A National Framework for Nuclear Waste Management

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Purpose of this Proposal

The intent of this document is to offer a path for making storage of spent nuclear fuel as safe as possible in all time horizons and in all types of locations: local on-site, interim consolidated, and remote long-term storage.

To achieve this goal, the proposal combines three distinct efforts within a unified framework to offer a comprehensive approach that can lead to synergies while offering a stronger prospect of creating the "critical mass" required to revitalize national policy.

• **Local on-site storage.** The first area of effort is directed toward refining the nuclear power plant decommissioning process with the goal of assuring that best practices are applied to the physical, informational and strategic aspects of plant shut-down and on-site storage. This can be thought of as the "local level" of the nuclear waste management challenge.

• **Regional interim storage.** The second area of effort focuses on "consent-based siting" of interim storage facilities that consolidate nuclear waste from several plants. The challenge is to define key steps in this process with sufficient precision and political realism to support a robust process.

• **National remote long-term storage.** The third area of effort is to re-energize nuclear waste management policy at the national level. On-site storage of spent fuel at existing and closed nuclear plants is current practice, not national policy. This default position results from a lack of coherent national policy and is at odds with the 30-year old Federal Nuclear Waste Policy Act as well as the Blue Ribbon Commission on America's Nuclear Future recommended by the President and appointed by the Secretary of Energy.

Current Conditions: Policy Paralysis and Environmental Risk

Today there is no national strategy for long-term storage of commercially generated radioactive waste at a stable, remote location. This lack has created a crisis in "waste confidence" – the assurance that radioactive waste generated as a byproduct of nuclear plant activity will be managed with the least risk.

For decades, government agencies, environmental groups and an array of interested parties have assumed such a capacity would be developed. Thirty years ago the Sierra Club national board of directors voiced its support for one or more permanent geologic repositories sited in the least hazardous locations. Yet, none exists today.

Of the communities that host America's more than one hundred nuclear plants, none ever signed up to be an indefinite host to nuclear waste. Nor have any of the sites where they are located been licensed for that purpose. Yet as each aging plant is retired, each site becomes just that.

On these sites sit concrete mausoleums holding spent nuclear fuel in casks whose potential for deterioration is heightened by the prospect that the Department of Energy, which maintains stator authority and ownership, will remove the waste only in the far future. In that event, transfer of casks from storage and their transport to a remote site would create its own set of challenges.

Nuclear waste management is a fundamental issue of national and social responsibility. The time has come for the actions required to address the current inaction and impasse. We must proceed with deliberation yet with a sense of urgency.

At each plant, the challenge is to identify and implement best practices for on-site storage that is as safe as possible. The term of art for this is "defense in depth" – redundant response procedures and capabilities that provide a fallback position in the event of system failure at any point.

At the regional, multi-plant level the challenge is to establish politically robust procedures identifying sites for consolidated interim storage, and to select specific sites from a roster of candidates qualified and willing to host such facilities.

At the national level the primary challenge is to embark upon a process to select one or more long-term storage sites that are technically feasible, politically achievable and socially acceptable. It would be optimal to establish a science-based process of evaluating remote sites that could serve as permanent repositories for nuclear waste and to establish one or more geologic repositories based on environmental characteristics and relation to the transport grid.

On-Site Storage: Applying Best Practices to achieve "Defense in Depth"

At each plant where spent nuclear fuel is stored, best practices have three aspects: physical, informational, and strategic.

The first requires identifying and installing appropriate technology. The second requires a high level of human performance. The third requires both logic and creative thinking.

Physical Elements

• Select cask design amenable to transport and possessing long-term capability to prevent fuel rods from being exposed to the atmosphere or exposing the atmosphere to radiation.

• Design and install concrete over-pack for security against seismic events and as added radiation shielding.

• Favor external monitoring of sealed systems rather than interior inspections requiring entry portals that could be vulnerable as failure points.

• Emphasize external inspections of cask damage, given that especially in a saline location most risk factors come from outside. Monitor the concrete over-pack as an indicator of internal conditions including stability of the helium environment.

