LESSONS LEARNED FROM THE U.S. NATIONAL STRATEGY – A PERSONAL PERSPECTIVE

P. B. LYONS
Retired: U.S. Department of Energy Assistant Secretary for Nuclear Energy, and
Commissioner of the U.S. Nuclear Regulatory Commission.
Golden, Colorado, USA
Email: peterlyons4@gmail.com

Abstract

Thirty years of watching attempts at implementation of a U.S. national strategy for high level waste management embodied in the Nuclear Waste Policy Act and its Amendments (of 1982 and 1987) from many vantage points have led to strong personal views on what has gone wrong with U.S. strategies. Instead of a repository open in 1998, the U.S. is still probably at least two decades away from opening a repository. My vantage points include management of the Los Alamos National Laboratory research programs for Yucca Mountain, years on the staff of the U.S. Senate, Commissioner of the Nuclear Regulatory Commission, and Assistant Secretary responsible for implementation of these strategies. In the talk, the stark differences between the path followed so far by the U.S. and the path recommended by the U.S. President's Blue Ribbon Commission on America's Nuclear Future will be discussed.

1. INTRODUCTION

Throughout this paper, contrasts will be drawn between two different radioactive waste geologic repository projects in the U.S. - the ongoing efforts to open Yucca Mountain (YM) and the accomplishments of the Waste Isolation Pilot Plant (WIPP). Since this paper is a personal perspective, a bit of my own history with both projects is needed, followed by very brief histories of each project.

I worked at the Los Alamos National Laboratory in New Mexico from 1969 to 2003. I was initially involved in diagnostics for underground nuclear tests, which required frequent visits to the Nevada Test Site, adjacent to YM. Later, the work at Los Alamos National Laboratory supporting R&D on YM reported through me, and I visited excavations near YM for studies on the geology and water percolation in that volcanic tuff media. And, during much of my time in New Mexico, WIPP was a major topic of discussion.

In 1997, I joined the staff of U.S. Senator Pete Domenici from New Mexico and served as Science Advisor to both him and the U.S. Senate Energy and Natural Resources Committee for eight years. WIPP and YM were significant parts of my legislative responsibilities. The Senator was responsible for the budgets of the Department of Energy (Department), and he and I traveled several times to both WIPP and YM. On visits to YM, I was struck by the amount of water in the underground environment, certainly not what I would have expected from that arid desert location. And in contrast to YM, I was impressed by the extremely dry conditions underground at WIPP.

During my tenure as Commissioner of the Nuclear Regulatory Commission (NRC) from 2005-2009, the application for YM was filed. When I was Assistant Secretary for Nuclear Energy from 2010 to 2015, I was responsible for all U.S. commercial waste management activities. The "Blue Ribbon Commission on America's Nuclear Future" [1] reported to the Department in 2012 and I directed preparation of the Administration's response, the "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," completed in 2103 [2].

2. EARLY HISTORY OF U.S. RADIOACTIVE WASTE MANAGEMENT

Extensive detail on this early history and on YM is available in the book, "The Road to Yucca Mountain," by J. Samuel Walker, former historian of the U.S. NRC. [3] Information and quotations in Sections 2 and 4 of this paper are taken from that reference.

In April 1948, J. Robert Oppenheimer, Chairman of the Atomic Energy Commission's (AEC) General Advisory Committee, dismissed the nuclear waste problem as "unimportant." But by 1955, Nobel Laureate Glenn Seaborg, who was later Chairman of the AEC, stated that "Probably the most difficult problem, which may well be the limiting factor in determining the extent to which nuclear energy will be used for industrial power, is that of disposal of the tremendous quantity of radioactive material." The U.S. National Academy of Sciences developed a report in April 1957 that stated, "radioactive waste can be disposed of in a variety of ways and at a large number of sites in the United States" and the "most promising approach for permanent disposal is to place it in salt formations." Following the guidance of the National Academy of Sciences, in 1963 the AEC directed the Oak Ridge National Laboratory (Oak Ridge) to study the suitability of an abandoned salt mine near Lyons, Kansas, called Project Salt Vault.

