accordingly. The tunnel fire was not amplified by intervention but rather exceeded the planned for maximum creditable accident typically used in risk calculations regarding transportation of wastes. This tunnel fire was analyzed by a Nevada contractor and found to have enormous potential radiological impacts if a highly radioactive waste shipment was involved in this rail incident. See: <http://www.state.nv.us/nucwaste/news2001/nn11459.pdf>

⁹ The DBT is a technique similar to risk management (Johnson 2005; Johnson 2004). It is a proxy threat, or risk, for the physical plant/operations. It is based in part on a scenario that has been codified from threats found in the real world, at least at the time of its formal regulatory articulation (NRC 2005; Blankenship 2005; Chetvergov 2005; Ellis 2005). It sets the benchmarks for training and security by identifying a representation of the risks of nuclear materials. It is used for the training, weapons and tactics that a HIE group could deploy. The best practices for DBT usage issue a call to design security to face contemporary threats, respective vulnerabilities and to allocate resources accordingly (NRC 2005; Khripunov 2005). Research shows that DBT's tend to focus on infrastructure and physical security hardware (Johnson 2005). The DBT has a long history in the US (since the 1970's) and the NRC/DOE believe it seemingly codifies the most reasonable threats NPP face. The DBT is generally the basis of physical protection systems (PPS) for fixed sites like an NPP or in this case the Texas interim storage facility under consideration. See: Johnson, R. G. 2004. "Adversarial Safety Analysis: Borrowing the Methods of Security Vulnerability Assessments." *Journal of Safety Research* 35: 244-248; Johnson, R. G. 2005. Unleashing Your Inner Mother-in-Law: How to do an Adversarial Vulnerability Assessment. Presentation at ASIS annual conference, Orlando Florida. Download date: July 23, 2007. Available at: <http://pearl1.lanl.gov/external/c-adi/seals/images/AVA.ppt>; Nuclear Regulatory Commission (NRC). 2005. "Design Basis Threat. (Footnote continued)

used to frame the risk of such attacks.¹⁰ Examining attack scenarios that could cause some degree of release of in-transit and/or stored radioactive inventory seems reasonable in light of the proposed actions, current threat environment and to better inform the public about risks so they can make a decision from an informed consent position. A brief discussion will be included on design basis events (DBE)¹¹ like those experienced in Japan. These are included since shipments and storage facilities will face such risks as well and these events may induce radiological emergencies or even radiological releases in extreme cases.

The discussion to follow suggests that regulators need to reconsider the risks, impacts and safety/security for any radiological waste transportation effort given the long historical record, and experience derived from research about the previously proposed Yucca Mountain geologic facility, the changing threat environment such shipments/facilities will face in the future and the need to plan for a robust variety of DBT's and beyond design basis events (BDBE).¹² In-transit risks are part of the equation

Federal Register, Volume 70, Number 214; Blankenship, J. 2005. "International Standard for Design Basis Threat (DBT)." Paper presented at the *NUMAT Conference*, Salzburg Austria. Download Date August 4, 2007. Available online at <http://www.numat.at/>; Chetvergov, S. 2005. "Evolution of Nuclear Security in the Republic of Kazakhstan." Paper presented at *NUMAT Conference*, Salzburg Austria. Download Date August 4, 2007. Available online at <http://www.numat.at/>; Ellis, D. 2005. "Training Programs for the Systems Approach to Nuclear Security." Paper presented at *NUMAT Conference*, Salzburg Austria. Download Date August 4, 2007. Available online at <http://www.numat.at/>; Khripunov, I. 2005. "Nuclear Security Culture: A Generic Model for Universal Application." Paper presented at *NUMAT Conference*, Salzburg Austria. Download Date August 4, 2007. Available online at <http://www.numat.at/>. Contemporary articulations of the DBT can be found at the IAEA website: <http://www-ns.iaea.org/security/dbt.asp>

¹⁰ Typically a DBT would incorporate the risk of an attack into a singular scenario as noted in Endnote 9. In the case of such a complicated effort needed to stock an interim facility like that proposed at the ISP CISF site in Texas, an individual DBT does not seem prudent or capable of covering the range of risks the transportation and storage activities would face. As such this presentation uses HIE to help articulate a reasonable range of potential threats rather than shortcut the process and use the traditional NRC/IAEA DBT procedure.

¹¹ In 10 CFR 60.2 (1) [Title 10 – Energy; Chapter I -- Nuclear Regulatory Commission; Part 60 -- Disposal of High-Level Radioactive Wastes in Geologic Repositories; Subpart A -- General Provisions], the term design basis events means: (1)(i) Those natural and human-induced events that are reasonably likely to occur regularly... or one or more times before permanent closure of the geologic repository operations area; and (ii) Other natural and man-induced events that are considered unlikely, but sufficiently credible to warrant consideration, taking into account the potential for significant radiological impacts on public health and safety. (2) The events described in paragraph (1)(i) of this definition are referred to as "Category 1" design basis events. The events described in paragraph (1)(ii) of this definition are referred to as "Category 2" design basis events." This report uses HIE for human initiated events and DBE for naturally occurring events that create risks for shipments or storage facilities. Planning for these two very different risks would likewise diverge into logical dissimilarities.

¹² For details on the post-Fukushima analysis of "event" see the DOE report from 2013 on the subject. The report is widely used as a reference and available at: https://www.energy.gov/sites/prod/files/2013/12/f5/BDBE_Report_final.pdf. Additionally, the NRC, IAEA and DOE all have definitions for DBE that have slightly different foci from each other. For example, the NRC's definition can be reviewed and located at: <https://www.nrc.gov/docs/ML1432/ML14328A170.pdf>; IAEA's training materials help illustrate the organization's position and the IAEA's definition can be found at: [http://www-ns.iaea.org/downloads/ni/training/specific_expert_knowledge/safety%20assessment/IV%201_2%20SA%20-%20Event%20Classification%20\(Coment1\).pdf](http://www-ns.iaea.org/downloads/ni/training/specific_expert_knowledge/safety%20assessment/IV%201_2%20SA%20-%20Event%20Classification%20(Coment1).pdf); the DOE's definition can be found at <https://www.energy.gov/ehss/beyond-design-basis-events>.

and need to be addressed by the receiving end of the transportation management program necessary to stock a proposed interim storage facility.

Target Profile

The target profile herein looks at the breadth and depth of facilities that could potentially initiate shipments to the proposed CISF in Texas. These are identified to help recognize the wide range of potential issues that may transpire. Additionally, the transit distances shipments would endure to get to the storage facility in Andrews County, Texas become vividly illustrated by means of these maps. The point is clear – these materials will traverse most states (~45), many political jurisdictions (hundreds) and far more communities than just the end point in Western Texas.

Trying to isolate analysis for the CISF to the end point of the shipment routes is problematic, shortsighted and not acceptable safety/security procedures. Such isolated analysis is no longer acceptable policy in the Post-Fukushima world and adds to the risks communities in the transit corridor face. A task force from the NRC released a report on the implications of the Fukushima disaster for nuclear power plants (NPP)¹³ operations in the United States.¹⁴ This and other resources¹⁵ were used to identify the impacts of the event, or HIE threat, regarding a radiological release.¹⁶ How these threats could be applied to a transport related incident in the United States and the storage of materials on an interim basis is further articulated herein. The rationale is simple; to stock a storage facility it is necessary to transport the materials to the site. The lack of details on the totality of waste conveyance in the ISP proposal, like the proposed Yucca facility in-transit issues, demonstrates that transportation is integral to the discussions on storage at the proposed CISF.

The discussion below is offered in an effort to situate the scope of the issues faced by the prime contractor (ISP), potential single source manager/supplier of wastes (DOE)

¹³ NPP operations are not without incident. Mismanagement, malfunctions and deception about the outcomes/events are seemingly commonplace for NPP operators. One good summary of the worldwide NPP radiological incidents is found on the website Wikipedia. See: https://en.wikipedia.org/wiki/List_of_nuclear_power_accidents_by_country

¹⁴ See: <http://www.nrc.gov/japan/japan-info.html>

¹⁵ See these for the basis of this overall presentation, including specific information, text and structure: Ballard, J. D. 2016. "Update: Fukushima Dai-ichi and Nevada's Contentions under NEPA." State of Nevada, Nuclear Waste Projects Office, Carson City, NV; Ballard, J. D. 2014. "Fukushima Dai-ichi and Nevada's Contentions under NEPA." State of Nevada, Nuclear Waste Projects Office, Carson City, NV; Ballard, J. D. 2013. "Japan's Fukushima Daiichi Disaster: Implications for Further Research on Terrorism and Sabotage." State of Nevada, Nuclear Waste Projects Office, Carson City, NV. Additionally, other research done for the proposed Yucca Mountain facility demonstrates risks. For example see: "Worst Case Credible Nuclear Transportation Accidents: Analysis for Urban and Rural Nevada" by Lamb and Resnikoff of Radioactive Waste Management Associates and Richard Moore, P.E., August 2001. This report is available at: <http://www.state.nv.us/nucwaste/trans/rwma0108.pdf>

¹⁶ For international experiences with transport of SNF see information on a British rail accident at <https://www.theguardian.com/uk/2002/jun/12/transport.world>; http://fissilematerials.org/blog/2014/01/nuclear_train_accident_in.html

and government regulators (NRC). This discussion is offered to better plan for contingencies in recognition of the potential consequence severity of the events that could transpire. It also recognizes how those adverse and cascading consequences may change the perception of, and negative potential for, the aftereffects of a HIE attack on the community wherein the transport of the wastes create a radiological incident. These are critical impacts that affected communities must be made aware of prior to consenting to any transportation efforts through, and storage facility in, those locations.¹⁷

Worldwide

According to the World Nuclear Association (WNA), nuclear power is one of the key energy sources across the global community. With over 453 commercial reactors located in ~30 countries, NPP's are readily available as a target and furthermore they have a unique profile as a target.¹⁸ Additionally as of 2018, this association reports that an additional 57 reactors are under construction worldwide. Not all of these will be added to the inventory of plants, as some will replace decommissioned facilities on the worldwide list of NPP. Still the inventory of available targets is robust. For example, NPP's provide ~11% of the world's electricity¹⁹ and the social stigma associated with all things radiological combine to make these plants potential symbolic targets of extreme value to violent extremists.²⁰

In addition to the NPP ~250 research reactors are also noted in over 50 countries, many at research institutions, universities and other high profile locations. Together these nearly 700 facilities represent a significant universe of potential targets for a variety of adversaries.²¹

These worldwide NPP and research facilities produce radioactive wastes in quantity and because of ongoing operations; they contribute additional wastes to the overall global stockpile of highly radioactive materials.²² These highly radioactive materials require

¹⁷ See the paper authored by Halstead and Dilger (2011) titled "Repository Transportation Planning, Risk Management, and Public Acceptance: Lessons Learned." Conference presentation at IHLRWMC, April 2011, Albuquerque, NM.

¹⁸ Details on current world NPP capacity can be found at the association's website and in its 2018 Annual Report. For specific details please see: <http://www.world-nuclear.org/getmedia/b392d1cd-f7d2-4d54-9355-9a65f71a3419/performance-report.pdf.aspx>. A different perspective on NPP worldwide can be found at: <https://www.worldnuclearreport.org/-2017-.html>

¹⁹ For 2016 data see: <http://world-nuclear.org/information-library/current-and-future-generation/nuclear-power-in-the-world-today.aspx>

²⁰ One of the more detailed articulations of this social phenomenon is from Spencer Weart's work on nuclear fear. See the book *The Rise of Nuclear Fear*. Cambridge, MA: Harvard University Press, 2012.

²¹ This was gleaned from the WNA. Information was originally downloaded on July 27, 2011. Details are available at: <http://www.world-nuclear.org/info/inf01.html>. This data has not changed greatly in the 7 years since first reported.

²² For estimates of the global inventory of these materials, including sources other than SNF please see: "Estimation of Global Inventories of Radioactive Waste and Other Radioactive Materials", 2010. IAEA TECDOC 1591. Information originally was (Footnote continued)

isolation from human contact and/or reprocessing of the SNF for further use, operations which also produces radioactive wastes.

World-wide the transport of these materials is an on-going activity, albeit seemingly much slower than would be needed to stock the proposed CISF facility. These shipments can be internal to an installation (e.g. cooling pool to dry storage), or external like moving to storage installations (e.g. by rail, truck or barge) or reprocessing facilities (e.g. by rail, truck or barge). Reprocessing facilities are not as widespread as power production or research installations. Reprocessing from various methodologies is currently done at facilities in Great Britain, Russia, France, Japan, and India.²³

Domestic

The United States has ~22% of the world's NPP plants for a total of ~99 NPP facilities located around the country at 65 sites and within 31 different states.²⁴ There are two main types of NPP facilities: pressurized-water reactors also known as PWRs and boiling-water reactors or BWRs.²⁵ Many NPP are currently operating, but some have been decommissioned, or are in the process of being, decommissioned.²⁶ The map below shows a geographic dispersion of these waste origination plants (NPP).

Of particular note is that many of these locations are in the Eastern portion of the United States and transportation of these materials to a storage facility in Texas will impact transit corridor communities around the country that are transportation hubs for rail activity and those near NPP concentrations (e.g. Chicago, Detroit, Saint Louis, etc.). Such NPP geolocations thus require long distance transport to the proposed Texas facility and through these hub cities.²⁷

downloaded on May 24, 2012. Information is available at: <http://www-pub.iaea.org/books/iaeabooks/7857/Estimation-of-Global-Inventories-of-Radioactive-Waste-and-Other-Radioactive-Materials>

²³ See the WNA (2018). Information was downloaded on August 23, 2018. Details are available at: <http://world-nuclear.org/information-library/nuclear-fuel-cycle/fuel-recycling/processing-of-used-nuclear-fuel.aspx>

²⁴ The number of NRC regulated sites is more extensive than these numbers. Estimates are that 45 states/territories are included on the total list of NRC sites. For reactors see: <https://www.nrc.gov/info-finder/reactors/> and for all see: <https://www.nrc.gov/info-finder/region-state/>. As to the best contemporary count of operational NPP please see: <http://www.beyondnuclear.org/reactors-are-closing/>

²⁵ One report (based on older numbers of active reactors = 104) shows that sixty-nine (69) of the nation's NPP are PWR and thirty-five (35) are BWR. See: <http://issues.org/28-2/alvarez/>. The differences in operations/design between these two main types of NPP are critical to security planning and risk mitigation at the plants.

²⁶ For a list of the many NRC regulated sites being decommissioned see: <https://www.nrc.gov/info-finder/decommissioning/>

²⁷ In the aftermath of the 9/11 attacks, government reports helpful to safety and security discussions were removed from public view by the NRC, DOE and other federal agencies. For example the NRC's *Safeguards Summary Events List* (SSEL) provided details on a variety of incidents relative to NPP and other facilities. The last easily available copy of this report (Version 4) was useful in *(Footnote continued)*



Additionally, America has ~45 research reactors at universities and other facilities around the United States. Many of these are operating, but some have been decommissioned and/or are in the process of being decommissioned. The next map shows the geographic dispersion of some of these research reactor facilities in relationship to NPP.



understanding the extent of sabotage from within the ranks of employees of nuclear operations. Considering the potential for a dedicated insider to help HIE perpetrators, such data is critical for communities to know prior to agreeing to shipments and storage at a CISF facility.

A basic assumption would be that fewer shipments and fewer miles traveled would equal a reduction in the risk of HIE or DBE. Given the potential for HIE, other issues also must be addressed by regulators and ISP for the proposed CISF. The proposal by ISP should address a range of threats even considering the need for information blackouts/exclusions (like the SSEL) typically in the post 9-11 world. NRC should likewise reconsider the placement of one or more CISF in the Western United States only. Given the performance of the dry storage facilities in Fukushima storage in place using HOSS is a viable alternative.

Lastly, the DOE has additional facilities that can contribute to the stockpiles of wastes that may need transportation and storage.²⁸ Locations of DOE sites may include: Argonne National Laboratory (ANL), East Tennessee Technology Park (ETTP), Idaho Cleanup Project (ICP), Idaho National Laboratory (INL), Los Alamos National Laboratory (LANL), Lawrence Livermore National Laboratory (LLNL), New Brunswick Laboratory (NBL), Nevada National Security Site (NNSS), Oak Ridge National Laboratory (ORN), Pacific Northwest National Laboratory (PNNL), Sandia National Laboratories (SNL), Savannah River Site (SRS), Waste Isolation Pilot Plant (WIPP), West Valley Demonstration Project (WVDP) and the Y-12 National Security Complex (Y-12).^{29,30} These facilities are shown on the map below.³¹

²⁸ The DOE is one party to this effort that may well become more important over the operational lifespan of the CISF. Secretary of Energy Rick Perry said “My hope of this committee and administration is that we, finally after 35 years of kicking the can for whatever reason, we can start . . . moving to temporary or permanent siting of this nuclear waste.” Confirmation Hearing of Secretary of Energy Rick Perry: Hearing before the Sen. Energy & Nat. Res. Comm., 115th Cong. (Jan. 19, 2017). Because of the presumption of this Energy Secretary, Nevada included language in its two recent legislative efforts to set fair rules for a potential re-start of Yucca Mountain licensing (see S. 95 (115th Congress) and H.R. 456 (115th Congress)).

²⁹ DOE. (August 2011). “Review of Requirements and Capabilities for Analyzing and Responding to Beyond Design Basis Events.” Office of Nuclear Safety Office of Health, Safety and Security. U.S. Department of Energy: Washington, DC. See p. i. For location names and acronyms, see p. 3 for map.

³⁰ Currently, the CISF is set to receive SNF and GTCC from commercial NPP. That was one aspect of the proposal that seemed clear but perhaps will change over time. DOE would potentially be the prime supplier for wastes that DOE has taken possession of prior to arrival at the CISF. DOE’s own jurisdictional SNF, HLW and GTCC materials are not specifically a part of the ISP CISF proposal at this time but ISP’s proposal suggests plans for additional modifications for waste limits and given 10 CFR, Section 72, which may in the future include wastes of a very different type than articulated in this version of the proposal. The Yucca Mountain experience has offered a lesson on DOE and wastes: The community near the CISF should expect mission creep as to additional forms of wastes if DOE is involved and additional waste shipment streams must be anticipated. One example was the evacuation of wastes from WIPP to the existing waste facilities in Andrews County. After the extensive contamination experienced at WIPP due to mistakes in packaging, suspect packages were sent to this facility. With such ambiguity as to exactly what will be actually stored at the proposed CISF, the presentation herein added DOE facilities to be on the conservative side of analysis. Much like Holtec, ISP uses the most desirable waste streams for their proposal. They excluded liquid, transuranic and other more problematic waste streams that could pose additional safety and security concerns, at least for the initial approval process.

³¹ The ISP Report focuses on SNF and greater than class C wastes from commercial NPP operations. The Yucca Mountain Project included HLW and other military related materials not listed as inventory potentials by ISP. This despite the report noting that 10 CFR, Section 72 focuses on the “Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste.” This begs the question, is ISP only expecting commercial wastes or will the facility be licensed for receipt of all waste streams under 10 CFR, Part 72? Will the DOE *ex post facto* seek to place defense wastes in the CISF? Will the foreign partnership involved in the ISP seek to place extra-territorial wastes at the Texas CISF? Such ambiguity for the materials that will be transported and stored at the facility is problematic since safety and security considerations might be very different for these dissimilar types of wastes. One again, the presentation herein assumes the totality of materials that would have been transported and stored at Yucca Mountain as logically the same inventory that is going to be stored at the CISF. Given the global retrievals of wastes by DOE operations and the inclusion of the foreign company in this partnership, assuming extra-territorial wastes is prudent.



