

U.S. Senate Bill S.854-IS – A Maladjusted Politicized Maze for Consent-Based Siting of New HLW-Repositories - 16019

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ABSTRACT

At the end of 2015, the USA's HLW-disposal program had been on hold since 2010 pending the enactment of enabling legislation for one or both of: 1) The Yucca Mountain HLW repository; and/or 2) The law proposed in Senate Bill S.854-IS "to establish a new organization to manage nuclear waste, provide a consensual process for siting nuclear waste facilities, ensure adequate funding for managing nuclear waste, and for other purposes." But, S.854-IS does not acknowledge the existence of the Yucca Mountain HLW repository, which, if re-enabled, would affect both when another HLW repository would be needed and its disposal capacity. Furthermore, it neither timely nor meaningfully integrates waste generators, facility-host(s) and other directly affected parties with the new "implementing" organizations deemed to be more susceptible to political influence and interferences than those plaguing the Yucca Mountain HLW repository program since 1987 that resulted in a multitude of contentions, lawsuits, delays, and increased costs. For these and other reasons very compelling and conclusive to the author, *the legal status of the YM HLW repository should be "definitive" before a law based upon S.854-IS is enacted. Instead, the near-term focus should be on:*

1. *Defining "consent-based" quantitatively.*
2. *Promptly siting and opening at least one large, expandable, "consolidated" HLW-storage facility allowing the government to begin taking title to commercially-generated HLW; most-expeditiously accomplished by amending existing legislation.*
3. *Updating S.854-IS based on lessons learned about siting, developing, and licensing nuclear-waste-storage and -disposal facilities in the USA and abroad the past 30+ years.*

INTRODUCTION AND BACKGROUND

At the end of 2015, the USA's repeatedly-delayed, federally-managed, HLW¹-disposal program had been on hold since 2010 pending the enactment of enabling legislation for one or more of the following, currently-considered, paths forward:

1. The mined repository for up to 70,000 metric tons (MT) of defense- (DHLW) (~10%) and commercially-generated HLW (CHLW) (~90%) evaluated since 1976 at the Yucca Mountain site in Nevada (Figures 1 and 2) [1-3]².

¹ Herein, the acronym HLW often covers both used (UNF) and spent nuclear fuel (SNF), as well as CHLW and DHLW. It also refers to solid-state HLW, unless otherwise stated.

² Main data sources supporting the information, conclusions, and recommendations presented herein are indicated by Arabic numbers [1] (listed in full in the REFERENCES section) or an Internet address [<http://www.nrc.gov>] within brackets.

2. Separate disposal solutions for CHLW and DHLW (sites to be determined) [4], including deep borehole disposal (DBD) of DHLW. As shown on Figure 3, the existing amount of CHLW exceeds by far the amount of DHLW, and it is also stored at a much larger number of sites in the USA.
3. The “prompt” consent-based siting and development (S&D) of the new HLW-disposition (storage and disposal) strategy/policy recommended by the Blue Ribbon Commission on America’s Nuclear Future (BRC) in January 2012 [5]. Adopted and adapted in January 2013 by the then U.S. Secretary of Energy (the Secretary) [6], and, most recently, in the March 2015 proposed law referred to as the Nuclear Waste Administration Act of 2015 (NWAA) in U.S. Senate Bill S.854-IS [7] (sites to be determined).

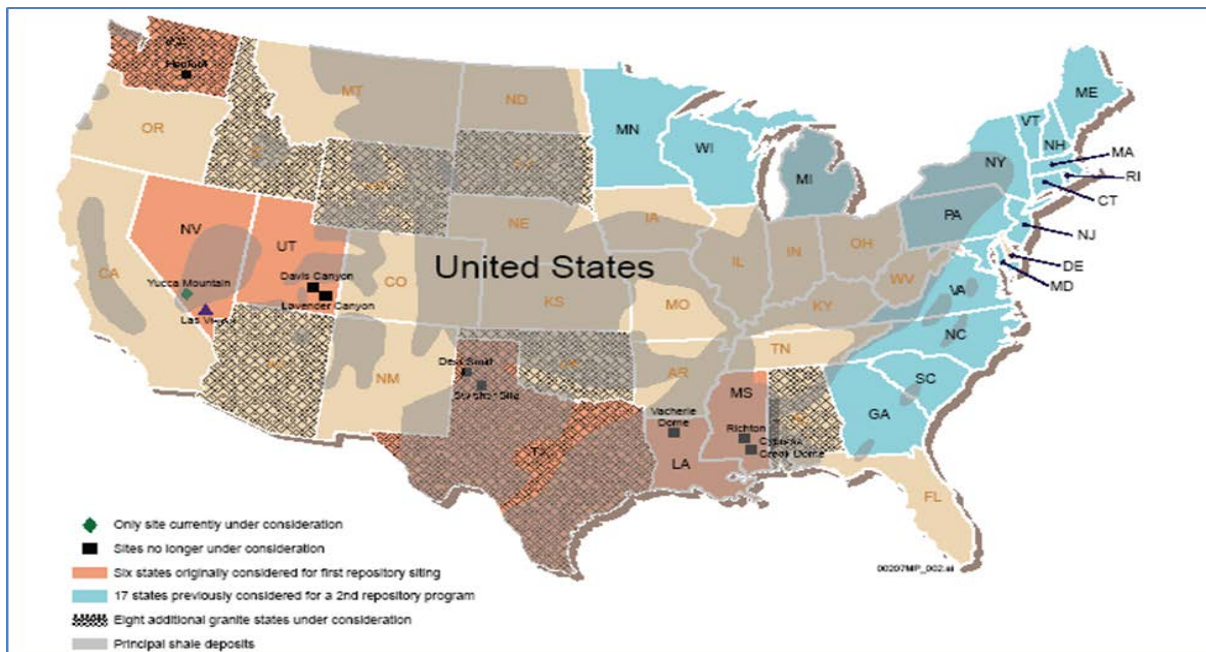


Fig. 1. U.S. states and rock types considered for HLW-disposal since 1982. (The candidate repository host rocks in - the six states shown in orange were basalt in WA, tuff in NV, and rock salt in UT, TX, LA and MS - the 17 states shown in blue were “granite”. **Shale deposits were not considered.**)