Large quantities of radioactive waste from the plutonium handling facility at the Rocky Flats Plant in Colorado, a part of the U.S. national defense complex, were transported annually to the Idaho National Reactor Test Station in the 1960s, but a serious fire at Rocky Flats in May 1969 focused attention on these shipments and raised environmental concerns in Idaho. To satisfy U.S. Senator Frank Church from Idaho, the AEC agreed that they would seek Congressional authorization to establish a repository for permanent disposal. With "encouraging results" reported by Oak Ridge, the AEC assured Senator Church that Idaho's wastes would be transferred to a repository that would open within a decade. However, significant concerns among the Kansas public were sparked by AEC staff comments that a decision to use the Lyons site had already been made, and the AEC purchase of land around Lyons, while seeking authorization for the entire project, further raised public fears. The project should have died quickly when the president of a nearby salt mine noted in 1971 that his shaft could channel water into Project Salt Vault and that, at a nearby injection well, about 170,000 gallons of water had mysteriously disappeared underground. The Kansas State Geologist noted that "the Lyons site is a bit like … Swiss cheese." Nevertheless, although prospects for the Lyons site were very dim by 1972, it wasn't until 1974 that the AEC Chairman officially confirmed that repository operations in Kansas were terminated.

3. THE WASTE ISOLATION PILOT PLANT

WIPP history is discussed in the book "Nuclear Reactions" by Chuck McCutcheon [4] and the brief history presented below is extracted from it.

Following the demise of Project Salt Vault, the State Senator for the Carlsbad, New Mexico region worked with local leaders to propose that the AEC study their salt beds for waste disposal. From the start, they worked with the New Mexico Congressional delegation in Washington and with the Governor of New Mexico. The local newspaper in Carlsbad was involved and maintained an open-minded editorial position. The local supporters of the project in Carlsbad studied the waste disposal plans and potential hazards and were available to discuss technical issues. The Governor's support was evident in a March 1973 message that, "As a general conclusion, I think [we] can operate under the principle that the State of New Mexico is one of the most logical locations for the national repository." An Oak Ridge report in 1972 agreed that the New Mexico part of the Permian Basin salt deposits "appears to be most promising." The initial target date for opening WIPP was 1980.

Despite the early support for WIPP, the path forward was anything but simple. Significant opposition was initially led by the Southwest Research and Information Center whose founder had a broad mistrust of nuclear power. He stated in later years that "it dawned on us that if we could make waste disposal the focus of attention, that so long as we could keep waste out of the ground, it could keep nuclear power from opening." Other groups later formed and provided further opposition to the project.

The Department aggravated concerns with repeated and confusing statements about the purpose of WIPP. Although the Department's plans were for disposal of transuranic defense waste from their national security laboratories and production sites, the Project Manager stated in 1977 that "consideration would obviously be given to making it a commercial [high-level] site." Such confusion led even supporters, such as Senator Domenici, to label disposition of commercial waste in WIPP as "inappropriate and premature." Nevertheless, in December 1978, the Secretary of Energy proposed that WIPP be for purely commercial wastes. That led to a standoff with the House Armed Services Committee, which wanted the focus to stay with transuranic defense wastes. In 1979, the Department returned the WIPP site to its original mission for disposition of only transuranic defense wastes.

Development of an appropriate oversight role for New Mexico figured prominently in the history of WIPP. In 1978, the Environmental Evaluation Group (EEG) was formed in New Mexico to provide technical advice to the citizenry. The EEG was funded by a cooperative agreement with the Department, but it was a part of the New Mexico Health and Environment Department. The EEG was instrumental in dealing with WIPP's technical issues. In later years, starting in 1991, the Department funded New Mexico State University to operate the Carlsbad Environmental Monitoring & Research Center or CEMRC. CEMRC has provided independent monitoring of a wide range of environmental samples associated with WIPP. Their data, available to the public, have helped to address issues and concerns within New Mexico.

