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# Congressional Preferences and the Advancement of American Nuclear Waste Policy

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# CONGRESSIONAL PREFERENCES AND THE ADVANCEMENT OF AMERICAN NUCLEAR WASTE POLICY

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# ABSTRACT

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The problem of nuclear waste disposal has existed since the time of the Manhattan Project in World War II. Although there exist a number of technological hurdles, the main cause that has consistently plagued a solution to nuclear waste has been the politics behind it. This thesis attempts to add to the political literature behind nuclear waste disposal by examining the nuclear waste disposal preferences of members of the United States House and Senate. It then compares and contrasts those preferences with a report by President Obama's Blue Ribbon Commission on America's Nuclear Future. The hope was to determine if the commission's recommendation, the controversial method of geologic disposal, would be an acceptable method to the Energy Committees of both houses of Congress or if there existed an alternative disposal method that found acceptance. The study's results found an alternative disposal method, reprocessing of nuclear waste, was acceptable to the Congressional committees, while there was a division of support in the committees in regards to geologic disposal. Even with these results, the lack of discussion of the issue of nuclear waste in the energy committees of Congress translated into a scarcity of data for the study. This in turn, weakens the explanatory effect of the results. However, given the weaknesses, this does not soften the

importance of the study or the issue of nuclear waste. Future studies, as data becomes available, will help shed light on the preferences of members of Congress for nuclear waste disposal methods. This information will be useful in possibly resolving the problem of nuclear waste disposal by finding a political solution that the United States Congress, the President of the United States, and the American public find agreeable.

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## DEDICATION

To mom and dad, thank you

for always believing in me.

To my family, thank you

for your encouragement.

To my friends, thank you for a good laugh

when it seemed like this thesis might not happen.

I love you all.

JMJ

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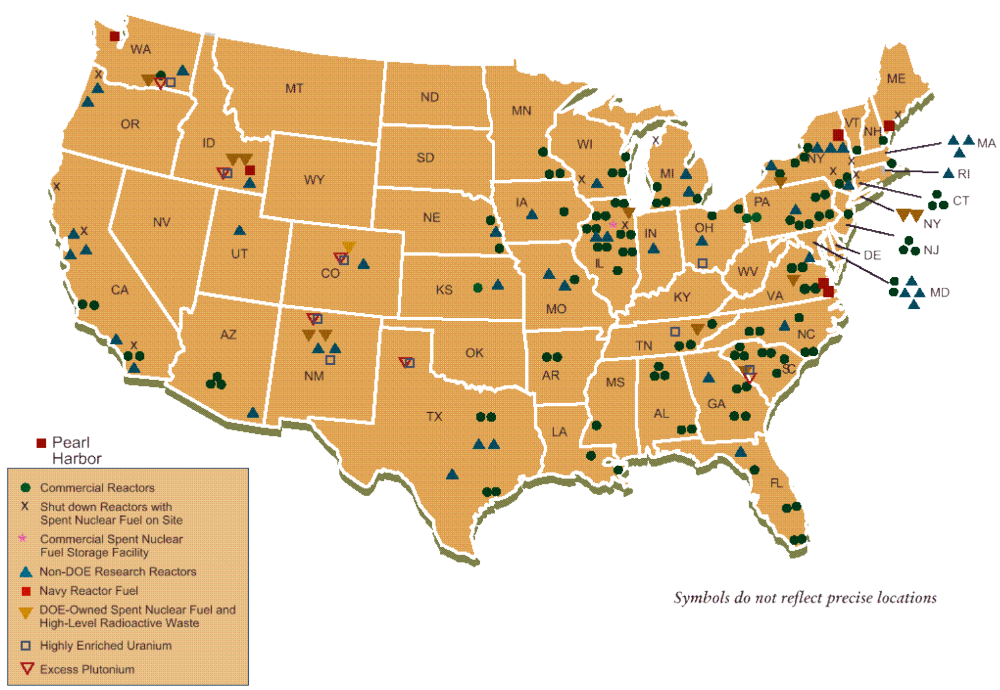
INTRODUCTION

Since the advent of nuclear power in the United States, an effective method for the disposal of high-level nuclear waste has not been successfully instituted. This delay has led to an accumulation of more than 70 thousand tons of nuclear waste scattered in more than 100 locations throughout the continental United States. Figure 1 depicts the distribution of these nuclear waste sites.

Figure 1

**Locations of Spent Nuclear Fuel and High-Level Radioactive Waste Destined for Geologic Disposal**



Numerous technological, engineering, and economic challenges have hindered the solution of the nuclear waste problem. Recycling methods that were believed advanced enough to deal with the nuclear waste were proving complicated in the early days of their application. These methods created safety hazards for workers and drove repair and other facility costs up. These challenges are compounded when the political aspects of nuclear waste disposal are taken into account.

The political solutions that have been implemented to solve the nuclear waste problem have resulted in the disregarding of potentially viable disposal methods while embracing other methods that have proven controversial and politically unfeasible. Technical challenges can be overcome with the passage of time and innovation. Examples of this are the breaking of the sound barrier, the moon landing, and, recently, the landing of probes on Mars. These government-sponsored technological achievements, while encountering obstacles, eventually developed technical solutions to achieve their goals. However, each one also required political support to continue government funding of the research and technology to reach those goals. The kind of political support these endeavors received has been lacking in nuclear waste disposal, creating a major stumbling block that has hindered resolution of this problem for the last 40 years.

One of the most significant political attempts to address nuclear waste disposal was made in 1978 when President Carter formed the Interagency Review Group on Nuclear Waste Management (IRG). Composed of representatives from over a dozen government agencies, including the newly created Department of Energy, the IRG's task was to study available disposal methods and recommend a policy for the final disposal of the nation's nuclear waste to the President. Among the IRG's findings was the recommendation of the disposal of high-level nuclear waste in long-term geologic repositories.

Another option weighed by the group, the recycling option known as reprocessing, was rejected not only by President Carter, but also by his predecessor Gerald Ford. Concerns over nuclear proliferation and the potential terrorism liability created by the radioactive by-products of the reprocessing stage shaped both presidents' positions. The IRG's findings also concurred with both stances position on reprocessing. Some of the IRG recommendations, including geologic disposal, were later adopted in the Nuclear Waste Policy Act of 1982 passed by Congress and signed into law by Carter's successor, President Ronald Reagan.

The 1982 Nuclear Waste Policy Act required studies to be made of a number of potential disposal sites around the United States. This included such provision as the consideration of different geologic media for a repository and the use of monitored-retrievable storage facilities that would serve as temporary storage for nuclear waste before final shipment to the repository. After several years of slow progress, amendments made by Congress to the Nuclear Waste Policy Act in 1987 eliminated a number of the 1982 provisions and restricted repository study and characterization to a single site: Yucca Mountain in Nevada. This action was met with outrage from environmental groups, citizens of Nevada, and the state's political establishment; it led these groups to take action. In addition to lawsuits, transportation issues, and terrorism concerns, the growing political influence in Washington among Nevada's congressional delegation helped contribute to the eventual stalling of Yucca Mountain's progress and the disposal of the nation's high-level waste.

Constant obstructions to the construction of a permanent waste repository, from political and legal fronts, have done nothing to address fact that nuclear waste has been accumulating and will continue to accumulate while the United States continues to use nuclear power. Furthermore, even if the use of nuclear energy in the United States ceased, the problem of high-level nuclear waste would still persist; elements present at storage sites in the United States will remain highly radioactive anywhere from several hundred to several million years. In the years since the 1987 amendments, significant and substantive policy work on nuclear waste disposal has largely remained in the political background. The September 11th attacks likely inspired a brief movement in policy, but court challenges by the state of Nevada stemmed that advance as well. It was not until 2010 that another President brought this issue to the forefront once more.

In his 2010 State of the Union Address, President Barack Obama pledged to increase the use of nuclear power in the United States to help in the reduction of fossil-fuel emissions. He later established a Blue Ribbon Commission headed by Secretary of Energy Steven Chu. The purpose of the commission was to propose recommendations on how to best dispose of the nation's nuclear waste, thus allowing the United States to increase its nuclear energy capacity. The establishment of this commission came after President Obama approved a significant defunding of Yucca Mountain, effectively halting, but not ending, the program. The formation of the commission also marked the first time since President Carter that a sitting president has actively taken a leadership role in helping to develop nuclear waste policy.