As described, discussed, and opined herein, S.854-IS does not account for several lessons learned in the USA and abroad during the past 30+ years that have proven to be imperative to timely and cost-effective S&D of HLW disposition facilities. This paper focuses on the organizational structure proposed in S.854-IS [7] (shown in TABLE I). It also highlights:

- Issues in S.854-IS [7] deemed to be missing or counterproductive to building trust and making timely and cost-effective progress in the future on the S&D, licensing, and opening HLW-disposal solutions in the USA; and
- Solutions that could mitigate or eliminate these issues, build trust, expedite progress, and reduce cost for future HLW-disposition facilities, including reducing the hefty penalties currently paid by federal-tax payers on behalf of the DOE since 1 February 1998 until it takes title to CHLW.

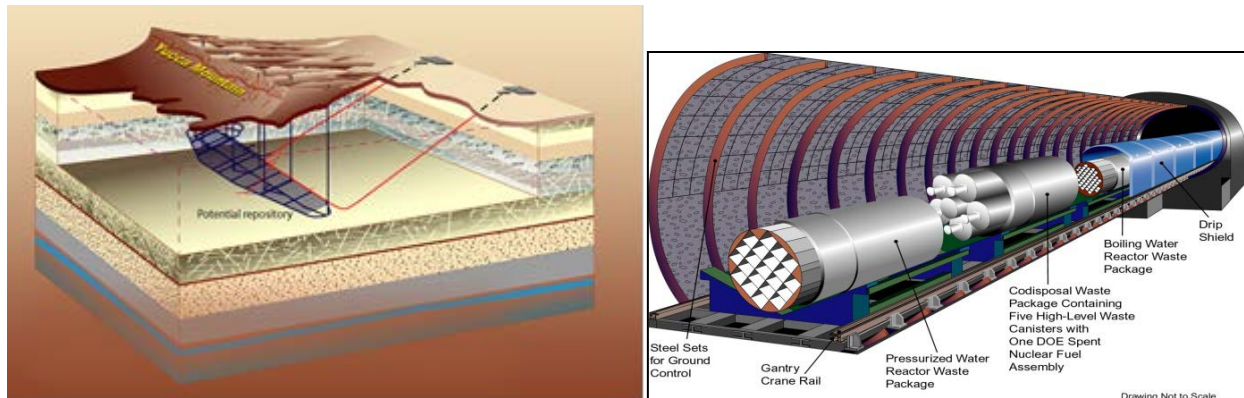


Fig. 2. Schematic illustrations of the layouts of (to the left) the Yucca Mountain HLW repository (in blue) and its existing, but since 2008 closed, access tunnels and underground research laboratory/niches (in red), and (to the right) the proposed disposal-room and HLW-emplacement configurations.