The production sites for GTCC materials are generally thought of as similar to that for DOE facilities and NPP. These would add shipment complexity to the proposed action.³² Together these NPP, research reactors and DOE facilities represent a domestic American target universe of ~160 domestic facilities that could be the origination points for shipments to the proposed storage facility.^{33, 34}

Attacks

Such a geographic dispersion analysis of origination sites suggests that no matter what the policy of the United States, or the inventory size for current/future supplies of radioactive materials the various sites produce, these wastes will generally need wet

³² A 2016 document listed WIPP (and vicinity), Hanford, INL, LANL, NNS, SRS as potential origination points. Interestingly “generic regional commercial disposal sites” were included in the listing. As of August 2018 the specific details of sites can be found at: http://www.gtceis.anl.gov/documents/eis/GTCC_EIS_Summary_Jan_2016.pdf

³³ The use of this number is a best estimate of total origination points. The author acknowledges that some facilities are co-located, thus shipments would be from multiple NPP at the same site, or a multifaceted DOE site, but each represents a data point in transportation analysis. Still knowing the exact location and details of shipment planning for each facility, or parts thereof, would help define who/what has title to the waste and thus who/what organization is going to initiate shipment (if DOE is excluded). This is true if they are in one location, or multiple locations at one site. This delineation is of interest to safety and security professionals since they will technically represent different risk profiles with respect to types of wastes, age of wastes, transportation routes and other variables.

³⁴ Details on the complexity of the potential different waste streams (NPP, decommissioning, defense operations, commercial operations), from the many potential origination sites (see maps), and for all forms of potential wastes (SNF, HLW, GTCC, liquid, solid, assemblies, etc.) is important to specify. That level of differential analysis is not found within the ISP CISF proposal and NRC should undertake this prior to the EA/EIS process so as to allow the bidders for interim storage facilities the data to plan for the full range of wastes that could be stored. Likewise, this analysis should therefore be part of the NRC evaluation so that stakeholders can fully comprehend the scope of activities necessary to stock the proposed facility. As part of the consent based analysis, impacted communities should be identified, political jurisdictions mapped and populations alerted to the possible transport of these materials through their communities, states, tribal lands, etc. Additionally training and equipment for the many first responder agencies would likewise need funding, advanced notification and on-going updates considering many rural areas would see volunteer fire agencies offering their response assets in the event of an incident. Details on official emergency response procedures for radiological emergencies can be found at: <https://www.remm.nlm.gov/onsite.htm>

storage at first (SNF being the bulk of wastes), potentially dry storage at the NPP (as fuel pools are already overstocked and extensive time will be needed to construct a CISF and then transfer the wastes to the facility), loading/transfer of storage/transport casks and ultimately transportation to the storage facilities (after suitable cooling outside of the reactor vessel). Also, logically such shipments will be subject to HIE risks over the lifespan of the transport and stocking effort. DBE's for the transport and storage are also necessary to define, understand and communicate, so that communities along the transportation routes and at the initiation and destination points, are risk informed.³⁵

The typical use of a singular DBE in NPP designs/nuclear facilities, or the DBT for a generic attack scenario against the same, fail to account for the risk complexity such a massive supply infrastructure implies.³⁶ ISP does not address the complexity of, or risks of the range of HIE in their proposal, even though they are a significant involved party in the end of fuel cycle operations and a substantial contractor, by partnership, who has operations at all phases of this shipment infrastructure.³⁷ Likewise, NRC has allowed this company to bid for the CISF without at least an effort at discussing safety and security implications of transportation risks from HIE or DBE.

This lack of the ability to perceive systematic risk complexity for a proposed interim storage facility may well underestimate the impacts of a radiological event involving these materials. Thus, a programmatic transportation inclusive Environmental Impact Statement (EIS)³⁸ should be initiated prior to the proposal process and should address

³⁵ Origination points for waste shipments are included since these NPP facilities may not currently have rail access and thus local communities will be subject to heavy-haul trucking shipments to a nearby railhead. A similar intermodal transfer process would be needed for barge shipments.

³⁶ ISP does discuss various potential natural disasters in their proposal – those defined by NRC regulations. Failures to address complex natural disasters in the aftermath of Fukushima are problematic. It is not ideal to ignore them when discussing transportation and the end of the transit nuclear storage facilities like the CISF. A disaster is rarely singular in nature – a flood causes bridges to wash out, roadways to collapse, power to be lost and so on. For example, the current presence of sinkholes in the Carlsbad area near both truck transport and rail infrastructure might help illustrate. In a hypothetical built off of current realities, a sinkhole develops, causes a train to drop into the hole and thereby creates a radiological incident. Even without a release, the fact that a radiological cargo is present will alarm the public. Emergency response to such a disaster would be localized at first and delays would ensue as heavy equipment needed to retrieve the cask(s) would need to be mobilized. Thus, what may seem like just a simple train wreck turns into a massive social disruption event involving evacuation, response, retrieval and remediation efforts. Not really simple and not one, but rather a complex set of impacts from this event can be noted as distinct possibilities. A single DBE for such contingencies, like a singular DBT, is problematic.

³⁷ ISP's proposal has few mentions of terrorism. This risk blindness mindset is problematic and may show a distinct intellectual opposition to any alternative analysis of threats transportation or such a facility may face.

³⁸ For a differentiation between programmatic and site specific EIS please see: <https://www.usbr.gov/pn/programs/eis/kkc/scoping/progsite.pdf>

the totality of the shipment infrastructure that will supply this new storage facility.³⁹ Failure to supply such a programmatic EIS prior to the proposal phase for a CISF has left ISP vulnerable to liability in the event of a radiological emergency at the storage site, but perhaps also while in-transit wastes are moving towards that destination. The ISP proposal is currently insufficient to address the transportation issue for waste movements to the proposed CISF on any level.

One of the key lessons learned from recent experiences with wastes and related facilities (e.g., NPP or potential storage) is that a single scenario based risk profile can be overwhelmed in various ways:

1. When the DBE/DBT is under-predicted. The perceived scale of a possible DBE in Japan was not sufficient to account for the actual risk designed for by system planners. This engineering deficit is critical to not repeat and helps demonstrate that engineering alone cannot address natural disasters let alone human factors like HIE.
2. When the DBE/DBT does not consider compounding events. Cascading events produce compounding complexity for an incident with the in-transit and stored wastes. Articulation of the ranges of potential release fractions, consequences and risks allow for a better methodology to recognize and convey these complex event risk profiles.
3. These risks can be further exacerbated by human error, failures in training, communication failures, security failures and so on. These may be the result of an atrophy of vigilance as years, even decades, of everyday experience with minor operational issues lead to a loss of attention to safety and security.⁴⁰
4. The cascading effects these compounding factors generate demands that planners seek more complex/realistic estimations of risk inducing events when planning for nuclear related material facilities and by logical extension transportation of radioactive waste shipments necessary to stock those facilities. Failure to address these complexities would be considered risk blindness and

³⁹ This argument has been made for years by the Nevada Agency for Nuclear Projects and their Nuclear Waste Project Office. For example Halstead and Dilger (2011) offer a summary of transportation issues in an April 11, 2011 presentation at the American Nuclear Society (ANS) meetings in Albuquerque, New Mexico. The title of this slide presentation was "Repository Transportation Planning, Risk Management, and Public Acceptance: Lessons Learned." One telling lesson learned was summarized by a quotation found on slide three: "Transportation must be given equal consideration with storage and disposal, at every stage, in planning and implementing a successful national nuclear waste management program."

⁴⁰ For information about the loss of vigilance (a.k.a. atrophy of vigilance) by complex organizations see: Freudenberg, W. R., & Gramling, R. (1994). *Oil in troubled waters*. New York: SUNY Press and/or Freudenberg, W. R., & Gramling, R. (2002). "How crude: Advocacy coalitions, offshore oil and the self-negating belief." *Policy Sciences*, 35(1), 17–41.

expose the CISF facility and those responsible for planning transport to liability for the consequences of an incident.

One way to help overcome risk blindness when considering transportation and storage of wastes is to analytically generate a range of attack scenarios with a range of release fractions resulting from these risks. Permutations of attack scenarios could be generated by development of compartmentalized risk threats. For example you could define such risk variables as:

AT + TF + HE = Risk Profile.

AT=attack threat, TF=technological failures, HE=human errors.

The resultant risk calculations then could be methodically and systematically manipulated during analysis to account for a range of potential risks and produce results that cover a range of potential outcomes.⁴¹ This spectrum of risk could then be articulated as a collection of possible attack or accident scenarios progressing from the least impactful to the most catastrophic.⁴²

The next section will examine the development of credible attack scenarios for HIE against waste transportation by rail, truck and barge, during intermodal transfer and for the storage of the materials at the end point of the transportation effort necessary to stock the proposed facility.⁴³

⁴¹ This suggestion is similar to the logic behind the RADTRAN program by Sandia National Laboratories. See: <https://prod.sandia.gov/techlib-noauth/access-control.cgi/2014/140780.pdf>. This Sandia computer code/program allows dose estimates for transportation activities – routine radiation estimates as well as those that might result from a radiological incident. When using the program the analyst has some choices to make as to variables that might affect the outcomes – so weather is a good example. Rain, wind and other weather related variables can be considered as to the overall impact on an incident. In a similar fashion analysts of HIE needs to be done in a fashion that allows such environmental (and other) variables to be manipulated as input factors so as to construct a variety of potential risk profiles that reflect a variety of consequences for an incident. This would also be true of BDBE.

⁴² For an example of such analysis see North Atlantic Treaty Organization (NATO). Project # SST.CLG.978964, “Terrorism Attacks on Nuclear Power Plants and Nuclear Materials Transports.” This multiple institution effort was led by Dr. Friedrich Steinhausler, Institute for International Security, Stanford University from October 2001 to July 2004. As of August 2018 the report remains unreleased to the public by NATO.

⁴³ The author has spent decades developing attack scenarios as related to SNF shipments and/or at NPP. The discussion herein does not address specific weapons or tactics since such information could compromise the safety and security of shipments and/or storage facilities.

Wastes as Targets⁴⁴

Several different adversaries and related factors could make the shipment of highly radioactive nuclear wastes prime targets for a HIE and attractive to a variety of potential violent political actors. These include risk factors from:

- International Groups
- Domestic Groups
- Lone Wolf Attacks
- Symbolic Value of Target

First, these shipments are an attractive target for international terrorist groups. They represent an easily identifiable target, a predictable transportation pathway, and one that allows for extensive planning and support from transnational sources. Examples include:

- The connection between some of the potential cargoes and the American military infrastructure presents a potential for retaliation attacks.⁴⁵
- Attacks on energy infrastructure have been a concern of terrorist experts for decades.⁴⁶ In this case NPP and the wastes this industry produces would be the focal point of attacks.
- Anyone attacking these cargoes would be able to create an enormous economic impact by the introduction of “event risk” into the energy industry and its related commodities markets.⁴⁷ Such “shock impacts” on spot or long-term energy markets may become a motivating factor for attacks.

⁴⁴ This section is a compilation of testimony given by the author. For specific testimony details see: Ballard, J. D. 2008. “Terrorism Risk and the Transportation of Spent Nuclear Fuel and High Level Radioactive Waste.” Testimony before the United States Senate, Committee on Commerce, Science and Transportation. Hearing on Safety and Security of Spent Nuclear Fuel Transportation, September 24, 2008. Available at <http://commerce.senate.gov/>; Ballard, J. D. 2002a. “Testimony” before the United States Senate, Committee on Energy and Natural Resources, One-Hundredth Seventh Congress regarding S. J. Res.34 Approving the Site at Yucca Mountain, Nevada, for the Development of a Repository for the Disposal of High-level Radioactive Waste and Spent Nuclear Fuel, Pursuant to the Nuclear Waste Policy Act of 1982. Available at <http://www.yuccamountain.org/leg/ballard052202.html>; Ballard, J. D. 2002b. “Testimony of James David Ballard.” United States House of Representatives, Subcommittee on Highways and the House Subcommittee on Transportation and Infrastructure. Available at <http://gopher.house.gov/transportation/highway/04-25-02/ballard.html>.

⁴⁵ For international example see: <https://www.aipac.org/-/media/publications/policy-and-politics/aipac-analyses/one-pagers/a-history-of-iranian-attacks-on-americans.pdf>

⁴⁶ For an energy related, oil industry specifically, illustrative example please see: <https://www.heritage.org/environment/report/coordinated-terrorist-attacks-global-energy-infrastructure-modeling-the-risks>. Additionally, in 2012 the magazine *Forbes* ran a story on this subject. See: <https://www.forbes.com/sites/matthewhulbert/2012/11/16/a-terrorist-guide-to-energy-carnage/#1bb583b75235>

⁴⁷ Assessment of ‘event’ risks takes time to fully identify and comprehend. For example the 9/11 attacks showed that the fear was not as bad as the reality, at least on economic impacts like stock market losses. Military spending on the other hand exceeded
(Footnote continued)

- The lack of more rigorous safety and security arrangements during transit is a grave concern. The use of certain tactics to prohibit the hijacking of the cargo and the scantiness of armed escorts for the totality of the shipment distances, or at the final destination, potentially add to the target attractiveness.⁴⁸

These and other types of human factors may increase the risk of international terrorism and raise the risk profile to levels that do not apply to normal rail, highway or barge shipments, even those with radioactive, toxic or other dangerous materials.⁴⁹ ***Highly radioactive wastes like SNF and GTCC are not normal commodities***; they represent a different type of risk depending on which waste is being analyzed and should be recognized as such.⁵⁰

The shipments may also represent a target profile for domestic groups who would perpetrate violence to advance their agendas. These domestic adversaries could be motivated by such factors as:

- Opposition to the forced acceptance of energy wastes into, or through, their community/state/region.
- Groups that could justify violence based on deeply held distrust of the DOE and its motives with respect to nuclear wastes.

expectations in the aftermath of that catastrophic event, funding that continues to this day. See: <https://www.thoughtco.com/economic-impact-of-terrorism-and-the-september-11-attacks-3209217>

⁴⁸ To reiterate, specific tactics and weapons that might be used against shipments or storage facilities are not discussed in this presentation due to their potential to promote attacks. They are noted here only as a way to illustrate vulnerabilities.

⁴⁹ Many in the nuclear industry argue that shipments of wastes are safe – just look at past shipments they typically say. The Western Governors Association recognizes this perspective in a policy statement regarding the proposed Yucca Mountain facility, albeit more much more cautiously: http://westgov.org/images/files/WGA_PR_2018-10_Radioactive_Materials_Management.pdf. Industry typically champions the safety record of several thousand shipments in the USA. See as an example: <http://www.nwtrb.gov/docs/default-source/meetings/2018/june/lanthrum.pdf?sfvrsn=4>. This begs the question: perhaps the shipments to, from and returning shipments that are sent back to the origination point, these multiple shipment pathways that are envisioned for this facility would challenge these arguments and create shipments numbers in the orders of magnitude greater than past experience data. Until exactly what will be shipped is defined (e.g. older fuel first?), when that will transpire (e.g. is it 20 year post reactor fuel), who will be the title holder of record defined (e.g. is it ISP as a key player in all functions associated with the movement of these materials to the interim facility), what is the role of the DOE and till many other variables are known, until then this proposal does not address this serious issue and leaves that work to the NRC to address in its request for the EA/EIS proposal process – not what has transpired to date on the Texas CISF but rather what should transpire when this current effort is abandoned as deficient, economically unfeasible and dangerous given the lack of the most critical aspect of transportation.

⁵⁰ From a security perspective the differences between defense wastes and commercial wastes is important. On the surface the ISP proposal would be about commercial NPP related wastes (SNF and GTCC), but it is not unreasonable to read the proposal and review federal regulations and come to a logical conclusion that more types of wastes can and will be stored at CISF if it is approved. Basically, after approval ISP will most likely seek additional inventory levels for wastes and some of those could easily be military related given DOE's sole supplier status or given the partnership ISP represents, foreign wastes. Each type of wastes would attract different adversaries and may create different hazards in the event of a radiological release during a HIE.

- Violent opposition to the shipments and nuclear facilities that transcend the normal adversarial relationship most protests have with NPP/shipments of wastes.⁵¹
- One again, the lack of more rigorous safety and security arrangements during transit is a grave concern. The use of certain tactics to prohibit the hijacking of the cargo and the scantiness of armed escorts for the totality of the shipment distances, or at the final destination, potentially add to the target attractiveness.

Domestic based adversaries represent as large a threat as a well-financed international terrorist organization, albeit with different motives perhaps. Domestic groups would have a situational awareness advantage over international groups, but that is not a barrier given time to plan attacks. Both domestic and international groups would have such time since the ISP proposal would allow for shipments over a decades long timeframe.

It is important to note that America is not immune to internal attacks, even potential devastating attacks using mass victimization tactics. After all, the country has already witnessed a domestic rail incident where a group was willing to remove a track section in front of a train carrying SNF at a location just outside of Minneapolis, Minnesota.⁵² While not successful, this incident represents an organized attempt to derail the radioactive cargo and draw attention to a groups' opposition to the shipment of nuclear wastes regardless of the potential consequences.⁵³ Likewise accidents involving wastes

⁵¹ The majority of anti-nuclear groups are non-violent by choice and philosophy. The vast majority of these activists use collective actions that might be misinterpreted as violent by the nuclear industry but these protests are not in fact violent political actions and not terrorism. The Golden Valley, MN example noted is a good exemplar (see Footnote 52 below). The future might change this as noted elsewhere – social movements morph as circumstances change. One aspect of security that is important to recognize is the anticipatory nature of such planning. Thus, this item is noted as a means to make an argument that shipments may face social movements that are not as non-violent as those of the past, or currently in opposition to the operation of NPP and/or shipment of wastes.

⁵² The Golden Valley incident is interesting in that it will not show up in accidents related to SNF. A train carrying SNF was scheduled to traverse the track, another train carrying lumber was waived forward first and when it reached the section of rail that had been deliberately removed, the lumber train derailed. Graffiti at the site showed that the derailment was designed for the SNF train, not the lumber shipment. The 1986 incident was taken from an article in the *Milwaukee Journal* dated October 28, 1986. One data quality problem with terrorism research is how to define the act of terrorism when cross-classification or misclassification of an incident could occur. For example, in 1972, skyjackers forced a Southern Airways DC-9 aircraft to circle Oak Ridge, Tennessee. The skyjackers threatened to crash the plane into the Y-12 Plant if demands were ignored. The question for terrorism research becomes was this an attack on a nuclear weapons facility, an aircraft attack, or could it be considered something else? This type of complex attack scenario should be of concern to transportation planners when they consider safeguards for shipments to the Texas CISF facility. Details on both incidents were compiled in 1998 by the author and available at: http://www.state.nv.us/nucwaste/trans/jballard.htm#N_17

⁵³ Protest groups in Germany have also interfered with transportation infrastructure in advance of shipments. The German groups did notify authorities of the potential rail/road hazards they created. These groups had a goal to prevent radiological incidents and used such non-violent actions to bring attention to the vulnerabilities. Likewise mass human protests, as a means of slowing down (*Footnote continued*)

are in the public record and should be recognized in planning for a storage facility and the transport necessary to supply that facility.⁵⁴

Lone wolf attacks are those perpetrated by a single individual. While there is no denying the potential threat they may pose, in general security planners are less concerned by these solo attackers than the more organized groups of attackers an international or domestic group pose. Recent history in the United States and elsewhere suggest these low level attacks by single individuals are increasing in frequency.⁵⁵

Symbolism

The primary reason why the highly radioactive waste shipments could become HIE targets is their symbolic value to terrorists, be they international or domestic.⁵⁶ Terrorism is normally defined in terms of the tactics used in the actual attacks, or by means of an analytical typology of adversaries, and/or the investigative focus is within the confines of criminal law. Another way of understanding terrorism is to focus on why certain targets are more symbolically attractive. The proposed shipment campaign may well have a very high symbolic profile. An example may assist in understanding: Why was the World Trade Center (WTC) the target of repeated attacks? These buildings

train or truck shipments, showed that thousands of protesters could effectively act as human blockades. Here again the protests were non-violent in actuality and in philosophy.