Despite this interest in nuclear waste policy reform, the reprocessing of nuclear waste, as well as a related method, transmutation, was rejected by the Obama Administration. Transmutation of nuclear waste has the potential to render inert several types of radioactive elements and decrease the amount of time the waste would be radioactive. However, like reprocessing, this method possesses the same potential vulnerabilities that could be exploited by terrorist agendas.

Similar to the IRG, the Blue Ribbon Commission has recommended a renewed effort for temporary storage of nuclear waste and the need for a permanent repository. One aspect that distinguishes the Blue Ribbon Commission from its predecessor is that the commission, while cautious of the potential for proliferation, has expressed interest in long-run efforts for future innovation into reprocessing and other nuclear waste disposal technologies.

Another characteristic the commission exhibited was a drastic departure from the federal government's manner of dealing with potential repository host sites in the past. Lack of consultation with the public, the practice of the Atomic Energy Commission (a precursor agency to the Department of Energy) to ignore concerns from communities located near potential repository sites, and the "not-in-my-backyard" mentality in Congress that approved the 1987 Nuclear Waste Policy Act Amendments were among several actions that created strong resistance to the citing of a repository. In contrast to this, the Blue Ribbon Commission has placed a greater emphasis on addressing local and state concerns through a consent-based approach.

While this new focus on more open communication between the United States government and state and local officials at potential repository sites is a marked improvement from past dealings, the possibility of resistance to nuclear waste storage sites by citizens and elected officials still exists. The experience in establishing Yucca Mountain as the nation's nuclear waste repository and past clashes between federal and local officials have yielded a great deal of evidence to support this claim. Furthermore, while the Blue Ribbon Commission's assessment is that alternative disposal methods are too costly and underdeveloped to be considered in the near term, it has not accounted for the political will of the United States Congress to support such efforts when faced with the political challenges presented by geologic disposal.

While there is an abundance of literature on the history of nuclear waste policy, numerous evaluations of the technical and economic aspects of different nuclear waste disposal methods, coverage by national and local media on nuclear waste, and records of Congressional debate on the issue, the political aspects of nuclear waste have not yet been explored in the manner that this study utilizes.

The purpose of this study is to help develop a general framework that assists in determining to what degree the stakeholder concerns of transport safety, site safety, economic effects, costs and benefits, the desire to host a repository, and fairness in determining a repository site have influenced members of Congress in forming their preferences for nuclear waste disposal methods. These stakeholders are anti-nuclear groups, elected officials in states along nuclear waste transportation routes, and Nevada lawmakers and citizens.

Much has been written documenting the politics and history of nuclear waste disposal, the efforts to come to a solution, and resistance by the public. Much has also been written on the potential dangers of alternative nuclear waste disposal methods and their higher costs when compared to the repository method of disposal. What has not yet been performed is a statistical analysis of the positive and negative preferences of members of the United States Congress when discussing repository storage and alternative nuclear waste disposal methods. A greater understanding of Congressional positions on nuclear waste disposal methods and what influences these positions may assist in the development of a political solution to the problem of nuclear waste.

This thesis tries to determine:

1. If the above-mentioned concepts emphasized by stakeholders are also emphasized by the United States House of Representatives and Senate Energy Committees.
2. If those concerns shared by the stakeholders and Energy Committee members are significant in shaping the nuclear waste disposal preferences of the United States House of Representatives and Senate Energy Committees.
3. If each concern shares a significant positive, negative, or indifferent relationship with one or more nuclear waste disposal methods.

The first chapter of this thesis will present a historical overview of nuclear waste policy in the United States. This will be used to highlight various stakeholder concerns that have been repeatedly voiced in the debate over nuclear waste policy. It will also highlight methods of nuclear waste disposal that have been proposed as possible alternatives to geologic repository storage. Highlighting these variables will set the stage for the processes in Chapter 2.

The second chapter will take the concerns and disposal methods found in Chapter 1 and use them as variables in a content analysis. The statistical tools used for evaluating the concern and disposal method variables will be explained in depth as well.

Chapter three will discuss the results of the analysis and the findings.

Chapter four will conclude the thesis by comparing and contrasting the findings with the Blue Ribbon Commission report that supports the status quo of a geologic repository for nuclear waste.  A possibility exists that the President could be influenced by the recommendations of his own committee and could possibly adopt the Blue Ribbon Commission findings as policy.

The results of this study will allow for an examination of the ethical challenges confronting the President should he adopt the Commission recommendations and should Congressional preferences run contrary to those recommendations.

Chapter 2

# OVERVIEW

## Historical Overview

In the 1940s the Manhattan Project was created to construct a nuclear bomb that would end World War II. Since then, the United States has been generating radioactive by-products and waste with no viable method to safely dispose of it. After World War II and seeing the potential of the atom, the United States Congress passed the Atomic Energy Act of 1946. This established the Atomic Energy Commission (AEC), the focus of which would be the control of nuclear materials from the Manhattan Project. In addition to this, it was tasked with the production of nuclear materials for weapons as the Cold War with the Soviet Union began. It also started research into other uses for the new technology, including the generation of electricity.

The first nuclear power plant in the United States opened on May 26, 1958, with financial assistance from the AEC. In the following year, the AEC began to implement actions that focused on the reprocessing of spent nuclear fuel that would be generated at these plants. At the time, it was believed that the domestic supply of uranium needed to create the fuel rods that powered nuclear plants would soon become scarce. To this end, reprocessing was pursued with some urgency by the AEC to ensure a readily available supply of uranium. These early reprocessing plants, while receiving financial aid from the United States government via the AEC, were commercially owned. Over time, however, two realizations about the reprocessing method became known.

The first realization was that the United States would not be running out of uranium supplies as quickly as the AEC and the commercial industry had assumed (Carter 93). This development, while relieving the problem of depleting uranium supplies, was a blow to reprocessing in the United States: why would money and capital need to be spent on expensive, experimental technologies to recycle spent uranium fuel rods if there was still an abundant supply of uranium?

The second realization was that the engineering and capital expenditures put into developing the reprocessing technology were numerous with many risks. Problems of radiation leaks, unsafe working conditions, and poorly engineered facilities drove up capital costs as remedies were employed. The financial benefits of ultimately recycling the fuel were being far outweighed by the costs to the health of workers at the facilities, the cost of developing the technology, and the cost of running the plants themselves. In addition to engineering complications and funding justification was a problem that arose from the reprocessing of spent nuclear fuel in the United States: the by-products of the process.

When the spent uranium fuel rods from the fission process in a nuclear reactor are reprocessed, they yield a number of elements that remain highly radioactive, in some cases, for as long as several million years. Of these elements, the main concern was one element in particular: Plutonium 239. This element, when reprocessing of spent nuclear fuel is performed, is separated out and, due to its fissile nature, can be readily used in the creation of a nuclear bomb. This was a great concern to the United States, especially after 1974.

On May 18, 1974, the United States and Canada, two countries working directly with India in its nuclear energy effort, were surprised when the country successfully detonated a nuclear bomb of its own. It was this achievement by India as the first nation outside the UN Security Council with nuclear weapon capabilities, along with the arms race in the Cold War between the United States and the Soviet Union and negotiations on the Nuclear Proliferation Treaty that solidified nuclear policy direction in the United States (Carter 115-117). The United States continued assisting foreign nations that wanted nuclear power, but also wanted to balance that help by ensuring that rogue nations and factions did not acquire a nuclear weapon.

With the potential of nuclear proliferation setting a tone in international relations for several years, President Ford, five days before the 1976 presidential elections, declared a moratorium on the reprocessing of spent nuclear fuel by the United States (Ford 2763-2778). His immediate successor, President Carter, went farther in a speech in 1977 (Carter 587-588), when he called for the suspension of the reprocessing of spent fuel from civilian reactors by the United States government. The idea was for the United States to support the peaceful acquisition of nuclear power by friendly nations and set an example for other countries by not reprocessing nuclear waste and producing plutonium. The hope was to prevent the possibility of nuclear proliferation via reprocessing methods. President Carter's executive order led the successor agency of the AEC, the Department of Energy, to pull all funding for private industry dedicated to the reprocessing of spent reactor fuel.

