

## **A Bottom's-Up Model for Siting and Developing Consent-Based Disposal Solutions for SNF and HLW in the USA - 17332**

Leif G. Eriksson\* and George E. Dials\*\*

\* Retired Consultant, Nuclear Waste Dispositions (nukewastedisp@gmail.com).

\*\* President and CEO, Pajarito Scientific Corporation, LLC. (gedials@pscnda.com).

### **ABSTRACT**

At the end of 2016, the licensing and continued development of the USA's only candidate HLW-repository since 1987 at the Yucca Mountain (YM) site in Nevada had been on hold since 2010 *pending the enactment of enabling legislation for one or more of the following paths forward:*

1. Re-start of the YM HLW repository.
2. Consent-based siting and development (S&D) of new HLW-repositories for commingled disposal of commercially- (CHLW) and defense-generated (DHLW) HLW.
3. Consent-based S&D of a repository and/or deep boreholes for DHLW only.

Public trust in the implementing and regulating entities and a definitive say in an apolitical S&D process by the directly affected parties (DAPs) are historical imperatives for gaining public acceptance and maintaining sustained support of any or all of them. However, due to the widespread negative legacy currently attributed to past politically-controlled S&D organizations, *an even more politically controlled organizational structure and an amorphous, "consent-based", S&D model like that introduced twice in proposed Senate bills since June 2013 will exacerbate, rather than mitigate, the main root causes to past contentions, lawsuits, delays, and cost-increases. We therefore recommend:*

- 1) *Assigning the responsibility for safe disposal of CHLW to an independent, chartered public corporation with requisite subject-matter expertise and adequate financial resources.*
- 2) *Enacting a related law that:*
  - a. *Defines "consent-based" in measurable terms;*
  - b. *Assigns irrevocable veto rights to facility host state(s) based upon the majority opinion of its legal residents at pre-determined S&D milestones.*
  - c. *Requires Congressional approval before the facility can open and close.*

### **INTRODUCTION**

During the past six decades, the policy in the USA, as well as in most other nation's benefitting from nuclear energy, has been to pursue disposal of its HLW<sup>1</sup> in carefully-sited and -designed deep-seated geological vaults (repositories) [e.g., 1-7]. At the end of January 2017, the USA's only legal candidate repository since

---

<sup>1</sup> Although their legal definitions in the USA differ [7], unless otherwise noted herein, the term "HLW" may include used nuclear fuel (UNF), spent nuclear fuel (SNF), commercially-generated HLW (CHLW), and/or defense generated HLW (DHLW). Furthermore, as used herein, CHLW typically refers to SNF only.

1987 for safe and secure disposal of comingled defense-SNF and HLW (DHLW), and commercial-SNF (CHLW) at the Yucca Mountain (YM) site in Nevada [7-10] had been on hold for seven years due to adverse political and public reactions [11-13] pending enabling legislation for it and/or one or more other proposed HLW-disposal solutions [14-22]. The main author-envisioned CHLW and DHLW prospects at the end of January 2017 are schematically illustrated in Figure 1.

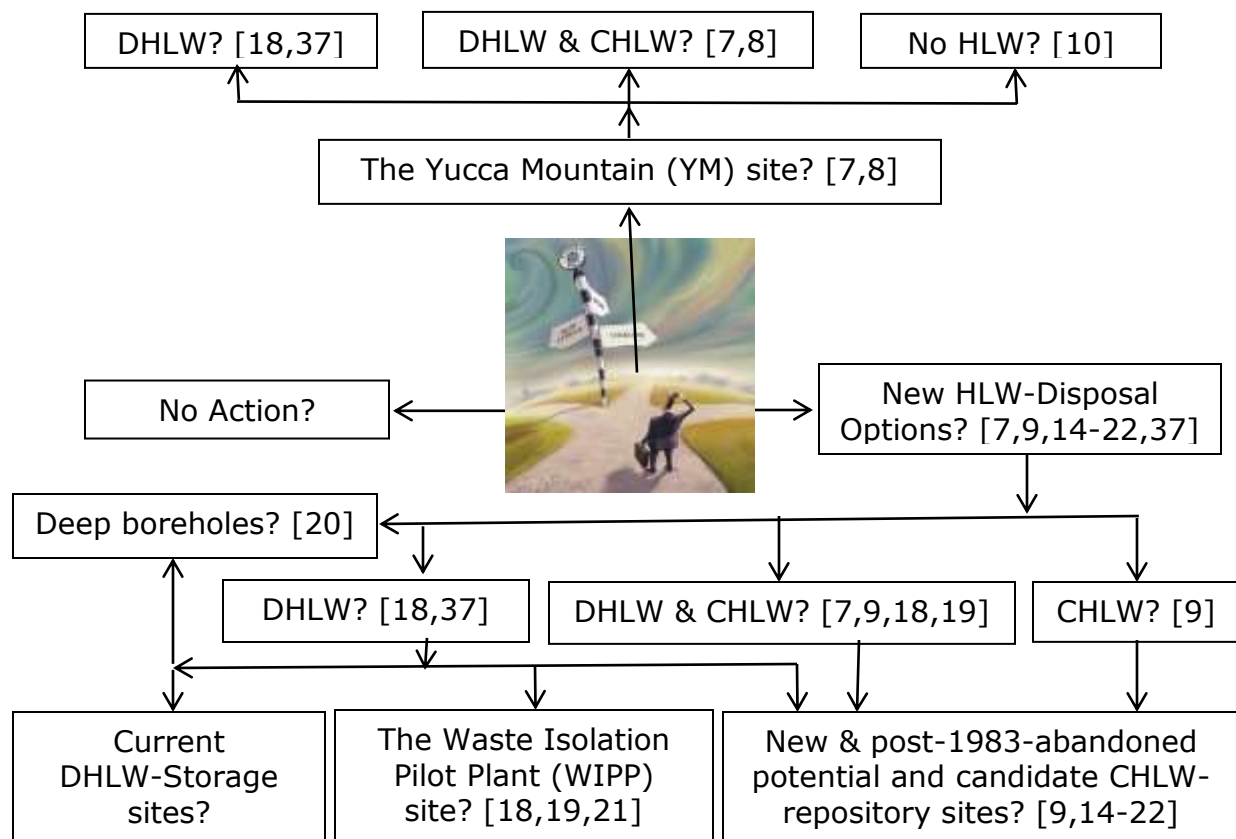


Fig. 1. Schematic illustration of main deep geological HLW-disposal options in the USA at the end of January 2017.