⁵⁴ Data from the Yucca Mountain Project could help understand the potential for accidents. A Nevada report states “Based on the 1971-1990 accident data, DOE calculated accident and incident rates for commercial spent fuel shipments to a repository. For truck shipments, DOE calculated 0.7 accidents and 10.5 incidents per million shipment miles. For rail shipments, DOE calculated 9.7 accidents and 19.4 incidents per million shipment miles. Because of the small number of spent fuel shipments and accidents during these years, DOE compared these accident/incident rates to the general accident rates for large commercial trucks and general rail freight movements. Based on this analysis, DOE concluded that accident rates for general truck and rail transportation should be used in repository transportation risk and impact studies. DOE recommended use of a truck accident rate of 0.7 - 3.0 accidents per million shipment miles and a rail accident rate of 11.9 accidents per million shipment miles. An estimate of the number of accidents likely to occur during spent fuel shipments to a repository can be obtained by multiplying the anticipated accident rates by the anticipated cumulative shipment miles. If all spent fuel were to be shipped to the repository by truck in larger-capacity casks, requiring about 46,000 shipments and over 100 million shipment miles, between 70 and 310 accidents and over 1,000 incidents would be expected over the operating life of the repository. Under the DOE base case scenario (88% rail, 12% truck), about 50 to 260 accidents and 250 to 590 incidents would be expected.” This older analysis does not anticipate the current generation of casks (e.g., Holtec has proposed a 37 PWE assembly rail cask shipment vessel). In years past 24 PWR assemblies was the cask rail shipment limit. For a more detailed, albeit dated, discussion see: <http://www.state.nv.us/nucwaste/trans/trfact03.htm>

⁵⁵ Lone wolf terrorism attacks are those perpetrated by a single violent social actor. The lone wolf is very difficult to detect and their actions are hard to counteract say security professionals. For additional information see: <https://www.pbs.org/wgbh/frontline/article/lone-wolf-attacks-are-becoming-more-common-and-more-deadly/>; and additionally please see: <https://www.theguardian.com/uk-news/2015/dec/06/lone-wolf-terror-attacks-impossible-to-stop-says-security-expert>

⁵⁶ J. D. Ballard has discussed the idea of symbolic attacks in many forums over the last several decades. For one example see: United States Senate, Commerce, Science and Transportation Committee, (September 2008), “Terrorism Risk and the Transportation of Spent Nuclear Fuel and High Level Radioactive Waste.” <http://www.state.nv.us/nucwaste/news2008/pdf/ballard080924.pdf>

symbolize more than just steel and concrete. Adversaries that attacked the WTC complex in February 1993, and again in September 2001, knew that this commercial office complex represented more than just buildings, it symbolized American economic might in a global economy. The attacks on this office complex were seemingly against the core values of American society and its perceived economic hegemony in the global community.

So, could an attack against waste shipments or storage be seen as such a symbolic act? First, at a most basic level, we should not forget that these wastes are highly radioactive and the general public fears this fact.⁵⁷ The cultural conditioning represented by such historical facts as the decades long Cold War doctrine of mutual assured destruction by nuclear weapon, and the images of mass victimization and destruction documented after the use of nuclear weapons during WW II, have these contributed to a generalized and specific anxiety about radioactivity and all things nuclear?⁵⁸

Depending on a reasonable person's position with respect to nuclear power and how the DOE has conducted the nation's nuclear operations, public perceptions are understandably affected. Typical discussions on this subject, especially on the pro-nuclear side, seemingly denigrate the 'uninformed' masses who dare to criticize the industry and especially the 'science of engineering' behind their actions. The idea that technology will save the day and that the nuclear engineers know what is right for the public, are very suspect philosophies to many outside of the nuclear energy industrial complex. This is especially true given the public is aware of the many failures involving the weapons complex and even with NPP operations. That public distrust of DOE, NRC and such industry proclamations is further reified after every nuclear power related accident and incident.

⁵⁷ Pop culture has a term for such fear – Radiophobia. This term is normally used in a derogatory fashion by nuclear energy insiders. It is exploited by the supporters of all things nuclear to denigrate the legitimate fears of the public. The legacy of mismanaged sites like Hanford, West Valley and Rocky Flats is profound. These sites were managed by DOE and now represent huge costs for American taxpayers for cleaning up the contamination and processing wastes. Likewise NRC does not have the best record either on decommissioned certain aspects of NPP shutdowns (e.g., Big Rock Point, MI). It is not unreasonable to expect the same type of administrative negligence to transpire at CISF's given the lack of change in managers and regulators that seemingly do not learn from history and mistakes from the past.

⁵⁸ One example of how this type of nuclear/radiological fear is entrenched in the culture:
<https://blogs.scientificamerican.com/guest-blog/the-rise-of-nuclear-fear-how-we-learned-to-fear-the-bomb/>

These historical facts are coupled with a generalized public distrust of government⁵⁹ and as noted its mismanagement of the nation's nuclear weapons arsenal, the by-products of the weaponization of the atom, and what some consider the trivializing attitude taken by the energy industry and federal agencies when it comes to the safety and security of the public health, workers, environment and economic well-being of the nation.^{60, 61}

Regardless of the actual health hazards posed by these shipments, and they are many, any incident involving these cargoes would elicit a public response of fear, panic and distrust of any authority figure wishing to explain the health science of radioactivity over the reality of the public perception of the risks. The symbolic value of an attack against highly radioactive waste shipments is easy to understand in this situation and should not be underestimated. Such public perceptions are very real in their adverse political, economic, legal and social consequences.

Dangerous Cargoes

Additionally, the radiological inventories within the cargoes, that must be transported to stock a CISF, are very dangerous. The DOE in the Final EIS for the former Yucca Mountain Project, reports that truck and rail casks will carry huge radiological inventories and in the event of a release latent cancer fatalities and large-scale economic losses will occur.⁶² Thus, the wastes are not only dangerous in a symbolic manner; they represent a potential weapon of mass radiological contamination. A type of potential dispersion device/weapon that would create a backlash against the continued use of nuclear power in America, a backlash against federal agencies and their efforts at regulating the transport of these materials, a backlash at the industrial

⁵⁹ See: Llewellyn, S., Brookes, S., & Mahon, A. (2013). *Trust and confidence in government and public services* (Routledge Critical Studies in Public Management; 12). More to the point on distrust in the nuclear enterprise is: Iversen, K. (2012). The Dirty Secrets of Rocky Flats. *The Nation*, 294(24), 23.

⁶⁰ For details see on worker safety: <https://www.osti.gov/biblio/7080383-doe-radiation-research-program-floundering-nas>. To see data that reviews the many sites the DOE is undertaking cleanup efforts at after years/decades of management issues see: <https://www.energy.gov/em/cleanup-sites>. Finally, the Hanford Washington facility, which DOE has managed for at least four decades, has experienced a myriad of issues from tunnel collapse, downwind contamination and many others. Hanford is a prime example of DOE mismanagement issues.

⁶¹ For details on DOE management of the nation's nuclear arsenal and wastes at production plants see: <http://www.chicagotribune.com/news/nationworld/ct-tunnel-collapses-nuclear-waste-site-20170509-story.html>

⁶² The exact details of the extent of these two categories of losses are debatable. DOE documents note smaller impacts: <https://www.energy.gov/nepa/downloads/eis-0250-final-environmental-impact-statement> than do other researcher(s). These alternative analyses differ from the DOE on the exact parameters of the losses and risks. For an illustrative example see: <http://www.state.nv.us/nucwaste/trans/rwma0108.pdf>.

partners of such efforts (ISP) and a backlash against anyone politically in charge at the time of the attack, and thus responsible for protecting public health and welfare.

Many observers would argue that a proactive substitute for transportation of these wastes across America is to use a safer alternative, like sheltering the wastes in place at their existing facilities using dry storage technologies until such time as the radiological inventory is far less dangerous.⁶³ This alternative strategy would allow the public to gain a semblance of acceptance for NRC actions and DOE management (or whoever is finally in charge) thus reducing the potential impact of any symbolic attack.⁶⁴ Such a “no-action alternative” strategy will also allow the wastes to naturally decay and as time passes reduce some of the waste’s radiotoxicity.⁶⁵

Lastly, the whole shipment effort has the potential to create an oppositional culture similar to that seen in recent years regarding the negative effects of globalization. As stated elsewhere, most to almost all of the organized opposition to NPP and waste shipments is non-violent. The futuristic vision herein is that once shipments start, once the public is apprised of the transportation risks for their communities in the transport corridor, once an incident transpires (HIE or DBE), once consent that was granted is not allowed to be revoked, then mass opposition may develop.

It is judicious to assume that this form of oppositional social movement is what America will be facing in the future. After all this is what has already transpired in Germany, France⁶⁶ and other industrial nations:⁶⁷ widespread anti-nuclear protests from well-organized and highly motivated protest groups should be anticipated for the transport effort to, and the operations of, the CISF. These shipments have the symbolic value capable of sparking such protests and these in turn increase the risks when

⁶³ Hardened on-site storage (HOSS) is a term used for such SNF ‘target’ hardening procedures. For details on such procedures, including wet storage safety, see: https://ieer.org/wp/wp-content/uploads/2010/03/HOSS_PRINCIPLES_3-23-10x.pdf

⁶⁴ Interesting arguments for the viability and desirability of dry storage at NPP were articulated in the aftermath of Fukushima and as a result of the performance of dry cask storage given the BDBE of the massive earthquake and the tsunami. For one example see: <http://issues.org/28-2/alvarez/>

⁶⁵ The National Environmental Policy Act (NEPA) allows for the analysis of various alternatives, including the no-action suggested herein. See: <https://ceq.doe.gov/>

⁶⁶ For details on Germany and French opposition see: <https://www.bbc.com/news/world-europe-13188507>. Please note while disruptive, these protests were non-violent by choice.

⁶⁷ For an example see the development of protest/dissent in Japan post-Fukushima: http://ieas.berkeley.edu/events/pdf/2012.04.20_sustainability_oguma_en.pdf

transporting/storing the materials, not necessarily by the groups themselves, but by others implanted within these.⁶⁸

Lessons Learned

This section of the report looked at some of the many factors that could go into the analysis of HIE/DBE risk and the ISP proposed CISF in Andrews County, Texas. Despite the thousands of pages of writing in the ISP documentation and application, the scarcity of actual details in the proposal by ISP, the lack of NRC regulatory oversight allowing a proposal to be presented without transportation analysis and the uncertain role of DOE, coupled with lack of clarity about what types of, and exactly how much, of these wastes will be stored at the Texas CISF is problematic. Deliberately obfuscating details and/or allowing ISP to produce this document without accepting responsibility for such precursor analysis, these NRC regulatory actions and inactions are problematic. As such this section has attempted to articulate the various ways risks could be framed for the proposed facility and how those disclosures would benefit the public acceptance of this project.

⁶⁸ The protesters against nuclear power and associated activities like transportation of wastes are overwhelmingly non-violent. On occasion the anti-nuclear movement has been subject to law enforcement/intelligence infiltration activities seeking to promote such violence. One of those occasions saw the protests resisting the attempt by law enforcement. That is not always the case with social movements. The idea herein comes from other protest movements where violent social actors embed themselves in otherwise peaceful groups, only to act out during a protest. The example that has been scrutinized was the WTO protests in Seattle. Curiously, after the fact the protesters said it was the actions by law enforcement that prompted the violence the world witnessed.

ISP PARTNERSHIP

ISP is a multinational organization with market leadership in many phases of end of the fuel cycle management for NPP produced SNF. ISP is the created corporate identity for the partnership of Wastes Control Specialists (WCS) and Orano, USA.⁶⁹ The ISP partnership has specific expertise for the on-site storage, packaging, transportation and interim/final storage of SNF/GTCC wastes.⁷⁰ Given the fact that this corporation has interests in decommissioning NPP, has designed storage systems, has developed transfer technology and now wishes to conduct interim storage, their operations would best be defined as a vertical integration form of operational control. In short, after the partnership was created ISP became one of the go to providers for outsourcing the end of the fuel cycle operations, has expertise that is hard to match in the industry and given these multiple layers of involvement has some unique liability in the case of a HIE or DBE.

The unique position this company holds in the nuclear industry has both positive and negative consequences for the proposed Texas CISF. On the plus side this company argues that it has unique expertise and knowledge that can help find solutions to the waste problems facing America.⁷¹

On the negative side, the partners in ISP have some questionable dealings in the past, have incentive to minimize risks of the facility to gain the contract for operations and hope the CISF proposal undergoes expedited scrutiny that may gloss over the real questions that arise when discussing such a remote site for the CISF and other serious questions that may arise for an interim facility.⁷² WCS's history of work in the area of

⁶⁹ In 2016 WCS was partnered with AREVA and NAC International. In January 2018, AREVA was renamed Orano. NAC has recently intervened in the Holtec application (September 2018).

⁷⁰ For WCS details please see: <http://www.wcstexas.com/about-wcs/overview/>. For ORANO expertise please see: <http://us.aveva.com/EN/home-3835/about-orano.html>

⁷¹ Debate on how the CISF funding will work has begun. DOE would normally provide such funding but given that current law does not allow that agency to fund anything but a permanent repository, the ISP proposal does not address this critical issue directly. The recent financial trouble experiences by one of the partners in this proposed CISF facility call into question the financing of the total operation. The lack of specifics for financing of the CISF operations may be a way to avoid the DOE illegality until the law is changed by Congress.

⁷² For discussions on a 'lost shipment' to WCS see: Strassman, N. "Uranium waste found on ranch". *Fort Worth Star Telegram*. For other issues see details on the potential contamination of water table below the existing WCS low level waste site, political contributions to Rick Perry when Governor of Texas and objections by staff at the Texas Commission on Environmental Quality. Orano, formerly AREVA, is partially owned by the government of France and has Kuwaiti financial interests. This company has proposed a uranium enrichment facility in Idaho. This attempt was placed on hold in 2011 after the company experienced what was termed "an investment freeze." Orano, formerly AREVA, was involved in the proposed Calvert Cliffs 3. Orano was the reactor vendor. However, a legal intervention in the NRC licensing proceeding blocked the proposal when it was ruled that French majority
(Footnote continued)

low level waste management is seem helpful for the operational side of the management of the proposed CISF but history has shown this company has some issues with operational decision making.⁷³

Despite the wealth of experience this partnership brings to the CISF proposal, they neglect any real analysis of the efforts that must be accomplished for the loading from existing facilities, transport to the remote site, waste transfer over the transportation routes and finally the emplacement of the wastes in their proprietary storage systems (Orano's, NAC's, etc.) at the CISF in Texas. Likewise, financial arrangements may be problematic considering WCS's past filings for protections and Orano's previous freeze on investments for other nuclear related facilities in the United States.

Additionally, the partnership uses a similar argument to Holtec and their application for a CISF in New Mexico. The start clean/stay clean philosophy both use seemingly is done, so at the direction of, or at least with the complicity of, the NRC and as a means to limit the need for facility infrastructure that may be potentially problematic. This philosophy has serious implications for the national transportation of wastes since it would require rejected wastes (a.k.a. return to sender shipments) to be reshipped over open railways (or highways or waterways) with a known radiological hazard. Such return to sender provisions will increase shipments as casks are rejected. More importantly these shipments are returned because they may be excessively contaminated or otherwise suspicious. This means that while the CISF seemingly starts clean, it offloads the potential contamination and thus endangers those transportation corridor communities all the way back to the origination point. The morality of this philosophy and the potential ISP liability of such actions make sure a philosophy highly suspect.

Lastly, the proposal does not address the potential that a permanent repository may never open, raising the very serious question that if approved, will this CISF become a *de facto* permanent surface storage including the safety, security, health, and

ownership (including *Electricité de France*) was illegal under U.S. laws and regulations prohibiting majority foreign ownership of an NPP licensed by the NRC and located on U.S. soil.

⁷³ WCS has experienced serious operational lapses in its LLRW storage and disposal work. For example, after the Los Alamos National Lab barrel burst in the WIPP underground facility, WCS agreed to accept more than 100 potentially bursting barrels from LANL, on short notice. WCS decided to store the potentially bursting barrels in a concrete overpack painted black. This management choice exacerbated surface heat levels during the hot West Texas summer. LANL had to intervene, asking WCS to put a layer of soil over the concrete overpacks, to at least attempt to minimize the heat impacts on these potentially bursting barrels. Another sign of the operational judgment is found in WCS's acceptance of those barrels in the first place. Currently, more than 70 of these barrels remain at WCS since it is illegal to return them to WIPP given their potential to burst while in transit. This incident calls into question the proposed start clean/stay clean philosophy of the ISP CISF noted in the ISP License Application document (see pages 11, 83, 85 and 92 for examples).

environmental implications that derive from that potential and over extended time frames. If the CISF does open in the future, when is that expected and how exactly will those wastes be shipped to the CISF. Questions of liability given ISP's unique position in the end of fuel cycle operations, foreign government ownership, issues with DOE waste title and so many other questions are left unanswered because of the paucity of analysis of the programmatic implications of this proposed facility.

The proposal offers few specifics, hides behind the secrecy of security regulations propagated by the NRC; the partnership limits its potential liability by legal ownership status (LLC) and uses other legal protections to give the NRC what they wish to hear.⁷⁴ NRC in procedure and ISP in application do not offer a cold eyed assessment of the issues. Not considering issues that communities will need to be apprised of to understand the risks, let alone give consent for the proposed facility to be sited, is neglect.

With respect to HIE on shipments and the proposed CISF, the details are completely lacking in the proposal. Obscuring the risks of transport and operational concerns like sabotage/terrorism by attempting to use generic analysis and presenting a Pollyannaish version of reality to gain a contract is not effective business; it is rent seeking behavior of the most dangerous type.⁷⁵

The proposal as reflected in the current form of the ISP ER is not reasonably worthy of being considered as an EA given the ISP (and NRC, if simply incorporated as is) choice to not address the most critical component: **Transportation**. The proposal is rather more like a NRC endorsed propaganda document replete with missed opportunities to communicate risks to the public and gain informed consent for the project. It is just meant to secure a contract, seek rent from said contract, and does not address the real intent of NEPA and likeminded regulations propagated to protect the public interest.

The NRC process of siting this ISP is what could be termed an attempt to gerrymander risks by offloading the CISF site to remote communities with little or no economic opportunities. These communities are another example of this rent seeking. The NRC,

⁷⁴ Realistically the NRC should have insisted that the DOE be more prominently featured in the proposal since this federal entity is so intertwined with the transportation of these wastes, by mission and law. As an example of rent seeking, ISP may be looking to DOE to play the central, or perhaps even exclusive, role as sole customer to the proposed CISF. This presentation does not address that relationship fully given the recommendations of outside reviewers like NAS/BRC that suggest DOE be excluded from the operations of a facility and management of the transportation to that facility.

⁷⁵ Many definitions of rent seeking are in the public domain. One from a business website might help understand the concept: <https://marketbusinessnews.com/financial-glossary/rent-seeking-definition-meaning/>

as a government regulatory body, should consider environmental racism and economic opportunism as part of the evaluation.⁷⁶

ISP has expertise in much of the end of the fuel cycle operations that are necessary to transport and store these wastes. The partnership has a history of questionable business practices, financial troubles and operational failures. Of course the proposal highlighted the more positive aspects, but downplaying or obscuring the negative aspects of the proposal is unethical and represents poor business practices since such avoidance behavior may increase future liabilities to the partnership if a radiological incident occurs. One means to offset such financial liability concern would be to require the partnership to establish a risk bond fund wherein the liability for malfeasance can at least be covered in the event of an incident and if not the partners decide to try and walk away from their joint responsibility for liabilities.

Any consideration by Andrews County as the end point of a supply chain to the CISF is not the only consent community that must be addressed. The state of Texas has preexisting agreements about wastes and WCS operations. The state also has oversight for transportation and inspection of cargoes. The state(s) will endure any return to sender shipments that result from start clean/stay clean rejects. As noted above, these shipments will be by definition contaminated or they will be of questionable structural integrity or have intact confinement of the radiological inventory. They represent an on-going, known and dangerous radiological hazard that ISP would be responsible for creating since the partnership will be the rejecting authority. Once a shipment is designated 'return to sender', the emergency response communities across the nation would need to be involved. The start clean/stay clean philosophy is hugely problematic and given the ISP proposal does not even try to estimate the number of shipments, nor possibility of rejects or impacts on those communities in the path of return, the proposal is deficient in the extreme on these points.⁷⁷

States will be involved in any shipment effort – to the Texas CISF, with the returns from the CISF especially, and of course as shipments are arranged to the future final storage

⁷⁶ The idea of how such facilities would affect tribal communities has a long history in the Yucca Mountain proceedings and other publications in the public domain. One example: <http://www.state.nv.us/nucwaste/news2005/wm/TribalImpacts.pdf>. Additionally, local economic constituents like businesses, ranchers and agricultural enterprises have started to express concerns over the placement of the CISF. Such opposition might be assuaged with NRC/DOE consent based siting educational efforts prior to seeking permission for siting the storage operations. The opposition of these groups might also be intensified when actual risks are communicated to the local community, especially transportation details.

