IS LONG TERM STORAGE THE ANSWER?

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ABSTRACT

Although controversial, the most cost-effective and politically-acceptable method of handling radioactive wastes may be to safely store wastes in an environmentally-acceptable, monitored manner while a political and technical consensus is reached on how to properly treat and dispose of such wastes. Because of the limitations imposed on treatment and disposal by state governments and environmental legal challenges, most waste tends to remain where it was produced. A judicious centralization of those wastes within states may result in a more desirable intermediate outcome than the current patchwork of disposal, treatment, and storage actions and inactions.

INTRODUCTION: A POLITICAL IMPASSE

There is great controversy over where and how radioactive waste can and should be treated and permanently disposed. The currently postulated costs of treating and disposing of certain types of radioactive wastes are so high that it may not be economically possible to carry out these plans in the near term. Further, the technology for some waste treatment and disposal is still unproven and/or final disposal criteria have not been identified, so there is great uncertainty and risk in building facilities that may not be technically practical or publicly acceptable. As a result, radioactive wastes continue to build up at sites around the United States. These sites include large DOE facilities and commercial nuclear power plants, as well as small hospitals in local communities. This unplanned and piecemeal interim storage situation results in radioactive waste being in closer proximity to population centers and protected groundwater and aquifers than it would be if sent to well-planned, well-designed, isolated regional long-term storage sites.

Radioactive waste is stored throughout the United States. The DOE report entitled "Integrated Data Base for 1992: U.S. Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics" issued in October 1992, provides details (both national and by state) on the amount of commercial spent fuel and both commercial and U.S. Government radioactive wastes. A listing of DOE radioactive waste by type and location can be found in the annual HAZWRAP report and in the Federal Facility Compliance Act (FFCA) inventory report, as well as in additional databases maintained by organizations such as Los Alamos National Laboratory. In addition, the DOE Office of Civilian Radioactive Waste Management, and organizations such as the League of Women Voters, track the amount of civilian spent fuel in storage, and surveys of commercial mixed waste in storage have been conducted at the request of the NRC.

Acceptable waste disposal is a complex issue in which only limited progress has been made; therefore, new solutions and approaches are required. The current status of various radioactive waste streams points out the need for such approaches on a national level. It is clear that Yucca Mountain, the planned final repository for both commercial spent fuel and defense high-level waste (HLW), will not open any time soon. Commercial spent fuel, never to be reprocessed, continues to be stored at reactor sites throughout the United States. The Department of Energy also has a significant inventory of spent fuel that requires safe storage until a repository is open, and the U. S. Navy has spent fuel in Washington State and Idaho. DOE HLW liquids at Savannah River, Hanford, and West Valley will eventually be treated and stabilized, but completion of those operations still faces some challenging technical and institutional problems. In the interim, the waste remains in underground storage tanks -- many still of the old single-shell design. For transuranic (TRU) waste, delays in opening the Waste Isolation Pilot Plant (WIPP) have forced continued storage activities at generator sites. Furthermore, the final waste acceptance criteria for WIPP and transport to WIPP are uncertain in the long term, and waste packages placed in 20-year retrievable storage in the 1970's are nearing the end of their design life.

Construction of additional Federal treatment or handling facilities undoubtedly will be required, but Congress has not yet appropriated sufficient funds to construct all of them and is not likely to do so in the near future. There is great public concern over the siting of any radioactive waste treatment facility, and both DOE and the commercial sector are experiencing difficulty in siting new low-level radioactive waste disposal sites. Lack of treatment and disposal facilities for mixed waste continues to be a problem which led to some regulatory relief in the form of the Federal Facility Compliance Act of 1992. DOE has imposed a moratorium on the shipment of hazardous wastes destined for commercial treatment, storage, and disposal facilities until sites can demonstrate that there has been "no radioactivity added." This creates a continued need for well designed, and in some cases permitted and/or licensed storage facilities. Currently, storage is occurring at a number of sites and is being done in a variety of different ways-- from leaving 55-gallon drums buried in the ground to building very expensive, new double-shell storage tanks at Hanford.

Many factors have contributed to the current gridlock where wastes are stored for an undefined period while alternate actions are debated. Regulatory authority over both commercial and DOE radioactive wastes is in many instances shared by different agencies (e.g. DOE, NRC, EPA, and States) with varied sets of regulations, interpretations, and objectives. These circumstances, coupled with citizen concerns regarding radioactive waste treatment, storage, and disposal, have created a situation where wastes are managed on a piecemeal basis rather than being addressed in a comprehensive manner. Impassioned pleas from state governors and local communities not to dispose of waste in their states or to demonstrate that disposed wastes will be safe for over 1,000-10,000 years results in de facto storage.