Although none of them had been enacted at the end of 2016, the focus herein is still on the organizational structure described in two proposed Senate bills since June 2013 [16,17] for siting and developing (S&D) new HLW-disposal solutions; referred to herein as **"the top-down model"**. Our main related reasons are:

1. The proposed top-down model is based upon the strategy recommended by the Blue Ribbon Commission on America's Future (BRC) in January 2012 [14], which likely will govern all S&D processes in the USA for HLW-disposition (storage and disposal) solutions for at least another decade.
2. Based on our observations and experiences in the USA and abroad during the past 45 years [e.g.,1-37], another top-down, politically-controlled, S&D model will likely exacerbate several core issues causing past contentions, delays, and the hitherto 7-year-long "comatose" state of the USA's HLW disposal program at the end of January 2017.

3. The USA has long-standing commitments and obligations to find secure, disposal solutions for its HLW without undue delay [e.g., 1-7,23].
4. Progress has been made and continues to be made on consent-based S&D of HLW repositories in other countries [4-6,25,31] and valuable process improvements are evident that could and should be promptly adapted and used to public and National Security advantage in the USA.

We thus promote an alternate, “strawman”, consent-based, model for S&D of new HLW-disposal solutions in the USA in this paper, referred to as “**the bottom’s-up model**”. Annotated background information and references deemed particularly relevant to our concerns about the lack of historical evidence in the USA during the past 60 years that a new politically-controlled entity could be more successful than its predecessor, politically-controlled entities, are also provided. However, the bottom’s-up model we describe is only one conceivable model for making the S&D process less susceptible to time-dependent policy shifts and other common impediments to progress [24]. We also emphasize from the outset that the version described and discussed herein only applies to the S&D of new HLW-disposal solutions. It includes the following key terms and concepts:

- **Directly affected parties (DAPs)** = Legal residents in either a State hosting a HLW-disposal facility or within a given “stand-off” distance from a HLW-transportation route in a State not hosting a HLW-disposal facility.
- **Interested parties (IPs)** = Legal residents outside a State hosting a HLW-disposal facility and outside a given “stand-off” distance from a HLW-transportation route in a State not hosting a HLW-disposal facility.
- **Social-equity-enhancing criteria (SEEC)** = Radiation-risk-based criteria distinguishing between DAPs and IPs.
- **Facility host incentives (FHI)** = Recognition of and compensations for the long-term inconvenience and risks imposed on a host State and its residents.

Furthermore, in December 2016, the U.S. Department of Energy (DOE) published and solicited public comments on a draft plan for consent-based S&D of a repository for DHLW only [18]. If implemented, as illustrated above on Figure 1, this plan will increase the number of prospective sites for safe and secure disposal of CHLW and DHLW, as well as the related DAPs and IPs, in turn affecting the applicability of the version of the bottom’s-up model we have described herein.

## **ANNOTATED BACKGROUND INFORMATION**

This section begins with background information on the January 2012 BRC report [14] followed by the related organizational structure promoted twice in the Senate since June 2013 [16,17] that we are particularly concerned about. It then goes back in time to the Nuclear Waste Policy Act of 1982 (NWPA) [7] and highlights a few selected events and observations deemed to be root causes for the 19-year delay in opening of the YM HLW repository [7,8], the six-year-long comatose state of the USA’s HLW-disposal program, its loss of international standing in the HLW disposal arena, and the pervasive lack of trust in politically-controlled entities in the USA at the end of January 2017 [e.g., 24]. This section concludes with background information on the DOE’s 2016 draft plan for a DHLW-only repository [18].

## The January 2012 BRC Report

In response to a 2010 request from the Obama administration, in January 2012, the BRC recommended a new policy for the back end of the USA's nuclear fuel cycle. It included a strategy based on eight Key Elements for promptly addressing and mitigating the following BRC concerns (**emphasis added**) [14]:

*"Put simply, this nation's failure to come to grips with the nuclear waste issue has already proved damaging and costly. **It will be even more damaging and more costly the longer it continues; damaging to state-federal relations, and public confidence in the federal government's competence, and damaging to America's standing in the world** – not only as a source of nuclear technology and policy but as a leader on global issues of nuclear safety, non-proliferation, and security."*

The related eight Key Elements identified by the BRC for coming to grips with the "nuclear waste issue" included (**emphasis added**):

1. **A new, consent-based approach to siting future nuclear facilities.**
2. **A new organization dedicated solely to implementing the waste management program and empowered with the authority and resources to succeed.**
3. Access to the funds nuclear ratepayers are providing for the purpose of nuclear waste management.
4. **Prompt efforts to develop one or more geologic disposal facilities.**
5. **Prompt efforts to develop one or more consolidated storage facilities.**
6. **Prompt efforts to prepare for the eventual large-scale transport of spent nuclear fuel and high-level waste to consolidated storage and disposal facilities when such facilities become available.**
7. Support for continued US innovation in nuclear energy technology and for workforce development.
8. Active US leadership in international efforts to address safety, waste management, non-proliferation, and security concerns.