In 1979, the Chairman of the House Armed Services Committee proposed legislation for WIPP with no State participation; Senator Domenici strongly objected. They then agreed on a role for New Mexico of "consultation and cooperation." However, in 1980, the Department announced that they were moving ahead with construction to be done by 1983 - with no State involvement. The Project Manager even stated, "We don't need anything else from the State, legally or officially." An unhappy New Mexico Governor filed suit in 1981. Meetings between the Secretary of Energy and the Governor of New Mexico led to another agreement, again using the phrase "consultation and cooperation" for the State role. By then, the opening date for WIPP was listed as the end of the 1980s.

In fact, many "opening dates" were set by the Department only to be later abandoned, but they caused continued concerns in New Mexico that WIPP might open before regulatory approvals were in place. Subsequent suits were also filed, with one in 1991 based on the "obsession by the Department to get the first bins emplaced." The continued delays in opening WIPP were also of great concern in other states. For example, the Idaho Governor in 1988 imposed a temporary ban on shipments of defense waste into Idaho.

So-called "land withdrawal legislation" was required to permanently reserve the land solely for WIPP functions before certifications and waste shipments could proceed. This legislation was delayed for many years, it passed in 1992. That important legislation determined the Environmental Protection Agency (EPA) as the regulator of WIPP, barred high level waste, and provided funding for highway improvements in New Mexico. The National Academy of Sciences endorsed the safety of WIPP in October 1996, and the certification application was filed with the EPA that year. The EPA certified WIPP in May 1998, and the first waste shipment arrived in March 1999.

The performance of WIPP has not been free of issues but, except for an accident in February 2014, it has generally operated successfully. [5] That accident, which fortunately had no health consequences, was caused by improper packaging of waste at the Los Alamos National Laboratory, which led to rupture of one drum and dispersal of radioactive material in part of WIPP and in the ventilation system. The accident caused a three-year delay for cleanup and installation of a new ventilation system and cost about $500 million. WIPP reopened in January 2017. [6] By January 2019, over 12,000 shipments had been made to WIPP and were emplaced in the salt [7].

4. YUCCA MOUNTAIN

While the growth of nuclear power in the U.S. pointed to significant issues with future waste, the early efforts to deal with that waste were complicated by shifts in government policy with regard to reprocessing. In the 1970s, the AEC focused on development of reprocessing to expedite both surface storage and geologic disposal. Proliferation concerns with reprocessing, however, led President Ford in 1976 to state that "I have concluded that the reprocessing and recycling of plutonium should not proceed unless there is sound reason to conclude that the

world community can effectively overcome the associated risks of proliferation." In 1977, President Carter stated that, "we will defer indefinitely the commercial reprocessing and recycling of the plutonium produced in the U.S. nuclear power operations." In 1981, President Reagan terminated Carter's deferral.

In 1978, a Department of Energy task force estimated that a target date for opening a repository would be between 1988 to 1993. These dates greatly concerned Senator Church who was still waiting for waste to leave Idaho after progress was promised to him in 1969. To address this debate, President Carter formed an Interagency Review Group (Review Group) on Nuclear Waste Management. This Review Group made several important contributions, including citing the importance of a "waste form" that would "inhibit the release of radionuclides into .. water" and viewing the packaging of the waste as a way of compensating for "geologic uncertainties." The Review Group also stated that federal agencies should "interface directly and extensively with all interested and affected parties." (Those words, similar in scope to the later concept of "consent-based siting," were then subsequently ignored.)