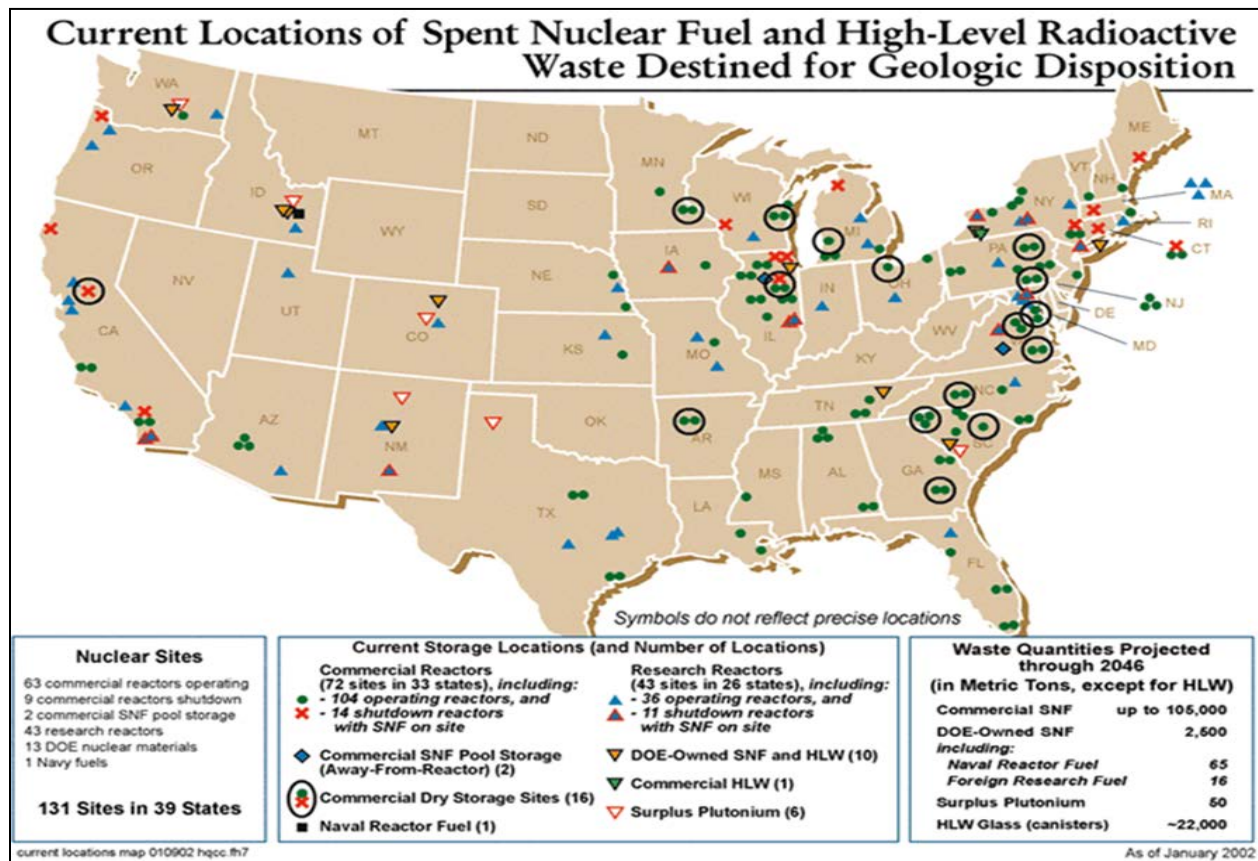


Fig. 3. Schematic illustration of storage locations in the USA for CHLW and DHLW destined for deep geological disposal in January 2002.

A supplementary WM2016 paper [8] elaborates on the application of the "consent-based" S&D process proposed in S.854-IS using the sites aborted under the Nuclear Waste Policy Act of 1982 (NWPA) between 1983 and 1987 recommended by the

then Secretary in December 2008 [9] as domestic examples. Both papers are based on the author's active involvement in and monitoring of, and reporting on nuclear S&D-related waste management, -storage and -disposal programs and activities in the USA and abroad since 1978 [e.g., 10-17] augmented by observations and recommendations by others [e.g., 1, 2, 4, 5, 9, 18-34]. They were prepared in the spirit of the following portions of the "A Gleam of Sunshine"* and "A Psalm of Life"*** poems by Henry Wadsworth Longfellow (1807-1882):

*"This is the place. Stand still, my steed, Let me review the scene,
And summon from the shadowy Past, The forms that once have been.
The Past and Present here unite, Beneath Time's flowing tide,
Like footprints hidden by a brook, But seen on either side."**

*"Lives of great men all remind us, We can make our lives sublime,
And departing, leave behind us, Footprints on the sands of time.
Footprints, that perhaps another, Sailing o'er life's solemn main,
A forlorn and shipwrecked brother, Seeing, shall take heart again.
Let us, then, be up and doing, With a heart for any fate,
Still achieving, still pursuing, Learn to labor and to wait."***

TABLE I. Independent Agencies in the Executive Branch and Related Positions and Terms of Service Proposed in S.854-IS [7].

Agency	Position	Selected and Appointed By	Term Limit
Nuclear Waste Administration (NWA)	Administrator	U.S. President and U.S. Senate	6 years ^a
	Deputy Administrator		6 years ^a
	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)	(TBD)	(TBD)
Nuclear Waste Oversight Board ^b (NWOB)	Member #1 ^c	U.S. President and U.S. Senate	1 year ^d
	Member #2 ^c		2 years ^d
	Member #3 ^c		3 years ^d
	Member #4 ^c		4 years ^d
	Member #5 ^c		5 years ^d
	Executive Secretary	The Oversight Board	No Limit
	Up to 10 Clerical staff	The Oversight Board	No Limit

^a "May serve more than 1 term."

^b "The U.S. President designates the Chair of the Nuclear Waste Oversight Board." (May also "... remove any member for "inefficiency, neglect of duty, or malfeasance in office".)

^c Not more than 3 members of the Nuclear Waste Oversight Board may be members of the same political party." ("3 members of the Oversight Board shall constitute a quorum for the purpose of doing business." [7])

^d "A member of the Oversight Board may be reappointed for an additional term by the President, by and with the advice and consent of the Senate."

DESCRIPTIONS AND DISCUSSIONS

Notwithstanding the aforementioned lofty intentions, portions of this paper are still biased, forward looking, speculative, and may go beyond the intended scope of S.854-IS. Following are some of the known author-biases embodied in this paper:

1. A scientific, engineering, or financial optimization for any given early stage of the back end of the nuclear fuel cycle needs to be considered in the context of the entire back end of the nuclear fuel cycle. The people involved in the related planning, decision-making, and oversight processes should thus: a) Possess relevant subject matter education and experience; and b) Be the same for as long as possible, to ensure relevant institutional knowledge is maintained and the disposal stage is not compromised or jeopardized by a preceding, "myopic" or "self-serving" decision.
2. The people and the entities directly affected by the proposed and candidate nuclear facilities should *"have a seat at the planning and decision-making table from the outset"* to ensure majority local support exists at all times.
3. The nuclear utilities are and will remain the pre-disposal custodians of the CHLW for at least another decade. The nuclear utilities should therefore also *"have a seat at the planning table from the outset"* to facilitate a real-time dialogue among all directly affected parties (DAPs) ensuring that all DAPs know in a timely manner what the intended disposal solution(s) is(are) and what it(they) can accept or need.
4. ***TRUST HAS TO BE EARNED. It does not come with the position or the organization, but DISTRUST does.*** But trust can also be lost due to lack of transparency and timely, fact-based, information. Hence, timely, factual, communication and transparency are keys to both building and maintaining trust, which, in turn, has and is expected to continue to govern acceptance and progress of any given HLW organization, entity, program, and activity.