⁷⁷ The ISP License Application document notes the start lean, stay clean philosophy in various places (see p. 11, p. 83, p. 85 and p. 92).

and/or disposal facility. The experience with Nevada has shown that these stakeholders must be involved in shipments coming from the proposed CISF to their final resting place – be it at Yucca Mountain or elsewhere. This will possibly become an unfunded mandate as the original shipment, or the returns, would reasonably be expected to have cost recovery provisions, but what about funding for such decades from now or longer? Can future generations of state leaders expect funding and cost recovery to be paid once the original problem of wastes at reactors has been mitigated and all that is left is a CISF no one wants to pay to destock?

As noted, the start clean and stay clean operational philosophy is fraught with potential serious problems. With no infrastructure to handle this type of contamination problem, will ISP wish to return to sender any shipment that its own partner may have packaged or that the ISP group is somehow responsible for since it has such a large part of the end of the fuel cycle activities? Perhaps ISP managers would not address the issue and place the cask into storage so that future generations will be forced to handle the problem? What happens if damage is done to the cask while unloading? Is that incident ISP's responsibility or will it be deemed a shipment issue and thus the partnership attempts to offload the issue back to the origination point?

Because this will be a national (perhaps even international) transportation effort, and given the serious issues with returning contaminated cargoes back to the sender, shipment corridors and chokepoints for shipments should also be subject to a consent process as is argued elsewhere. It will not be just routine radiation emissions, accidents and other risks these communities face. No, given the intentions of ISP, these communities face real, known and dangerous potential contamination events as these rejected shipments return across their jurisdictions and to origination points. What about those origination points? Will those communities likewise be subject to forced contamination because ISP wants to start clean and stay clean?

Communities that will be heavily impacted range from Chicago where much of the train traffic will transit through to smaller communities like Buffalo, Detroit, and Kansas City.⁷⁸ The lack of a site specific EIS that addresses a fuller range of risks and of a programmatic EIS that addresses transportation, routine radiation emissions, training for first responder communities, equipment needs and many other aspects noted in this report, demand that the NRC and DOE conduct more detailed analysis. The siting process needs such analysis to be expanded to include all aspects of the end of the fuel

⁷⁸ Identification of affected communities is difficult since transportation planning for the proposed CISF was not done. Looking at the example set forth by Yucca Mountain analysis, these and many other communities would be directly affected by rail shipments.

cycle operations that this partnership and its proposed CISF facility will engage in during the totality of operations to stock/destock the storage of the wastes considered for the West Texas facility.



CONSEQUENCES

Once an incident happens, the variety of consequences for communities in the transportation corridor, or near to the CISF site, would be significant. These include radiological, economic, social, political and legal consequences for the community, for ISP and for the agencies that oversaw the CISF process. As happens in the aftermath of a radiological emergency, economic consequence estimates are the most prominent in the media and these estimates will be varying greatly. Guesstimates of radiological impacts will be equally random and range from willful dreams of no environmental impacts to depictions of a radiological apocalypse. Such disparities in radiological release estimations and economic consequences rest on differing analytical assumptions, and ultimately, the motives of those reporting on the releases. The typical radiological and economic impacts reported in the aftermath of an incident do not account for other aftereffects that will be discussed below (social, political and legal).

Likewise lessons learned from radiological releases at Fukushima and the consequences that transpired in Japan, tells planners in America to focus on considerations of the short-term, moderate-term and long-term radiological impacts in conjunction with the economic, social, political and legal impacts. Currently no pre-existing protocol is in place that will allow local, state, tribal and national government agencies a prearranged methodological means to judge these risks, or assess them in the aftermath of an incident in-transit or at the proposed Texas CISF.

Radiological Impacts

Assessing potential radiological consequences is predicated on knowing the radiological inventory history. For example the burn-up rate of the SNF, the number of years out of reactor for the fuel assemblies in the shipment, does the shipment encompass the oldest fuel in the inventory or newer fuel assemblies, are dedicated trains designated and used for the shipments, and many other variables that offer clues as to the radiotoxicity and risks the shipment poses in-transit.

The actual mode of transport is also important since legal-weight and heavy-haul truck cargoes differ in inventory size over rail cargoes or barge shipments. Intermodal cargoes, for example heavy-haul truck to rail, could be foreseen as similar to rail cargoes except for those road miles necessary to traverse given some NPP do not have rail access. Barge to rail intermodal transfer may likewise demonstrate a similar risk profile to rail, but so few details on this mode of transit are known that this is currently an assumption. One compounding factor in intermodal shipment is the actual transfer of the cargo – this is a potentially risky operation to physically handover such heavy

cargoes from one mode to another and adds risk complexity to the transportation effort.

All of this suggests that planning by transportation and storage managers must first determine the inventory to be shipped. Once that has been decided, details on the actual removal of the cargo from the reactor location, use of intermodal transfer when necessary, specifics on route planning for everyday shipments, alternative routes when interruptions occur, remain questions needing to be answered, and only then plans for the transportation of these cargoes can be assessed. This sounds easy but after decades of work on Yucca Mountain the DOE had little success in satisfying the concerns of the affected parties in Nevada, let alone the many transit corridor communities that such shipments would impact across the nation

It may be obvious but radiological contamination has significant consequences for the human animal and the lived environment. Direct human radiological health consequences include potential increases in cancer rates, genetic alterations, birth defects, increased risks of fungal/bacterial infections and so on. These should be anticipated prior to any shipment campaign and within the operational lifespan of the proposed storage facility. These types of consequences require immediate assessment by trained health professionals and thereafter, long-term tracking of the health of exposed workers, vulnerable populations and the public. These radiological exposure screenings typically look at radiation poisoning, thyroid cancer and certain other cancers, but in the case of a transportation emergency, pre-differentiation of groups and potential impact identification may help in such monitoring. Groups could include: the general population in the vicinity of the accident, vulnerable populations in the area (elderly, children, and most especially pregnant women) and the emergency response workers who will be tasked with minimizing the impacts of the incident. These are the most immediately evident groups that would need long-term monitoring after an incident involving a release fraction of the radiological inventory but others may arise as the circumstances dictate.

As noted in a previous study of post-Fukushima Japan,⁷⁹ some of the consequences are not directly related to radiological contamination *per se*, but rather could best be considered under a category called the social-psychological health affecting consequences of being caught in a radiological disaster. These include depression, anomie, alcohol abuse, drug abuse, increases in unhealthy lifestyles (smoking,

⁷⁹ The materials in this section are from an analysis done by the author: Ballard, J. D. 2013. "Japan's Fukushima Daiichi Disaster: Implications for Further Research on Terrorism and Sabotage." State of Nevada, Nuclear Waste Projects Office, Carson City, NV.

overeating, etc.) and many more. These would apply to both the civilian population and the first responder communities. The extensive body of research on post-disaster mental health consequences for emergency workers should inform the assessment of such factors, but also have applicability to the more directly impacted general population group.

Data collection procedures from such monitoring should be pre-determined and systematized; procedures to check the quality of the data set in place, financial support for long-term research established and institutionalized since it will be necessary to follow these populations for decades post-incident.

In the case of an HIE incident or BDBE with significant radiological release from transported or stored SNF/GTCC wastes the immediate groups would be:

- Monitoring of the general population in the surrounding areas that may have had contact with the radiological contamination.
- Monitoring of special populations with increased radiological vulnerability (e.g., children, elderly, pregnant women, etc.) in the surrounding areas that may have had contact with the radiological contamination.
- Monitoring of the workers (e.g., engineers/drivers/guards) at the incident site.
- Monitoring of the emergency response workers at the scene (e.g., fire/police/medical etc.) and in the background scenes relative to the disaster (e.g., medical/lab workers/testing etc.).
- Monitoring of the contamination to the environment over time to ensure these groups are representative of all that are at risk.
 - a. Short-term isotopes
 - b. Moderate-term isotopes
 - c. Long-term isotopes
- Monitoring and maintenance of the data collected by such efforts and assurance of its quality across time.

In addition to the radiological consequences for an incident involving SNF or GTCC wastes, there exists an area in the literature that applies to this proposal and the transportation necessary to support the ISP facility – routine radiation exposures. First, the casks do not completely contain the penetrating radioactivity during transit. Each shipment will provide small doses of gamma and neutron radiation to those in or near the transit corridor. The long-term health effects of such small dose radiation exposures are of concern to communities and should be pre-determined by planners and communicated.

The next section will address the economic consequences of an incident involving these cargoes. Lessons learned from recent radiological emergencies in Japan should inspire policy makers and regulators to pre-plan for the variety of impacts for the ISP CISF, including the very real possibility of serious radiological contamination and the costs of such incidents. Thus, developing and then using a predetermined analytical matrix format is prudent public policy. At the end of this consequences section one such matrix example is offered in hopes it can assist in consequence assessment and emergency response planning by communities faced with shipments through their community and at the storage site in Andrews County, Texas. The matrix therein is one way to collect such information but again it is only potentially effective after the details on cargoes and transportation are known. Since DOE/NRC rarely accepts public criticisms of their efforts, this matrix is offered to promote the development of such analytical tools by those government agencies.

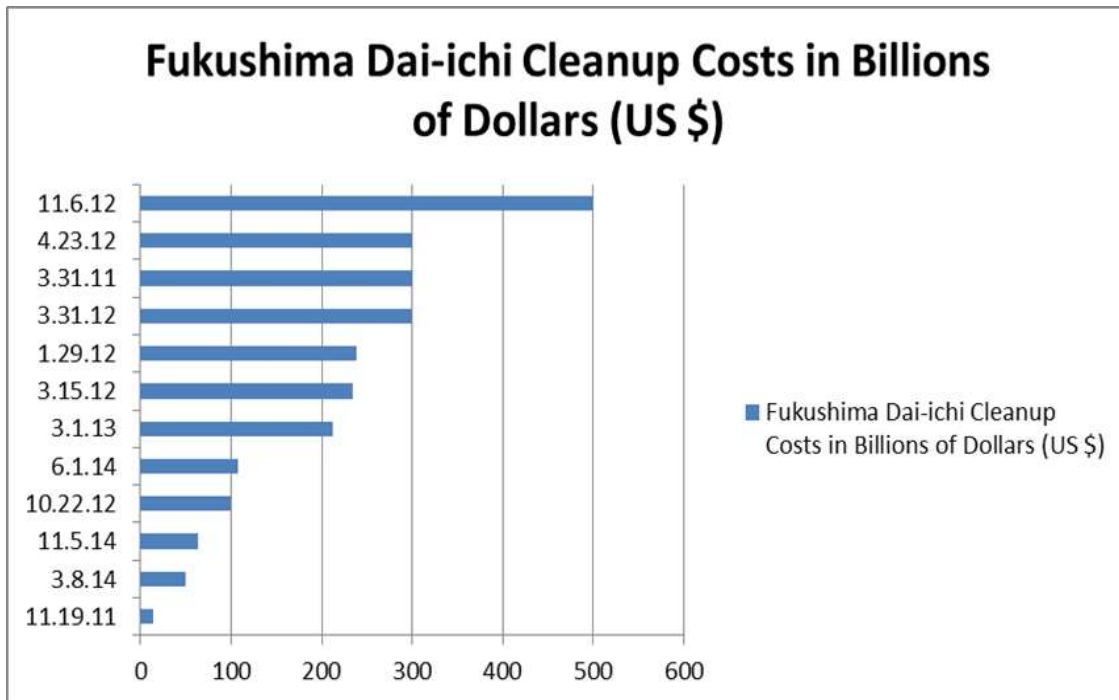
Economic Impacts

This section will examine the implications of a radiological incident and assess the potential economic impacts of successful HIE acts, or BDBE accidents, related to waste shipments and storage. Why would this economic analysis become necessary? The estimation of costs from Fukushima varied widely and show the need for a social scientifically valid and reliable instrument to assess these impacts in the event of a BDBE accident or HIE concerning SNF/GTCC materials destined for the proposed storage facility, that may transpire within the confines of that facility and for the overall exit transportation effort that will be needed when the CISF is eventually shuttered.⁸⁰

⁸⁰ Details on variable economic estimates for transportation incidents can be found in NRC Docket No. 63-001, High Level Waste Repository, December 19, 2008. STATE OF NEVADA'S PETITION TO INTERVENE AS A FULL PARTY. In a report prepared for the State of Nevada ("Potential Consequences of a Successful Sabotage Attack on a Spent Fuel Shipping Container: Updated Analysis Revised Final Version" (11/01/2008), Radioactive Waste Management Associates (RWMA) re-evaluated earlier cleanup cost estimates and prepared new estimates for a range of sabotage event scenarios. According to the authors, cleanup costs following sabotage events similar to those evaluated by DOE in the FSEIS, in which the casks are penetrated but not perforated, could range from \$3.5 billion to \$45.8 billion (2008\$). Transportation sabotage events in which the casks are fully perforated could result in cleanup costs of \$463 billion to \$648 billion (2008\$) (See p 1051). In contrast, DOE says "costs for cleanup after a severe accident in which radioactive material was released could be in the range of \$300,000 to \$10 billion." However, DOE admits that the \$10 billion figure "was not based on a truck or rail accident, but rather was based on a National Aeronautics and Space Administration (NASA) study of potential reentry accidents for the Cassini space mission, which used a plutonium powered electricity generator" (p. 1054). The State of Nevada estimated that cleanup costs following a severe rail accident could be up to \$189.7 billion. ("Worst Case Credible Nuclear Transportation Accidents: Analysis for Urban and Rural Nevada" (08/01/2001) (p. 1055).

The estimates of damages from the Japanese disaster are disturbing in how varied they are on the economic impacts; they diverge widely and represent questionable methodologies of assessing consequences.⁸¹

This divergence of economic impact opinion can be visualized by longitudinally recording cost estimates for an actual disaster (Fukushima). For years the State of Nevada has tracked the cost estimates of the Fukushima Dai-ichi incident as part of their NEPA contentions.⁸² The following chart is a representation of the variability of those estimates as found by Nevada research.



Post-Fukushima analysis shows that the economic cost estimates have begun to coalesce around ~180 to ~200 billion (USD). Importantly for communities in the transportation corridor, and near the CISF, the clean-up timeline has elongated towards 40 years. Thus, such immediate post-incident estimates should be considered fungible

⁸¹ These estimates are for the set of disasters, earthquake and tsunami, at Fukushima. Separate costs for each are just as questionable and subject to political factors. For example TEPCO has offered various assessments and released a report that “shows” they were not necessarily at fault for underperforming assessments of potential disaster parameters. See June 20, 2012 *The New York Times* article by H. Tabuchi “Nuclear Operator in Japan Exonerates Itself in Report.”

⁸² J. D. Ballard. July 31, 2017. Report for the Nuclear Wastes Project Office titled: “Updated Testimony Preparation: Nevada NEPA Contention #NEV-NEPA-09.” Available from NWPO, Carson City, Nevada.

as these are in current dollars, they may underreport the costs of social displacement and as more data becomes known, adjustments are to be expected.⁸³

Many of the cost estimates reported in this chart are for the totality of the disaster and not just the radiological release as observers did not specify what they were estimating, how they did so or what variables were used. Thus they are more likely wild guesstimates on the part of non-neutral observers and in many cases represent hopeful propaganda by government and industry. Are they in any way social scientific? Not in the least. The real lesson to take away from this chart is that estimates vary, they change over time (most upward) and in this case, they grow as the full impact of the incident becomes known. Having a pre-existing economic impact model in place to estimate these impacts would make such wide fluctuations in estimates better regulated and lend some much needed methodological rigor to the process.

Data

While there are many means to organize economic data for such an analysis, the effects of a radiological disaster are an underdeveloped area of social science. The economic impacts from such disasters could be identified by means of the thematic grouping of certain economic issues and into relevant analytical categories.⁸⁴ In the case of the CISF analysis the following categories are suggested:⁸⁵

- Direct economic impacts
- Indirect economic impacts
- Stigma impacts

⁸³ Original data details can be found in a series of reports done for the State of Nevada by J. D. Ballard.

⁸⁴ This discussion is different from traditional economic analysis. Disasters, human initiated or natural, do not easily fit economic impact analysis (EIA) protocols. Due to social obligations and the lack of good data, cost-benefit analysis (CBA), is likewise not easy to accomplish. The planners for any effort at the transportation of nuclear waste need to move beyond traditional EIA and CBA to invent new economic models to assess the impacts of a radiological disaster prior to its occurrence. Perhaps they could build off of existing platforms like Transportation Economic Development Impact System (TREDIS) and the various agencies' assessment tools for impacts from transportation development. Likewise environmental impact assessment (EIA/EIS) procedures were designed to assess both the positive and negative impacts of projects. Transportation EIA/EIS's were designed to assist policy makers to decide the least impactful alternatives for a given transportation program. In the case of the Yucca Mountain EIS reports, the critics have argued that these documents were used more as propaganda in support of shipments and not as intended (see State of Nevada criticisms).

⁸⁵ In addition to the prevalent negative economic consequences from mass disasters are those impacts that could be considered more positive in nature. These are generally identified *ex post facto* and the economic impacts they represent transpire after an event. These should likewise be assessed when considering the overall impacts of natural and technological disasters. They include short-term positive economic impacts (i.e., direct government inputs to the economy to support rescue/recovery efforts, etc.); moderate-term positive economic impacts (i.e., rebuilding and economic stimulus efforts, etc.) and long-term positive economic impacts (i.e., investment in improved infrastructure and technology, etc.). The focus of this report is to develop a pre-incident mechanism to assess a radiological incidents impact and as such these potential positive impacts are not considered.

The discussion below will address these impact categories and concludes with the elaboration of a typology that is meant to promote the development of pre-existing economic impact assessment protocols in advance of any BDBE, or HIE, in relation to waste transport to, or storage at, the CISF facility.⁸⁶

Direct

Economic analysis of disasters typically focus on a limited number of calculations – morbidity, mortality, loss of homes, loss of businesses, etc. – what could be termed more individualized impacts of the disaster.

These calculations are not without controversy. The statistical value of life is one questionable calculation used by agencies to try and assess the impact of a loss of a single life. Interestingly these ‘value of life’ rates have been rising and thus are subject to concern by corporations, like ISP, who will be faced with potential liabilities in the event of an incident/lawsuit.⁸⁷

Expansion of the discussion of direct economic impacts may be necessary to better capture the range of variables that will be necessary to create a truer picture of a radiological disaster. The Japanese experience offered some insight into what is necessary to assess as a community/society experiences a radiological emergency. These include:

- The disruption to the energy infrastructure/market shocks.
- Loss of industrial production for those industries that will be closed temporarily or permanently.
- Negative impacts on environmentally sensitive economic sectors like farming and fishing.
- Uncertainty risks/shock to capital markets.
- Impacts on GDP/GNP.
- Loss of temporary or long-term use of infrastructure components, including those associated with other transport modes that run near or on the same pathways as the transport pathway.
- Loss of physical plant for local, small, moderate and large business.
- Lower output for certain industrial segments that may be impacted by supply disruptions.

⁸⁶ These variables were identified from a variety of sources. They have been collated and summarized for use in the discussion.

⁸⁷ See <http://www.nytimes.com/2011/02/17/business/economy/17regulation.html? r=2>. Download date June 29, 2012.

- Health care costs for the immediate, short-term, moderate-term and long-term needs of exposed individuals/communities.
- Reconstruction costs for homes, roads, telecommunications and other critical infrastructure.
- Measures to ensure safety of food stocks/food protections.
- Radiation monitoring.
- Resettlement and dislocation costs for local/downwind and down watershed populations.
- Emergency management/security costs for disaster area.
- Education costs for those displaced by the disaster.
- Costs of clean-up, waste remediation and soil/structure decontamination.

These and other direct impact variables represent what could be viewed as more aggregate economic impacts on the community. While they will transpire in the immediate geolocations of the disaster, they represent impacts on the larger social community – region, state, nation and internationally.

Indirect

The indirect impacts of a radiological incident are equally as important, albeit perhaps much harder to quantify. These include:

- Economic ripple effects to local industry and economy.
- Revitalization costs.
- Domestic confidence.
- The economic costs associated with resiliency.
- Social disruptions.
- Opportunity cost increases.
- Loss of liquidity in the economy.
- Increased insurance costs.
- Heightened sovereign debt.
- Future mitigations for industry and regulatory agencies.
- Increased control and regulation of industry, transportation and critical cargoes.