POSSIBLE APPROACH: A COHERENT STRATEGY

This paper suggests a comprehensive national approach for developing a long-term storage capability for certain types of wastes. This strategy has two parts:

- Establish public dialogue regarding long term storage and disposal options
- Take near term action to establish interim storage

Under a comprehensive storage approach, there would be a strategy of safely storing wastes under controlled conditions at a number of regional sites until there was sufficiently wide agreement and adequate political support to provide funding to carry out the required steps of treatment and final disposal. This approach has the benefits of lower costs over the next couple of decades, which could prove to be politically palatable if the many stakeholders understand that it is the only real option to the gridlock alternative of no action.

A graphical presentation of how the various forces converge in the current situation to cause gridlock and how the new interim storage approach could refocus the action drivers and public concerns is presented in Fig. 1.

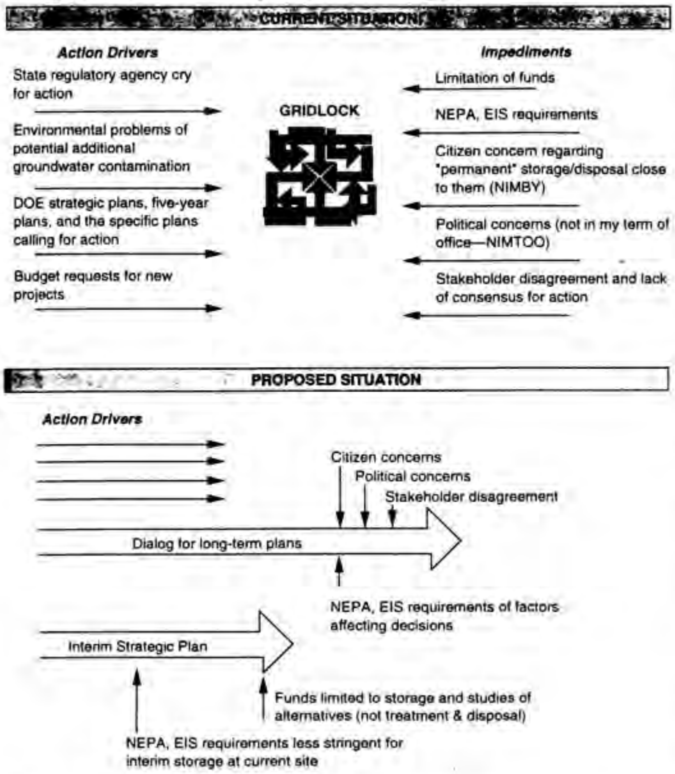

Fig. 1. Change of planning orientation can move current "gridlock" situation to more healthy situation of dialog and interim storage.

Public Dialogue on Long-Term Options

While an interim storage approach is being put in place, an active public dialogue is needed on the subject of long-term storage, as well as ultimate disposal, that considers the input of all stakeholders, costs, political realities, and public opinion on the appropriate allocation of federal funds.

The national approach requires more than the typical systematic analysis which takes into account the pertinent technical factors (e.g. inventories, projected additions, storage techniques, transportation factors, potential environmental impacts, costs, and siting parameters). It must also consider social and cultural (and perhaps religious) aspects of the situation. In addition and perhaps of most importance, it must realistically address the citizens' overriding concern: "How long will it be there?"

In order to obtain a broad enough consensus of support, all workable solutions must provide a majority of the affected public with a supportable belief that they are doing their share to solve this unavoidable national problem but not significantly more than their fair share. This critical value judgement must take into account national, regional, and local equity (to the extent possible). As final disposal decisions are made, locations chosen for storage will demand some consideration for the load they have shouldered during the (possibly) extended storage period. For instance, the Southeast Compact has over $1600 in access fees alone for a 55 gallon drum of low-level waste, and states (and the federal government) are offering millions of dollars for siting radioactive waste facilities. Therefore, future treatment and disposal facility locations must be considered during this decision process. This is not to say that some grouping of storage, treatment, and disposal facility locations is not possible, just that the technical and economic factors of clustering will have to be weighed with other social and cultural factors and equity issues. Any such analysis will only be as successful as the credibility with which it is received by the many stakeholders affected by the outcome. Extensive involvement with these stakeholders is a necessity from the beginning.