Due to the unique evolution of and wide range of nuclear waste management and disposition issues faced by the USA's HLW-disposal program during the past 60 years, described and discussed below, in quasi-chronological order, are only events deemed by the author to have contributed to its dysfunctional status at the end of 2015 or that might affect its future. Trust, money, and time were the main selection criteria for the issues and events described and discussed herein.

In September 1957, in a report on land disposal of **liquid** HLW [18], the National Academy of Sciences-National Research Council made the following conclusions:

1. "Waste may be disposed of safely at many sites in the USA, but"
2. "Disposal in cavities in mined salt beds and salt domes is suggested as the possibility promising the most practical immediate solution of the problem."
3. "Disposal could be greatly simplified if the waste could be gotten into solid form of relatively insoluble character."

However, during the ensuing 25+ years, all attempts to S&D deep geological disposal solutions for liquid and solid HLW were unsuccessful, which precipitated the February 1983 NAWPA [1, Sec.111(a)(3)].

In January 1983, the USA enacted a new law, the NWPA, mandating the then Secretary to establish an implementing organization within the DOE, the Office of Civilian Radioactive Waste Management (OCRWM), and charter it to take title to the nation's CHLW and open the USA's first HLW repository no later than on 31 January 1998 and its second repository no more than three years later [1]. At that time, they were projected to be the first two HLW-repositories to open in the world by a margin of >10 years and the USA's HLW-disposal program was an international role model and benefitted from tremendous global prestige. The Secretary could also take title to a limited amount of CHLW (300-1,900 MT) by providing storage for it [1, e.g., Secs. 131, 135, 136, and 141], but was discouraged in 1989 [20] and has not pursued this option by the end of 2015. There was, however, a very strong commercial interest in facilitating CHLW storage at non-government sites that could allow the Secretary to take title to it by an amendment [34] to the NWPA [1].

In December 1987, the U.S. Congress and the U.S. President directed the then Secretary by an amendment (the NWPAA) [2] to the NWPA [1] to only evaluate the Yucca Mountain site in Nevada for the nation's first HLW repository. The 1987 NWPAA, widely referred to as "the screw Nevada act", created intense public and political opposition that was exacerbated in Nevada when Congress, at the advice by the DOE, overrode the Governor of Nevada's veto in 2002.

In the second half of 1990, it became clear to the nuclear utilities that the DOE would not be able to open a HLW repository or otherwise begin taking title to their CHLW before 1 February 1998. Accordingly, they filed successful lawsuits that *entitled them to "breach of contract" penalties" until the DOE began taking title to a given utility's CHLW.*

In December 2008, the then Secretary advised the U.S. President and the U.S. Congress that the USA's first HLW repository would open no earlier than 2017, but more likely 2020 [9], i.e., at least 19 years, but more likely 22 years later than that mandated by the NWPA [1]. He also reported the USA's stockpile of HLW destined for deep geological disposal would exceed the legal disposal capacity of the Yucca Mountain HLW repository in 2010 and recommended its legal capacity be increased. Alternatively, he recommended the S&D of another HLW repository based upon the 6 potential (all in salt) and 2 candidate (in basalt and in salt) sites shown on Figure 1 abandoned between 1985 and 1987. But, none of the aforementioned options had been graced with enabling legislation at the end of 2015.

In 2010, the Obama administration, through the then Secretary:

1. Stopped the development of the YM HLW repository.
2. Defunded and dissolved the DOE's implementing organization; the OCRWM.
3. Motioned the NRC for withdrawal of the June 2008 construction license application (CLA) for the Yucca Mountain HLW-repository [3], which prompted several law suits. (The NRC subsequently rejected the Secretary's motion.)
4. Chartered the BRC to recommend a new national strategy for the back end of the nuclear fuel cycle.

In January 2012, the BRC issued its final report [5]. It contained the following introductory statement (*emphasis added*):

We approached our task from different perspectives, but with a shared sense of urgency. 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 prospects for maintaining a potentially important energy supply option for the future, 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 expertise, but as a leader on global issues of nuclear safety, non-proliferation, and security.

The BRC also reported it had been directed to not comment upon the suitability or the future of the Yucca Mountain HLW repository/site. It then recommended a new national strategy for the back end of the nuclear fuel cycle based upon eight Key Elements (KEs) that included [5]:

- a. A new consent-based approach to siting future nuclear waste management facilities. (KE 1)
- b. A new organization dedicated solely to implementing the waste management program and empowered with the authority and resources to succeed. (KE 2)
- c. Prompt efforts to develop one or more geologic disposal facilities." (KE 4)
- d. Prompt efforts to develop one or more consolidated storage facilities." (KE 5)

In June 2012, the U.S. Court of Appeals for the District of Columbia Circuit (the A-Court) vacated the 2010 update of the Waste Confidence Decision (WCD), and the NRC stopped all related licensing and re-licensing of nuclear facilities shortly thereafter. The A-court referred to NRC's 2010 version of Finding 2 statement "... a permanent geologic repository would be available in the first quarter of the twenty-first century"³ with "when necessary", as "another in the growing line of cases involving the federal government's failure to establish a permanent repository for civilian nuclear waste." [31].