It was in this same period that President Carter tasked the Interagency Study Group of the newly created Department of Energy to investigate what methods could be developed to deal with the problem of nuclear waste. Its study was influenced by earlier works and projects that had investigated the possibility of burying nuclear waste, particularly in salt formations near Lyons, Kansas, in the early 1970s. While the Lyons, Kansas effort ultimately failed because of opposition from the host community due to poor relations with the community on the part of the AEC, the use of geologic formation to store nuclear waste was still viewed as a sound method when the study group was formed (Carter 136-137).

The findings of President Carter's Interagency Study Group were released in 1979 with the conclusion that geologic disposal proved to be the safest method of disposing of nuclear waste, given the technology and costs at the time. The choice of geologic disposal was seen as the safest method of disposal due to the ability to isolate the nuclear waste from the population centers surrounding the nuclear plants, the ability to locate the waste in an area with many natural barriers to contain radiation released by the stored waste, and the advantage of having a centralized location for storing the nation's waste. This disposal method was seen as superior to reprocessing in that it was safer, cheaper, and proliferation resistant.

The Interagency Review Group's findings heavily influenced the Nuclear Waste Policy Act, passed by Congress in 1982. After much debate and several compromises on the development of a construction timetable and a scheduled opening of the facility, the method of using a permanent geologic repository prevailed.

Some of the provisions of the Nuclear Waste Policy Act of 1982 were:

- Geologic disposal would be the method employed for the permanent disposal of nuclear waste (Nuclear Waste Policy 6965).
- Under the guidance of the Department of Energy, five potential sites would be chosen to determine if they would be suitable for scientific evaluation for the

repository. Of these, three of the sites would be recommended to the President of the United States for the actual scientific evaluation (Nuclear Waste Policy 6965).

- The Secretary of Energy would recommend a site to the President who, in turn, would submit a recommendation to Congress who would then approve or disapprove of the site. The governor and legislature of the selected state would have a 60 day window to disapprove of the action and send their disapproval back to Congress for further consideration. Congress would then have 90 days after the disapproval to reconsider the site recommendation and either side with the governors' disapproval or approve the site and override the disapproval (Nuclear Waste Policy 6973)
- Acceptance of nuclear waste would begin in 1998 after the Department of Energy submits two licenses to the Nuclear Regulatory Commission to begin construction and accept waste (Nuclear Waste Policy 7004-7005).

A year later, the Department of Energy recommended nine sites in several states around the country suitable for hosting a repository. Among these was Yucca Mountain in Nevada. While the recommendations were being made, progress on the timetable finding suitable sites for the monitored-retrievable storage facility and the repository was slow to occur. This caused the Congress to act once again, and in 1987, the Congress passed amendments to the Nuclear Waste Policy Act of 1982.

The new amendments were included to fast-track the progress on the repository. The major provisions established by amendments to the Nuclear Waste Policy Act of 1982 were:

- The delay of constructing a monitored-retrievable storage facility until a geologic repository is licensed for construction (Nuclear Waste Policy 6987-6992).
- The elimination of eight of the nine potential sites for scientific study (Nuclear Waste Policy 6692).
- The designation of Yucca Mountain as the only site that would be characterized and recommended as the site of the repository (Nuclear Waste Policy 6692).

These provisions worked to the advantage of politically powerful states like Texas, Louisiana, Washington, Tennessee, and Mississippi by ensuring that nuclear waste would not be permanently stored in their states (Vandenbosch 86). The amendments left the less politically powerful state of Nevada with the burden of storing the nation's nuclear waste. As would be expected, there was resistance to this. The most notable objectors were elected officials and citizens of Nevada.

The delays persisted and continued as Nevada Senator Harry Reid gained greater influence in the Senate. Ultimately, he rose to the rank of Senate minority leader and later, when Democrats won the Senate in the 2000s, majority leader. His influence helped to block the passage of Yucca Mountain as the repository for the nation's nuclear waste.

After the events of September 11, 2001, the Bush Administration in 2002 approved Energy Secretary Spencer Abraham's recommendation for Yucca Mountain as the nation's nuclear waste repository and sent it to Congress for approval. Despite the efforts of the Nevada delegation led by Senator Reid, Congress gave approval for Yucca Mountain and sent the approved legislation to Governor Kenny Guinn and the Nevada legislature for them to voice their approval or disapproval of the measure in the 60 day time period allowed by the Nuclear Waste Policy Act. Governor Guinn and the Nevada legislature sent Congress their disapproval and testified at energy committee hearings to make their case against the use of Yucca Mountain as a nuclear waste repository site. Despite Nevada's elected officials and community representatives making their case in opposition to the repository, Congress upheld the approval of Yucca Mountain as the nation's nuclear waste repository. Even with this action, however, repository construction was quickly stalled due to complications from a legal standpoint regarding the Environmental Protection Agency.

The Environmental Protection Agency (EPA) was responsible for setting the performance standards that would guide the Nuclear Regulatory Commission's evaluation of the DOE's license application for the Yucca Mountain site. The EPA standard would be used to determine how long the site would be safe for the general public. Its original recommendation was set for 10,000 years of protection. This standard went contrary to recommendations proposed by the National Academy of Sciences, which stated that the expected radiation doses per year would rise rapidly after 10,000 years and reach their highest peak in 300,000 years. The EPA's refusal to change its estimate forced the state of Nevada to file lawsuits against the agency shortly after the approval of Yucca Mountain by President Bush in early 2002. The state of Nevada lawyers argued that the 10,000-year safety standard was arbitrary and should be adjusted to comply with the National Academy of Sciences recommendations (Vandenbosch 183). In July of 2004, the United States Court of Appeals for the District of Columbia ruled in favor of Nevada in regards to the radiation standards. In 2005, the EPA amended the original standards to comply with the findings of the National Academy of Sciences (Federal Register 49014).

In July 2011, the Blue Ribbon Commission on America's Nuclear Future (BRC), a commission appointed by President Obama in 2010 to study the current state of nuclear waste disposal and headed by Energy Secretary Steven Chu, released its preliminary findings in a draft report that was given to President Obama in early 2012. The recommendations, which may set the administration's policy in regards to nuclear waste disposal, recommend geologic disposal as the chosen method for dealing with the country's nuclear waste. The recommendations propose a more open, consent-based approach to negotiating the placement of future repository sites around the United States. While this is a great improvement on the top-down attitudes of the past, the Blue Ribbon Commission's recommendations are still promoting a disposal method that entails much controversy and public resistance.

## Literature Review

A survey of the available literature reveals a number of recurring themes in the American public's overall concerns about nuclear waste policy and the Yucca Mountain repository.

## Transportation Safety Concerns

### *Transportation Accidents*

Throughout the 1970s, even before the Nuclear Waste Policy Act and the establishment of Yucca Mountain's repository, the American public showed concern about the possibility of an accident occurring with nuclear waste. As Samuel Walker states in his book *The Road to Yucca Mountain*:

> [T]he transportation of nuclear materials emerged as an increasingly prominent public concern. Since the 1940's, the AEC had shipped various radioactive materials…without causing serious accidents that endangered public health. It was confident that the experience it had gained and the precautions it had developed provided ample protection against hazardous occupational or public exposure to radiation sources in transit. Nuclear critics were not convinced, however, and the transportation of spent fuel rods became another in a series of controversial issues that surrounded the safe storage and disposal of radioactive waste. (Walker 142)

Walker then presents the legal problems associated with the transportation of nuclear waste in the 1960s and 1970s. Radiation exposure from potential accidents with rail cars and trucks on highways were a great concern in northeastern and mid-western areas. Many did not want these routes going through their counties or cities, especially the larger metropolitan cities with the greatest possibility of fatalities. New York City was particularly vehement in its disapproval of waste transport from the nuclear facilities near the Hudson River through the metropolitan areas. Some citizens at public hearings went so far as to threaten government representatives with violence (Walker 158).

Drop tests, fire tests, and other "torture tests" had been performed on simulations and models of the transportation containers in which the spent fuel would be transported. These tests proved that the containers were successful in securing the contents inside (Walker 152-153). Even still, these successes did nothing to alleviate the past and current concerns related to the health and safety risks.