Depolarization of stakeholders at the outset is a priority! The problem is clearly one which exists now and cannot be avoided. It is not a question of taking actions today to eliminate the need for storage -- that day is past, if it ever really existed. It now is in the best interest of every stakeholder to work together to find the most equitable and effective solution to this inescapable local, regional, and national problem. Delay in recognition and satisfaction of the short or mid-term need for waste storage accomplishes nothing. The pertinent questions are: "Where?," How?," and "For How Long?"

The current dialogue on DOE's existing approach for meeting regulatory guidelines should continue to ensure there is full discussion and understanding of the cost and pitfalls of alternative approaches, but a comprehensive storage approach should be considered actively as the preferred approach, or as a "fall back" alternative if the current discussions or lack of Congressionally-appropriated funding does not allow the desired treatment and disposal to be completed expeditiously.

Interim Storage Implementation

The proposed effort involves establishing a public dialogue, possibly getting the National Academy of Sciences to consider radioactive and mixed waste storage criteria, and perhaps having EPA and NRC review their regulatory policies and practices and request public comment on possible new approaches. For this to be successful, it will require more than Federal action-- it will require the acceptance by many stakeholders (e.g. environmental groups, state governments, senior officials at large DOE sites, Congressional authorization and appropriation committees, and possibly favorable court rulings if approaches are challenged in the courts). Therefore, an integrated effort and national strategy is needed where many organizations and individuals are involved in developing the approach and, thereby, develop a sense of ownership in it.

This storage approach recognizes the inevitability and cost advantage of properly designed and monitored regional

10-50 year storage sites. Among the issues to be considered are states' "equity" issues involving the siting of storage facilities, EPA/NRC/state overlapping jurisdictions, and appropriate storage design criteria and monitoring requirements consistent with the risk, packaging, and transportation issues.

Many interim storage options are available, and some are listed in Fig. 2.

Interim Storage Options	Pros/Cons/Other Factors
Leaving contamination in ground	+ Least expensive – Future groundwater contamination possible – Content of problem undetermined – Not a multi-decade solution
Controlled air barriers with vertically or horizontally drilled wells	+ Does not require soil removal or treatment + Reversible process to substantially reduce future contamination of groundwater
Soil freezing with directionally drilled wells	+ Does not require soil removal for treatment + Reversible process to stop future contamination of groundwater
Grouted barriers	+ Does not require soil removal or treatment – Non-reversible process (e.g., additional contaminated material in ground)
Above ground monitored storage warehouses (e.g. Hanford) or concrete slabs	+ Protection from weather + Mitigation of groundwater contamination – Requires material to be in drums or compact waste form ± Can be in expensive warehouses or on inexpensive concrete slabs
Dry spent fuel storage	+ Properly designed canister allows storage of centuries or more • Requires NRC license
Wet spent fuel storage	– Allows cladding to deteriorate so limited to 30–50 years • Requires NRC license

Fig. 2. Interim storage options have been developed that allow wastes to be safely maintained for multiple decades.

Examples of approaches to long-term storage include those being undertaken at the Hanford 200 West Area, the Idaho Radioactive Waste Management Complex, the K-25 site at Oak Ridge, and Savannah River. Improved approaches for monitoring mixed and radioactive waste would also be addressed, as well as the most appropriate technologies for the wastes being stored and the surrounding geologic conditions.

When appropriate, the most cost-effective storage option may be construction of "Butler" type buildings from General Plant Project funds (for projects less than $1.2 million). These buildings would protect storage containers from environmental degradation due to rain, snow, and airborne projectiles. This storage approach is better than the status quo of minimally-protected storage, and substantially less costly than building very expensive "permanent" type storage facilities based upon strict adherence to all regulations, codes, guides and standards. Storage facilities designed as interim storage using "Butler" buildings may receive more acceptance from citizen groups than if built as "permanent" storage.

At Hanford, DOE is committed to construct storage warehouses for 55-gallon drums and crates, and the construction of new one million gallon double-shelled tanks. The advantages (and disadvantages) of pumping high-level liquid waste from some of the leaking/volatile tanks and storing it in special stainless steel tanks (with a cost of hundreds of millions of dollars), and the regulatory acceptance of that approach, can serve as a case study affecting development of a national storage strategy and how improvements in the current storage activities could be made. At other locations, such as Idaho, fabric covered, air support structures with a concrete base may provide more cost-effective interim storage.

Contaminated soils could be left in situ and untreated, if no significant environmental problems resulted, or could be enclosed by a subsurface barrier. Barriers include controlled air barriers, freezing technology, cone grouting, and encapsulation flood grouting. Developed by BDM Federal and K&M Engineering, the circulating air barrier confinement system utilizes vertical or horizontal wells to remove liquid wastes as they migrate down toward the groundwater and enter the dried area. Contaminated material also can be confined by freezing the soil beneath and around the contamination by pumping cryogenic fluids through directionally-drilled pipes, using technology developed by RKK Ltd. and freezeWall Incorporated. Additional information is available from Kaiser Engineering's Hanford Evaluation of Subsurface Barriers from December 1992 - March 1993.