In January 2013, the then Secretary released a 14-page DOE strategy for how the new, "consent-based", HLW-disposal and -storage facilities recommended by the BRC would be pursued by the DOE [6]. It included unsubstantiated projections the USA's first consent-based, *consolidated*, HLW-storage facility would open "by 2023" and its first consent-based HLW-disposal facility would open "by 2048", i.e., 50 years later than that mandated in the then still applicable 1983 law [1].

In June 2013, S.1240-IS [30] was introduced in the U.S. Senate in an effort "to establish a new organization to manage nuclear waste, provide a consensual process for siting nuclear waste facilities, ensure adequate funding for managing nuclear waste, and for other purposes" in response to the January 2012 BRC recommendations [5] and the related strategy proposed by the then Secretary in January 2013 [6], but, it did not pass the democrat-controlled Senate.

³ Finding 2 in the 1984 WCD version stated "... a repository will be available by 2007-2009."

In August 2013, the A-Court ruled the U.S President and the NRC had violated the laws governing the Yucca Mountain HLW-repository program [1, 2] by stopping its development in 2010, and directed them to promptly continue developing it pending the enactment of a statutory basis for it to be aborted for other reasons than failure to comply with applicable regulations [32]. At the end of 2015, only the NRC had complied with this ruling, but it still lacked sufficient funds to complete the CLA-review process.

In November 2013, the A-Court ruled [33] the proposed 2013 strategy [6] was "... based on assumptions directly contrary to law", and "truly pie in the sky", and directed the then Secretary to ask the Congress to relieve the nuclear utilities from paying any nuclear-energy-generation-related fees into the Nuclear Waste Fund (NWF), which took effect in May 2014, "until such time as either the Secretary chooses to comply with the NWPA as it is currently written or until Congress enacts an alternative waste management plan."

At the end of 2014, according to the Nuclear Energy Institute (NEI) [https://en.wikipedia.org/wiki/Nuclear_Energy_Institute]:

- The stored CHLW amounted to 74,258 MT, which exceeded the legal disposal capacity of the Yucca Mountain HLW repository [1, 2] by 4,258 MT;
- The existing stockpile would continue to grow at an annual rate of 2,000-2,300 MT and the would exceed a total of 100,000 MT in 2028 unless the DOE began taking title to it before then; and
- The annual "breach-of-contract" penalties paid by the federal-tax payers on behalf of the U.S government since 1 February 1998 until the DOE begins taking title CHLW amounted to ~\$500 million in 2014. The gross total amount of these fees was estimated to exceed \$30 billion in 2028.

As shown on Figure 4, some nuclear utilities had already re-packaged CHLW in dry-storage-containers (DSCs). **At the end of 2009**, 13,856 MT of CHLW (~22%) were already stored in dry casks and there were more than 65 NRC-licensed sites with DSCs **in 2013**. The dimensions and weight of the DSC will govern its transportation and disposal option(s). The DSCs shown on Figure 4 are 1.7 m in diameter, 4.72-5.38 m high, and weigh 49.2 MT, but they may not be the biggest or the heaviest at the time a HLW repository opens.



Fig. 4. View of large vertical DSCs containing HLW.

In March 2015, S.1240-IS [30] was re-introduced in the then republican-controlled U.S. Senate as S.854-IS [7] by four U.S. Senators; three of whom had also introduced S.1240-IS. Pursuant to Sec.201 of S.854-IS [7], *“the purposes of the Nuclear Waste Management Administration (the Administration) are:*

- (1) to discharge the responsibility of the Federal Government to provide for the permanent disposal of nuclear waste;*
- (2) to protect the public health and safety and the environment in discharging the responsibility under paragraph (1); and*
- (3) to ensure that the costs of activities under paragraph (1) are born by the persons responsible for generating the nuclear waste.”*

To accomplish the aforementioned purposes, S.854-IS proposed the establishment of a Nuclear Waste Administration (NWMA) in the executive branch comprised by the Nuclear Waste Administrator (NWA) and the Nuclear Waste Oversight Board (NWOB). TABLE I summarizes their respective positions, how the individuals serving in these positions would be appointed, and their respective term limit, if any. Following are some envisioned issues and reasons why S.854-IS does not outline a promising path forward for timely and cost-effective S&D of consent-based HLW disposition facilities in the USA based upon the author’s related experiences:

- A. The proposed organizational structure would be much more susceptible to political influence and interferences than the OCRWM ever was due to having all of its upper manager being selected and approved by the U.S. President and the U.S. Senate, whereas the OCRWM only had its Director selected and approved in this fashion. As follows, the staff selection and appointment procedure, and term limits proposed in S.854-IS do not convey the message that either the NWA or the NWOB, would be “independent” in the context recommended by the BRC [5]. Instead, it conveys the message that they could facilitate “reciprocity staff-selection” based on services rendered in the past. A message reinforced by the well-above the government pay-scale salary levels made available to the Administrator and the Deputy Administrator and the many term-limits. Also, none of them would be held accountable or incentivized for performance, i.e., they would not have an apparent vested interest in progress. The credibility, acceptance, and performance of the upper managers in the NWA and the members of the NWOB could therefore be stigmatized by suspicion, distrust, and disrespect for them being beholden to their selectors, whether they are or not.
- B. S.854-IS transferred some, but not all, of the Secretary’s responsibilities defined in the NWPA [1] and the NWPAA [2] to the NWMA, leaving “jurisdictional” uncertainties that may fuel politically-motivated and/or self-serving turf battles between affected executive branch and federal government entities and their respective staff. A related multi-faceted issue of concern to this author is that it would add two “virtually-autonomous” executive branch entities to the USA’ already compartmentalized and fragmented nuclear waste management fabric [e.g., 13, 14, 19, 25]. Another issue is where the applicable subject matter (e.g., repository-sciences and –engineering, and public health and environmental protection) and regulatory and legal expertise would reside or come from, because the individual job descriptions for the positions described in