In 1982, the Nuclear Waste Policy Act became law, requiring the Department to study at least five sites and recommend three of them to the President by 1985. The President was then to designate one site and inform Congress by 1987. Capacity of the first repository was limited to 70,000 metric tons. A second repository site was to be recommended by 1990. A surcharge on nuclear power (1 mill ($0.001) per kwh) was to be paid by generators into the Nuclear Waste Fund to finance disposal. The Department was to take possession of used fuel by 1998. While a state governor could veto a repository chosen in his/her state, action by both Houses of Congress would override the state. Three sites were selected by the Department in 1986 in Texas, Nevada and Washington. The Department also suspended its search for a second site because its need "was not pressing."

Public concerns in the three designated areas ensued. This led to the 1987 Amendments to the Nuclear Waste Policy Act (1987 Amendments), which designated YM as the sole site for the Department's geologic characterization activities. U.S. Senator Harry Reid of Nevada (who only began his Senate tenure in 1987) promptly labeled this the "Screw Nevada Bill." The 1987 Amendments provided no path forward if YM was not successfully licensed, which supported the view that the decision to use YM was independent of technical justification. The 1987 Amendments also established the Nuclear Waste Technical Review Board to provide technical advice to Congress and the Administration; but their role is different from the EEG established for WIPP that advised the government and citizens of New Mexico.

The 1987 Amendments precipitated over 30 years of adamant opposition in Nevada. Las Vegas newspapers were strongly opposed because of YM's "proximity" to their town (about 90 miles away). Many articles claimed that transportation of high-level waste in the vicinity of Las Vegas and the potential for serious accidents would destroy the gambling industry. A "Report to the Nevada Governor and Legislature" in 2000 [8] concluded that "Yucca Mountain is a "bad deal for Nevada" and that YM "represents a significant gamble for Nevada's future economy and socioeconomic well-being." The Congressional delegation and State government of Nevada consistently opposed YM and raised many objections. Many "risk analyses" have been published related to YM and its impact on Nevada. [9,10] And, as the characterization of YM proceeded, it was evident that its geology was much more complex than initially thought and that the underground environment was not as dry as expected. [11]

In February 2002, the Secretary of Energy recommended YM to the President. When the Nevada Governor vetoed this selection, his veto was overridden by Congress. At that time, the target opening date was 2010. In 2008, the Department submitted their YM application to the NRC and now estimated an opening date in 2020. Included in the application, in recognition of the less-than-dry conditions, was the Department's plan to place titanium drip shields over each cask of used fuel. Furthermore, these drip shields were to be put into place only at the closure of YM, about 100 years after opening, which would certainly present an interesting technical challenge. (I was an NRC Commissioner at this time, and I was rather surprised to learn that a site chosen for its excellent geological conditions would require such an extreme system of engineered barriers.) Funding for YM was stopped by President Obama in 2010, largely based on continuing opposition in Nevada [12], and it has not resumed.

The NRC, of course, analyzed the repository exactly as the Department specified, i.e., with the drip shields. In 2015, the NRC issued their Safety Evaluation Report that found the Department's application generally satisfactory. The NRC staff noted that the NRC should not authorize construction until all land and water rights

were in place. Issuance of the license also required successful adjudication of about 300 contentions [12,13], i.e. issues raised by a concerned individual or group. Many of these contentions were filed by the State of Nevada.

With opposition in Nevada, it is difficult to imagine that the needed State permits will ever be granted. For example, work on YM has used water transported to the site because Nevada has never issued a water permit. Construction of the planned train route will also require many State permits. Legislation has been proposed that would remove Nevada's control over such permits, but it has not advanced beyond the House of Representatives. [12]

Technical concerns with YM have been presented, which were evaluated by the NRC, including nearby seismic and volcanic activity. Perhaps the major concern involves the position of the disposal area far above the water table in a strongly oxidizing environment. [14] In such an environment, both used fuel and canister materials may not be stable in the presence of water. Some YM critics note that the U.S. is the only country considering a repository in an oxidizing environment. [14] These issues may be re-visited whenever adjudication of the contentions proceeds.