*Radiation Exposure in Transit*

In addition to the concerns of an accident, a number of cities voiced concerns about increased radiation exposure, including cities in Nevada. They reasoned that with regular deliveries of nuclear waste from regional sites to Yucca Mountain, residents along those paths would be exposed to greater amounts of radiation than normal. These concerns came mainly from residential areas where trucks carrying the spent fuel in their protective containers would be passing by. A State of Nevada website best summarizes this concern of dosage.

> Even after ten years of cooling, spent nuclear fuel emits dangerous levels of gamma and neutron radiation. A person standing one yard away from an unshielded spent fuel assembly could receive a lethal dose of radiation (about 500 rems) in less than three minutes. A 30 - second exposure (about 85 rems) at the same distance could significantly increase the risk of cancer and/or genetic damage…Routine exposures become especially problematic in situations where the transport vehicle is caught in heavy traffic with cars and other vehicles in close proximity for extended periods. Routine exposures also are of concern when the cask vehicle is stopped for repair, fueling, inspections, etc…The health effects of low level radiation are poorly understood. There is evidence that even small amounts of radiation can have long-term health implications. The potential effects of repeated exposures to large numbers of nuclear

> waste shipments along highways or railroads during the 25-year repository emplacement phase have not been adequately addressed and could have adverse health consequences for certain segments of the public. (State of Nevada Nuclear Waste Project Office)

These are concerns that can be traced to the earlier objections to transportation through metropolitan areas. Even without an accident, there is a public perception that radiation emitted from passing trucks in such volume could still create a danger to the public, especially from terrorism.

*Terrorism Concerns*

Two things can be observed about terrorism concerns. The first, as has been previously stated, is that the rejection of reprocessing spent nuclear fuel and transmutation would alleviate the concern of a terrorist group obtaining a nuclear bomb from spent fuel. If the fissile material, specifically Plutonium 239, is not separated from the nuclear waste as it would be if reprocessed, there is no danger of a terrorist group's obtaining the material.

The second observation is that Uranium 235 and Uranium 238, the fuel used in a nuclear reactor, are not enriched to a high enough level to be of any danger. The uranium used in a nuclear fuel assembly is enriched at 4 or 5 percent purity. This is enough to allow for a nuclear chain reaction in the reactor chamber of a nuclear power plant. In order to be used in a nuclear bomb, the uranium would have to be enriched to over 95 percent purity. This would be difficult for a terrorist group to do in secret, given the resources and complex machines needed to perform the task and the radiation leaks generated by such activity. In addition, other resources would be needed to hide the transportation of the waste and cover up the trail such a theft would leave behind. This is not to say that terrorism is not a concern as it is intertwined with the health and transportation concerns previously voiced.

With that said, the problem that terrorism poses to the transportation of waste is the potential for breaching the protective container of the shipment. Consideration of this hazard was heightened after the terrorist attacks of September 11, 2001. A report by the Department of Energy entitled the Final Environmental Impact Statement for Yucca Mountain (FEIS) was released shortly after the terrorist attacks. This was a document that was part of the review process of Yucca Mountain for the President and Congress, leading to their approval for the repository. It was timely in its analysis, but not as satisfying to the public in regards to terrorism. Robert and Susan Vandenbosch, in their book *Nuclear Waste Stalemate*, make the following analysis:

> Of heightened interest since the September 11, 2001, attack is the possibility of a terrorist attack during transportation. Although the FEIS was published some months after the attack, most of the analysis in it was performed prior to the attack. The report does include the possible consequences of a saboteur 'using a device' on a truck or rail cask. It concludes that such an event could cause 48 latent cancer fatalities in an assumed population of a large urban area. Not considered is the impact of possible panic induced by public fears of nuclear radiation. As a consequence of the September 11 attack, the DOE and other agencies are reexamining safety and security issues for transportation shipments. (Vandenbosch 205)

These concerns about transporting nuclear waste are not limited to transit. Terrorism, accidents, and health exposure also extend to the ultimate destination of the waste.

**Site Safety Concerns**

Once the nuclear waste arrives at the facility for final disposal, it will still carry many of the same concerns that it did in transit. Waste stored in a repository such as Yucca Mountain will have numerous concerns about its ability to contain radioactivity.

Walker in *The Road to Yucca Mountain* and Carter in *Nuclear Imperatives* chronicle the failed efforts in the first attempt at a geologic repository in Lyons, Kansas in the early 1970's (Carter 65-71; Walker 51-75). In their books, both authors discuss the concerns of citizens that nuclear waste would be stored in their community. While the science of disposing nuclear waste in the Kansas salt formations was sound, AEC representatives pressed on with their recommendations for a storage facility and ignored calls from the community in opposition to it. The efforts were ultimately discouraged when it was found that the salt formations that were going to be the testing ground for the storage of waste had pre-existing drill holes and were near oil deposits as well. The possibility of groundwater infiltration or accidental drilling could have created a disaster.

Carter goes further in *Nuclear Imperatives* when he mentions opposition to sites in Michigan, Ohio, New York, Utah, and Texas among others. Many of their proposed disposal or test sites were located near areas important to farming or groundwater, or near populated areas (Carter 147-165).

**Economic Effects on a Community**

In the book, *Public Reactions to Nuclear Waste*, the authors of the study make several conclusions about the problems affecting the population of Nevada. One of their conclusions is that "[i]f a repository were to be sited at Yucca Mountain, Nevada, the city of Las Vegas and the state would likely suffer substantial economic losses due to a significant convention decline" (Dunlop, Kraft, and Rosen 296). The observation is further evidenced in the Clark County Yucca Mountain Impact Assessment Report sponsored by Clark County Nevada. The study was conducted in 2002 and came to the following conclusion in regards to environmental impact on gaming and tourism in Las Vegas:

> The study indicates that if only 4.5% - 5.7% of current visitors decide to no longer visit Las Vegas because of these shipments, losses in gaming revenues would fall by more than one-half billion dollars. If 10.0% - 15.0% of the current volume of visitors decided to vacation elsewhere because of the shipment campaign, gaming revenue losses would likely grow to between $1.1 billion to $1.7 billion. Such losses might have been considered unprecedented prior to September 11, 2001. However, the terrorist attacks that occurred over two thousand miles away from Clark County resulted in dramatic drops in revenues for the gaming industry and in gaming tax revenues for state and local governments. If losses of this level were to be sustained for a prolonged period, the effects on the bottom line would be grave for a number of facilities. In the event of a severe, prolonged downturn such as could result from a high level radioactive nuclear waste shipment accident, the gaming revenue losses could reach $2.8 billion to $3.7 billion over one year. (22)

These results were obtained within two weeks of the September 11, 2001, attacks. They were the result of a survey by a private company contracted by Clark County that questioned over a thousand tourists after the September 2001 attacks. These responses from tourists reflect fears expressed by several gaming CEO's also surveyed in the Clark County Yucca Mountain Impact Assessment Report in regards to Yucca Mountain (19; 53). Intertwined with this is the recurring problem of transportation. These results reveal some of the more focused consequences, in this case economic losses to the city of Las Vegas that could result from a transportation accident involving nuclear waste. These reactions from the surveyed tourists may reflect the fears that many residing in the area may harbor if an accident were to occur.

## Cost-Benefit Concerns

Disposing of nuclear waste in a repository has proven to be a difficult concept to sell to inhabitants in the vicinity of a possible site. As has been demonstrated in terms of short run complications from the standpoint of transportation and safety concerns, there are problems of logistics that need to be addressed. The previous section has shown that guarantees of safety to the public from radiation exposure during transport cannot be fully realized. Cities and states, regardless of reassurances, will fight efforts to allow the waste to pass through their territory so long as there is even a remote possibility of an accident or repeated or prolonged exposure to radiation from the shipments. The post 9/11 survey conducted by Clark County in Nevada on the economic impact on Las Vegas underscores this point.

Proper compensation is an issue with short and long-term aspects. In the short run, if a community is economically harmed by the proximity of a nuclear waste repository, what would constitute proper compensation? Can a community truly be compensated for lost jobs and revenue and other consequences a waste repository could bring? This question highlights the potential long-term stigma about a region if a nuclear waste facility is constructed. There would be a permanent loss of economic opportunities that would require compensation.

## Desire for a Nuclear Facility

As has been evinced, there was a tremendous amount of resistance by Nevada. This phenomenon would hold for any community that was subjected to the same kind of force by the government. The Blue Ribbon Commission's open approach to siting future nuclear waste repositories does acknowledge this problem, in a way.