- S.854-IS are managerial, legal, and fiscal (please see issue D. below for additional "subject-matter" comments).
- C. Despite the A-Court's related rulings in 2012 [31] and 2013 [32, 33], S.854-IS neither acknowledges the existence of the YM HLW repository nor the potential impacts of its existence. As follows, the Yucca Mountain HLW repository would not be a viable S.854-IS option at the end of 2015. However, with time it could become a "consent-based" option if the current political opposition at the state level in Nevada changes, because its host community, i.e., Nye County, already supports it. But, of course, the Nye County's support can also change with time.
- D. S.854 -IS limits the NWA to *"no more than 3 Assistant Administrators"* who *"shall be considered career appointees"*, but it does not require any of them to possess the subject matter education or experience referred to in issue B above, which, in turn, would be imperative *"to protect the public health and safety and the environment"* referred to above in purpose (2) for the NWA above, and, e.g., in Section 306, to ensure that the S&D program timely includes and pursues key elements and programs and promptly rejects or modifies or cancels elements and programs not contributing to the successful licensing of the pursued HLW-disposition facilities, where licensing is implied to also cover public health and safety and the environment.
- E. Based upon the historical record, it is unclear to the author how any new organizational structure would be able *"to ensure that the costs of activities under paragraph (1) are born by the persons responsible for generating the nuclear waste."* Case in point, all federal-tax payers, whether they benefit from nuclear energy or not, have paid the breach of contract penalties due to the Secretary's failure since 1 February 1998 to comply with the "Standard Contracts" it signed with the nuclear utilities pursuant to the 1983 NWPA [1].
- F. S.854-IS did not define the qualitative terms *"consensual"* or *"consent"* quantitatively, which was not a BRC recommendation, but still is bound to result in prolonged negotiations and lawsuits due to the inherent, subjective, "the beauty is in the eyes of the beholder", nature of qualitative terms and the prevailing opposition to anything nuclear-related, regardless of its respective merit or need. As follows, in order to save time and cost, and, perhaps even more so, based on the historical record for the HLW-repository sites considered in the USA under the NWPA, ***the pending law should define: a) The minimum percentage of eligible support and rejection votes required for "consent"; and b) Who the eligible voters are.***
- G. Two related key issues are: a) The proposed planning and decision-making authority for the "consensual siting process", which is virtually-exclusively vested in the Administrator; and b) ***S.854-IS*** [7, Sec. 103.(2)] ***defines the term "Administrator" differently and incompatibly with the definition of this term in the NWPA*** [1, Sec. 2.(1)]. Conceivably, the NWPA definition will take precedence. Issue b) is only one of several examples on disconnects between S.854-IS and the NWA/NWPAA that need additional attention.
- H. S.854-IS fails to accommodate the author's understanding of BRC's intent of KE 2, which is defined in the text portion of its report as follows(emphasis added) : *"Move the Secretary's related responsibilities "to a new, independent, government-chartered corporation ..."* [5, e.g., page viii]. The term "independent" in the context of the current text of S.854-IS could easily be

inferred to mean “independent” of the will of the DAPs. As follows, one of the most important and challenging issues to reconsider and reconcile in S.854-IS is how the therein proposed politically-nominated and -beholden staffing protocol of the NWA and the NWOB shown in TABLE I, would allow any of these entities to be perceived as “independent” by the facility hosts and other DAPs. As mentioned herein, the respective rate of timely and cost-effective progress achieved by the implementing organizations in the USA and abroad during the past 20+ years was governed by how competent, transparent, and trustworthy the facility-hosts and other DAPs, including federal and state regulators, considered the implementing organization to be, and the pedigree/maturity of the proposed disposal concept. One way to enhance the independence of these entities would therefore be to drastically reduce the number of politically-appointed members on them and instead populate them with individuals possessing the relevant expertise and representatives selected by the host-entities and the nuclear utilities.

In September 2015, 14 U.S. House of Representatives introduced a bill, H.R. 3643, referred to as “the Interim Consolidated Storage Act of 2015” to a Congressional Committee for consideration. If accepted and enacted as proposed, it would amend the NWA [1] to: a) Authorize the sitting Secretary to enter into contracts for storage of certain HLW; b) Take title to the aforementioned HLW; and c) Make certain expenditures from the NWA. Regardless of the outcome of H.R. 3643, it shows that the NWPA can be amended to expedite the transfer of CHLW to the Secretary in the presence of adequate political will [25].

As of October 2015, the USA and 69 other “States” had signed the International Atomic Energy Agency’s (IAEA’s) [<https://www.iaea.org>] 1997 “*Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*” (Joint Convention) [23] affirming that the ultimate responsibility for ensuring the related safety ultimately, rests with the “State”. One related significant benefit is that organizational structures, procedures and processes employed in the 70 signatory nations, and their respective related effectiveness, are continually available to the both signatories of the Joint Convention and the IAEA to learn from and then take advantage of; an approach embraced and promoted in this paper.