• Provide physical security through procedures and protections against human hazards of inadvertent or deliberate actions that would increase risk or cause harm.

• Provide physical security against natural hazards through structural design, including isolation of hazardous materials from risk factors.

Informational Elements

• Implement performance-related inspection schedules that reflect both industry standards and site-specific characteristics.

• Assure frequency of inspections at regular intervals during the casks' licensed period of operations and for as long as they are in use.

• Provide sustained long-term management to assure that inspection schedules, monitoring and repair capabilities are maintained over decades – given that accidents often arise from human error.

• Identify "critical canisters" most crucial for inspection in each array to focus on parts of the system most vulnerable to stress and aging that might cause corrosion and cracking of canisters and consequent leakage.

• Supplement physical inspections with modeling simulations, especially to evaluate performance-critical elements that are difficult to access.

• Integrate ongoing information flows of experience and data coming from nuclear plant sites using similar technologies and procedures. Adjust operational practices and facilities design as appropriate.

Strategic Elements

• Develop and install redundant systems, each with its own margin of safety, to assure that if one system fails others are in place.

• Evaluate and prioritize options for emergency repairs of unanticipated deterioration or radiation leaks; e.g. placing a canister in a transport cask, moving it to a fuel pool, or performing on-site repair.

• Monitor and assess technology developments and on-going research related to new physical systems and operational procedures. Evaluate possibilities created by technological advance; e.g., eliminating initial storage of spent fuel in pools that require active cooling.

• Identify likely timeframes required before each promising new technology comes on line. Develop management plants accordingly.

• Propose San Onofre as a key national site for development of techniques to manage aging facilities.

• Urge national policymakers to implement the Waste Policy Act and recommendations of the 2012 Blue Ribbon Commission report, with regard to long-term storage as well as consolidated interim storage for removal of spent fuel, especially from decommissioned plants.

Regional, Multi-Plant Storage: Consent-Based Siting of Interim Facilities

Restoring Momentum

The United States lacks a comprehensive nuclear waste management program. Accordingly, 72,000 metric tons of high-level nuclear waste remains stranded at more than 60 temporary installations across the country.

This condition has resulted in a demonstrated need and growing support for the consolidated interim storage of spent nuclear fuel from decommissioned reactors. However, federal action on this front is hindered by a lack of consensus.

Currently there is little will and no apparent political upside for policymakers in Washington to take the lead. Political realities indicate that solutions will not be instigated by the federal government. Little if nothing is going to change unless federal legislators, regulators and agencies can see some sort of a path forward.

This is a waste management problem with a large political component. The path is politically blocked by the absence of a process to identify communities that would host consolidated interim storage.

The Response

To meet this need, the Community Consent Siting Initiative (CCSI) is proposed. The CCSI is designed to develop a legitimate, transparent and effective siting process. The specific means, a "siting road map," then becomes the focus to which stakeholders can relate and can drive necessary action. This map would include sequential "off-ramps" to achieve process outcomes that are enduring because they are based on an iterative approach.

There are three interest groups who are immediate parties to this situation:

• Nuclear host communities that don't want to be storage sites for spent fuel.

• U. S. communities that do want it for economic reasons - places in Texas and Mississippi for sure and perhaps places in Idaho, New Mexico and elsewhere.

• Utilities that would benefit from improved risk management.

Things will move if there is political will, built in a way that is step-wise, inclusive and collaborative. The first step is to develop a methodology for siting interim storage. "Consent-based siting" is the current buzzword but it has no meat on the bones. A process must be developed and fleshed out for presentation to Congress, which must provide the supporting legislation and funding.

A detailed feasibility study is required that identifies all necessary steps in such a way that they can be handed off to DOE. It is important to do the entire process in a measured, transparent and stepwise fashion. An honest conversation about which communities might serve as hosts could be the catalyst.

The proposed mechanism is the National Spent Fuel Siting Council (NSFSC). It would be the means to develop a short list of candidate sites as the basis for negotiation with DOE. This process would take 6 to 8 years and would focus solely on fuel from decommissioned reactors.