> [D]ecision-makers will need to balance competing interests, make trade-offs in the face of uncertainty, and be willing to move forward without full consensus. In these cases, stakeholders and the public are entitled to a clear understanding of how decisions were reached and how different values and interests were considered and resolved in the process. (7)

Other parts of the BRC study also point to success with the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico as an example of how an open approach to a community can work (Blue Ribbon Commission 48-49). WIPP, a testing ground for the geologic disposal of nuclear waste, was approved by both houses of Congress in October of 1992 with the Waste Isolation Pilot Plant Land Withdrawal Act. While it has been welcomed by the community as an economic stimulant, the desire for the waste has a condition attached to it that was included in the WIPP Land Withdrawal Act: High-level nuclear waste (the kind that would be stored at Yucca Mountain) would not be stored at WIPP. Any attempts to do so have met with resistance by the surrounding community near Carlsbad (Carter 186).

While being sensitive to the concerns of the community in their report, the BRC still sees the need to force a decision "without full consensus" (Blue Ribbon Commission 7) for future nuclear waste repositories. The resistance shown to the Yucca Mountain Project should force a reconsidering of disposal options. If a community does not want to host a site, no amount of tactics and force, may convince it to accept the proposition otherwise. It was force in the 1987 Nuclear Waste Policy Amendments that galvanized Nevada to resist the repository. It was the arbitrary EPA rules that forced Nevada to file suit against the government in another effort to halt Yucca Mountain's progress.

**Fairness**

While not the geologically ideal place for storing radioactive wastes, Yucca Mountain is isolated, for the most part, from the general population. It is in an arid region and could be easily protected from infiltration by terrorists. However, this fact does not necessarily address the idea of fairness.

The idea of fairness as described in the literature looks at preserving intergenerational equity: not allowing the mistakes of the present generation in regards to nuclear waste to place a greater burden on future generations (Vandenbosch 6). While an ethical consideration, the problem of fairness has one other aspect. That question is: Why should a state that has no nuclear power plants be the sole repository for the entire country's nuclear waste? A focus has been placed on functionality and the suitability of the Nevada desert for a storage facility, but the consideration of "why Nevada?" is sometimes lost in the debate. Since the 1987 Amendments, the state of Nevada, by all accounts, seems to have been selected because its Congressional delegation was not strong enough to resist the policy; it was given the repository by default. This consideration of non-use of nuclear power is another aspect that must be considered before a nuclear waste disposal method is considered.

The literature review points to six concerns that particular stakeholders in the American public voiced in regards to the disposal of nuclear waste in a geologic repository.

1. Transportation safety of nuclear waste at a host facility
2. Site safety of a host facility
3. Economic impacts to the region due to the presence of a nuclear waste repository
4. Costs and benefits of having a nuclear waste repository around or near a community

5. The desire of a community to host a repository facility
6. Fairness in citing a nuclear waste repository, especially if a community does not have nuclear facilities of their own

The stakeholders holding these concerns are citizens along transportation routes, citizens near nuclear power and nuclear waste facilities, citizens and elected officials in potential repository sites, and the citizens and elected officials of the state of Nevada.

With the nature of nuclear waste as a highly radioactive substance, it can be assumed that these concerns, voiced by these stakeholders, would also apply, not only to the disposal of nuclear waste in a geologic repository, but also to alternative disposal methods as well. The historical overview makes mention of four alternative methods of nuclear waste disposal:

1. At reactor storage (also called On site)
2. Interim storage (also called monitored retrievable storage or MRS)
3. Reprocessing
4. Transmutation

The above disposal methods, which also include repository storage, may have different ways of containing nuclear waste, but they all must deal with the major problem of nuclear waste: containment of radioactive material (Carter 9-39).

The six concerns developed from the literature for the study to follow are used to create a model describing the major factors shaping the political environment on nuclear waste disposal. If one or more of these four alternative disposal methods exhibits strong, positive sentiment among the six concerns listed, the alternative disposal methods could serve as viable alternatives to a geologic repository.

A clue to how well accepted these disposal methods are may lie in the disposal method preferences of the elected members of the United States House of Representative and the United States Senate. It is also in the House and the Senate that legislation on the disposal of nuclear waste will ultimately be decided. Information on these preferences may yield insight into a possible political solution to the final disposal of spent nuclear fuel in the United States. A framework depicting these preferences may indicate agreements and disagreements on the different disposal methods between the House and Senate. Agreement between these two houses on an alternative would present a potential way forward in the progress of nuclear waste disposal.

# Chapter 3

## DATA AND METHODS

The data to be analyzed comes from transcripts of questions and statements from members of the energy committees of the United States House of Representatives and Senate. The energy committees of the two houses of Congress have been chosen as the source of the data to allow for a timely collection of manageable data for this thesis. To obtain useful data, content analysis will be applied to the transcripts.

An obvious route to collecting Congressional data would be to conduct a survey of the preferences of all 535 members of Congress based on variables found in the literature. This approach, however, would take a great deal of time and effort. Furthermore, the data collection would be complicated due to the busy nature of the elected officials and their staff; the rate of response would probably be low. The same might be true even if the sample size was decreased to include only members of the House and Senate energy committees; combined, they would number more than seventy members. By using transcripts, the statements and types of questions asked by members of Congress may provide a reflection of their own preferences. With this type of information, the use of transcripts as a data source avoids the problem of the long data collection process a survey would require. In addition to this, the limiting of the data source to the energy committees in both houses also accounts for congressional procedure and the chances of legislative approval of bills that could be associated with the issue.

Legislation initially introduced on the floor of the House or the Senate is referred to a relevant committee. That committee conducts hearings and investigations specific to the proposed legislation to determine its merits. The remarks from the legislators and those testifying are transcribed for future reference. Transcribed statements and questions from the House and Senate energy committees would help determine the preferences of the committee members for different methods of nuclear waste disposal.

If proposed legislation makes it out of the committee, it may have a greater chance of being considered on the floor of the respective house it was introduced in. While it may not be a guarantee of passage, the passing of legislation out of a committee to the floor allows the measure to be considered by the particular house of Congress.

The surveyed transcripts will range in date from the 106$^{th}$ Congress beginning in 1999 to the 112$^{th}$ Congress ending in November of 2012. Ranging the data from 1987 (the year Yucca Mountain was singled out as a repository) to 2012 (the current year) would include a large amount of superfluous data; major legislation affecting nuclear waste disposal does not arise between the time of the 1987 Amendments and the September 11, 2001, attacks. The September 11$^{th}$ attacks led to an increase in domestic security measures employed by the United States government that has continued to the present. I assume a much more relaxed sense of security in the period before September 11, 2001. Starting the sampling period with the Congress of 1999 would still capture the relaxed, pre-war state of affairs in the Congress and would suffice in accounting for the political environment before and after September 11. The acceptance of geologic disposal or on-site nuclear waste storage may increase in this period due to terrorism concerns associated with the alternatives of reprocessing or transmuting nuclear waste.

November 2012 is chosen as the end of the sampling period. I assume an election year may place a greater concentration by Congress on advancing ideological legislation that assists candidates running in the election. With issues like nuclear waste likely to be given less emphasis, the availability of data may decrease, thus creating a natural cut-off for the data collection bounds.

Selection of a transcript to be surveyed was dependent on the presence of the phrases SPENT FUEL, NUCLEAR FUEL, NUCLEAR WASTE, AND NUCLEAR. If any one of these phrases or if the total combined number of these phrases equaled at least 30 observations, the transcript was chosen for the content analysis. This is a rule of thumb from statistical analysis (Dielman 40-41).

The literature-based concerns that will be searched among the remarks of the committee members in the transcripts are as follows:

- Transportation risks
- Site safety
- Negative economic impacts to the region
- Fairness
- Cost-benefit calculus of disposal methods
- Desire for repository storage

Political party membership will also be accounted for because of the opposing positions taken by Republicans and Democrats on the nuclear issue: Republicans have been more in favor of nuclear power and its continued use while Democrats are more opposed to the technology (Carter 120; Walker 106-107). Whether the representative is from a state that uses nuclear power will be accounted for as well in a dummy variable.