Stigma

In the aftermath of a radiological emergency involving SNF/GTCC wastes, stigmas of various sorts will arise and create negative economic impacts for the community when such a disaster occurs. The assessment of such is difficult to quantify since the analysis

of these variables would perhaps entail the need for fuzzy logic procedures.⁸⁸ These stigma impacts could include:

- Dread risks increasing costs.
- Increased anxiety by the public.
- Higher levels of risk awareness and aversion.
- Loss of quality of life for those affected by the disaster.
- Changes in social acceptance of nuclear power, waste shipments and storage facilities.
- Shadow evacuations by those not directly affected but nevertheless impacted.
- Post disaster victimization including crime, health care and loss of community.
- Property value losses due to negative perceptions of communities.⁸⁹

The lessons learned from Fukushima should be incorporated prior to the commencement of shipment to, and storage activities at, the proposed CISF. Traditionally the NRC/DOE have neglected such impacts and focused on limited ways to visualize economic consequences. These ‘consequence assessments’ are typically a ranged amount, curiously a range that includes a collective upward bound that approaches that defined by the Price–Anderson Nuclear Industries Indemnity Act (~12 billion US dollars).⁹⁰ Such ranges fail to account for the fuller range of consequences impacts noted above and miss completely those noted below.⁹¹

The NRC/DOE consequences estimates are typically focused on NPP incidents not involving in-transit materials or CISF type facilities, except when DOE was forced to address such in the Yucca Mountain NEPA processes. As a lesson learned, such NPP estimates have proven severely undervalued for Fukushima. The same might be expected in the event of a radiological emergency while wastes are in-transit or at the CISF storage site. The NRC/DOE should preplan to assess these impacts and once an incident transpires, monitor those estimates over the short-term, moderate-term and

⁸⁸ To better understand the philosophical idea behind fuzzy logic (ideas normally used in engineering) see:

<https://plato.stanford.edu/entries/logic-fuzzy/>

⁸⁹ Nevada communities have produced several of these analyses. For example see an analysis of Clark County, NV:

<http://www.state.nv.us/nucwaste/trans/uer2001dec.pdf>

⁹⁰ NRC. Download date June 29, 2012. See: <http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/funds-fs.html>

⁹¹ The ambiguous plans for the inventory levels make predictions of final inventories problematic. It might be safe to say the CISF could end up with a very large concentration of a wide variety of highly radioactive wastes. It is a given that transport to that facility would endure accidents/radiological events, what is not known until details are made available is how many and what contamination level these represent. Given this expected reality and the operation of the CISF by a private company with foreign investment, the limits of the PAA liability could be tested and perhaps no ready assurance of that insurance funding can be assured under current law/regulation.

long-term to assist modeling alterations based on the emerging science in the field of the economics of radiological disasters.

Social Consequences

This section will examine the social implications of an incident related to the SNF/GTCC materials to be transported to, and stored at, the proposed Texas facility. This section is focused on assessing the potential social impacts of successful HIE acts against nuclear waste shipments/storage facilities. Once again the Japanese experiences offer lessons that program planners could benefit from in analyzing the proposed Texas facility.

In the case of the Japanese radiological disaster, the local population experienced enormous negative social impacts: deaths, families evacuated near the incident site, food/soil/environmental contamination and emerging radiological hotspots across the geoscape which are not within the exclusion zones – many of which will need attention in years to come.⁹² These types of post-incident social impacts can be articulated and measured as short-term, moderate-term and long-term social disruptions.

Assessing these impacts is not easy and no readily available systematic analytical tool exists. The literature on impacts from large-scale natural disasters is fragmented and might not provide the awareness needed for a radiological incident. Typically resiliency is the term used to describe the ability of a society to withstand the consequences of adverse events. In this case understanding what the impacts are and how to define them is the goal of the pre-analysis suggested herein.⁹³

The social impacts from technological failures like a radiological emergency (disaster) can be identified by means of the thematic grouping of certain sociological issues and then into relevant analytical categories. In the case of this analysis the following are suggested:

- Impacted social groups.
- Anomie/social ennui.
- Social dislocation.
- Social psychological effects.

⁹² How many died as a result of the disaster and radiological release? Overall death totals are available at <http://www.guardian.co.uk/world/2011/mar/21/japan-earthquake-death-toll-18000> (download date June 6, 2012). Additional details are available but parsing those deaths to radiological issues and the twin disasters experienced at Fukushima is an unresolved issue. See: (download date June 7, 2012): <http://www.greenpeace.org/usa/en/media-center/reports/Lessons-from-Fukushima/>

⁹³ For details on resilience preparations see: Comfort, L. K., A. Boin, and C. C. Demchak (Eds). 2010. *Designing Resilience: Preparing for Extreme Events*. Pittsburgh University Press.

In addition to the negative consequences, certain social cohesion impacts from mass victimization events could be observed.⁹⁴ These impacts transpire after a tragic event and should likewise be assessed when considering the overall influences of technological disasters. These include:

- Short-term social cohesion impacts.
- Moderate-term social cohesion impacts.
- Long-term social cohesion impacts.

The discussion below will address the more negative impacts of a radiological incident and add to the matrix at the end of this section. That matrix is meant to promote the development of pre-existing social impact assessment protocols in advance of any BDBE accident, or HIE, concerning SNF and GTCC transport and storage.

Social Groups

Radiological disasters, like natural disasters, impact social groups in differing ways. The risk profile of some groups is differential than that of others. For example, in general during any disaster, the event has impacts on some groups (i.e., women, especially pregnant women, the elderly, children, economically disadvantaged, recently relocated, etc.) that exceed the impacts on certain other groups (men, economically advantaged, long-term residents with intact and robust social networks, etc.).⁹⁵ Such differential impacts are important to understand and plan for with a facility like the Texas CISF.

Additionally the impact on those social communities in closest proximity to the disaster, by location and/or by choice in the case of emergency responders, differs from other social communities outside of the immediate disaster area. Fire, police and medical personnel are prime examples – these first responders will be differentially impacted during and after a disaster.⁹⁶ Likewise, those in closest physical proximity to the center of a radiological materials incident suffer a variety of impacts that other groups distant from the incident site do not. All told these greatly impacted groups represent what could be termed high-risk social sectors of society that will need to be addressed during a disaster and especially during one involving these radiological materials.

⁹⁴ See Durkheim, E. (1997). *The Division of Labor in Society*. Trans. L. A. Coser. New York: Free Press,

⁹⁵ For an assessment example see: Liddell, M. K. and C. S. Prater. "Assessing Community Impacts of Natural Disasters." *Natural Hazards Review*, November 2003.

⁹⁶ Alexander, D. A. and S. Klein, (2009). "First Responders after Disasters: A Review of Stress Reactions, At-Risk, Vulnerability, and Resilience Factors." *Prehospital and Disaster Medicine*, downloaded on June 12, 2012, available at <http://pdm.medicine.wisc.edu>.

Anomie/Social Ennui

The impacts on each of the social groups discussed above can be further broken down into several sub-groupings of more specific social impacts, not all are mutually exclusive. The first grouping of social impacts is based in the idea of anomie and social ennui. Anomie is the lack of social norms, a breakdown of bonds between individuals and society, community, nation state and the individual's social identity.⁹⁷ Social ennui is the idea that once such a breakdown occurs, the human animal becomes lost and without purpose – they disconnect from social activities and disengage from the body social.⁹⁸

Several symptoms/indicators of this disconnected social being have been noted: loss of confidence in social institutions; increases in generalized social conflict; and even suicide as a result of such social trauma. Incidents involving radiological materials represent the onset of multiple cascading traumas – the disaster itself is soon followed by the potential temporary or permanent loss of house/home, work, friends, social support systems, economic viability and so on. All of these factors and more can contribute to a loss of social stability and self-control in a community – all can impact the body social and all should be anticipated in the event of a radiological event.⁹⁹

Social Dislocation

The consequences of a severe dislocation of the social order of a society are profound.¹⁰⁰ On the more macro level, it represents a disruption in the functioning of social institutions, economic arrangements, and community relations and impacts large-scale social relationships. Mass evacuation resulting from radiological contamination is one such dislocation. Macro level risk impacts on social life after disasters (e.g., internal migration, stigma effects, lower property values, loss of social institutional supports and so on) are additional indicators of social dislocations. The result of such evacuations can cause more micro social impacts like social concerns over children (e.g., schooling, care, feeding, health, etc.). Social dislocations, like those resulting from a radiological

⁹⁷ See <http://www.merriam-webster.com/medical/anomie>, download date June 8, 2012.

⁹⁸ This particular subject is normally attached to topics like social media and technology. See <http://www.mediapost.com/publications/article/172678/entering-the-era-of-social-ennui.html>

⁹⁹ Gleaned from M. K. and C. S. Prater. "Assessing Community Impacts of Natural Disasters." *Natural Hazards Review*, November 2003 as well as FEMA webpages at www.fema.gov.

¹⁰⁰ Social order is the basis of much of sociological theory. One good summary can be found in Hechter, M. and C. Horne (2003). *Theories of Social Order: A Reader*. Stanford University Press. Social disorder (a.k.a. social disintegration) then is a state opposite to, or at least far from, such order as hypothesized by social order theorists. Durkheim, E. and Tonnies, F. are two theorists closely associated with these ideas.

incident, also exacerbate existing social ills at the micro level (e.g., drug use, alcohol abuse, etc.).¹⁰¹

Social-Psychological

Social psychology effects refer to those impacts that derive from social interactions and their intersections with social structures/cultural values.¹⁰² One way to start to develop a gauge of these impacts in the aftermath of a radiological disaster is to look at after incident effects on police, fire, medical and other first responders. These more micro level impacts are not usually immediately evident and may take years to manifest. The personalized risks for these first responders include depression, anxiety, PTSD, drug and alcohol abuse, increases in domestic violence, grief, and social lethargy. On the more macro level, effects may manifest as alterations in the career pathways, negative effects on families/relationships and impacts on future generations.¹⁰³

Social Cohesion

The enumeration of the negative impact categories of anomie, social dislocation and social psychological effects would be reason enough to construct a measurement device/instrument that would assist in the aftermath of a radiological emergency. During the short-term aftermath of a disaster some temporary social good may also be noted. Examples include temporal increased social cohesion as people rally around community, short-term increased sense of national /regional pride for the response efforts, instances of unselfish behavior as people share scarce resources and maybe some increases in feelings of self-reliance.

These short lived impacts will dissipate and a return to more normalized behavior will result. The moderate-term effects may include sharing of grief (collective grief), collective action to mitigate future risks and discussions on increasing resiliency to social calamity. Like the short-term impacts, these moderate-term impacts will dissipate and a return to more normalized behavior will result.

¹⁰¹ For a primer on what micro and macro levels of social impacts consist of please see:

<http://www.everydaysociologyblog.com/2011/05/micro-meets-macro-walking-in-your-community.html>

¹⁰² See C. H. Cooley. 1902. *Human Nature and the Social Order*, New York: Charles Scribner and additional theorists can be found in Coser, L. A. 1970. *Masters of Sociological Thought: Ideas in Historical and Social Context*. New York: Harcourt, Brace and Jovanovich.

¹⁰³ Noting their opposition to nuclear power, and defying traditional gender roles in Japanese society, a group of 100 Fukushima women protested nuclear power to protect their children, families and way of life. Downloaded June 12, 2012, see <http://world.time.com/2011/11/03/fukushima-women-demand-better-protection-for-children-exposed-to-radiation/>

Long-term impacts vary and could be positive or negative. They may include social mobilization, social movements and reconstruction. For example, in the aftermath of the Japanese experience at Fukushima, the newly formed Reconstruction Ministry was designed to facilitate response to such short-, moderate- and long-term impacts.¹⁰⁴ The fact that such a ministry needed to be created shows the need to preplan for such events. As suggested herein planning for the infrastructure of such an agency and having it ready prior to a radiological event may help mitigate negative consequences of an incident.

The lessons learned from Fukushima should be used to create a pre-determined social impacts assessment tool for radiological accidents/incidents. The categories above are one way to organize the variables that could be considered and begin the development cycle for an analytical instrument usable when a SNF/GTCC radiological accident, or HIE, transpires. Traditionally the DOE and NRC have failed to account for such impacts in their assessment of potential effects from a radiological incident, but the tragedy in Japan has proven these variables are critical to assess and they need monitoring in the short-, moderate- and long-term.

Political Impacts

This section will examine the implications of a radiological disaster by assessing the potential political impacts of BDBE, or HIE acts, against nuclear waste shipments and/or storage facilities.

Jurisdiction

Considerations of political impacts begin with a recognition of jurisdiction. In the event of any radiological emergency the various levels of political jurisdiction will each be challenged in the short-term, moderate-term and long-term. The Japanese experience helped demonstrate the variety of obligations, responsibilities and management/response the various levels of jurisdiction must address during a radiological emergency.

Political impacts encompass the need to manage a crisis and include the costs of failure to manage the crisis. These failures will exacerbate the risks and have career and personal costs for political authorities. During an incident in the United States, political authorities from local towns/cities, states, tribal governments, regional confederations of states, national government and international agencies would reasonably be expected to

¹⁰⁴ The structure of such an agency is not without problems. Japan's efforts are illustrative on the pitfalls and need for such an agency. Please see <http://www.bbc.co.uk/news/world-asia-pacific-14024206>, download date May 30, 2012.

provide effective and timely responses. For example, these various political authorities would be expected to provide emergency response assets and will also have the need to assist in recovery from the incident, possible relocation of the community wherein the incident occurs and offer other mitigation efforts for the radiological consequences.

Much of the transport of wastes to the proposed CISF will traverse rural areas with few emergency response assets. Thus, depending on location, these first responder entities may represent standing professional emergency response assets or in much of the transportation corridor, they will be volunteer departments designated to handle the emergency. While the discussion that follows is more esoteric than management of the everyday aftereffects of a disaster, this discussion can help provide the pathway by which political effects will be discussed, measured and politicians held accountable.

Presumption of Response

Local authorities will be the first responders to a SNF/GTCC incident and bear the brunt of the initial impacts of that radiological incident. The public will expect timely and effective responses. To meet that demand, these political entities will quickly establish incident, and then unified, command structures to help enlist/organize the help of contingent jurisdictional assets to assist in their emergency response efforts.¹⁰⁵ These unified command structures will not only solicit mutual aid from surrounding communities, but start the process of requesting state and federal support from various agencies like the governor's office and federal agencies. Federal support could come from agencies like DOE, DOT, EPA and FEMA. International agencies like the IAEA will most likely offer help and may be allowed to assist. NRC will likewise have a hand in the aftermath of an incident, as will the ISP.

In general, a rule of thumb is that the higher the level of political authority needed to support an emergency, the longer the delay in getting assets to the incident site. The burden of managing the incident falls, at least in the critical initial phases, on local emergency management agencies like the fire departments in immediate proximity to the incident. Political authorities should recognize the emergency management related consequences of any campaign for the transportation of SNF/GTCC materials through their jurisdiction and to the proposed CISF in Texas.

¹⁰⁵ Typically a radiological incident would see the fire and rescue assets taking the response lead. During an incident that lead would come to incorporate many agencies and move from an initial incident command structure normally enacted at the front of a response to unified command structures used towards the end of a response cycle. Plans should be in place for the initial and subsequent response command. See:

<http://www.phe.gov/Preparedness/planning/mscc/handbook/chapter1/Pages/emergencymanagement.aspx>

Impacts on the localized authorities can include:

- Contingency training for emergency response assets.
- Pre-staged response assets to handle such a radiotoxic incident.
- Specialized equipment necessary to protect response personnel.
- Evacuation planning and actual physical assets to accomplish evacuations in case of a large-scale radiological incident.

These are a few of the more visible public service functions that local political authorities should consider in advance of any shipment campaign. While the federal assets will most likely come after an emergency, the immediate need to respond and provide for public safety will become priority one for local authorities.

The following section details some of the functions that may be required during an incident. The discussion also includes consequences for those political entities/individuals that fail in planning and providing these.

Political Consequences

Political authorities were expected to provide many functions before and during the Fukushima incident (and as lessons learned will be in the aftermath of a CISF related incident). These include reasonable political expectations such as :

- Truthful and accurate communications on the risks of radiological incident related activities.
- Provide for economic (re)development as a result of radiological incident activities.
- The provision for a safe and secure social environment.
- Assumption of governmental response in the case of a radiological disaster.
- Realistic risk informed planning.
- Support for the continuation of the geolocation's ways of life.
- Reliable post-incident decision making.

The consequences for local to national political authorities were severe in the aftermath of Fukushima. Because of failures to act, some of these local and national leaders lost their support from the community/nation. To paraphrase an old nuclear industry adage: 'an accident anywhere is a disaster everywhere.' The political consequences related to the energy industry that may arise in the aftermath of a radiological disaster include items like:

- Calls for nuclear industry regulatory reform.
- Increased safety culture for nuclear industry.
- Recognition and consequences for official disinformation/inaccurate information.

- Reassessment of the culture of self-regulation of risk by industry.
- Loss of political trust, political will and legitimacy of political institutions.
- Increased opposition to nuclear power.
- Change in political authority as one group loses political legitimacy.
- Support for recovery and cleanup costs being a priority.
- Subsidies to support the energy industry. The argument would be the energy industry is “too big to fail.”
- Direct assumption of risk and liability by local and state governments.
- Increased support for emergency management.
- Funding for scientific and safety innovations.
- Loss of public confidence and resultant loss of power as change in political structures/parties is sought by the public.
- Investigations into post-incident response, recovery and communications.
- Investigations into the security, safety, training, regulation and other programmatic aspects of a transportation program or storage facility like the CISF.

These political issues can be summarized by means of a typology that has a focus on short-term, moderate-term and long-term impacts. That typology is incorporated into the matrix noted elsewhere and located at the end of this consequence section of the report.

Legal Aspects

This section will include an exploration of compensation laws in the event of a radiological disaster. Additionally, the liability of large corporate entities/partnerships (e.g. energy, transportation, security, etc.) is discussed as it relates to radiological emergencies.

The Price-Anderson Nuclear Industries Indemnity Act (a.k.a., Price-Anderson Act, PAA) was passed in 1957 and designed to protect the energy industry from liability in the event of a radiological incident. This partial indemnification act provides limits for compensation in the event of a nuclear power generation related incident. As of 2011 the Act can fund up to ~\$12.6 billion (US 2011 dollars) towards any incident (primary cost recovery).

The PAA was originally passed to assist in the development of a civilian nuclear power industry and has been subject to several legal challenges. Over the years the act has been revised and renewed periodically. The PAA provides funds above the insurance limits each NPP can obtain in the market and is self-funded by these same utilities as a hedge against risks and costs. If any event exceeds these limits, Congress and the

Executive Branch, have specific reporting mandates tied to the government's ability to pay compensation in excess of these funds. Thus, the self-funding PAA mandates have a backup mechanism to pay for an incident, effectively an unfunded liability on taxpayers. Given the focus, NPP, these funds may not necessarily cover an incident involving shipments to and storage at the Texas CISF.

DOE facilities also have similar liability limits, albeit slightly lower than the industry norm (~\$11.6 Billion), that indemnify these operations from liability. This liability funding pool may, but not necessarily, cover CISF, licensees and contractors working with DOE projects like enrichment, weapons production and the national laboratories.¹⁰⁶

Unlike normal judicial procedures, the jurisdiction automatically vests to federal courts in cases of compensation under PAA. Companies have a three-year time limit from discovery of damage to make claims. To date the PAA fund has paid ~\$150 million (primarily due to Three Mile Island) and the DOE has incurred ~\$65 million in payouts for its operations.

Critics of the PAA suggest it is a government subsidy for the energy industry, specifically privately owned nuclear power generation facilities. They argue that while it may have served some economic growth purpose in the initial years of the nuclear industry, some critics suggest that the continuance of this subsidy is not defensible given the mature state of the NPP industry.

As noted, PAA limits may also be challenged in the event of transportation related radiological incidents.¹⁰⁷ Transported materials are not fixed sites and while DOE is currently designated as the shipper of record, utilities that participate in the overall effort to stock a CISF - lobbying, design, testing and so on related to the shipment mechanisms – they may vest some of the liability as a result.