The NSFS Council would:

• The Council would be created as a non-profit single-purpose entity to implement a voluntary siting program. The NSFS Council would include leaders of prominent state and tribal organizations as well as utilities, labor, industry, NGOs, community and federal representatives.

• The Council would develop a Spent Fuel Siting Protocol. “Consent based” siting enjoys popular support yet no document describes the elements of such a process in sufficient detail.

To fill this void, the NSFS Council would undertake a multi-stakeholder process to create a Spent Fuel Siting Protocol defining the siting guidelines and hosting-agreement terms necessary to secure consent from communities.

• The Council would create political preconditions for Federal authorization by engaging and aligning stakeholders from across the nuclear waste arena. This broad base of support would then be deployed to catalyze enactment of legislation supporting operation of consolidated interim storage facilities.

• The Council would implement a protocol that identifies viable candidate sites through a voluntary and competitive process on a national scale. This effort would launch a comprehensive awareness and outreach campaign, provide resources and technical information to interested communities, and manage a proposal vetting and site selection process.

• This process will result in a list of candidates who have satisfied threshold terms outlined in the Protocol and are qualified to serve as potential hosts for a storage facility. These short-listed sites will then undertake definitive negotiations with the federal government to host a storage facility.

The Goal

To be sure, the approach described here does not solve the entire back end of the nuclear fuel cycle. Instead, the goal is more modest: interim storage of spent fuel from decommissioned reactors.

The solution is not technical -- it is political with a healthy dose of deliberative democracy and economic development incentives.

This modest goal is achievable in a manageable timeframe. The intent is to reduce "very long periods of time" to 15 years or less by establishing interim spent fuel storage facilities for fuel in willing host communities that offer enduring and informed consent. It is also intended to serve as a model process for undertaking the ultimate stage of siting one or more national repositories.

National Long-Term Remote Repository Storage

From Paralysis to Achievement

Today America finds itself confronted by multiple challenges. Likely outcomes appear less validating than at great moments in our history. This time of greater uncertainty has led to a political culture of accusation and blame rather than to a heightened level of mutuality in problem solving. As the cycle of time and events revolves in the history of our nation, we are required to rise to a higher level in understanding reality and in dedication to best outcomes for America.

The roster of urgent issues is lengthy. On that list is the long-term management of nuclear waste, a challenge that has arisen because we initially overestimated our ability to deal with nature at its most imponderable and underestimated the political and social roadblocks. In the decades that followed, we became aware of the true magnitude of the task.

This situation can breed worst-case scenarios that freeze us into demotivated despair, or it can summon us to work toward the best solutions. We must deepen our resolve to strive for outcomes grounded in environmental responsibility, appropriate use of technological capability, and commitment to the common good.

America has long proclaimed itself the "can do" nation. The Manhattan Project and Atoms for Peace are among the foremost examples supporting this claim while the decade-long Man on the Moon Program is perhaps the most famous example.

It is time to rouse ourselves from the torpor of accepting second-rate solutions so that a national paralysis and embarrassment can be transformed into a national achievement. Other countries have moved far past us in their quest to deal with the issue while we are lagging behind and losing leadership. The hour has come to keep faith with both the health and safety of our people and protection of the environment.

At this point of chronic crisis there is need to consider the creation of a Federal inter-agency task force and a supporting public-private partnership whose mission is to develop and implement an effective nuclear waste management within ten years. A similar commitment got us to the moon in 1969. Today we need to put an equal effort and equal passion into resolving a situation of national embarrassment and unneeded risk to human safety and the environment.

This national task force and partnership effort would put safe storage of nuclear waste on a par with the Manhattan Project, which developed the atomic bomb and launched the nuclear era, and Atoms for Peace, which commercialized nuclear power nationwide.

The Yucca Mountain Conundrum

The momentum necessary to renew progress toward this third line of defense requires a policymaking climate that has a clear process for assessing scientific evidence and securing political and community consent with regard to specific sites.

These fundamentals have been placed in a gray area by the recent political history of a potential long-term remote geologic repository at Yucca Mountain, Nevada.