5. PERSONAL PERSPECTIVES ON A SUCCESSFUL SITE SELECTION PROCESS

A comparison of the success of WIPP with the ongoing quest for YM provides a wealth of contrasts that form the basis for my personal perspectives

5.1 Involvement of affected stakeholders with public acceptance of the repository site

At WIPP, it was local citizens acting with the government of New Mexico that proposed the AEC study of defense waste disposal at Carlsbad. Thus, the initial acceptability of WIPP within New Mexico was well developed and key stakeholders were consulted, involved and supportive.

But for YM, the 1987 Amendments simply mandated its selection with no state consultation or agreement. The 1987 Amendments supported a view that YM was chosen independent of technical feasibility and strictly by politics. The State of Nevada and its Congressional delegation have consistently fought YM ever since. (The three Nevada counties closest to YM have supported the project. However, their total population is below 2% of the State, while Clark County with the city of Las Vegas represents 73% of Nevada's population.)

While many issues have plagued the YM project, none rises to the extremes of this one. Based on my experience, consent-based siting is the only viable approach for successful completion of a repository project. Of course, an important issue for such siting is exactly whose consent is needed and what form that consent should take, and that will vary with different projects and stakeholders. But at least some significant majority of those affected by a repository choice should be supportive!

A strong lesson for the U.S. can be found in the international community. Finland, France and Sweden are moving ahead very effectively with their repository projects, each based on a consent-based process. [15] And as the "Reset of America's Nuclear Waste Management: Strategy and Policy" [16] report notes, countries like Canada, Japan and the United Kingdom that are re-evaluating their own strategies for identifying a national repository are using some variation of a consent-based process.

5.2 A management organization focused on project completion that is free from political pressures.

My eighteen years in Washington taught me some of the challenges of maintaining strong federal support for a complex, decades-long, project. The U.S. political system provides opportunities for many changes in federal policy and priorities over such a long time.

Admittedly, a counter argument is that WIPP has been quite well supported despite the challenge of existing as a federal program. But WIPP grew out of strong concerns in several states with accumulation of defense wastes. Those concerns translated into several legally binding agreements between states and the federal government, with large penalty clauses for failure to move defense waste by specific dates. This provided the Department with strong fiscal motivation for achieving success at WIPP. (Not all defense nuclear waste can be accepted by WIPP, only that qualifying as transuranic and meeting strict acceptance criteria.) It was important that

WIPP began with support from the New Mexico Congressional delegation, which has typically included members of both political parties, as their support has been instrumental at several key points in the history of WIPP.

But for YM, the 1987 Amendments required the federal government to create the repository and take title to the fuel by 1998, but there were no legislated financial penalties if they failed. Furthermore, once the utilities paid their fee into the Nuclear Waste Fund, their financial responsibility for the used fuel was completed - the rest of the process was up to the government. The utilities were certainly concerned when the Department failed to take title and move the used fuel by 1998, but they were then successful in suing the Department for their costs of managing used fuel at each reactor site. Thus, the utilities are not financially penalized for the absence of YM. Furthermore, while significant funds ($6.9 B through Fiscal Year 2017 [17]) have been paid to the utilities in recovering their costs, those funds are NOT derived from the Department's funds or the Nuclear Waste Fund. Instead, they are derived from the "Judgment Fund" of the Department of Treasury, which is used for paying claims against the federal government. Judgment Funds are derived from taxpayers, but the costs do not appear in the Department's budget and are not subject to annual appropriations.

In addition, the situation with the Nevada Congressional delegation was quite the reverse of the New Mexico delegation. The New Mexico delegation generally supported progress on WIPP, while the Nevada delegation was intent on blocking progress on YM. And as Senator Reid rose from the most junior Senator in 1987 to become Senate Majority Leader in 2007, the fortunes of Nevada and their ability to block funding and other legislation rose along with him.