Radiological wastes have long been downplayed by industry and DOE/NRC and these self-motivated arguments may have established some precedence that could allow

¹⁰⁶ Current law may not cover the operation of the CISF. This brings into question if the facility would qualify for PAA funds in the event of a radiological incident. Given the lack of specifics for DOE involvement and management of the wastes in the proposal, liability money from the DOE may likewise be excluded. This then leaves ISP at the mercy of lawmakers who might need to enact legislation *ex-post-facto* to an incident, to "save" this company that is so embedded in the end of fuel cycle. The recent economic challenges this company faced, the involvement of foreign investors and other factors, do suggest that ISP has several unique factors that add risk to approval of the Texas CISF facility.

¹⁰⁷ This topic brings up a legal issue noted earlier – how can DOE take title to the waste, and liability for an incident, for shipments to a private run facility like the proposed CISF? The NWPA, as Amended (1987), limits the transfer of title, and thus the liability transfer, only for shipments to a permanent repository.

lawsuits based on a variety of liability claims. The next section of this report addresses these potential liability claims.

Liability

One of the interesting developments coming from the Japanese experience is the idea of corporate liability in the event of a radiological emergency. Questions about the design of the physical plant, lack of training by TEPCO and deliberate obscuring of facts about the magnitude of the disaster (by the company and government) suggest that these entities may vest huge levels of liability in the form of public obligations/duty after the incident occurs.

These obligations can fall into several categories:

- Nonfeasance – neglect of the public duty.
- Misfeasance – incomplete, inappropriate and incorrect service of the public good.
- Malfeasance – deliberate and aggressive actions that cause injury to the public good.

In general, the legal liability in the United States, or an obligation to pay debts, is covered by the compensation laws noted above. Public liability is more the area these topics fall under and may exacerbate the liability of the corporations involved if a disregard for public good can be proven.¹⁰⁸

As suggested in various places, liability is another important legal area and will be about those actions done by these entities and that increase the chance of something injurious happening.

- **Contingent liability** – those liabilities dependent on some future event – for example the incidence of cancer in a community in the long-term post-incident timeframe.
- **Manufacturer's liability** – those liabilities that accrue from the manufacture of products. In the case of SNF/HLW transportation it could suggest liability from design failures when faced with attacks, failures in testing to account for

¹⁰⁸ By logical extension, the same may be true of consent to transportation and storage activities. If it is not secured and an incident occurs, the company responsible for the storage, loading, cask design and so on may be liable. In this case, ISP's rent seeking at the CISF may generate serious liability risks for its various corporate partnerships that may do work at the beginning of, and during, the in-transit phases of the transportation process.

realistic threats and even liabilities for utilities that ship newer fuel first when an older fuel first shipment doctrine was proven to lower consequences.

- **Strict liability** - may likewise be an issue if utilities make the decision to ship fuel in less than optimal conditions and for reasons of inventory control, cost savings and so on.
- **Design defects and failure to warn** (market defects) are major concerns that should be considered when shipments are undertaken and given the known consequences of radiological emergencies.
- **Breach of warranty** – considering the stance of industry, spokespersons from industry and industry trade groups like NEI in their public advocacy and testimony, products claims and advocacy could be considered a warranty and thus liability incurs from their claims.
- **Consumer protections** may likewise be applicable given the utilities' use of dedicated fees/taxes on consumers for the disposal of these wastes.

The legal aspects of a disaster will become a major issue in the post-incident epoch. A company like ISP may not be as shielded as their investors or partners wish under PAA. Rather, they and any entity involved in any aspect of the efforts to transport or store wastes may face a litigious social environment in the aftermath of a radiological incident.¹⁰⁹

As noted, the functional philosophy of the Texas CISF has serious flaws and these will result in increased liability to the overall partnership. Given the potential major support for transportation this company may engage in to supply the Texas ISF, the proposal as written exposes the partnership to serious business risk and functional accountability hazards.

The use of pre-existing analysis protocols for legal aspects of the transportation and storage phases of the CISF would seem warranted for the peace-of-mind of communities but also for the companies engaging in contracting for these shipments/storage. The idea that liability coverage would automatically vest to any sub-contractor for the transportation or storage efforts may become a specious, fallacious and potentially an unsound business practice.

¹⁰⁹ One interesting text on the American legal system and litigation potentials can be found in: Lieberman, J. (1981). *The litigious society*. New York: Basic Books. It is interesting that this 1981 book noted environmental and even NEPA suits.

Analytical Typology

The following typology was discussed in each of the above sections and is offered to assist in development of pre-incident analytical protocols needed to help communities understand the risks of shipments/storage in their jurisdiction. This matrix can help in the establishment of a pre-incident analysis to assist in understanding a variety of consequences related to the transportation, or storage, of the wastes.

Matrix Example

	SHORT-TERM (30 days)	MODERATE-TERM (30 days to five years)	LONG-TERM (Beyond five years)
Radiological Impacts	Tracking of specific short-lived radionuclides (i.e., I-131, Cs-134, etc.) that have immediate impacts on the environment, human health and important infrastructure concern such as the food supply.	The human health consequences of immediate exposure, the cleanup and/or scrubbing decisions, elevated background radiation levels and other variables will be in need of monitoring. Examples include Cs-137 and I-131 as the most common radionuclides monitored but Cs-134, Sr-90, and Co-60 are other significant radioisotopes.	The accumulation of health effects, the need to monitor children and impacts on the human/environmental spheres are certainties. In addition to Cs-137, expect evidence of plutonium (Pu) with significant long-term implications. Expectations that Pu will be part of shipment cargoes are not an unreasonable and foreseeable risk to address.
Economic Impacts	In the short run economic impacts would be reflected by capital markets. Each variable should be detailed as to their short-, moderate- and long-term impact.	The moderate-term impacts may be characterized by rescue and recovery efforts. Government responses will be critical and likewise characterize this timeframe.	The long-term effects of a disaster could be summarized by the rebound of negative impacts and how long such rebounds take to transpire. For example the loss of real property values and time to rebound from such losses is one social-economic barometer.
Social Impacts	Anomie, dislocation and social psychological effects. These should be identified, assessed, data collected, data	Anomie, dislocation and social psychological effects. These should be identified, assessed, data collected, data	Anomie, dislocation and social psychological effects. These should be identified, assessed, data collected, data

	<p>archived and data storage planned for longitudinal studies.</p> <p>Additionally social cohesion impacts should be monitored. These should be identified, assessed, data collected, data archived and data storage planned for longitudinal studies.</p>	<p>archived and data storage planned for longitudinal studies.</p> <p>Additionally social cohesion impacts should be monitored. These should be identified, assessed, data collected, data archived and data storage planned for longitudinal studies.</p>	<p>archived and data storage planned for longitudinal studies.</p> <p>Additionally social cohesion impacts should be monitored. These should be identified, assessed, data collected, data archived and data storage planned for longitudinal studies.</p>
Political Impacts	<p>Immediate response management until additional assistance can be located, mobilized and deployed.</p>	<p>Moderate-term support for the victims, management of the economic, social and radiological consequences.</p>	<p>Management of the long-term community recovery efforts and the reestablishment of economic, social and radiological norms.</p>
Legal Impacts	<p>Immediate might include restraining orders. Not much would be expected in the immediate aftermath of an incident since it would require time to collect process and analyze data.</p>	<p>Moderate-term support for the victims, management of the economic, social and radiological consequences might well be predicated on the agreement to not seek legal remedies. This phase of the legal cycle would see data being collected, damages defined and so on.</p>	<p>Long-term legal damages would be the expected norm. The lengthy process of liability establishment in the United States might delay these cases for years, if not a decade or more.</p>

INFORMED CONSENT¹¹⁰

The identification of risks from HIE and consequences from a range of attacks has been the focus of the above sections. ISP's partnership and the end of fuel cycle activities necessary to stock the CISF were likewise discussed and how this relationship of transport to storage argues for a more in-depth EA/EIS of the proposed facility in Texas is important enough to stop the process, redefine what will be shipped and how, and incorporate that knowledge into the process prior to requesting CISF proposals. This section will discuss the role of informed consent on the proposal and how to move forward towards gaining that consent by communities.¹¹¹

The potential CISF should at a minimum adhere to the mandates of current policy, recommendations from non-partisan commissions/review bodies and seek consent-based siting (CBS).¹¹² That approval will take time and effort on the part of the NRC/ISP and/or other entity involved in this process. Typically CBS is thought of as a multi-faceted process – it involves issues related to ethics, politics, economics, time,

¹¹⁰ Consent-based siting is a topic that directly relates to Informed Consent. The BRC report on America's Nuclear Future (2012) reviewed the policies for managing the nation's nuclear waste. This report noted that any repository for SNF and HLW should use a consent based siting process. This was because transportation and storage would affect groups of states, individual states, tribal communities, and local governments (see Blue Ribbon Commission on America's Nuclear Future, Report to the Secretary Of Energy 47–58 (2012). In 2013, DOE adopted this recommendation for "consent-based siting." U.S. Department of Energy, Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste 10–14 (2013)). In January 2017, DOE issued a Draft Consent-Based Siting Process for Consolidated Storage and Disposal Facilities for Spent Fuel and High-Level Radioactive Waste. Consent-based siting that directly flowed from the BRC recommendations and DOE actions to date have reinforced this policy choice.

¹¹¹ As of May 29, 2017, the original request for comment on consent based siting can be found at <https://www.federalregister.gov/documents/2015/12/23/2015-32346/invitation-for-public-comment-to-inform-the-design-of-a-consent-based-siting-process-for-nuclear>. A criticism by the IEER on this process can be found at: <https://ieer.org/resource/repository/comments-doe-consent-based-siting-nuclear-waste-2016/> (Makhijani 2016). Downloaded on May 29, 2017.

¹¹² The current legislation on this subject is different than what is proposed/and discussed herein. Currently two pieces of legislation have been introduced: The Nuclear Waste Informed Consent Act (H.R. 1364) and companion bill (S. 691) are proposals that guided the collection of data by the DOE and would inform NRC regulations if in their final version they are enacted into law and upheld after legal challenges. The DOE seemingly expects that state, tribal and local entities where a storage facility would reside are 'all in' once they agree to placement. Debates on consent in DOE hearings showed some sentiment for the ability of the state/local government to withdraw that consent (<https://today.anl.gov/2016/03/doe-launches-consent-based-siting-public-meeting-in-chicago-march-29/>). Additionally, the transportation corridor communities were not part of the DOE process *per se* and thus would have wastes transported through their communities with no consent given or revocation possible. Details on consent-based siting, as it became known, are available at: <https://bipartisanpolicy.org/blog/doe-announces-steps-forward-on-consent-based-siting/>. Current status (August 25, 2018) is up in the air with DOE's website reading "Thank you for your interest in this topic. We are currently updating our website to reflect the Department's priorities under the leadership of President Trump and Secretary Perry." This particular statement is available as of August 26, 2018 at: <https://www.energy.gov/ne/consent-based-siting>

technology, socio-economic impacts, culture and many other factors.¹¹³ Given the current Texas CISF proposal and NRC's motive to find and secure interim sites (to date in New Mexico and Texas), time is a critical factor – delays may equate to a loss of consent. CBS is not just about the communities in the immediate geolocation of the CISF; it involves destination communities, tribal units, and the state where the facility will be located. The CBS should include other in-transit communities and states/state groups from origination communities to those along the totality of the transportation corridor.

A few truisms should be recognized in the efforts to gain viable consent.¹¹⁴ One of the critical aspects not addressed in current policy, or actively excluded, is that once consent by communities is given, it can be withdrawn.¹¹⁵ This is unlike what is codified in current consent-based siting policy discussions and the inclusion rationale is that maintaining agreements/relationships is a critical aspect for any CBS program as well as transportation effort and storage facility.

Consent in the case of transportation and storage of these highly radioactive wastes presents several challenges to transportation and siting planners. These can be summarized as the four T's.

T₁ – Transportation

Transportation will continue to be the Achilles heel for any repository or interim storage facility as long as the DOE/NRC fails to address the concerns of stakeholders.¹¹⁶ So a truism should help understand this statement: Safety and security professionals understand that origination points are generally safer than wastes in-transit. Once the wastes leave the confines of a guarded and secure NPP, or DOE facility, the risks of a

¹¹³ This report builds off of the NAS recommendations. This organization published a report that calls for more involvement by communities in decisions about nuclear waste. For more details see:

<http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=10119>

¹¹⁴ The materials in this section evolved from a presentation by the author of this report given at the DOE Consent Based Siting Meeting, Sacramento, CA on April 26, 2016 titled: "The Four T's to Consider." The issues identified were generic in orientation at the hearing and have been adapted to the context of the Texas CISF proposal.

¹¹⁵ It seems logical that the current generation of political leaders who consent may not represent the wishes of future generations. Likewise changing demographics for the destination county and even for in-transit communities may have an alternative perspective on risks of such shipments. Informed consent comes from a scientific backstory and not allowing the consentee to change their minds is antithetical to the scientific methodology agencies pride themselves on for decisions about nuclear activities. Not allowing a change in consent goes against the canons of science and is potentially illegal under federal law. For some insight see the Code of Federal Regulations (CFR) Title 21: <https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=50.25>

¹¹⁶ The Western Governors Association and the State of Nevada have repeatedly noted their concerns about transportation planning for the proposed permanent geologic storage facility in Nevada. For a summary of their concerns see: <http://www.state.nv.us/nucwaste/news2009/pdf/nv090421ntp.pdf>

BDBE or HIE rise. Transportation issues are critical to siting, as demonstrated by experiences with the current WIPP facility and the former proposed facility at Yucca Mountain.

The wastes are highly radioactive and shipments create potential radiological hazards including those from routine exposures, BDBE accidents and HIE. In preliminary analysis of routes and impacted communities by Nevada for the previously proposed Yucca Mountain storage facility, approximately 50% of the current American population lives in counties potentially affected by the shipments to potential interim site(s). Demographic shifts in American society could increase the impact on these populations, be they normal populations or the more vulnerable groups like the elderly, children and pregnant mothers.

Public perception of risks and hazards is high, may not be equal to the reality of the situation, but cannot be overlooked by transportation planners and/or siting process administrators. NAS¹¹⁷ and BRC¹¹⁸ have recommended detailed risk management measures, including cask testing, route identification, accident prevention, and emergency response preparations. These risk reduction measures should be adopted early in the process (i.e., prior to proposals or EA's) to enhance safety and address public concerns (i.e., long before shipments begin).

A pre-proposal education campaign will be necessary to alert communities to risks and address their concerns. Once the community has been advised of these risks, then and only then can consent be sought and confirmed. Maintaining consent is critical and annual reporting of any incident involving these wastes, in-transit or at the origination/destination points, should be readily available for public review. This needs to be a proactive effort on the part of NRC/DOE and become systematized so that communities can make longitudinal assessment of the quality of the risk reduction programs these entities employ.

T₂ – Terrorism (HIE)

A potential terrorism (HIE) campaign is an issue and it must be planned for and addressed by any potential facility. As noted, fixed facilities like NPP/CISF and the waste

¹¹⁷ To view details contained in the full NAS report, as of August, 26, 2018, see the document at: <http://www.state.nv.us/nucwaste/news2007/pdf/nv070625caciepr.pdf>. Full report reference is as follows: NATIONAL ACADEMY OF SCIENCES, *Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States*, Washington, DC: The National Academies Press (2006).

¹¹⁸ To view details contained in the full BRC report, as of August, 26, 2018, see the document at: https://www.energy.gov/sites/prod/files/2013/04/f0/brc_finalreport_jan2012.pdf

shipments between them will potentially face accidents, protests, sabotage and terrorism. Likewise, facilities and shipments will have important symbolic value to domestic and international groups as HIE targets (see discussion above).¹¹⁹

The American public is concerned about such risks, and these concerns will impact consent processes for all aspects of the end of fuel cycle operations discussed herein. NRC studies have assessed the vulnerabilities, typically in a reactive manner, of such potential risks. NRC has developed *ex-post-facto* counter-measures and adopted new post-incident regulations to better protect shipments and facilities. Considering the dynamic nature of terrorism, that work needs to be continually updated as the threat environment changes, adapts and morphs.

As a first step, NAS has recommended additional measures, which could be adopted to enhance security and address public concerns. The routing and siting process should likewise look to reduce risks of HIE in an on-going proactive process that uses the community as a sounding board for concerns and uses ISP as a data provider for on the ground experiences if that facility is approved.

T₃ - Tribal Lands

Depending on the location of the routes and site(s) chosen for an interim facility, a significant number of reservations/tribal lands and communities of color may be disproportionately impacted by waste shipments and the proximity of a site storing wastes. One estimate for the former site at Yucca Mountain was that from 20 to 50 reservations/tribal lands may be impacted depending on route selection decisions. A like universe, perhaps even larger, of tribal entities would be expected for the Texas CISF since many of the transportation routes would be essentially the same and given the tribal diversity of the state and adjacent states. In fact given the need to move these materials multiple times, this universe of tribal lands may actually be larger.

Native populations have some unique traditions and issues with the highly radioactive wastes. The cultural issues associated with tribal consent actions – may become significant, such as the “seven generations” timeframe (Iroquois tradition) as these

¹¹⁹ Generally those within the nuclear industry, supportive lobbying groups, regulators and companies serving the nuclear industry consider the risks minimal. One example is the Brookings Institution which sees little, or no, risks at the NPP or storage facilities but fails to consider the whole of the transportation effort needed to move wastes from Point A (NPP) to Point B (Interim or Permanent storage facilities, CISF). For their somewhat limited perspective see: <https://www.brookings.edu/articles/terrorism-and-nuclear-energy-understanding-the-risks/>. Additionally, the transportation issue is not unique to America – Australia had similar concerns expressed by John Large (<https://www.smh.com.au/national/nuclear-waste-site-a-target-for-terrorists-expert-warns-20100510-uor7.html>) as well as those documented domestic issues found in the State of Nevada’s Agency for Nuclear Projects office website: <http://www.state.nv.us/nucwaste/>

tribal conventions impact native council decisions (a.k.a. consent). Potential native religious impacts will need to be considered and addressed as part of planning and operations. Socio-economic impacts for tribal communities and associated environmental justice issues for communities of color need to be considered and addressed in the proposal, environmental assessment, environmental impacts and in the planning for the CISF proposal, and if later approved, operations. One issue rarely discussed is Indian nation sovereignty. This will likewise be an important legal issue in any CBS process.

The local communities near the proposed facility and their current and future racial/ethnic composition may also be relevant. An exploration of the communities in the estimated transportation corridor may likewise yield significant environmental justice impacts. Thus, transportation is critical to a NEPA process considering the movement and storage of these materials through tribal lands.

T₄- Trust

The public distrust for the energy industry, nuclear power, federal regulators like the NRC, operational agencies like the DOE and all things nuclear, is profound. Past experiences with Hanford, Rocky Flats, West Valley and many other DOE managed projects has left the public skeptical of anything to do with wastes and by extension the programs and NRC regulatory oversight about how to move or store them. NRC response to threats like 9/11 and the aftermath of Fukushima is on-going. What has transpired to date means that NRC/ISP must first invite public comments on how to build the trust relationship needed for consent-based siting before they charge forward with siting proposals and public comments. This endeavor must account for the totality of the end of the fuel cycle efforts needed to stock said facility, not just for the proposed CISF storage in isolation as evidenced in the ISP proposal. For example the NRC/ISP could first acknowledge a range of risks, propose measures to minimize/manage those risks and thereafter communicate these risks to the public in everyday language, not regulatory double speak.¹²⁰

¹²⁰ The legal and regulatory environment regarding nuclear waste is byzantine at best. The regulations include many agencies and issues. For example some that may apply include: 10 CFR Part 72, Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste; 10 CFR Part 20, Standards for Protection Against Radiation; 10 CFR Part 73, Physical Protection of Plants and Materials; OSHA Regulations, 29 CFR Part 1920, Procedure for Variations from Safety And Health Regulations Under the Longshoremen's and Harbor Workers' Compensation Act; OSHA Regulations, 29 CFR Part 1910, Occupational Safety And Health Standards and Emergency Planning and Community Right to Know Act of 1986, Title III, Pub.L.99-499.

To secure community consent for siting, this report would recommend NRC/ISP engage in actions to build and maintain trust with local, tribal, state and regional governmental entities as a precursor to proposal generation. The NRC, ISP and DOE should acknowledge past failures with storage facilities/operations and what measures they will have undertaken to mitigate their failures.