Relationships will be explored between the six literature-based concerns listed and the following nuclear waste disposal methods:

- Geologic repository storage
- Reprocessing
- Transmutation
- On-site storage
- Monitored-retrieval storage

Extracting information on the six literature-based concerns will occur through a content analysis of the committee transcripts in the previously specified sampling period of 1999 to November 2012. The concern variables and disposal methods will be coded as dummy variables with 1 denoting that a particular method is being discussed at that moment in the transcript and 0 denoting the other methods that are not being discussed at that moment. The same procedure will be applied to the concern variables with 1 denoting a discussed term and 0 denoting the other concerns that are not being discussed. Figure 2 depicts a portion of the data table to better explain the procedure.

Figure 2. Depiction of View, Disposal Methods, and Concerns as Dummy Variables

| View | **Repository** | **Onsite** | **Transmutation** | **Reprocessing** | **Interim** | Site Safety | Transportation Risk | Desire for Facility | Cost-Benefit | Fairness | Economic Effect |
|---|---|---|---|---|---|---|---|---|---|---|---|
| -1 | **1** | **0** | **0** | **0** | **0** | 0 | 1 | 0 | 0 | 0 | 0 |

Here, the method **Repository** is being discussed and a concern that it is being related to at that moment in the text is **Transportation Risk**.

Positive, neutral, and negative preferences linking concern and disposal methods will be coded from a -1 to 1 scale as depicted in Figure 2. Positive will be 1, neutral will be 0, and negative will be -1.[1] Figure 2 depicts a relationship between Repository and Transportation Risk seen in a negative way by a senator or representative.

In the House of Representatives, the variables political party, district with a nuclear facility, state with a nuclear facility, and state with nuclear power will be included. Figure 3 shows how these three variables will be depicted.

Figure 3. Depiction of Partisan and Geographic Variables as Dummy Variables

| Party | District | State Power | State Waste |
|---|---|---|---|
| 1 | 1 | 0 | 1 |

Here, a Democrat is making the statement (Democrat will be coded as 1 while Republican will be coded as 0). The representative is representing a **District** with a nuclear facility (1 will mean "yes" if there is a facility while 0 will mean "no" if there is not a facility), they are from a state that uses nuclear power (1 will mean "yes" if it does use nuclear power while 0 will mean "no" if it does not use nuclear power), and they are

[1] Discrete variables were used for simplicity in measuring negative, neutral, and positive views. The -1 and 1 values can be interpreted as extreme views of congress members and senators. This range could, in future studies, be composed of continuous variables along a scale where -1 and 1 values are extreme, unflinching support or disapproval and the values between represent views that are between extremes and possibly open to change in view. Future studies could explore this measurement of views.

from a state that stores nuclear waste (1 will mean “yes” if waste is stored there while 0 will mean “no” if waste is not stored there). The Senate analysis will be the same with the exceptions of the “district” variable, as senators represent an entire state rather than a single district.

From these results, descriptive statistics were generated. Depicted are the mean ratings of positive, neutral, and negative preferences of a particular method being discussed by a senator or representative. In addition to this, the descriptive statistics table shows the percentages of mentions each disposal method and concern were given by members of the House and Senate. It also depicts the percentages of Democrats making statements (since Democrats are given a dummy variable of 1 and Republicans a dummy variable of 0, Democrats will be the only directly measured party; the percentage makeup of the Republicans can be determined by subtracting the Democrat percentage from 1), percentages of senators and representatives coming from a state that uses nuclear waste, percentages of senators and representatives coming from a state that stores nuclear waste, and, in the case of House members, if that member’s district has a nuclear facility. This table would also yield information on what methods and concerns received the greatest and least mentions in the transcripts. It will also depict the mean **View** rankings of each disposal method. This ranking will help determine the strength of the views expressed towards different disposal methods. This will depict any agreement or disagreement on disposal method views between the houses of Congress, indicating if consensus on alternative disposal methods exists.

A regression analysis will then be performed with the variable **View** (the positive, neutral, or negative perception of the method-concern relationship) as the dependent variable and the method, concern, partisan, and geographic variables functioning as independent variables. The relationship between these dependent and independent variables will determine what disposal methods and concerns are statistically significant in forming positive, negative, or indifferent attitudes in members of Congress. It will also show what effects party and the presence of nuclear waste facilities have on the perception of the methods-concern relationship and if these relationships are statistically significant.

Data extraction for the regression analysis via content analysis will proceed in the following manner:

1. Mentions of the disposal method terms will be noted in each transcript. A mention of a phrase or its synonym would signal either a random reference made in passing or the establishment of a theme of discussion at that particular point in the text. A subsequent mention of a different disposal method may likely signal a transition in the theme of the discussion from one disposal method to another. Partial phrases were used to encompass different suffixes that might be used in the text. For example, GEOLOG was used to find the phrase “geologic repository,” to broaden the possibility of finding other phrases that may refer to the geologic repository method, but are not the exact phrase “geologic repository.” This was done to ensure that the number of possible references to these disposal methods that may be missed in the content analysis was minimized. The disposal method terms used were:

- Geologic Repository: GEOLOG, REPOSIT
- Reprocessing: REPROC, FAST, BREED
- Transmutation: TRANSMU

- On Site Storage: SITE
- Interim/Monitored Retrievable Storage: INTER, MRS, MONITOR, TEMPOR (temporary storage), STOR

2. The six literature-based concerns will then be searched for within these disposal method theme intervals. Synonyms and variant phrases of the literature-based concerns will be included in the search. This will show associations, if any, between concerns that influence senators and representatives and the disposal method intervals developed in the previous step. The keywords searched for in the text were:

- Transportation Risk: TRANSPO, TRUCK, RAIL, TRAIN, RISK
- Economic Impact: ECONO, REVENUE
- Fairness: FAIR, EQUIT
- Site Safety: SAFET, SITE (the context of the phrase would determine if SITE referred to Site Safety or On Site Storage)
- Cost-Benefit: COST, BENEFIT, LOSS, PROFIT
- Desire for Facility: WANT, DESIRE, COMMUNITY

3. Following this, positive, negative, and indifferent adjectives associated with the literature-based concerns were searched for. This helped to establish if concepts found in the second data gathering stage are seen in a positive, negative, or indifferent light in relation to a specific disposal method.

All literature-based concerns were individually evaluated during the content analysis to determine if they were associated with the disposal method theme. Indifferent mentions are simply associations between a concern and a disposal method; the statement by the member of Congress merely associating the two concepts. It is not making a judgment of positive or negative in regard to their relationship, which is depicted in the data by a 0 in the variable **View**. A senator or representative may relate a concern to a disposal method, but it may just be an identification of a relationship, and not significantly affect a senator or representative's perception of a disposal method.

One data set will analyze the energy committee transcripts of the House of Representatives and the other set will be used for the energy committee transcripts of the Senate. Another reason for creating two sets of analysis is to determine the possibility of convergence or divergence in preference trends in both houses. If there is a trend of support in one house but not the other, there is a possibility that future legislation may not easily be passed for consideration by the President.

# Chapter 4

## ANALYSIS OF RESULTS AND WEAKNESSES

### Analysis

While some of the results appear to be weak, their exploration of other politically acceptable nuclear waste disposal methods should not be ignored. This study was conducted to determine the positive, neutral, and negative views of members of Congress when exploring their preferences between literature-based concerns and nuclear waste disposal methods. While there has been a vast amount of literature and history written about the subject of nuclear waste disposal, similar studies of congressional preferences in nuclear waste policy were not found. This study is a first step in observing these preferences. This study can be considered as a guideline for future research rather than a comprehensive study. Despite some weaknesses, the study can still be helpful in forming a framework for future studies of nuclear waste policy in Congress. Analysis of the descriptive statistics tables in Figure 4 and Figure 5 yields the following conclusions:

- There is mutual opposition in the House and Senate energy committees to On Site Storage and Interim Storage of nuclear waste. On Site Storage showed mutually strong mean values of the dependent value, View, of -0.714 in the Senate and -0.807 in the House, demonstrating a greater tendency for the variable View to be closer to -1. Mutual opposition to Interim Storage also exists in the House and Senate, but the degree of opposition between the two is not as strong: The Senate has a mean View of -0.600 while the House as a relatively less negative View of -0.167.