With regards to Key Element 2, the BRC added:

***"We believe a congressionally chartered corporation offers the best model, but whatever the specific form of the new organization it must possess the attributes, independence, and resources to effectively carry out its mission."***

Although "the best model" remains to be defined, our experience-based interpretation of the above BRC findings is that the real key to resolving the "nuclear waste issue" referred to by the BRC is that the **implementing entity is deemed politically-independent, competent, and trustworthy by those whose consent is needed.** The BRC also deemed time and adequate funds to be of utmost importance. Put simply, the implementing organization must possess adequately-pedigreed leadership and adequate financial resources that can't be spuriously controlled or diverted at will by Congress or the White House.

### The Top-Down Organizational Structure Promoted in the Senate Since 2013

TABLE I shows the main elements of the top-down model proposed in the 2013 and 2015 Senate bills about which we remain gravely concerned, because they strongly suggest that the resulting organizations can be politically controlled. Additional information on the two aforementioned Senate bills can be found in [16,17,35].

TABLE I. Independent Agencies in the Executive Branch, and Related Positions, Selection Processes, and Terms of Service Proposed in S.854-IS [17].

Agency	Position	Selected and Appointed By	Term Limit
<b>Nuclear Waste Administration</b>	Administrator	U.S. President and U.S. Senate	6 years <sup>a</sup>
	Deputy Administrator		6 years <sup>a</sup>
	Inspector General		No Limit
	General Council	The Administrator	No Limit
	Financial Officer	The Administrator	No Limit
	Up to 3 Assistant Administrators	The Administrator	No Limit
	? Clerical staff	To be determined (TBD)	TBD
<b>Nuclear Waste Oversight Board <sup>b</sup> (NWOB)</b>	Member #1 <sup>c</sup>	U.S. President and U.S. Senate	1 year <sup>d</sup>
	Member #2 <sup>c</sup>		2 years <sup>d</sup>
	Member #3 <sup>c</sup>		3 years <sup>d</sup>
	Member #4 <sup>c</sup>		4 years <sup>d</sup>
	Member #5 <sup>c</sup>		5 years <sup>d</sup>
	Executive Secretary	The Oversight Board	No Limit
	Up to 10 Clerical staff	The Oversight Board	No Limit

<sup>a</sup> May serve more than 1 term.

<sup>b</sup> The U.S. President designates the Chair of the NWOB. (**May also "... remove any member for "inefficiency, neglect of duty, or malfeasance in office".**)

<sup>c</sup> Not more than 3 members of the NWOB may be members of the same political party. (3 members of the NWOB shall constitute a quorum for the purpose of doing business.)

<sup>d</sup> A member of the NWOB may be reappointed for an additional term by the President, by and with the advice and consent of the Senate."

### The Nuclear Waste Policy Act of 1982, as Amended in 1987, and Related Events Deemed of Importance to Future S&D Efforts

Following more than 25 years of unsuccessful efforts by various government-chartered and politically-controlled entities, the Congress concluded in 1982 that the USA's HLW-disposal program needed both a face lift and a blood transfusion. To that effect, the NWPA was passed by the Congress and then signed by the U.S. President in January 1983 [7]. It directed the Secretary of Energy (Secretary) to promptly establish a dedicated office within the DOE to open the USA's first HLW repository no later than on 31 January 1998. The NWPA was amended in December 1987 to expedite the selection of the USA's first and thenceforth only candidate HLW repository site, i.e., the YM site in Nevada.

Although many of us thought in 1983 that the NWSA [7] would effectively mitigate the root causes of the Lyons, Kansas, salt mine site selection failure in the 1970s, as evidenced more than once since then by the historical record, it did not. We therefore feel obliged to mention that the above BRC assessment reflects a >65-year-long historical record. For example, Section 111.(a)(3) of the NWSA [7] reads, *"Federal efforts during the past 30 years to devise a permanent solution to the problems of civilian radioactive waste disposal have not been adequate."* Accordingly, the BRC's overall assessment in January 2012 cannot credibly be attributed to a single individual, political party, county, State, administration, or interest group. In other words, ***we are all at fault.***

In December 2008, the Secretary reported to Congress that instead of opening by 2010 [36], the YM HLW repository would open no earlier than in 2017, but more likely in 2020 [9]. Two major root causes to this additional delay were the autocratic manner in which the YM site was prematurely selected to be the nation's only candidate HLW-disposal site in December 1987 [8] and the Congress and the President overriding the Governor's related veto in 2002 [11,13], that also created a lasting adversarial relationship to and distrust of the implementing organization for the S&D of the YM HLW repository within in Nevada and elsewhere [11,13]. The "illegal" stoppage, unsuccessful motion for withdrawal of the construction license application, and attempted abandonment of the YM HLW repository program in 2010 [10-13,36] effectively took the USA out of the internationally-prestigious distinction of opening the world's first HLW repository, which it had been forecasting until then. The Secretary also advised Congress in December 2008 that the legal disposal capacity of the HLW repository, i.e., 70,000 metric tons (MT) of heavy metals or an equivalent amount of uranium, would be less than the projected domestic stockpile of HLW designated for deep geological disposal in 2010 [9]. Two related conditions of concern to us and many other people in the USA at the end of January 2017 are:

1. The amount of CHLW alone stored in surface facilities at more than 130 locations in 39 states across the USA [32,34] designated for deep geological disposal exceeded 76,000 MT, and it will continue to grow at an annual rate of ~2,000 MT until the DOE takes title to some or all of it [7]; and
2. Additional DHLW not designated for deep geological disposal was stored or contained at other sites; in particular, at government-operated sites.

We conservatively estimated that based on the related conditions for less than 70 sites storing, long-lived, transuranic radioactive waste (TRUW) in the 1990s that more than 100 million people reside within 50 kilometers stand-off distance from the aforementioned HLW sites and are at risk to be exposed to highly-radioactive, air-borne, isotopes in the event the waste storage containments are breached.