NRC, ISP and DOE have trust issues with many stakeholders and some of these issues have been articulated by independent evaluators like NAS and BRC. These federal-level agencies and the ISP partnership must deal with that reality as part of the CBS process. For example, BRC recommended that an entity other than DOE should take over the nuclear waste program because of trust issues. Similarly, NAS recommend taking the transportation program away from DOE.¹²¹ As a prerequisite to any EA proposal, NRC should decide who will manage the program to transport wastes, what is the status of title to the wastes and given the ISP partnership's unique position in the end of the fuel cycle activities, they should be directly involved in a programmatic assessment (EIS/EA). An additional question for NRC to articulate is would it be good public policy/regulation to encourage the monopolization of the waste industry by focusing so much of the end of the fuel cycle activities in one or two companies?

As part of CBS, or just as good policy, NRC should invite public comment on the pros and cons of alternative management entities (i.e., Federal Corporation, Private Corporation, or an Independent Federal Agency) and other transportation issues (many noted herein).

Implications

This subsection of the report does not necessarily offer solutions to the issues associated with informed consent, rather it attempts to build a public record of concerns, ideas and comments that should help the NRC/DOE/ISP identify/codify issues associated with the process of gaining CBS for the transport and storage of America's inventory of wastes in an interim facility like that proposed for Andrews County, Texas.

Besides public hearings, NRC should consider using a group of experts external to that agency, and external to DOE, to help articulate the issues, processes and goals of a long-term transportation, storage and security schemata. This external programmatic review committee should be an essential part of CBS processes and not be stacked with energy

¹²¹ A good question arises from this distrust of DOE. With the recommendations from the BRC and NAS in the public record, why is the DOE still a primary player in the CISF proposal but not featured as such? As of now the DOE would be sole supplier of SNF and GTCC wastes to the ISP's CISF.

industry ‘experts’ or ex-government agency personnel. Variety in the selection of experts will help minimize the effects of echo chambering and risk blindness within the industry.

Additionally, identification of issues that have in the past been problematic, or that could be problematic in the future, is critical. To help identify, understand and problem solve such issues, NRC should consider using a ‘red team’ approach. Transportation planners, security experts, socio-economic assessors and many other experts might be assembled into a research/assessment team and used to assist NRC CBS efforts. Again, this group should not be stacked with insiders to offer a wider range of expertise to be used.

NRC/DOE should be tasked with defining the parameters of CBS but the process may better be understood as setting the agenda for the planning of this proposed project, understanding of the importance of communication of the risks/consequences and identification of meaningful costs of the project. These pre-program activities must be transparent if they are to assist in securing consent, and eventually work towards the implementation of transportation planning, site selection and safety/security assurance.

Additionally, the NRC/DOE is seemingly tasked with regulating and securing the shipments and facilities as well as aspects of creating and maintaining a safety/security culture. If NRC/DOE were to set forth a specific plan for all phases of the proposed program from start to finish, and prior to any action or proposal, this action will facilitate CBS informed route selection, site selection, and security/safety for these. Most importantly this action would assist in securing and maintaining consent for the length, breadth and depth of the program.

RECOMMENDATIONS

The observations of the author are codified in this listing of recommendations relative to the CISF proposal, as well as the involvement of DOE and NRC. These include issues associated with the relationships between ISP partners, DOE and NRC, transportation of wastes across the United States and the proposed storage facility. These suggestions are derived from the analysis herein and based in part on the background of the author (see next section).

1. The NRC process that solicited a proposal, and the actual ISP proposal, should require the perpetration of a site specific and programmatic EA/EIS for the totality of the processes required to stock the proposed CISF. This partnership exhibits many of the supply and transportation elements from the end of the fuel cycle and could reasonably be expected to seek approval for many of the transportation related activities necessary for the stocking of the CISF. As such the proposal presented is insufficient to address all of the aspects of this partnership with respect to the packaging, transportation and storage of wastes. This deficiency is significant because the proposal does not address key elements of the totality of efforts needed to stock the CISF, does not address the risks of transportation and does not seek consent for the activities that would logically be necessary and sufficient to stock the CISF.
2. The NRC should first define the following information and then seek proposals for an interim facility proposal. Considerations of exact number of shipments to the CISF by specific transportation modalities (rail, highway, and barge); expected numbers of start clean/stay clean shipments (return to sender) and the number of shipments from the CISF to a permanent repository based on operational lifespan of the CISF. Such data would be necessary to make a best estimate of risks to communities in the transportation corridor and for the operational lifespan of the CISF. Additional details on any foreign shipments that may be sent to the CISF should be identified and communicated prior to the creation of an application. This deficiency is significant because the resultant proposal does not address the key element of transportation and thus, communities near the CISF and along the transportation corridors cannot make reasonable considerations of risks.
3. Prior to the solicitation of a proposal, or the filing of an application to construct and operate, the NRC should identify BDBE's and DBT's for the whole of the effort needed to stock a CISF. Such exemplars are necessary so that

- communities can actually make informed consent to what they may realistically be expected to face over the lifespan of the program. Additionally, as part of this process, NRC should publicly define a range of scenarios for both HIE and cascading natural hazards, including release fractions that reasonably approximate the full range of consequences – no release, moderate releases and catastrophic releases. One additional aspect is the threats such shipments would face over time and how proactively NRC regulations could help mitigate those risks, even those that are BDBE/DBT. The role of the IAEA in the process should be defined, especially if the shipments to stock this facility are foreign in origin. This deficiency is significant because the publically available proposal components do not consider the prospect of HIE. Likewise, the potential for BDBE with cascading multiple disaster scenarios are not discussed by ISP because the regulations have failed to ask for such analysis, even after the multiple disasters experienced at Fukushima.
4. NRC should define exactly which NPP, DOE facilities and other origination sites will ship to the proposed facility and how (e.g., heavy-haul truck for some of the journey; rail for whole journey; barge for part of the journey and then rail, etc.). If the Texas CISF anticipates a future receipt of foreign wastes, details on those shipments need to be forthcoming now and not at a future date. Such an inventory of origination sites and transportation modalities will help communities to better understand the shipment numbers going through their communities by rail, truck and barge. This deficiency is significant because the NRC has not made the ISP consider these issues in the proposal, even though such details are necessary for the safe, secure and legal operation of the CISF.
 5. Prior to the initiation of a proposal process, the NRC should define exactly which routes the shipments will take to the CISF. If in the alternative NRC decides not to negate the ISP proposal and proceeds with licensing, such details should be made public at the CISF Draft EIS stage, in order to provide the concerned public and intervening groups with an opportunity to submit comments under NEPA. As part of this analysis, and considering the length of the shipment campaign, alternative routes and transport methodologies (contingencies) must be articulated.
 6. The NRC should define specific operational details such as use of dedicated trains and specific security procedures for waste shipments. This information would help communities understand the risks they face in any effort to stock the CISF. NRC should make these available as part of the scoping process so that

- communities can make informed decisions as to the shipment campaign and what risk levels they are willing to allow. This deficiency is significant because the proposal does not address this key component as a result of the neglect of the NRC's premature proposal process.
7. The NRC must define the wastes to be shipped to this facility – exact details on burn up history; years out of reactor for each shipment or part thereof; procedures regarding oldest fuel first; and percentages of cargoes/shipments for SNF/GTCC and these should reflect other lessons learned from the proposed Yucca Mountain Project. The lessons learned from Yucca Mountain show this is an NRC deficiency that is significant because the proposal does not articulate these important details that would affect safe and secure operations at the CISF.
 8. Given the variety of “inventory” that the CISF may accommodate, NRC specifically defining what types of fuels and how far each will travel for each inventory level seems prudent policy and regulation. For example at ____ inventory level (number of tonnes of SNF/GTCC) the NRC would expect that rail miles would total ____, truck miles total ____ and barge miles _____. Of these shipments, SNF would be expected to be ____%, HLW ____% (if anticipated) and GTCC ____%. This level of detail would allow the construction of accident rates for each transport mode for the totality of the shipment effort needed to stock the CISF and relative to each waste type. This deficiency is significant because the proposal does not offer any discussion of the accident rates for necessary transportation to the facility.
 9. The NRC should define shipments, transportation routes and radiological cargo. Such an inventory and details may assist emergency responders to know what they face when asked to respond to a radiological incident and how best to mitigate the risk in the event of an incident. This critical deficiency is significant because the local emergency responders will be first on scene and will need to mitigate the radiological hazards without assistance for an unspecified length of time until state and federal assets arrive.
 10. Given the need to train, provide equipment and provide the necessary protocols to first responders, the NRC/DOE should be specific as to the *longitudinal* funding sources (40-60 year life expectancy for the interim facility, or even significantly longer?) for such first responder efforts in those communities along the transportation corridor and at the end point CISF. Additionally, ongoing funding must be provided the exact training procedures for initial shipments,

- start clean/stay clean returns to sender and eventually shipments to a permanent repository. DOE does administer the 180c funding but that funding stream is not guaranteed in this case and if that agency is excluded from a role on the interim or final facility as suggested in various reports, what funding stream would pay for the on-going emergency response equipment, training and other related expenses? This deficiency is significant because these agencies, many volunteer based, will need to conduct initial training, updates to that training and new volunteer/employee training on a continuous cycle.
11. NRC must define the actual routine radiation exposures the public will face per shipment and over the lifespan of the operational life of the CISF. This includes but is not limited to workers involved in the shipment process, workers aligned to shipments/operations, the public who live within 800 meters of each side of any transportation route; and vulnerable populations of elderly, children/in-utero children/expectant mothers within that 800 meter zone on each side of the routes. This deficiency is significant because the health effects of such routine radiation are not completely known and health effects due to long-term exposures to daily/weekly/monthly doses are not well understood.
 12. NRC must define the beyond routine radiation exposures the public will face as a result of any return to sender shipments based on the start clean/stay clean operational philosophy. This information needs to be calculated over the operational lifespan of the CISF. These contaminated shipments will increase exposures and the regulations for such are different than for routine exposures. Impacted populations include workers involved in the shipment process, workers aligned to shipments/operations, the public who live within 50 miles of any transportation route; and vulnerable populations of elderly, children/in-utero children/expectant mothers within that 50 mile zone. This deficiency is significant because the proposal does not address such shipment returns and this has placed the ISP at a liability disadvantage the NRC should have anticipated. The start clean and stay clean philosophy used in the proposal has radiological, financial and liability implications and those should be addressed in the proposal.
 13. NRC must provide details on secure in place locations for shipments in the event of a radiological incident involving rail, truck or barge. This deficiency is significant because the NRC has not addressed this reasonably expected security feature that would impact operations at the CISF and along the transportation corridor.

14. NRC must define the exact organizational structure responsible for the shipment and storage facility. BRC has suggested DOE is not to be involved, so who and what will replace this entity? If, as planned, the DOE is the primary supplier, then what will be its role in the financing, regulation and determination of awarding contracts given limitations under the Nuclear Waste Policy Act and Nuclear Waste Policy Act, as amended. This deficiency is significant because perhaps the NRC must first get legislative approval for shipments, then change its regulatory structure and finally seek out a service partner capable of meeting those expectations. The current proposal is deficient because it was not given this opportunity to address the concerns since the NRC and DOE have not done the work necessary to bid the CISF properly.
15. The NRC must define the role reprocessing may play at this or a nearby geolocation. Reprocessing is currently not allowed but if that was to change and a local facility was constructed, by ISP or other CISF provider, if these entities wanted to engage in that activity, the whole question of retrieval, shipment, storage and reprocessing of wastes should be pre-determined. A similar programmatic and site specific NEPA process should be required. This deficiency is significant because the NRC would be required to change American policy and create regulations to address the significant additive/cumulative risks such reprocessing brings to the CISF proposal.
16. The NRC must define the consequences for a range of HIE/DBE and have in place such analysis plans in the event of a radiological incident. At a minimum this would include assessment protocols for radiological, social, economic, political and legal impacts. It should also address the BDBE procedures in the event of a cascading sequence of events like what happened at Fukushima. This deficiency is significant because the details for such analysis do not exist in the public domain, NRC has engaged in obscuring of these details under the guise of security and the information is needed for the public to make informed decisions about risks.
17. The NRC should specifically report on the differential impacts on tribal communities/populations and generalized environmental justice concerns for the proposed CISF. This deficiency is significant because of the unique nature of tribal approval processes, the cultural aspects of such approvals and the fact that tribal lands do not necessarily have the same applicable legal provisions under the Interstate Commerce Clause as do non-tribal corridor communities.

18. NRC should define with regulations what specific penalties for attenuation of vigilance over the shipment phases and the operational lifespan of the CISF will apply to ISP if mismanagement occurs. This deficiency is significant because the NRC has failed to plan for the extended lifespan of the facility and failed to recognize the fragility of corporate structures when faced with liability and long-term obligations to the public.
19. NRC/DOE needs to specify the exact procedures and financing mechanism that communities will undergo to recover costs associated with any DBE/HIE. This deficiency is significant because these agencies will need to finance the operations for decades of operational lifespan and recognizing the political nature of funding for such activities before, during and after the storage activities are completed.
20. NRC/DOE should define exact procedures and financing mechanisms that communities will undergo to receive compensation associated with the CISF transportation and operation. This deficiency is significant because these agencies do not offer any guarantees of economic relief for acceptance of the wastes and no benefits for communities in the event of BDBE and HIE.
21. NRC should provide corridor communities regular communications on the number of shipments necessary to stock the Texas CISF, percentage of the CISF filled to date, types of wastes shipped/stored, accidents/incidents involving shipments to, and operations at, the proposed CISF, and details on any remediation efforts for risks identified during the timeframe discussed. Past experience and contemporary problems demand that ISP submit emergency reports on any event within 48 hours of an incident/accident for all of their operations and events that transpire. This deficiency is significant because the communities in the transit corridor and at the end point in Andrews County, Texas, must have this information to make decisions on emergency responder support levels and even to consider on-going support by means of continued consent to operations.
22. The NRC should specifically incorporate the BRC and NAS report recommendations on consent based siting, waste transport and storage. The BRC (2012) conveyed to regulators, agencies and the public that *any* future repository for SNF and HLW should be sited based on the consent of the affected state, tribal, and local communities. In 2013, DOE adopted this recommendation for “consent-based siting.” As of December 2015 DOE issued their document

- titled “Draft Consent-Based Siting Process for Consolidated Storage and Disposal Facilities for Spent Fuel and High-Level Radioactive Waste” and thereafter sought public comment. The actual policy for consent based siting has not been incorporated into any current legislation or rule, but, rather, reflects the non-binding recommendations of the BRC and DOE. As for transportation of nuclear waste, this activity poses risks for any community that these materials may cross. This deficiency is significant because the recommendations represent public safety, security, environmental, and health protection best practices.
23. The ISP proposal (USNRC Docket # 72-1050) focuses on SNF and GTCC wastes from NPP operations. The Yucca Mountain Project included high-level wastes (HLW) not listed by ISP.¹²² This waste type was not specifically listed by ISP despite the applicability of 10 CFR, Section 72 which notes “Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste.” The exclusion of HLW makes the proposal ambiguous as to the materials that will be transported to, and stored at, the proposed facility. This deficiency is problematic since safety and security considerations might be different for these dissimilar types of wastes.
24. Specific accident scenarios relative to the CISF proposal are beyond design basis events and could be exacerbated by human interference. An exemplar event was the Baltimore Tunnel Fire (July 2001). This tunnel fire was analyzed by a Nevada contractor. See: <http://www.state.nv.us/nucwaste/news2001/nn11459.pdf> The NRC/DOE should demonstrate situational awareness of these events and demonstrate specific plans to mitigate said risks as part of the request for proposal process. This requires that NRC/DOE detail the transportation infrastructure and planning necessary to stock the CISF. This deficiency is significant because the analysis of events in the ISP proposal is not sufficient to cover cascading impacts as noted elsewhere.
25. Transportation of wastes to the proposed CISF is an issue that NRC/DOE must address. This ISP proposal does discuss on-site transportation but does not address the totality of transportation needed to stock the CISF. This deficiency is significant because the proposal then does not present a realistic risk profile for the proposed facility since transportation is necessary to stock the CISF.

¹²² For specific details on what types of wastes the State of Nevada expected to receive at Yucca Mountain see: <http://www.state.nv.us/nucwaste/yucca/trfact01.htm>

26. The NRC must provide details on the complexity of the potential different waste streams (NPP, defense operations, commercial operations, perhaps even reprocessing), from the many potential origination sites, and for all forms of potential wastes (SNF, HLW, GTCC/liquid/solid/assemblies, etc.). That level of differential analysis is not found within the ISP CISF proposal and NRC/DOE should undertake this inventory effort prior to the proposal let alone the EIS process so as to allow the bidders for interim storage facilities to plan for the full range of wastes that could be stored at the proposed CISF. Likewise, this analysis should therefore be part of the NRC evaluation so that stakeholders can fully comprehend the scope of activities necessary to stock the proposed facility. This includes the planned additional requests for waste inventory additions, both domestic produced and the potential for the storage of foreign wastes that may be requested by ISP in years or decades to come. This deficiency is significant because the vendors are ill-informed and the resultant proposal does not address the real risks of operations.

27. Identification of affected communities is difficult since transportation planning for the proposed CISF was not done. NRC/DOE should identify the primary and secondary transport/storage communities prior to any proposal. This deficiency is significant because the ISP proposal does not do so and thus, is of no help in mitigation of adverse effects that could be planned for and mitigation efforts implemented from the onset of transportation to and from a storage facility.

28. NRC/DOE should recognize that disasters, human initiated or natural, do not easily fit economic impact analysis (EIA) protocols. Due to social obligations and the lack of good data, a reasonable cost-benefit analysis (CBA) is likewise not easy to accomplish. The transportation policy planners and federal regulators for any effort needed for the movement of nuclear waste must move beyond current EIA and CBA methods to invent new economic models to assess the impacts of a radiological disaster. Perhaps they could build off of existing platforms like Transportation Economic Development Impact System (TREDIS) and the various agencies' specific assessment tools for impacts from transportation development. In this case the focus should be on those pre-existing models on transportation impacts from a radiological incident during transit activities. This deficiency is significant because the exclusion of such recognition places communities at risk from cascading BDBE and HIE.

29. NRC should engage in full disclosure of the transportation details behind the proposed CISF environmental reports necessary to site a CISF (EIA or EIS). These procedures were designed to assess both the positive and negative impacts of projects like the proposed CISF in Andrews County, Texas. Transportation EIA/EIS's were designed to assist policy makers to decide the least impactful alternatives for a given transportation program. In the case of the Yucca Mountain EIS reports, the critics have argued that these documents were used more as propaganda in support of shipments and not as intended to inform effective policy. For example see State of Nevada criticisms for the decision on Yucca Mountain: Case Number 02-1179, State of Nevada v. Spencer Abraham et al. in the United States Court of Appeals for the District of Columbia Circuit. The Nevada petition says "The FEIS fundamentally distorts and misrepresents the nature of the "proposed action" itself, failing to inform Nevada, other agencies and members of the public of essential details necessary to make an elementary comparison between the "proposed action" and the "no project" alternative. It fails to disclose that the Yucca Mountain site would not be a "geologic" repository as defined in the NWPA. It arbitrarily excludes from the "proposed action" the handling, transportation and disposition of radioactive waste from at least 54 sites in the United States." (Section 11 of the petition). This deficiency is significant because the process engaged in by bidders is incomplete since the NRC has failed in disclosing details that are of substance to any decision on bidding and especially on approvals by communities.
30. Given the partnership involved in this CISF and the sensitive details relative to DOE defense wastes that might be stored at the CISF, assessment of the potential national security related aspects of this proposal are critical. For example, how such national security related information would be shielded from the foreign partner(s). Additionally, what specific data and information on security safeguards will be the disclosure parameters of such a partnership given this sensitive material and foreign involvement in the wastes from weapons production activities (HLW) now and in the future? This deficiency is significant because the DOE is responsible for maintaining safeguards for the nation's nuclear arsenal.

AUTHOR'S BIOGRAPHY

Starting in 1994 when James David Ballard was a graduate student at UNLV, he developed an interest in Yucca transportation security. While he had been interested in terrorism for several years, and having taught classes on the subject, he had little detailed knowledge of the Yucca Mountain Project and shipment discussions up until that point. The author was aware of Yucca given his geographic location (Las Vegas), but not the details of the transportation related safety and security issues that would come to dominate his scholarship over the decades.