Sample cases in point, at the end of 2015, Finland [<http://www.posiva.fi>], France [<http://www.andra.fr>], and Sweden [<http://www.skb.se>] hosted the world’s most advanced HLW-repository programs. Their HLW-repositories were scheduled to open in 2023, 2025, and 2027, respectively. Three key reasons Finland and Sweden are among the current three global front-runners to open a HLW repository are:

- A. They both have long-standing, fully-integrated, nuclear waste management programs that are successfully managed and funded by the nuclear utilities [13, 14, 29]. Put simply, the nationally-elected representatives do not control the staffing or the day-to-day operation of the implementing organizations or the regulators. But, consistent with the Joint Convention [23], they do approve both the proposed and final disposition solutions [14, 23]. They also set the related fee that needs to be set aside by the nuclear utilities to ensure that adequate funds exist for the safe and secure disposition of their respective HLW. The

Swedish Radiation Safety Authority (SSM) recommends this fee [<http://www.stralsakerhetsmyndigheten.se>].

- B. Both programs continue to work closely, albeit in different ways [29], with their respective prospective and candidate HLW-repository host communities.
- C. Finland adopted lessons learned in the then more advanced Swedish HLW-repository program more than 25 years ago and then promptly adapted them to domestic conditions. It also continued to collaborate with Sweden.

However, both the Finnish and Swedish HLW-disposal programs have experienced delays and cost-increases, and will continue to face both socio-political and scientific/technical challenges, as have and will all national programs chartered to S&D disposal solutions for long-lived radioactive waste. The related global historical record dating back to 1955 [e.g., 5, 11-29] shows beyond any reasonable doubt to the author that four ***long-standing imperatives*** for progressive and sustainable S&D processes for HLW-disposition facilities are:

1. The extent of which host entities and other DAPs TRUST the implementing organization, the regulator(s), and/or other "interested-party" sources.
2. The pedigree and perceived robustness of the proposed disposal concept.
3. The proposed disposal solution, i.e., public health and environmental radiation protection, is governed by stringent, nationally-uniform, licensing regulations promulgated and continually overseen for compliance by at least one independent, competent, regulator.
4. The DAPs in the host entities have a timely involvement and definitive say in the S&D process, and the candidate host entities also have a definitive say in the licensing process, including a politically-irrevocable veto right up until a given point, e.g., one year, after the license to receive HLW has been approved by the NRC, and adequate funding to retain its/their own subject-matter experts.

At the end of 2015, the USA's HLW-repository program had been on hold since 2010 and it will remain on hold until such time enabling legislation had been enacted for one or both of the following paths forward:

- i. The Yucca Mountain HLW repository; and
- ii. The new, consent-based, HLW-disposition facilities proposed in S.815-IS that mirrors the strategy proposed by the Secretary in January 2013.

Furthermore, the projected opening of the USA's first and only candidate HLW repository since 1987 at the Yucca Mountain site [1, 2] was 17 years overdue and on hold since 2010 pending enabling legislation and the resolution of a large number of unresolved contentions and likely lawsuits. In the event it survives current and future challenges, and both the currently-missing, enabling legislation and a competent implementing organization are in place, based upon the most-recent, related, past prediction in December 2008 [9], it would open no earlier than 9 years later, but more likely 12 years later. In the event it does not survive, based upon the most-recent, related, past prediction in January 2013 [6], another HLW repository would open 35 years later. In both cases, the USA's continually-growing stockpiles of CHLW and DHLW (Figure 3) will have to be safely and securely stored and the federal-tax payers will have to continue to pay damage fees on behalf of

the government/DOE to the nuclear utilities until it takes title to the CHLW. As mentioned in the preceding text, the NWPA [1] allowed the DOE to take title to up to 1,900 MT of CHLW in a "Monitored Retrievable Storage" (MRS) facility, but decided against it. Conceivably, this option, including an increase in the amount to be stored, could be expeditiously accomplished by an amendment to the NWPA.

For these and other reasons very compelling and conclusive to the author, the organizational structure, staffing protocol, and term limits outlined in S.854-IS do not meet the aforementioned imperatives. The one-year term limit for one of the NWOP members (TABLE I) appears particularly unrealistic in light of the durations of the nominating and approval periods for several past Directors of the OCRWM. However, as opined herein, all term limits are counterproductive to retain both qualified professionals and institutional knowledge, and should be voided with one possible exception to ensure "State" involvement [23]; the "Administrator's".

No other nation has hitherto experienced delays of the duration (>29 years) or pushed the related hefty financial burden (projected to exceed \$30 billion in 2028) resulting from the government's inability to comply with the law since 1 February 1998 on to the federal-tax payers without trying to amend the law or holding any party accountable. In addition, the nuclear utilities were relieved in 2013 from paying into the NWF until the Secretary had a viable plan/program for the safe disposal of the CHLW [33]. As follows, there is no apparent, near-term, financial incentive for the nuclear utilities to support an expeditious transfer of the title of the CHLW to the government. Furthermore, it could lead to increases in the size and weight of the DSCs due to related storage cost benefits, requiring subsequent opening of DSCs and repackaging the HLW with the associated incremental health and environmental radiation risks, in smaller containers/canisters due to transportation or disposal constraints.