Other important lessons we learned during the past 45 years are that the implementing entity must be populated by individuals possessing relevant subject-matter experience and credibility, who are allowed and willing to work with both DAPs and IPs, and are held accountable and recognized, as appropriate, for results. But we have not found any historical evidence that replacing an underperforming federal entity that has no control over its decisions or funding level with a new,

even more, politically-controlled entity under the executive office, would be the “best” approach or even conducive to engendering public trust and/or achieving progress. Instead, our findings strongly suggest several components of the “nuclear waste issue” referred to by the BRC in 2012 [14] will be exacerbated rather than mitigated, unless future entities responsible for the S&D of HLW-disposal/solutions:

- ✓ Are better shielded from spurious political interferences than its predecessors;
- ✓ Have a measurable definition of “consent-based”; and
- ✓ Benefit from a politically-independent leadership with relevant subject matter experience and access to and control of adequate funds.

### **The DOE’s DHLW-only Repository**

In October 2014, the DOE released an “*Assessment of Disposal Options for DOE-Managed High-Level Radioactive Waste and Spent Nuclear Fuel*” [37]. It was prepared by a team of federal and contractor personnel led by the DOE Office of Nuclear Energy (DOE-NE). It recommended - “*the DOE pursue separate disposal options for some DOE-managed HLW and SNF.*” The team also recommended, “*the DOE begin implementation of a phased, adaptive, and consent-based strategy with development of a separate mined repository for some DOE-managed HLW and cooler SNF, including some portion of the inventory of naval SNF.*”

In March 2015, the U.S. President stated in a memorandum to the Secretary, “**the development of a repository for the disposal of high-level nuclear waste resulting from atomic energy defense activities only is required.**” This memorandum was accompanied by a DOE report concluding:

- “*The Secretary may develop a Defense HLW Repository under his Atomic Energy of 1954 Authority.*”
- “*In developing a Defense HLW repository, the Secretary would be subject to U.S. Nuclear Regulatory Commission (NRC) licensing authority, but would not be subject to U.S. Nuclear Waste Policy Act’s (NWPA) siting provisions, apart from the State and tribal provisions specified in Section 101 of the NWPA.*”

In December 2016, the DOE published a Draft Plan for a Defense Waste Repository only. On December 19, 2016, DOE solicited public comments on it in the Federal Register by March 20, 2017 [18]. Therefore, a departure from the policies employed and programs pursued in the USA for S&D of both CHLW and DHLW repositories since January 1983 [7] appears imminently pending. As elaborated on in several past papers [e.g., 19, 21,28,34], we support and laud such an effort.

Although no formal proposal or plan currently exists for a separate repository for CHLW only, this may be a blessing in disguise, because the DOE’s recent draft plan for a DHLW-only repository [18] does not include all DHLW. But, it still offers a promising path forward for advancing the opening of the USA’s first new DHLW repository, in particular, if the current defense-waste mission at WIPP was expanded to accommodate DHLW or the current YM mission was limited to DHLW only (Figure 1). The opening of a DHLW-only repository could likely be further advanced by assigning the related S&D effort on government-owned and -operated

sites to the DOE Office of Environmental Management (DOE-EM), because it already manages them and also has several national laboratories with highly-qualified repository-sciences experts under contract. *We want to stress again that the long-standing lack of progress on the S&D of HLW-repositories in the USA is not due to lack of domestic state-of-the-art experts in repository sciences or risk assessment.*

## **DESCRIPTIONS AND DISCUSSIONS OF OUR BOTTOM’S UP MODEL**

Our bottom’s-up model for consent-based S&D of HLW disposal solutions in the USA embodies the following fundamental principles:

- A. The regulators do what they are chartered to do by current laws in recognition of the underlying notion that each of them has highly qualified, domestic, subject-matter experts and relevant experience for overseeing and ensuring that well-informed decisions are made, in turn, making them more readily accepted by objective laypeople.
- B. The DAPs are duly represented from cradle to the grave in the S&D process and have unfettered access to independent experts, real-time involvement and input in the decision-making process, including veto right by the facility-host state(s) up to a pre-determined point in the S&D process. Two acute imperatives are therefore to ***promptly define the DAPs and “consent-based” in measurable terms to provide a transparent and defensible starting point for informed and reasoned decision-making.***
- C. The U.S. government shoulders the ultimate responsibility for any given SNF and HLW-management and -disposal facility/site. In particular, after the facility is closed. It therefore has the sole definitive say at the two last decision-making milestone of the S&D process, i.e., before the actions to open and close the facility are warranted and taken.

The ensuing descriptions and discussions are governed by the following three fundamental imperatives/premises:

1. ***Trust and credibility are imperative to public acceptance of any given HLW-storage- and -disposal-facility concept in the USA.***
2. ***Timely acceptance and sustained support by the majority of the DAPs are imperative to the viability and rate of progress on any given, consent-based, HLW-storage and -disposal facility in the USA.***
3. ***Trust and credibility cannot be bought or claimed by any given societal or corporate position; they have to be earned through demonstrated leadership and achievements.***

But, we can only address select portions of our bottom’s-up model herein. Additional information is available in our related WM2013 [32] and WM2015 [34,35] papers.

## **Decision Points Subjected to State-Wide Referenda**

Our bottom’s-up model contains the following four, milestone-based, decision-making, points, at which time the Governor of a State considered for or hosting a HLW-disposal facility is **required** to conduct a state-wide referendum within 90



days and then is then bound by the related outcome, i.e., abort it if more than 40% of the votes are against its continued S&D:

- A. The nomination of a potential HLW-disposal site.
- B. The nomination of a candidate HLW-disposal site.
- C. The approval of the construction license application.
- D. The docketing of the application for a license to receive HLW (at that time, the prevailing geology and its present and future characteristics and reactions in response to the repository-related human intrusion, the disposed HLW, and other features, events, and processes should be well known).