He approached the NWPO (State of Nevada Agency for Nuclear Projects, Nuclear Waste Projects Office) for funding to conduct an examination of the terrorism related issues of the Yucca project – this was in anticipation of a dissertation level research project. While funding was secured for the writing of the initial report, that report was not viable for a dissertation topic according to his dissertation committee. That initial scholarship, a ~200 page report, was prepared over the next 25 months. This initial document was entitled "Preliminary Study of Sabotage and Terrorism as Transportation Risk Factors Associated with the Proposed Yucca Mountain High-level Nuclear Waste Facility." The preliminary study was published in 1997 but the arguments date to 1994 when the author started his collaboration with Nevada's NWPO.

At that time, and continuing today, the concerns were that the DOE was underplaying the risks of terrorism, they had underestimated the risks of multiple weapons (shaped charges) as suggested by a US Army report on potential attack scenarios and that the DOE failed to consider tactics that may be relevant (e.g., Tow Missile). For details please see: Ballard, J. D. 1997. "Preliminary Study of Sabotage and Terrorism as Transportation Risk Factors Associated with the Proposed Yucca Mountain High-level Nuclear Waste Facility." *Nuclear Waste Projects Office: Carson City, NV.*

While this initial report was being readied for publication by the Nevada NWPO, Halstead and Ballard undertook a much more detailed and focused report on threats, risks and sabotage/terrorism related issues. This report, "Nuclear Waste Transportation Security and Safety Issues" was a more refined articulation of the concerns Nevada had over the Yucca Mountain transportation planning. These authors expanded the basic arguments to include attacks using shaped charges, missiles and deliberate releases of the inventory of radionuclides. For details please see: Halstead, R. J. and J. D. Ballard. 1997. "Nuclear Waste Transportation Security and Safety Issues." *Nuclear Waste Projects Office: Carson City, NV.*

These two reports, and additional work done in the years before the author was involved with Yucca Mountain studies, were the basis of a training seminar. In 1996, just prior to the official publication of the two reports noted above, FEMA held a conference to address the first responder issues Nevada had concern with. A co-author presented a summary of the

work done to date at the “Southwest Counter-Terrorism Symposium.” This presentation was important in that it directly connected terrorism and the potential radioactive waste shipments to Yucca shipments – a connection that word choices by DOE had minimized (DOE uses sabotage, or extra regulatory event, to distance the arguments from the more politically charged term of terrorism). Please see: Halstead, R. J. and J. D. Ballard. 1996. “*Southwest Counter-Terrorism Symposium.*” FEMA Provided Training for First Responders. Las Vegas, NV.

During the timeframe for the writing of the above reports, two congressional bills arrived for public debate. Ballard et al. provided arguments on terrorism, tactics, scenarios and weapons as part of the discussion of these bills in a policy paper “Nuclear Waste Transportation Security and Safety Issues: Potential Transportation Impacts of S.104 and H.R.1270.” Please see: Halstead, R. J. and J. D. Ballard. 1997. “Nuclear Waste Transportation Security and Safety Issues: Potential Transportation Impacts of S.104 and H.R.1270.” *Nuclear Waste Projects Office*: Carson City, NV.

In the year after the initial reports noted above became public (1997) the author distilled the various arguments into an academic paper for a national criminology conference. This public presentation offered a tri-phase risk assessment format - attacks against transportation infrastructure used to move waste materials; cargo capture and potential release based attacks; and direct attacks using modern ordinance designed to release the radioactive inventory from their shipment casks. These three scenario epitomes represent the beginning of a spectrum of attacks and imply that a variety of possibilities exist for a combination of attackers, weapons and consequences. Please see: Ballard, J. D. 1998. “The Transportation of Nuclear Waste, First Responders, and Terrorism Policy.” *American Society of Criminology*. Washington, D.C.

The State of Nevada petitioned the NRC for rulemaking on the threats against potential Yucca shipment containers around the same time frame. Ballard’s work was incorporated into the petition. This rulemaking petition references the documents and collaborations above. In particular this petition questions the DBT and assumptions underlying regulations that would support Yucca Mountain safety and security procedures. Please see: Ballard, J. D. 1999. “*Nuclear Regulatory Commission Documentation for Petition*. Agency petition for Rulemaking pursuant to 5 U.S.C. § 553 and 10 C.F.R. § 2.800 - 2.804.”

Soon after this rulemaking petition, the DOE published its DEIS for Yucca Mountain. A group of scholars were asked to review relevant portions of this very large DOE report and analyze its arguments for Yucca transport. The result was a report that reiterated several previously identified flaws in the DOE's safety and security discussions. Weapons, tactics and scenarios were discussed at great length. Please see: Ballard, J. D. 1999. “The Impacts: Department

of Energy Draft Environmental Impact Statement” post-publication review. *Nuclear Waste Projects Office*: Carson City, Nevada.

During the summer of 2000 the author directed a group of UNLV graduate students in the construction of the “Nuclear Waste Transportation Accidents: State of Nevada’s Curriculum Guide for Law Enforcement, Public Safety and Medical Personal.” This DOT funded effort was focused on developing curriculum for Nevada state patrol officer training - fact sheets, training materials and a detailed schedule for a multiple year training. The result was a weeklong training suggestion (40-hour curriculum). This training regimen held a focus on terrorism on a training day when the officers would be asked to envision training tactics, weapons and terrorism. Please see: Ballard, J. D., D. Stewart, K. Kerrigan, and J. Schneider. 2000. “Nuclear Waste Transportation Accidents: State of Nevada’s Curriculum Guide for Law Enforcement, Public Safety and Medical Personal.” *Nuclear Waste Projects Office*: Carson City, Nevada.

After the summer project with UNLV graduate students was completed, the author was invited to attend a UN conference on terrorist victimization. He used Yucca illustrations to underscore the threats to shipments and so they could be visualized. The conclusion of this presentation was that victimization has multiple dimensions. The paper used Yucca Mountain illustrations to underscore the need for scenario and transportation risk study reconsiderations based on a wider range of threats and how these various scenarios could differentially impact communities. Please see: Ballard, J. D. 2000. “Weapons of Mass Victimization: Considerations for the 21st Century.” *United Nations Congress on Terrorist Victimization: Prevention, Control, and Recovery*. Vienna, Austria.

In September of 2001, a group of authors presented a summary of Nevada’s positions at an industry conference in Chicago. The paper asked critical questions on sabotage – for example the research asked are the DOE scenarios creditable? A week after this presentation the attacks of September 11, 2001 transpired. Please see: Halstead, R., F. Dilger and J. D. Ballard. 2001. “State of Nevada Studies of Potential and Sabotage: Critical Issues.” 13th Annual Symposium on Packaging and Transportation of Radioactive Materials (PATRAM 2001), Conference CD Rom. *PATRAM*: Chicago.

Directly after the attacks of 9/11 several authors reconsidered the impacts of these attacks and arguments being made by DOE and the nuclear industry that power plants were a target and this justified Yucca Mountain approval. The author was invited to Stanford University to present a paper – “Shelter-In-Place: The Logic of High-Level Nuclear Waste Security.” This paper was focused more on the bureaucratic culture of DOE and how this culture was defined by the Cold War era and that this legacy hinders the agency from refocusing on threats like those posed to SNF shipments, especially in a post 9/11 world. Extensive reiterations of arguments from above are noted, but within the new reality of a post 9/11

threat environment. Please see: Ballard, James David. 2002. "Shelter-In-Place: The Logic of High-Level Nuclear Waste Security." State of Nevada's *Agency for Nuclear Projects*: Carson City, NV.

About six months after the 9/11 attacks, Ballard was asked to testify in both the U.S. House of Representative and U.S. Senate on Yucca Mountain issues. The reason, President Bush had directed congress to go forward with Yucca Mountain. These hearings were part of the authorizing process for the facility and mandated by law. In the House hearings, extensive discussion on scenarios and risks associated with transportation can be seen in the testimony. These included discussions on both accidents and human initiated events. Weapons were also part of these discussions, albeit in forms with no specific details, since the author was careful not to focus on a "how to" attack but offered more generic scenarios to educate lawmakers on potentials. Please see: Ballard, James David. 2002. "Testimony of James David Ballard." *United States House of Representatives*, Subcommittee on Highways and the House Subcommittee on Transportation and Infrastructure.

During this same time frame Nevada decided to withdraw some of the web based terrorism related scholarship due to security concerns. Following the House testimony, the U.S. Senate also held hearings on Yucca security and safety. Here Ballard refined the House testimony arguments and addressed some questions that arose as the result of House testimony. Once again scenarios, weapons and tactics were discussed. Please see: Ballard, James David. 2002. "Testimony" before the *United States Senate*, Committee on Energy and Natural Resources, One-Hundredth Seventh Congress regarding S. J. Res.34 Approving the Site at Yucca Mountain, Nevada, for the Development of a Repository for the Disposal of High-level Radioactive Waste and Spent Nuclear Fuel, Pursuant to the Nuclear Waste Policy Act of 1982.

After the House and Senate testimony the author collaborated with a group of international scholars to analyze the impacts of terrorism on nuclear power generation facilities and transport of wastes across the EU. Funding was provided by NATO and the principle investigator was situated at Stanford University. After the authorization for Yucca Mountain was approved by Congress in 2002, Ballard also focused on developing the arguments for those most immediately affected by this congressional policy decision, the first responder community. During the process, F. Dilger joined the NATO project and helped extensively with the modeling of the radiation release data. Please see: Steinhausler, F., M. B. Maerli, S. Rydell, G. Bunn and J. D. Ballard. 2004. *Terrorist Attacks on Nuclear Power Plants and Nuclear Materials Transports*. NATO: Brussels, Belgium.

About the same time, the National Academies of Science initiated an assessment project to understand the transportation of SNF. The Academy held hearings where the author presented testimony to this body. This presentation was used to summarize various Nevada

arguments, augmented by the knowledge gained from the NATO project. Scenarios were more refined and weapons choices expanded as a result of that involvement. Please see: Ballard, James David. 2003. "Nuclear Waste Transportation: Lessons from 9/11/2001 Applicable to Nuclear Waste Transportation Program Planning, Security, and Emergency Response." Testimony in Las Vegas hearing before the *National Academies of Science*, Committee on Transportation of Radioactive Waste.

As a result of the collaborations on the NATO project a conference was convened in Austria that was focused on nuclear facilities and security issues. The author presented at this international conference and used his NATO research on scenarios and weapons to argue that asymmetrical tactics apply to shipments in the EU, FSU and USA. To summarize, the NATO project allowed the author to build off of Nevada studies, sharpen the focus of that research and this process was critical because the scenarios were vetted in an unusual collaborative process – the NATO group red teamed these with weapons experts, arms dealers, radiation health experts, physics professionals and so on. The result was that new ideas on weapons, tactics and scenarios were added into existing arguments. Please see: Ballard, James David. 2002. "Asymmetrical Sabotage Tactics, Nuclear Facilities/Materials, and Vulnerability Analysis." *European Union High Level Scientific International Conference on Physical Protection* (NUMAT Conference). Salzburg, Austria.

By 2004, a group of researchers were able to summarize the various arguments on transportation and security risks. The presentation at a nuclear industry conference gave the chance to reiterate Nevada's arguments on scenarios, weapons and tactics. This paper summarized a host of arguments the DOE had "forgotten" when discussing Yucca Mountain as a repository. Please see: Halstead, R. J., F. Dilger and J. D. Ballard. 2004. "Beyond the Mountains: Nuclear Waste Transportation and the Rediscovery of Nevada." *Waste Management* 2004. Tucson, AZ.

The following year another EU conference was held and two authors presented a paper on these issues. This presentation was built off of a combination of Nevada and NATO arguments. Please see: James David Ballard and Fred Dilger. 2005. "Transporting Nuclear Wastes from Energy Production Sites: What Can Terrorists Do And How?" *Nuclear Energy and Security* (NUSEC). Salzburg, Austria

Also in 2005, Halstead, Dilger and Ballard offered "Planning for an Unpredictable Event: Response to Terrorist Attack against SNF Shipments" at the Waste Management conference. This summary of previous work was a reminder to the industry, DOE and others that any state that is targeted for transportation through it, or a waste storage facility within it, should do their due diligence on research about weapons, tactics and consequences for waste shipment attacks. This is because DOE/NRC has not done so to date and these affected communities should continue to develop those arguments. Please see: Halstead, R. J., F.

Dilger and J. D. Ballard. 2005. "Planning for an Unpredictable Event: Response to Terrorist Attack against SNF Shipments." *Waste Management*. Tucson, AZ.

In 2007, the DOE released its Draft SEIS for Yucca Mountain. Nevada asked various contractors to analyze this document (a process that was similar to that done for the DEIS). The author prepared an analysis of the DOE document looking at HIE and weapons, tactics and consequences. DOE failed to mount an effective argument against Nevada's research and still continued to disregard Nevada's arguments in many respects, not the least of which were scenarios. Please see: Ballard, J. D. 2007. "Assessment of Supplemental Environmental Impact Statement (SEIS) Developed by DOE." *Nevada's Agency for Nuclear Projects: Carson City, NV*.

This same year the author was tasked to use open source data to analyze various scenarios for attacks against a NPP and its dry storage facility. The result was a 'red team' assessment of the known threats for a fixed site storage facility for nuclear waste. Scenarios, weapons and tactics were intertwined with this analysis. Please see: Ballard, James David. 2007. "Threat Assessment of Diablo Canyon Nuclear Power Plant in California." *Nevada's Agency for Nuclear Projects: Carson City, NV*.

In 2008, Nevada tasked a team approach to the issues noted above and the author articulated a new methodology to assess risk in transportation for sabotage and terrorism. This triangulated methodological approach used a national labs alternative risk assessment procedure to help in creating this multi-dimensional approach to threats. Please see: Ballard, J. D., R. J. Halstead, F. Dilger, M. Resnikoff and H. Collins. 2008. "Assessing the Vulnerability of Yucca Mountain Shipments: A Threat Matrix for Human-Initiated Events." *Waste Management* 2008. Tucson, AZ.

In 2008 the author was once again asked to testify in the U.S. Senate for the Committee on Commerce, Science and Transportation: Hearing on Safety and Security of Spent Nuclear Fuel Transportation. This presentation used the methodologies developed in the Waste Management paper noted above to summarize Nevada arguments against transport and also argued for a shelter-in-place alternative like dry storage. Please see: Ballard, J. D. 2008. "Terrorism Risk and the Transportation of Spent Nuclear Fuel and High Level Radioactive Waste." Testimony before the *United States Senate*, Committee on Commerce, Science and Transportation. Hearing on Safety and Security of Spent Nuclear Fuel Transportation, September 24, 2008.

In preparation for Waste Management 2008, Halstead et al. crafted a document entitled "State of Nevada Perspective on the U.S. Department of Energy Yucca Mountain Transportation Program." This presentation summarized the work of the last 14 years on transportation issues, including sabotage/terrorism issues, weapons and scenarios. Halstead

worked as lead author and guided the group as they constructed these arguments. Please see: Resnikoff, M. , R. J. Halstead, F. Dilger, J. D. Ballard and H. Collins. 2008. "State of Nevada Perspective on the U.S. Department of Energy Yucca Mountain Transportation Program." *Waste Management*. Tucson, AZ.

In 2009 the GAO asked the author to review their "General Accounting Office (GAO) Request for Feedback on Radioactive Waste Management." The author provided a written review of the proposed methodology to study various waste storage and transport alternatives. This criticism of GAO methods of scenario development was offered and based on years of Nevada arguments against uncreative attack parameters and as an alternative to the industry perspective the GAO seemed to have used to construct their document. Please see: Ballard, James David. 2009. "General Accounting Office (GAO) Request for Feedback on Radioactive Waste Management." *GAO*: Denver, CO.

The scholarship continued with a focus on transportation planning and security/safety of wastes. A review of the 25-year history of Yucca Mountain transportation planning was undertaken with two co-authors and presented at the Waste Management conference. Please see: Halstead, R. J., F. Dilger and J. D. Ballard. 2011. "Yucca Mountain Transportation Planning: Lessons Learned, 1984-2009." *Waste Management* 2011. Phoenix, Arizona. Additionally, the NRC was busy with rulemaking on physical protection regulations for SNF shipments. Ballard, J. D. 2011. "Report on the status of the NRC proposed rulemaking for 10 CFR 73.37, Physical Protection of Irradiated Reactor Fuel In Transit, and a compilation of written comments submitted to the NRC in response to the October 13, 2010 Federal Register notice (75 FR 62695-62716). Report includes comments submitted to NRC on the associated guidance document, NUREG-0561, Rev.2." *Nuclear Waste Projects Office*, Carson City, NV.

Soon after the waste management conference the Japanese disaster struck and Fukushima became known to the world. Nevada was very interested in the performance of the cooling pools, the status of the SNF and later would learn about the performance of the dry casks at the site of this disaster. A great deal of the scholarship used in the presentation on the proposed CISF came from this research. Please see: Ballard, James David. 2011. "Report Reviewing Safety and Security Aspects of the March 2011 Fukushima Daiichi Nuclear Disaster, Identifying Human-Initiated Events Before and After the Earthquake And Tsunami. *Nuclear Waste Projects Office*, Carson City, NV.

Of interest to the proposed CISF proceedings was a presentation on the NRC acceptance of rulemaking contentions by the State of Nevada. This report out on the final settlement of the NRC petition (1999) noted above showed that Nevada had almost all of its issues settled by rulemaking and they represented a significant change of policy.

Please see: Dilger, F., J. D. Ballard and R. J. Halstead. 2012. "Physical Protection of Spent Fuel Shipments: Resolution of Stakeholder Concerns through Rulemaking." *Waste Management*. Phoenix, AZ.

Still the issues were not finalized, nor had all of the concerns brought forth, in the author's research, been addressed. Neither were those associated with Nevada's concerns. Once again three researchers conversant in the subjects presented a paper on these issues. Please see: Dilger, F., R. J. Halstead and J. D. Ballard. 2012. "Full-scale Cask Testing and Public- Acceptance of Spent Nuclear Fuel Shipments." *Waste Management*. Phoenix, AZ.

Two researchers used their knowledge of the Yucca Mountain issues to address those in a different state and for a NPP of concern. Please see: Dilger, F. and J. D. Ballard. 2013. "Comments on the Waste Confidence Generic Environmental Impact Statement Draft Report for Comment (NUREG-2157), September 2013." Prepared for the States of Vermont and Connecticut, *Attorney General's Office*. Montpelier, Vermont.

The Fukushima disaster was teaching all the safety and security professionals working on SNF/HLW issues something to think about. This incident offered a unique opportunity to reconsider DBE and DBT's in light of the cascading and compounding nature of the disaster. It challenged accepted engineering and operational wisdom on waste security and safety. Please see: Ballard, J. D. 2013. "Japan's Fukushima Daiichi Disaster: Implications for Further Research on Terrorism and Sabotage." *Nuclear Waste Projects Office*, Carson City, NV.

The tie to Nevada's Yucca Mountain transportation contentions with the NRC was the subject of the next several reports on Fukushima. Please see: Ballard, J. D. 2014. "Fukushima Dai-ichi and Nevada's Contentions under NEPA." *Nuclear Waste Projects Office*, Carson City, NV and Ballard, J. D. 2016. Update: Fukushima Dai-ichi and Nevada's Contentions under NEPA." *Nuclear Waste Projects Office*, Carson City, NV.

The Holtec CISF application for a potential New Mexico facility was analyzed in August/September 2018. The history of work above helped to inform that analysis. This document was submitted to the NRC as part of the contentions offered on behalf of several groups. The contentions were collated and authored by Terry Lodge, Esq. As of the submission date of this report the Holtec document was only submitted to the NRC, not published by the author.

The author has long argued that the choice of weapons and tactics in threat analysis matters, the use of multiple scenarios is not only possible but desirable, and argues against the static DBT baseline and risk assessment methodologies used by DOE/NRC. Multiple variable risk analysis is a more robust way of gaining understanding. What is typically offered in public

settings by DOE/NRC are methods less than robust considering the threat environment we face in a post 9/11 world and after the Fukushima disaster. These same arguments underlie the analysis and the suggestions in this report.