As described, discussed, and opined herein, put simply, the organizational structure proposed in S.854-IS (see TABLE I) would further compartmentalize and fragment the existing "dysfunctional" HLW-management fabric in the USA, rather than integrating it into a cohesive, holistic, fabric. Particularly concerning to the author is the "consent-based" process outlined in S.854-IS, because it could marginalize the facility hosts and other DAPs even more than the current contentious process outlined 33 years ago in the NWPA [1], as amended in 1987 [2]. An integral component of this concern is the qualitative term "consent-based" introduced by the BRC in 2012 [5], because it still remains to be defined quantitatively or in another measurable form [16, 17] at the end of 2015 [6, 7]. Based on the historical record and its strong inherent litigious component in the USA, unless this term is defined quantitatively in a future law, it could, and likely would, feed a free-for-all debate that would seriously delay and, possibly, even jeopardize the S&D of future HLW-disposition facilities.

Another perceived, long-standing root cause to the lack of timely progress on the S&D of CHLW-disposal solutions in the USA is the lack of accountability and incentives for the "implementer" to make timely and cost-effective progress. Put simply, no "implementer" has been held accountable to date for overspending a given budget or grossly missing milestones. S.854-IS extends this "immunity".

The only parties with long-standing financial interest in progress are the nuclear-utility-rate- and federal tax-payers, and the nuclear utilities. Similar to past laws, the nuclear utilities would remain persona non grata in the S&D of future centralized CHLW-storage and –disposal facilities. This is counterproductive, because they have both the financial interest and the extensive, requisite, CHLW-storage expertise required to get it done in a timely and cost-effective manner, which, in turn, brings up another S.854-IS issue; the roles and responsibilities of the up to three Assistant Administrators (see TABLE I).

In addition to the S&D of centralized CHLW-disposition facilities, the scope of work the NWMA will have to deal with also includes their design, construction, and operation. But, the job descriptions for the Administrator and the Deputy Administrator of the NWA and the five members of the NWOB do not even require any nuclear or radiation-related scientific or engineering HLW-management and disposition education or experience. Consequently, unless the Assistant Administrators possess the requisite subject-matter education and experience among them, it could result in behind-the-scene control by the main contractors. Again figuratively speaking, flocks of hungry foxes would be guarding the hen houses if the NWA does not have relevant, resident (in-house), subject matter expertise. It could also result in decisions being made early in the S&D process requiring time-consuming and/or costly modifications at a later stage.

Another critical performance factor for the NWA and the NWOB is the access to funds over a longer budget period than one year. A five-year budget period being reviewed and adjusted as needed every third year would force long-term forward planning and accommodate interim adjustments. It could also be a job-stability factor incentivizing competent professionals to join the NWA. But, regardless of the qualifications and ambitions of the prospective members of the NWA and the NWOB, and their ease of access to money, progress cannot be accomplished in a projectable or controlled fashion unless the term “consent-based” is defined quantitatively so it that can be used as an unambiguous yardstick, which it is not in S.854-IS. This can be done in several ways in the pending law [e.g., 11, 12, 15, 16, 19, 20, 23, 27, 28], but regardless of how it is defined, a future law *should require that acceptance as well as rejection, whichever the case may be, are based upon the majority opinion of the facility hosts and other DAPs before taking effect.*

SUMMARY OF MAIN CONCLUSIONS AND RECOMMENDATIONS

S.854-IS purportedly commits to a consent-based S&D process of new HLW disposition facilities, but it neither defines the term “consent-based”, nor a transparent S&D process for how potential and candidate facility-hots will interact in a timely and meaningful manner with the proposed executive agencies. Instead, it virtually excludes the facility hosts and other DAPs from timely participation and definitive say in the S&D process at any time. Based upon the historical record for similar activities in the USA during the past 30+ years, S.854-IS needs to be clarified, revised, or replaced. Otherwise, the resulting law will very likely serve as another broadly-contested, time-consuming, and costly, Ferris-wheel-like, pathway into another quagmire for a new HLW repository S&D process that, ultimately, may fail for one or more of the reasons highlighted in this paper. Other key conditions

and conclusions supporting the recommendation that S.854-IS needs to be clarified, revised, or replaced are:

1. The legal status of the Yucca Mountain HLW-repository will have significant spatial and temporal impacts on future needs for disposal solutions. Siting a potential new HLW-repository before the legal status of the Yucca Mountain HLW repository is definitive would therefore be premature.
2. The organizational structure proposed in S.854-IS further compartmentalizes and fragments the management and disposition of the nation's HLW. It would also be vulnerable to instant distrust and rejection by the DAPs due to the inherent "reciprocity" embodied in the staff selection process, the related term limits, and the well-above federal pay grades made available to the Administrator and the Deputy Administrator.
3. At the end of 2015 the most acute current and future public health and national/homeland security issue in the USA is CHLW storage for which there are viable legal paths forward. HLW-storage has been safely done for more than 70 years in the USA and the related legal and regulatory frameworks are already in place. The opening of a sizeable, expandable, "centralized", CHLW-storage facility on government-owned and -operated land withdrawn from public use, is deemed by the author to offer the most promising, expeditious, solution for reducing and minimizing public-health and national/homeland security risks, and the burden on federal-tax payers for having to bail out the DOE until it takes title to CHLW.

In summation, the near-term focus should be on Conclusion 3 and the development and enactment of a law for consent-based HLW-disposal, should be deferred until such time the statutory future of the Yucca Mountain site has been finalized by law.

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