Following milestone D and in the absence of a Host State veto, ***Congress would be responsible for the decisions on whether or not to open (receive waste) and close (seal off and monitor) the facility.***

### **Identification of Decision Makers**

In addition to being indeterminate and thereby very susceptible to protracted definition-negotiations and lawsuits, a fundamental shortcoming of the term “consent based” is that one simply cannot appease 100% of the population in any given county, state, region, or country. To serve as a transparent, rational, starting point for the S&D of any given nuclear facility, at a minimum, the “consent-based” terms must define from the outset. We see two fundamental questions that promptly require answers:

- 1. Whose “consent” is needed?**
- 2. What quantitative value constitutes “consent”?**

But we chose to only describe the application of the bottom’s-up model to BRC’s Key Element 4 herein. Other versions of it could and should also be applied to BRC’s Key Elements 5 and 6. We would, however, like to re-iterate with reference to BRC Key Elements 5 and 6, respectively, that large amounts of HLW are already safely and securely stored at more than 140 sites in more than 39 states, i.e., we know how to do it, and safe and secure transportation of SNF and HLW, as well as many other long-lived radioactive residuals, have already been accomplished in the USA and abroad for more than 40 years. The 15-year-long transportation record for WIPP is particularly re-assuring - 11,894 shipments with 90,984 cubic meters of TRUW on 22,852,673 kilometers of public roads without a single radiation release incident or terminal traffic accident ([www.wipp.energy.gov/shipments.htm](http://www.wipp.energy.gov/shipments.htm)).

In an effort to stimulate the required definitional process, we undertook the effort in 2013 with Critz George [32] to establish a set of “strawman” parameters for facilitating the answers to these two questions by defining “Social Equity Enhancing Criteria” (**SEECs**) intended to help separate affected populations into “consent givers” and “consent advisers” based on all risk factors. We also described a set of “Facility Host Incentives” (**FHIs**) based on the historical records in the USA and abroad that we envisioned embodied components providing the DAPs the resources and subject-matter expert and financial support they needed for understanding the diversity of scientific, health, and risk issues involved and for making informed decisions.

The following, generic, **SEECs** were designed to provide simple, rational, defensible, tools for identifying and communicating with different population groups when siting a given nuclear facility in a societally-equitable manner. In other words, **they were designed to ensure that the voices and opinions of the people subjected to potential risks from a proposed nuclear facility (and its waste-transportation routes) are identified and prioritized from the outset**, and informed of that fact and their substantial role in Federal policy.

*SEEC 1. Geographically-based distinctions between people:*

- a. Legally residing in a State hosting a HLW facility (= **facility DAPs**);
- b. Legally residing in a State within a given "stand-off" distance\* from a related HLW-transportation route (= **transportation DAPs**); and
- c. Legally residing outside a given "stand-off" distance\* from a related HLW-transportation route in a State not hosting a HLW-disposal facility (= **IPs**).

*SEEC 2. "Majority consent" is presented as a guiding principle with these parameters:*

- a. Only required in facility-host states; and
- b. Defined as more than 40% of votes "against" its continued S&D.

\* Values remain to be determined (TBD) based upon applicable State- and site-specific (TBD) regulations and permits.

**The fundamental scientific-based underpinnings of SEEC 1 are:**

- 1) Radioactivity and its related health effects and risks are quantifiable.**
- 2) Radioactivity and its related health effects and risks decrease with "stand-off distance", shielding, and time.**

**The fundamental objectives of SEEC 2 are to:**

- 1) Provide a transparent, quantitative, definition for "consent-based".**
- 2) How this definition may be applied.**

**The nexus for all proposed SEECs is logic based on risks that, in turn, identifies DAPs and IPs.**

We conducted a hypothetical SEEC exercise in our WM2013 paper using the YM site as a guinea pig [32]. But, it is not reported herein. Instead, we chose to describe the following adapted set of "generic" **FHIs** that have already been used successfully to plan, manage, and advance WIPP ([www.wipp.energy.ws](http://www.wipp.energy.ws)), and leading foreign programs for safe and secure deep geological disposal of HLW at the Olkiluoto site at Eurajoki in Finland ([www.posiva.fi](http://www.posiva.fi)), the Meuse/Haute-Marne site in France ([www.andra.fr](http://www.andra.fr)), and the Forsmark and Oskarshamn sites in Sweden ([www.skb.se](http://www.skb.se)) during the past 30+ years:

1. "Independent" facility-host subject-matter expert-groups.<sup>2</sup>

---

<sup>2</sup> Based upon, but not limited to, the now dissolved New Mexico Environmental Evaluation Group (EEG).

2. *A multi-state organization made up of the Governors in states with waste-transportation routes.*<sup>3</sup>
3. *A comprehensive, forward-looking, fully-integrated, periodically-updated Facility Siting and Development Plan that also commits the facility-siting entity to issue a related status report at least every third year, that is timely **available to all DAPs and IPs.***<sup>4</sup>
4. *Several annual public meetings in which the DAPs and the **IPs** have the opportunity to learn about the status of the program and to interact in real time with the implementing organization(s), key participating scientists, and the related regulators.*<sup>5</sup>
5. *Veto right by Host States, executed by its Governor, based upon state-wide referenda, until the license application to receive nuclear material has been docketed by the regulator(s).*<sup>6</sup>
6. *A standing national advisory board populated by representatives from academic disciplines that could contribute to the formation of a set of moral, ethical and scientific guidelines by which the problem of nuclear waste disposition is to be addressed and resolved.*<sup>7</sup>

**The main common intended objective of the above six FHIs is to gain and maintain majority DAP acceptance and support.** They embody the related, fundamental ethical and moral obligations of ensuring that the risks the DAPs may be exposed to from a proposed nuclear facility are understood, adequately safeguarded against, and can be irrevocably rejected by **a majority of them** until the S&D of the facility has reached the point of being ready to close.