Under the interim storage option, only very limited funds would be spent on treatment, disposal, or remediation of soils that do not present a current risk by further contaminating groundwater. In the meantime, the most effective treatment programs can be developed that properly consider waste minimization approaches, so unnecessary wastes are not removed from the ground, thus resulting in additional requirements for waste storage and disposal. The 1994 DOE Annual Report on Waste Generation and Waste Minimization, and the Waste Minimization/Pollution Prevention Crosscut Plan, provide additional information.

The storage approach needs to consider several factors for the different types of wastes:

- For DOE defense transuranic wastes, the operating date for the Waste Isolation Pilot Plant may be further delayed, and continued interim storage may be needed.
- For DOE high-level waste, it may be cost effective, or necessary from a practical point of view, to store certain of the liquid high-level wastes at Savannah River or at Hanford in existing or new tanks for decades until improved treatment and disposal technology is available.
- For spent nuclear fuels, action needs to be taken so that further contamination of the storage environment does not occur due to cladding deterioration under current storage arrangements, and so there is not double handling with spent fuel being stored in containers that are not suitable for future transport or disposal. The DOE Office of Civilian Radioactive Waste Management Multi-Purpose Canister procurement planned for 1994 helps address the long-term storage and transport of spent fuel and DOE's 1998 obligation under the Nuclear Waste Fund provisions.
- For mixed low-level waste, generated by DOE or the commercial sector (including hospitals), waste may be most appropriately stored until public policy consensus decisions are made (e.g. including state, local, and other stakeholder groups) on a long-term national treatment and disposal strategy utilizing the framework established by the FFC Act, and follow-on legislation; the recently prepared mixed waste conceptual site treatment plans for Oak Ridge, Richland, Idaho, Savannah River, Nevada, Lawrence

Berkeley Laboratory, and other sites all indicate interim storage facilities will be built and used in many locations throughout the U. S.

- For DOE non-mixed low-level waste, DOE hazardous waste, and DOE sanitary waste, ongoing efforts utilizing current treatment and disposal methods for those wastes should continue; no long-term storage should be needed.
- For commercial/hospital non-mixed low-level waste, storage is needed until the state compacts are successful, at which time disposal can take place; if compacts are not going to establish disposal facilities in the near term, regional monitored storage may be preferable to leaving wastes scattered in various locations very close to where citizens live and work for years to allow sufficient decay to occur.

Additional details regarding DOE storage will be addressed in the DOE Environmental Management Programmatic Environmental Impact Statement which is being prepared for public review by August 1994. That PEIS should address the number of low level/mixed waste storage sites, that may range from four (e.g. Hanford, Idaho National Engineering Laboratory, Oak Ridge and Savannah River) to eleven sites. Mixed waste options will be driven by the DOE site treatment plans. Options for transuranic waste and other waste storage also will be addressed. A "no action" alternative will be evaluated that may contain some parts of an interim storage strategy.

ADDITIONAL INCENTIVES FOR ACTION

As DOE decontaminates and decommissions facilities, including the disposition of weapons production residues and other "material not classified as waste," and increases its environmental restoration activities, it will generate more wastes requiring storage before ultimate disposal. Consequently this topic must be addressed and factored into any long-term strategy.

Also, as commercial medical facilities consider limiting their use of nuclear medicine techniques and technologies due to mixed waste issues, the general public will see more clearly how non-action affects them.

As recent natural calamities have vividly brought to our attention (e.g. extensive flooding in the mid-West; hurricane devastation in Florida and the Gulf Coast; fires and earthquakes in California), the current national situation which has led to extended storage in facilities and at locations not selected for this purpose is certainly not the preferred solution. Some rational, comprehensive, compromise solution is an environmental imperative.

SUMMARY

A cohesive, thoughtful approach for dealing with the serious and far-reaching issue of the long-term storage of radioactive waste, pending its disposal, which is politically palatable can be successful in encouraging action by all involved parties in resolving the current waste gridlock, while meeting the pertinent environmental and economic requirements of state and federal regulators, and Congress.

This paper presents a promising approach for senior managers and technical professionals concerned with the current "treatment-storage-disposal" impasse created by conflicting regulations, and state leaders grappling with alternative approaches for dealing with radioactive waste from DOE or commercial/medical use in their state. New ideas are needed.