- There is disagreement between the House and Senate energy committee preference for Transmutation. In the Senate, there is a single positive data point for Transmutation while there is a -0.167 mean of View for Transmutation in the House. This is the depiction of Transmutation given the few data points in the set. More data would be needed for a more definitive result. It also depicts how little consideration this method is paid in the energy committees.
- There is also a disagreement between the House and Senate view of Repository Storage. The Senate has a negative mean of View with -0.233 while the House has a positive mean of View at 0.375. The division in the view of this disposal method is interesting to note because Repository Storage is the recommended method of disposal outlined in the Nuclear Waste Policy Act of 1982 and the 2012 Blue Ribbon Commission Report, yet there seems to be a lack of agreement between the houses of Congress on whether it is a positive or negative nuclear waste disposal method.
- Reprocessing is the only method that has demonstrated a mutual, positive agreement between the House (mean View = 0.105) and Senate (mean View = 0.333) energy committees.

Figure 4. Descriptive Statistics of Senate Disposal Methods

| Method | Mentions | View | Transport Risk | Site Safety | Desire for Repository | Cost-Benefit | Economic Impact |
|---|---|---|---|---|---|---|---|
| Reprocessing | 18 | 0.333 | 0.056 | 0.333 | 0.000 | 0.500 | 0.111 |
| Repository Storage | 30 | -0.233 | 0.433 | 0.267 | 0.167 | 0.100 | 0.033 |
| Interim Storage | 5 | -0.600 | 0.400 | 0.200 | 0.000 | 0.200 | 0.200 |
| On Site Storage | 7 | -0.714 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 |
| Transmutation | 1 | 1.000 | 0.000 | 1.000 | 0.000 | 0.000 | 0.000 |

| Method | Party | State Power | State Waste |
|---|---|---|---|
| Repository Storage | 0.367 | 0.267 | 0.800 |
| Reprocessing | 0.222 | 0.167 | 0.889 |
| On Site Storage | 0.286 | 0.429 | 0.857 |
| Interim Storage | 0.600 | 0.000 | 1.000 |
| Transmutation | 0.000 | 1.000 | 1.000 |

Figure 5. Descriptive Statistics of House of Representatives Disposal Methods

| Method | Mentions | View | Transport Risk | Site Safety | Desire for Repository | Cost-Benefit | Economic Impact |
|---|---|---|---|---|---|---|---|
| Repository Storage | 104 | 0.375 | 0.269 | 0.423 | 0.183 | 0.115 | 0.010 |
| Reprocessing | 19 | 0.105 | 0.000 | 0.316 | 0.000 | 0.632 | 0.053 |
| Interim Storage | 12 | -0.167 | 0.083 | 0.083 | 0.083 | 0.750 | 0.000 |
| Transmutation | 6 | -0.167 | 0.000 | 0.333 | 0.167 | 0.500 | 0.000 |
| On Site Storage | 57 | -0.807 | 0.000 | 0.754 | 0.000 | 0.246 | 0.000 |

| Method | Party | District | State Power | State Waste |
|---|---|---|---|---|
| Repository Storage | 0.375 | 0.394 | 0.904 | 1.000 |
| Reprocessing | 0.421 | 0.316 | 0.789 | 0.895 |
| On Site Storage | 0.456 | 0.316 | 0.825 | 1.000 |
| Interim Storage | 0.417 | 0.167 | 0.833 | 1.000 |
| Transmutation | 0.667 | 0.667 | 1.000 | 1.000 |

Analysis of the regression results leads to the conclusion that the only statistically significant variable found consistently among the disposal methods was Party. Repository (Figure 6), Reprocessing (Figure 7), and On Site Storage (Figure 8) were all statistically significant disposal methods in the House. Each regression analysis depicts an F-Statistic less than 1%; thus, it is likely that at least one of the independent variable coefficients is not zero and does an impact on **View**. The Senate only saw statistical significance of Party in Reprocessing (Figure 9) with an F-Statistic of 0.161. All other regression analyses were not statistically significant due to high F-Statistics, indicating high probabilities that those independent variable coefficients were zero.

Democrats were likely to view Repository and Reprocessing negatively while Interim Storage was viewed positively. Stakeholder concerns, while mentioned by committee members to varying degrees, were not consistent across the board as statistically significant variables influencing View in the same manner as the Party variable.

Figure 6. Regression Analysis of House Repository Storage

SUMMARY OUTPUT

| Regression Statistics | |
|---|---|
| Multiple R | 0.704 |
| R Square | 0.496 |
| Adjusted R Square | 0.459 |
| Standard Error | 0.572 |
| Observations | 104 |

ANOVA

| | df | SS | MS | F | Significance F |
|---|---|---|---|---|---|
| Regression | 7 | 30.919 | 4.417 | 13.480 | 0.000 |
| Residual | 96 | 31.456 | 0.328 | | |
| Total | 103 | 62.375 | | | |

| | Coefficients | Standard Error | t Stat | P-value |
|---|---|---|---|---|
| Intercept | 0.628 | 0.605 | 1.038 | 0.302 |
| Cost-Benefit | -0.013 | 0.598 | -0.021 | 0.983 |
| Site Safety | -0.031 | 0.580 | -0.053 | 0.958 |
| Transport Risk | -0.459 | 0.595 | -0.773 | 0.442 |
| Desire for Repository | -0.831 | 0.589 | -1.411 | 0.162 |
| Party | -0.694 | 0.151 | -4.607 | 0.000 |
| District | -0.099 | 0.147 | -0.670 | 0.505 |
| State Power | 0.372 | 0.196 | 1.897 | 0.061 |

Figure 7. Regression Analysis of House Reprocessing

| SUMMARY OUTPUT | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| *Regression Statistics* | | | | | |
| Multiple R | 0.824 | | | | |
| R Square | 0.679 | | | | |
| Adjusted R Square | 0.555 | | | | |
| Standard Error | 0.540 | | | | |
| Observations | 19 | | | | |
| | | | | | |
| ANOVA | | | | | |
| | *df* | *SS* | *MS* | *F* | *Significance F* |
| Regression | 5 | 8.002 | 1.600 | 5.493 | 0.006 |
| Residual | 13 | 3.787 | 0.291 | | |
| Total | 18 | 11.789 | | | |
| | | | | | |
| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | |
| Intercept | 2.707 | 0.842 | 3.216 | 0.007 | |
| Cost-Benefit | -1.943 | 0.822 | -2.362 | 0.034 | |
| Site Safety | -2.000 | 0.763 | -2.620 | 0.021 | |
| Party | -1.379 | 0.634 | -2.176 | 0.049 | |
| District | 0.305 | 0.603 | 0.505 | 0.622 | |
| State Power | -0.328 | 0.340 | -0.964 | 0.353 | |

Figure 8. Regression Analysis of House On Site Storage

| SUMMARY OUTPUT | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| *Regression Statistics* | | | | | |
| Multiple R | 0.499 | | | | |
| R Square | 0.249 | | | | |
| Adjusted R Square | 0.191 | | | | |
| Standard Error | 0.494 | | | | |
| Observations | 57 | | | | |
| | | | | | |
| ANOVA | | | | | |
| | *df* | *SS* | *MS* | *F* | *Significance F* |
| Regression | 4 | 4.204 | 1.051 | 4.312 | 0.004 |
| Residual | 52 | 12.673 | 0.244 | | |
| Total | 56 | 16.877 | | | |
| | | | | | |
| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | |
| Intercept | -1.211 | 0.204 | -5.927 | 0.000 | |
| Cost-Benefit | 0.112 | 0.154 | 0.729 | 0.470 | |
| Party | 0.197 | 0.141 | 1.397 | 0.168 | |
| District | 0.513 | 0.164 | 3.134 | 0.003 | |
| State Power | 0.151 | 0.187 | 0.808 | 0.423 | |

Figure 9. Regression Analysis of Senate Reprocessing

| SUMMARY OUTPUT | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| *Regression Statistics* | | | | | |
| Multiple R | 0.717 | | | | |
| R Square | 0.514 | | | | |
| Adjusted R Square | 0.249 | | | | |
| Standard Error | 0.594 | | | | |
| Observations | 18 | | | | |
| | | | | | |
| ANOVA | | | | | |
| | *df* | *SS* | *MS* | *F* | *Significance F* |
| Regression | 6 | 4.115 | 0.686 | 1.942 | 0.161 |
| Residual | 11 | 3.885 | 0.353 | | |
| Total | 17 | 8 | | | |
| | | | | | |
| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | |
| Intercept | 0.956 | 0.767 | 1.247 | 0.238 | |
| Site Safety | 0.020 | 0.501 | 0.040 | 0.968 | |
| Transportation Risk | 0.044 | 0.970 | 0.045 | 0.965 | |
| Cost-Benefit | 0.044 | 0.484 | 0.091 | 0.929 | |
| Party | -1.054 | 0.366 | -2.883 | 0.015 | |
| State Power | -0.230 | 0.403 | -0.570 | 0.580 | |
| State Waste | -0.429 | 0.649 | -0.662 | 0.522 | |

Interestingly, references to the stakeholder concern, Fairness, were never made in the committee transcripts. This could be due to errors made in the search for concerns and methods during the content analysis. It could also be due to an actual absence of references to Fairness by members of the energy committees. Both are plausible conclusions due to the possibility of human error in the former and the history of nuclear waste disposal policy in the United States (e.g., the singling out of Yucca Mountain in politically less-powerful Nevada in 1987) in the latter case.