## **MAIN OBSERVATIONS, CONCLUSIONS, AND RECOMMENDATIONS**

The failure to open the YM HLW repository by 31 January 1998 [7] resulted in 71 lawsuits [36]. In 2009 the DOE predicted the related breach-of-contract damages to the nuclear utilities would total close to \$12.3 billion (\$12.3B) if it was able to begin accepting CHLW by 2020, whereas the nuclear utilities estimated the breach-of-contract damages would amount to ~\$50B, not including litigation expenses amounting to ~\$150 million (M). In December 2009, the Congressional Research Service (CRS) deemed the opening of the YM HLW repository by 2010 “an unlikely

---

<sup>3</sup> Based upon, but not limited to, the Western Governors’ Association (WGA), which still oversees TRUW shipments to the WIPP repository ([www.wipp.energy.ws](http://www.wipp.energy.ws)).

<sup>4</sup> Based upon the Swedish Nuclear Fuel and Waste Management Company’s (SKB’s) ([www.skb.se](http://www.skb.se)) Research, Development, and Demonstration Plans and SKB’s, Posiva of Finland’s ([www.posiva.fi](http://www.posiva.fi)), and USA’s Nuclear Waste Technical Review Board (NWTRB) Annual Reports ([www.nwtrb.gov](http://www.nwtrb.gov)).

<sup>5</sup> Based on how WIPP communicated in a timely, transparent, interactive manner with **stakeholders** and other **interested parties** that enhanced public acceptance and support, and rate of progress. The nexus for this successful process was the 1994-1998 WIPP Disposal Decision Plan (DDP) [29].

<sup>6</sup> Based largely upon the Swedish approach ([www.skb.se](http://www.skb.se)).

<sup>7</sup> We envision something like this growing out of the BRC beginnings but taking on the scale and scope of the Swedish National Council for Nuclear Waste ([www.karnavfallsradet.se](http://www.karnavfallsradet.se)), but it would have to have its focus area coordinated with that of the NWTRB to avoid overlap.

occurrence” since all construction on the YM HLW-repository had ceased [36]. In 2014, these awards amounted to ~\$750M per year and were estimated to reach \$1B per year, and to reach a total amount of \$30.6B by 2028. However, in our estimate, a HLW repository opening in the USA by 2028 is still an unlikely occurrence. Because, even if national policy were changed again in the near term to enable the continued S&D of the YM HLW repository and Nevada agreed to it, following the re-establishment of a legal implementing entity, the opening of the YM HLW repository would still be at least another 9 years, but more likely another 12 years away [9]. The corresponding period for a new consent-based HLW repository was estimated by the Secretary in January 2013 to be 35 years [15].

Simply stated, we believe the political pressures and financial limitations imposed upon past politically-chartered organizations responsible for the S&D of HLW repositories in the USA by frequent, poorly based, premature changes in national and state politics and policies are the main inherent root causes to the several-decades-long, beleaguered and unsuccessful status of the USA’s HLW-repository program to date. As the factual record for the past 60+ years of unsuccessful efforts by various, politically-controlled organizations to S&D a HLW-repository in the USA shows, past efforts are documented by related lessons learned, but the lessons learned are not timely implemented and the responsible parties are not held accountable. The related domestic legacy is a deeply rooted distrust in the ability and willingness of politically-controlled S&D entities to prioritize programmatic issues, achieve project-completion milestones and, enable real progress at established costs objectives and costs reductions. Simply stated, the top down model now faces a more wide-spread and deeper legacy of distrust in politically-controlled S&D entities than ever before. We have thus concluded:

1. In order to be successful in the S&D of future consent-based HLW-disposal solution, the DAPs need to be involved in setting the S&D criteria used to qualify a site and then also be an integral component of the subsequent decision-making process.
2. A government-chartered organization would not be considered politically independent. It would be directly associated with the reputation earned by its government-chartered and -controlled predecessor organizations, thus greatly diminishing its problem solving effectiveness.
3. That transferring the responsibility for the S&D of new HLW-disposal solutions from the current federal branch to an even more, politically-controlled, entity in the Executive Branch will not mitigate these root causes.

No HLW-disposal solution will likely open in the USA within the next decade, which means that the solution(s) on Figure 1 “surviving” the November 2016 election will have to face at least five more national elections. Based upon our related experience and observations, *and as evidenced in Finland and Sweden during the past 30+ years, the most promising solution for minimizing adverse impacts of pending national political changes is to **privatize the S&D process for CHLW-disposal facilities.***

The BRC coined the “consent-based” S&D concept in January 2012 [14]. In December 2015, the DOE solicited public feedback on what the qualitative concept

“consent-based” S&D of nuclear waste disposition (storage and disposal) facilities could or should mean. It then launched a related public meeting campaign in early 2016 to sound out public opinion at 8 different geographical locations and released a related draft report in January 2017 on the consent-based siting process for consolidated facilities for SNF and HLW for public comments by the 14<sup>th</sup> of April 2017 ([www.energy.gov/ne/downloads/consent-based-siting-process](http://www.energy.gov/ne/downloads/consent-based-siting-process)). However, at the end of January 2017, a measurable definition of “consent-based” S&D of new HLW repositories is still pending. Furthermore, based upon published reports on the feedback received by the DOE by the end of January 2017, it appears that the DOE has been inundated by varying interpretations of consent-based. Furthermore, many of these seemed to have very little, if anything, to do with consent-based S&D of new HLW-disposition facilities ([www.energy.gov/consentbasedsiting](http://www.energy.gov/consentbasedsiting)).

Although we recognize and support that “consent-based” S&D of future HLW-disposal facilities is the new socio-political imperative, we find it counterproductive to public trust and confidence that this qualitative term/concept, which was coined by the BRC in January 2012, re-iterated by the Secretary in January 2013, and in two subsequent, proposed, Senate bills, remains to be defined quantitatively five years later. In other words, five years have already been expended on wordsmithing, whilst no progress has been made in the field on the S&D of a HLW-disposal facility in the USA. A fact that is not conducive to improving the USA’s international standings.