5.3 Assured funding for the duration of the project

Any project of the magnitude and duration of YM requires assured access to adequate funding when needed by the project. Funding disruptions due to limited appropriated funds have been very damaging to the project. In contrast, the strong vested interests in many states helped keep WIPP funded and the powerful New Mexico Congressional delegation further assisted the process.

While YM is to be funded by the Nuclear Waste Fund, that Fund is not a separate bank account awaiting withdrawals. The Nuclear Waste Fund is simply part of the large federal budget and use of it is subject to appropriations just like any other federal activity. The Nuclear Waste Fund contained about $43B in 2018 and earns about $1.5B interest annually. [17] But, with concerns on balancing the federal budget, any proposed transfer of $43B would have a remote chance of success. Thus, it is a daunting challenge to imagine how that Fund can be accessed today for its intended purpose. At a minimum, such access would have to be spread over many years.

In my view, if the Nuclear Waste Policy Act in 1982 had required that utilities move the fuel from their sites into safe, NRC-licensed, long-term disposal by a specific date, the U.S. would probably have a functioning repository today. The utilities could have been given control over the Nuclear Waste Fund or it could have been left up to the industry to generate their own funding through rates for nuclear-generated electricity. The industry probably could have developed suitable storage and disposition sites. (Several countries have achieved or are achieving success in identifying repository sites with largely privately funded models, including Sweden, Switzerland, Finland, Canada, and France.) [16].

5.4 Public education on the project

The local citizenry of Carlsbad quickly became well informed on the proposals that led to WIPP. The local paper maintained an open-minded editorial stance. State government was supportive in the early days of the project. While opposition did form later, it mostly involved groups outside of southeastern New Mexico. The Carlsbad supporters were always well equipped with information on the benefits and any potential hazards from the project. The State was involved in development of shipping corridors and the same is true for all states through which WIPP waste moves. Effective training of emergency responders along all WIPP transportation routes was in place before any waste moved. When there was concern with transport of waste through the capital of New Mexico, Santa Fe, a bypass route was funded by the federal government.

In contrast, YM was adamantly fought by the Nevada Congressional delegation, the State government, and the Las Vegas newspapers after the 1987 Amendments. Headlines and editorials against the project were routine. The citizens of Las Vegas were bombarded with articles [9,10] suggesting that YM would doom the gambling industry. Fears were raised about transportation of radioactive wastes through Las Vegas. [8]

Little information to counter these local fears was presented in ways that reached most of the Nevada population. There is no question that transport of nuclear materials is handled safely throughout the world. This activity has an exemplary safety record thanks to carefully designed shipping casks and protocols. But that information was lost on the general population of Las Vegas. Furthermore, the primary route for shipment to YM proposed by the Department would involve "mostly rail" transportation utilizing a "preferred" train route from Caliente, Nevada, bypassing Las Vegas [19] – but those messages were not presented effectively. (However, concerns have been expressed by the U.S. Air Force about the choice of route by the Department of Energy. [20]) The Nevada Congressional delegation also argued that transportation across the entire U.S. would present serious hazards in many states.

In addition, the Nevada delegation worked to block attempts to bring more public information into their State. When the Department proposed creation of public information resources in Nevada during my tenure on Senate staff, the Nevada delegation led by the powerful Senator Majority Leader blocked the funding. On assignment from Senator Domenici, I was sometimes asked to find paths forward on YM with the Nevada Congressional delegation – my discussions were far from successful.

5.6 Effective organization of a waste management campaign

Transuranic waste was routinely packed in 55-gallon steel drums throughout the Department's national security laboratory and weapons production site complex. For WIPP, shipping canisters for these drums were carefully developed and extensively tested. Video footage of some of the most dramatic tests was publicly available to demonstrate the cask's integrity under incredible accident scenarios. Today, WIPP shipments have traveled the equivalent of 30 roundtrips to the moon without a serious accident or injury. Rigid "Waste Acceptance Criteria" were developed for all waste destined for WIPP.