The sequence at Yucca was (a) intensive study of site characteristics; (b) protest of potential siting by a powerful political figure; (c) halting of the review process by higher political authority.

There is need to revisit and, where needed, augment the extensive body of research regarding features of Yucca Mountain that might argue for or against its selection. The entry point for this exercise is not advocacy pro or con but review of existing research as a basis to develop selection criteria based on crucial characteristics of each site.

As matters stand, it is difficult to gain a clear sense of the weight of scientific evidence related to Yucca Mountain. At the conclusion of research, Yucca was considered a potential candidate. Yet the national administration put next steps on hold after the then-Majority Leader of the U.S. Senate protested the site (in his home state) reputedly saying Nevada should not host nuclear waste storage facilities because Nevada does not have any nuclear power plants.

Site evaluations require geologic, hydrologic, seismic, and other environmental assessments combined with analysis of transport routes and other operational factors. It is perhaps fortunate that the logic of the comment cited above is purely political and takes no position on the environmental or operational appropriateness of Yucca Mountain.

The contiguous forty-eight states constitute a landmass of 3 million square miles. In the Western half much of this land is arid. Significant portions are remote even from small human populations, raising the issue of what a politically acceptable definition of "consent-based" siting would be in such locations.

Clearing the air on Yucca Mountain may be a classic case of a "necessary but not sufficient condition." Gaining a clear sense of process requires restating the findings about Yucca in objective terms that are widely recognized and accepted as valid for assessments of this and other sites. In itself such clarity may not resolve the process of site designation. Yet absent such clarity, restarting a viable process becomes more difficult.

Maintaining the Momentum

Local and regional progress do not have to go on hold until national policy is implemented. Indeed, action at all levels to make nuclear waste management safer are mutually reinforcing. Steps to be undertaken during this process could include:

• Moving as much as waste as possible as quickly as possible from fuel pools to state-of-the-art dry cask storage containers.

• At the state level, launch a temporary nuclear waste storage program at a site, such as a military weapons facility, made available only to closed nuclear power plants.

• If required, use Eminent Domain to acquire land for permanent and interim storage sites. Assure these sites are served by a railroad spurs.

• As soon as possible, transport canisters by train to interim storage, with transfer a DOE responsibility at this point.

• Provide interim storage sites wit with pads and bunkers, transportation links, security personnel, auxiliary, buildings, transfer and holding pools, and emergency equipment.

• Build capability at each temporary site for R & D on long term storage solutions, including advances in the ability to reload or repair damaged fuel canisters.

• Create a national, world-class laboratory for scientists and students to experiment with other uses for nuclear waste that might actually be safe (and perhaps even beneficial) for centuries to come.

The end game: Free decommissioned plants from radioactive waste within 10 years of closure. Place a maximum limit of 60 years on interim storage, design and construct one or more permanent sites using the best technology developed between now and then.

In Summary

Nuclear waste management is a classic challenge of the type America has solved repeatedly in the past and is currently applying to areas such as climate change. Part of the key to a strategy was expressed by the late journalist Joseph Kraft: "When a problem arises created by technology, apply more technology." This is not a call for blind faith in a future rescue but for openness and rigor in monitoring and applying developments in technical capability.

Another strategic key is to assure excellence and dedication in the workforce – the human factor without which no systems can provide a swift, complete, reliable response. This involves not only finding the right people and training them well but maintaining a spirit of vigilance over a very long time period compared to the norm for most enterprises.

Finally, political will is required to benefit from the technology and human skills that address this challenge. There must be a shift in mindset. Nuclear waste management should no longer be treated as a distasteful problem to be shunted aside and dealt with through second-rate solutions. Rather, it should be seen as a first-rate national challenge to which America responds with a "can do" spirit, knowing we have the tools and talent to do so.

As an ongoing commitment cleaned up the nation's waters and vastly improved air quality. A similar commitment can address and master an environmental risk of comparable proportions. This outcome would relieve host communities of grave concerns and serve as a source of national pride at a time when such achievements are appreciated. Let's get on with the job.