In our opinion, the need for a measurable definition of consent-based increased further following the DOE’s announcement in December 2016 [18] that it intended to pursue consent-based S&D of a deep geological repository for DHLW only. In hindsight, another, likely less time-consuming and probably more appealing approach to laypeople would have been, and still is, to re-assemble the BRC and ask it to define “consent-based” in measurable terms. Alternatively, the National Academies of Science, Engineering and Medicine - National Research Council could be asked to develop a measurable, risk-based, definition for public comment.

Also, the rate of progress on HLW-disposal solutions is linked to the public’s perception of the related health risks and cost impacts on current and future generations. As stressed by the BRC, the most expedient reduction of the radiation-exposure risks posed by current, HLW-storage sites is to promptly move the HLW underground, for both storage and deep(er) geological disposal. Contingent upon the design and ventilation of the underground-storage and -disposal vault(s), inadvertent releases of radionuclides would be contained underground, and human ingress and egress would be more controllable. But moving HLW from one site to another for surficial storage without knowing the location of where the HLW will be disposed of is likely to increase both radiation risks and costs.

In closing, although this paper only addresses a few of the inherent and unresolved core issues and historical challenges encountered in connection with consent-based S&D of HLW-disposal solutions, we believe our bottom’s-up model provides a more promising and lasting model for coming to grips with the nuclear waste issue

referred to by the BRC in January 2012 [14] than the autocratic, top-down, model promoted in the Senate bills introduced in June 2013 [16] and March 2015 [17].

## REFERENCES

1. NATIONAL ACADEMY OF SCIENCES – NATIONAL RESEARCH COUNCIL, DIVISION OF EARTH SCIENCES, COMMITTEE ON WASTE DISPOSAL, 1957, *The Disposal of Radioactive Waste on Land*, National Academy of Sciences – National Research Council, Washington, D.C., USA, Publication 519, September 1957.
2. DIALS, G.E., 1973, *International Implications of High-Level Radioactive Waste Management in Western Europe*, Thesis, Massachusetts Institute of Technology, Cambridge, Massachusetts, June 1973.
3. INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA), 1997, *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*. INFCIRC 546, International Atomic Energy Agency, 24 December 1997.
4. PALMU, M.P., and OUZOUNIAN, G., 2011, *Development of the Strategic Research Agenda of the Implementing Geological Disposal of Radioactive Waste Technology Platform*, Proceedings from the 2011 Waste Management (WM2011) Conference, Phoenix, Arizona, USA, February 27 - March 3, 2011.
5. THE COUNCIL OF THE EUROPEAN UNION, *Council Directive 2011/70/EURATOM of 19 July 2011 establishing a Community framework for the responsible and safe management of spent nuclear fuel and radioactive waste* (Document 32011L0070), 19 July 2011.
6. ORGANISATION OF ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD) NUCLEAR ENERGY AGENCY – NUCLEAR ENERGY INSIDER, 2012, *Geological Disposal of Radioactive Waste: National Commitment, Local and Regional Involvement*, A Collective Statement of the OECD Nuclear Energy Agency Radioactive Waste Management Committee Adopted March 2012 (NEA No. 7082)(ISBN 978-92-64-99183-5).
7. PUBLIC LAW 97-425, 1983, *The Nuclear Waste Policy Act of 1982* (NWPA), signed by the U.S. President on January 7, 1983.
8. PUBLIC LAW 100-203, 1987, *The Nuclear Waste Policy Amendments Act of 1987*, signed by the U.S. President on December 22, 1987.
9. U.S. SECRETARY OF ENERGY, 2008, *Report to the President and the Congress by the Secretary of Energy on the Need for a Second Repository*, U.S. Department of Energy, Office of Civilian Radioactive Waste Management (DOE/RW-0595), December 2008.
10. THE EXECUTIVE OFFICE OF THE PRESIDENT OFFICE OF MANAGEMENT AND BUDGET, 2009, *A New Era of Responsibilities: Renewing America's Promise*, U.S. Government Printing Office, Washington, D.C., February 2009, pp. 63-65. ([www.whitehouse.gov/omb/assets/fy2010\\_new\\_era/Department\\_of\\_Energy.pdf](http://www.whitehouse.gov/omb/assets/fy2010_new_era/Department_of_Energy.pdf))
11. ALLEY, W.M., and ALLEY, R., 2012, *Too Hot to Touch: The Problem of High-Level Nuclear Waste*, Cambridge University Press, U.K., November 2012 (ISBN: 9781139854368).