The commercial nuclear industry presents a dramatic contrast to WIPP. The absence of any government-mandated strategic waste management plan for all nuclear plants led to a wide variety of storage systems. Much of the used fuel is now in dry casks, but the casks vary from ones suitable and certified for transport to ones that are not. Without a disposition protocol in place for YM, some of the current casks might be put into YM, if they could be moved there, but others would probably require repackaging of the waste before transport or emplacement. This lack of advanced planning dramatically complicates any path forward for U.S. commercial used fuel.

Another aspect of the waste management campaign deserves discussion as well – issues of knowledge management. While the path to opening WIPP was long, it stayed within the time of a typical researcher's technical career. Thus, many of the scientists who began work on WIPP were still available for contributions as WIPP opened and in subsequent years. Continued interest in WIPP issues served to maintain funding at the lead laboratory, Sandia National Laboratories, throughout the ongoing history of WIPP. That continued funding enabled effective knowledge management, as senior staff nearing the end of their careers worked with entry-level staff to transmit their knowledge.

But the situation with YM is very different. Inconsistent funding of YM, coupled with project termination and changes in operating contractors has left the knowledge base seriously fractured. Again, Sandia National Laboratories was the lead laboratory, but many of their original researchers on YM projects have left technical work and new staff were not always available for knowledge transfer. There have certainly been efforts to capture knowledge gained in the YM program and an extensive set of literature awaits new researchers. But the invaluable ability to directly interface with the original researchers is now, in some cases, lost forever. Any effective organization for high level waste management must be sustained over decades. This need is closely coupled to the points in Subsection 5.3 discussing the need for assured funding for the duration of the project.

5.7 Technical advice for state and local governments and the citizenry

At WIPP, a matter of contention was the extent of State involvement in the disposal. While suits were filed on this issue, the outcome effectively involved New Mexico in the processes. The New Mexico EEG provided the State and local citizenry with their own technical capability to evaluate issues and the CEMRC provides independent environmental monitoring with data publicly available.

The opposition in Nevada precluded that State from forming any group like the EEG or even in seeking a strong role in project leadership. In contrast, Nevada formed the Nevada Commission on Nuclear Projects in 1985, which, in their first Report in 1986 [18], stated that, "The Commission … urges the Governor to continue his strong opposition." And while the Nuclear Waste Technical Review Board was created by the 1987 Amendments, it reported to the Congress and Administration – and thus was not a resource available for trusted consultation in Nevada. (and, by then, public opinion in Nevada was already firmly against YM.)

6. RECENT PROPOSALS FOR SUCCESSFUL SITE SELECTION PROCESSES

My perspectives are far from unique. Many observers of the lack of progress on waste management in the U.S. have noted the same issues. Two outstanding studies have been completed in recent years exploring alternatives to the current state of U.S. high level waste management policies. Both the "Blue Ribbon Commission on America's Nuclear Future" (BRC) [1] and the "Reset of America's Nuclear Waste Management: Strategy and Policy" (Reset) [16] developed outstanding proposals to place the U.S. high level waste management program, including used fuel, on a path to success. The Administration's Strategy document in January 2013 generally supported the recommendations of the BRC [2].

The BRC and Reset studies differ in some areas. For example, the BRC recommended formation of a "Federal Corporation" to run the program while the Reset proposed a "utility-owned, not-for-profit, implementing corporation." While I prefer the option proposed by Reset, the two studies are adamant that a new organization, separate from the Department, must be created to reform our national approach. It must isolate the project from the short-term changes in political views and it must have an assured long-term funding path. Consent-based siting is prominent in both studies and, in my view, is of over-riding importance if the U.S. is to proceed toward successful management of high-level wastes.

REFERENCES

[1] Blue Ribbon Commission on America's Nuclear Future, Report to the Secretary of Energy, January (2012), https://www.energy.gov/sites/prod/files/2013/04/f0/brc_finalreport_jan2012.pdf.