12. U.S. COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT, 2013, *On Petition for Writ of Mandamus filed by Aiken County et al., No. 11-1271*, August 13, 2013.
13. FERGUSON R.L., and GEBER, M.S., 2014, *Nuclear Waste in Your Backyard - Who's to Blame and How to Fix It*, Archway Publishing, 1663 Liberty Drive, Bloomington, IN 47403, (LoC # 2014913303).
14. BLUE RIBBON COMMISSION ON AMERICA'S NUCLEAR FUTURE (BRC), 2012, *Report to the Secretary of Energy*, 26 January 2012. ([www.brc.gov](http://www.brc.gov))
15. U.S. DEPARTMENT OF ENERGY (DOE), 2013, *Strategy for the Management and Disposal of Used Nuclear Fuel and High-level Radioactive Waste*, January 11, 2013.
16. U.S. SENATE BILL 1240-IS, 2013, *The Nuclear Waste Administration Act of 2013*, introduced in the U.S. Senate by U.S. Senators Wyden, Murkowski, Feinstein, and Alexander on June 27, 2013 (replaced by S.854-IS in 2015).
17. U.S. SENATE BILL 854-IS, 2015, *The Nuclear Waste Administration Act of 2015*. Introduced in the U.S. Senate by U.S. Senators Alexander, Cantwell, Feinstein, and Murkowski on March 24, 2015 (has not been enacted).
18. U.S. DEPARTMENT OF ENERGY (DOE), 2016, *Draft Plan for a Defense Waste Repository*, Federal Register/Vol.81, No. 243/Monday, December 19, 2016/Notices 91925 (Comments due by 20 March 2017). ([www.energy.gov/ne/downloads/draft-plan-defense-waste-repository](http://www.energy.gov/ne/downloads/draft-plan-defense-waste-repository))
19. DIALS, G.E. and ERIKSSON, L.G., 2014, *Nevada and New Mexico: Two Particularly Promising States for HLW Repositories*, Proceedings from the WM2014 Conference, Phoenix, Arizona, USA, March 2-6, 2014.
20. BRADY, P.V., ARNOLD, B.W., FREEZE, G.A., SWIFT, P.N., BAUER, S.J., KANNEY, J.L., RECHARD, R.P., and STEIN, J.S., 2009, *Deep Borehole Disposal of High-Level Radioactive Waste*, Prepared by Sandia National Laboratories Albuquerque, New Mexico 87185 and Livermore, California 94550 (SAND2009-4401), printed in August 2009.
21. ERIKSSON, L.G., 2000, *The Waste Isolation Pilot Plant Mission: Could It Be Expanded To Solve Other National Radioactive Waste Disposal Needs?*, Submitted to the WM2000 Conference, Tucson, Arizona, USA, February 24-28, 2000.
22. ERIKSSON, L.G., 2016, *Salt Rock – the 60-Year-Old Prodigy Host Rock for Consent-Based Disposal of Long-Lived Radioactive Waste*. Proceedings from the WM2016 Conference, Phoenix, Arizona, USA, March 6-10, 2016.
23. CARTER, L.J., 1987, *Nuclear Imperatives and Public Trust Dealing with Radioactive Waste*, Resources for the Future, Inc., 1616 P. Street, Washington, D.C. 20036, 1987.
24. VIETH, D.L., and VOEGELE, M.D., 2013, *Role of Congress in the High Level Radioactive Waste Odyssey: The Wisdom and Will of the Congress*, Proceedings from the WM2013 Conference, Phoenix, Arizona, USA, February 24-27, 2013.
25. ERIKSSON, L.G., 1986, *A Comparative Review of High-Level Radioactive Waste Disposal Programs in Sweden and the United States*. Prepared for the Swedish National Board for Spent Fuel by the Earth Technology Corporation.
26. ERIKSSON, L.G., and PENTZ, D.L., 1989, *Geosciences and Geoengineering Challenges to Geologic High-Level Radioactive Waste Disposal in the United*

- States of America*, Proceedings of the 28th International Geological Congress, Washington, D.C., July 1989.
27. MCFADDEN, M.H., and ERIKSSON, L.G., 1999, *The Successful 1998 Certification of the Waste Isolation Pilot Plant Transuranic Waste Repository - Ten Important Lessons Learned*, Proceedings of the WM1999 Conference, Tucson, Arizona, USA, February 28-March 4, 1999.
  28. ERIKSSON, L.G., DIALS, G.E., and PARKER, F.L., 2003, *A Holistic Approach for Disposition of Long-Lived Radioactive Materials*, Proceedings from the WM2003 Conference, Tucson, Arizona, USA, February 23-27, 2003.
  29. DIALS, G.E., and ERIKSSON, L.G., 2003, *The WIPP Disposal Decision Plan: The Successful Roadmap for Transparent and Credible Decision-Making*, Proceedings from the 10th IHLRWM Conference, Las Vegas, Nevada, USA, March 30–April 3, 2003.
  30. ERIKSSON, L.G., 2010, *A 'Smörgåsbord' of Lessons Learned During 32 Years of Siting and Developing Deep Geological Disposal Systems for Long-Lived, Highly-Radioactive Wastes*, Proceedings from the WM2010, Phoenix, Arizona, USA, March 7-11, 2010.
  31. ERIKSSON, L.G., 2010, *Spent Fuel Disposal Success vs. Failure - A Comparison of the Swedish and U.S. Repository Programs*, Radwaste Solutions, Jan./Feb. 2010, pp. 22-30.
  32. ERIKSSON, L.G., DIALS, G.E., and GEORGE, C.H., 2013, *Societal-Equity-Enhancing Criteria and Facility-Host Incentives Supporting Five Key Elements in the January 2012 Blue Ribbon Commission Report*, Proceedings from the WM2013 Conference, Phoenix, Arizona, USA, February 24 – 28, 2013.
  33. ERIKSSON, L.G., 2015, *Robust Disposal Concept, Uniform Regulations, and Trust In The Messenger; Three Fundamental Building Blocks for Consent-Based HLW-Disposal Solutions in the USA*, Proceedings from the WM2015 Conference, Phoenix, Arizona, USA, March 15-19, 2015.
  34. ERIKSSON, L.G., and DIALS, G.E., 2015, *Status of HLW disposal in the USA and Progressive Paths Forward Based Upon Lessons Learned in the USA and Abroad since 1973*, Proceedings from the WM 2015 Conference, Phoenix, Arizona, USA, March 12 – 16, 2015.
  35. ERIKSSON, L.G., 2016, *U.S. Senate Bill S.854-IS – A Maladjusted Politicized Maze for Consent-Based Siting of New HLW-Repositories*. Proceedings from the WM2016 Conference, Phoenix, Arizona, USA, March 6-10, 2016.
  36. CONGRESSIONAL RESEARCH SERVICE, 2009, *The Yucca Mountain Litigation: Breach of Contract Under the Nuclear Waste Policy Act of 1982*, December 22, 2009 (7-5700) (R40996).
  37. U.S. DEPARTMENT OF ENERGY (DOE), 2014, *Assessment of Disposal Options for DOE-Managed High-level Radioactive Waste and Spent Nuclear Fuel*, October 2014. ([www.energy.gov/ne/downloads/assessment-disposal-options-doe-managed-high-level-radioactive-waste-and-spent-nuclear-fuel](http://www.energy.gov/ne/downloads/assessment-disposal-options-doe-managed-high-level-radioactive-waste-and-spent-nuclear-fuel))