[2] U.S. DEPARTMENT OF ENERGY, Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Waste, January 2013, https://www.energy.gov/em/downloads/strategy-management-and-disposal-used-nuclear-fuel-and-high-level-radioactive-waste.

[3] WALKER, J.S., The Road to Yucca Mountain, University of California Press (2009).

[4] MCCUTCHEON, C., Nuclear Reactions, University of New Mexico Press, 2002.

[5] Department of Energy, What Happened at WIPP in February 2014, https://wipp.energy.gov/wipprecovery-accident-desc.asp

[6] CONCA, J., WIPP nuclear waste repository reopens for business, Forbes online, January 10, (2017), https://www.forbes.com/sites/jamesconca/2017/01/10/wipp-nuclear-waste-repository-reopens-for-business/#7d3c3a1f2052

[7] U.S. DEPARTMENT OF ENERGY, Office of Environmental Management ,WIPP Marks Milestone with 12,000th Safe Transuranic Waste Shipment, November 14, 2017, https://www.energy.gov/em/articles/wipp-marks-milestone-12000th-safe-transuranic-waste-shipment

[8] NEVADA COMMISSION ON NUCLEAR PROJECTS, Report to the Governor and Legislature, Socioeconomic Impacts of a Yucca Mountain Repository, December, (2000), http://www.state.nv.us/nucwaste/news2001/commrpt2000socio.pdf

[9] EASTERLING, D., The vulnerability of the Nevada visitor economy to a repository at Yucca Mountain, Risk Anal. 17 5 (1997) 635.

[10] SLOVIC, P., LAYMAN M., KRAUS N., FLYNN J., CHALMERS J., GESELL G., Perceived risk, stigma, and potential econo-mic impacts of a high-level nuclear waste repository in Nevada, Risk Anal. 11 4 (1991) 683.

[11] STATE OF NEVADA, Nuclear Waste Project Office, New Evidence of Rapid Water Movement Supports Disqualifying Yucca Mountain, http://www.state.nv.us/nucwaste/yucca/chlorine.htm.

[12] CONGRESSIONAL RESEARCH SERVICE, Civilian Nuclear Waste Disposal, RL33461, September (2018).

[13] U.S. GENERAL ACCOUNTABILITY OFFICE, Disposal of High-Level Waste - Key Issues, https://www.gao.gov/key_issues/disposal_of_highlevel_nuclear_waste/issue_summary.

[14] TALBOT, D., Life after Yucca Mountain - Geologist Allison Macfarlane on the future of nuclear waste, MIT Technology Review, June 23, 2009, https://www.technologyreview.com/s/414029/life-after-yucca-mountain/

[15] MACFARLANE, A., EWING, R., Déjà vu for U.S. nuclear waste, Science. 356 6345 (2017) 1313.

[16] Stanford University Center for International Security and Cooperation and George Washington University Elliott School of International Affairs, Reset of America's Nuclear Waste Management: Strategy and Policy; October 15, 2018, https://cisac.fsi.stanford.edu/research/projects/reset-nuclear-waste-policy.

[17] SFORZA, T., Nuclear waste burial fund grows to $43 Billion, but [the Department] has not buried an ounce of spent fuel, Orange County Register, February 1, (2019), https://www.ocregister.com/2019/02/01/billions-pile-up-in-nuclear-waste-burial-fund-but-no-permanent-storage-solution-on-the-horizon/.

[18] Report of the State of Nevada Commission on Nuclear Projects, Presentation to the Governor and the 64th Session of the Nevada Legislature, November (1986), http://www.state.nv.us/nucwaste/news/comm1986.pdf.

[19] U.S. DEPARTMENT OF ENERGY, Office of Civilian Radioactive Waste Management, Record of Decision on Mode of Transportation and Nevada Rail Corridor for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye county, NV, Federal Register. 69 68 (2004) 18557.

[20] ROGERS, K., Air Force Chief objects to Yucca Mountain nuclear routes, Las Vegas Review-Journal, July 22 (2017).