Political Party is the only statistically significant variable common among the statistically significant disposal methods. Democrats in the House are likely to view Repository Storage and Reprocessing negatively and On Site Storage positively while in the Senate, Democrats are likely to view Reprocessing negatively. If the results of this study focus on the disposal method where positive agreement occurs, reprocessing, despite opposition to it by Democrats, is the disposal method that carries a higher likelihood of being approved by both Congressional energy committees. A negative partisan view of Reprocessing does exist, but it allows focus to be placed on this statistically significant variable. This result may assist in determining what preferences and concerns not discussed in the study could change the minds of the majority of Democrats in the energy committees. The determination of these partisan preferences and concerns could strengthen the possibility of the Congress adopting the reprocessing of nuclear waste as an alternative to the status quo of Repository Storage. Such an adoption could lead to a possible resolution to the problem of nuclear waste disposal through the by-passing of the geologic repository controversy.

## Weaknesses and Issues

### *Data Weakness*

While there are over 250 data points in the model, there is still a problem of availability of data in certain areas. The data collected for the Senate resulted in only 61 lines of data with limited capacity to observe and test individual disposal methods and concerns in a statistically significant manner. The variable "Transmutation" has only one record in the Senate and less than 10 in the House, hardly useful in interpreting the strengths of Congressional views in regard to this disposal method. The same holds true for some of the other concerns and disposal methods in the House. This lack of observation can only provide a general idea of support in the House, but, again, not yield detailed information on the statistical significance of the observations.

Contributing to the limited data points available for the study was the number of available energy committee transcripts discussing nuclear waste disposal. House transcripts ranged from February 1999 to February 2012 with 16 surveyed transcripts while the Senate ranged from July 2001 to February 2012 with 8 surveyed transcripts. On the one hand, this may indicate a weakness in the 30 data point minimum established in the data and methods section. It may also be a result of the lack of discussion of the problem of nuclear waste in the House and Senate and how this issue has been consigned to the political background.

### *House and Senate Behavior*

With the content and data analyses using information taken from a 13 year period, there is the problem that opinions in the Senate and House of Representatives may fluctuate over time. The shifting of power between parties and the election and retirement of new and old members, respectively, make this likely. This possible fluctuation of preferences might make it difficult for the regression models to have any accurate ability in predicting senator and representative preferences towards disposal methods and concerns as time goes on. A brief discussion of this phenomenon is in order to address this issue.

In *Agenda Setting in the U.S. Senate* by Hartog and Monroe, the observation is made that there is a greater likelihood of the majority party in the Senate achieving consideration of its bills because the majority party has greater control over bill considerations, hence controlling what bills go to committee. With more majority-favored bills going into the majority-controlled committee, there is a greater likelihood of their passage out of committee and on to the floor. So, according to Hartog and Monroe, a bill in the Senate will likely make it out of committee if it was initially favored by the party in power in the Senate (81). This observation points to a weakness that must be accounted for in future studies.

In addition, this observed increase of the predictable chances of a majority party achieving bill consideration and passage to the floor to committee is not so in the House. Instead, the issue of consideration and stability is further complicated when discussing behavior in the House of Representatives.

Unekis and Rieselbach, in their book *Congressional Committee Politics*, make the observation that lines of faction division are drawn in House committees in different ways, depending on the "member motivations, committee agendas, environmental conditions, and committee norms and practices" (160). They go on to say: "Congress-by-

Congress comparison reveal that individual panels may take on new forms as time passes…We do, however, believe that stability reflects combinations of conditions peculiar to particular committees more than the impact of any individual influence on all panels" (161). These observations of the stability of committee consistency in both houses of Congress suggest that, depending on the divisiveness of the issue and the social and economic conditions that motivate individual representatives, the House committee has a greater possibility of changing its views more quickly than does the Senate. This could affect the views of the House Energy Committee and the observed results of this study, over time, at a more accelerated rate than in the Senate.

One stabilizing point, however, does come later when Unekis and Rieselbach later observe: "Panels that take legislation to the full chamber with the unified support of a cross-party coalition are more likely to see that legislation survive, unamended, than those bodies that are unable to find consensus in committee" (162).

If there is a united front in regards to a piece of legislation, Unekis and Rieselbach believe that passage of legislation from the floor, to a committee, and back to full consideration on the floor is possible in the House. Nonetheless, future studies should take this problem of stability into account before making final recommendations about actions that should be taken in regards to nuclear waste disposal policy.

*Apportionment in the House and Senate*

The study attempted to account for the effect of apportionment in the House and Senate using the variables **State Power** and **State Waste** in the Senate and **District**, **State Power**, and **State Waste** in the House. These variables tried to determine the statistical significance of the presence of a nuclear waste facility in a senator's or representative's state or district and whether the presence affected their view of the various nuclear waste disposal methods. The apportionment literature suggests that a response to the presence of a nuclear facility would be more pronounced in the House than in the Senate. Robert Baker in *House & Senate* illustrates this observation of the responses of representatives and senators while discussing illegal immigration when he says, "The breath and complexity of House and Senate constituencies also played a role in the distinctive House-Senate differences on immigration reform in the 109$^{th}$ Congress (2005-2007). A member representing a district with an industry or even a single factory that is a magnet for immigrants from Mexico and Central America might look upon immigration policy with different eyes than a senator in whose state that single factory might not loom very large" (207).

Applying the lesson of this example to our discussion, we can surmise that the presence of a single nuclear power or waste facility in a congressional district would generate a stronger response from a representative than would a single nuclear power or waste facility in a highly populated state represented by a senator. This difference in the emphasis from a nuclear power or waste facility's presence could invite conflict between the House and Senate that could further delay nuclear waste disposal legislation. While this is an interesting observation to explore, the lack of data in the survey leaves this question unanswered in the scope of this study. More data as it becomes available in the future may help shed light on this question as it relates to nuclear waste disposal preferences.

*Content Analysis Weakness*

Missing from the content analysis was more than one point of view of the data. In the content analysis literature, the issue of verification in data observation is constantly referred to (Weber 15-17; Laver 66-75; Shapiro 225-238). This idea calls for the meaning of the observed text to be evaluated by more than one observer. Each person in the data observation is trained on what to look for and then makes their observations. Results are then compared to determine convergence between different observers.

This might have helped improve the accuracy of the study's results, but given the time and resource constraints, it was not possible at this time.

Chapter 5

# CONCLUSION

## Evaluation of the Blue Ribbon Commission Recommendations

The Blue Ribbon Commission's strategy to resolve the problem of nuclear waste disposal in the United States has eight elements:

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

To implement this strategy, the Blue Ribbon Commission recommended the following legislative actions.

1. Establishing a new facility siting process – The NWPA, as amended in 1987, now provides only for the evaluation and licensing of a single repository site at Yucca Mountain, Nevada. The Act should be amended to authorize a new consent-based process to be used for selecting and evaluating sites and licensing consolidated storage and disposal facilities in the future, similar to the process established in the expired Nuclear Waste Negotiator provisions of the Act (but under new organizational leadership, as described below).
2. Authorizing consolidated interim storage facilities – The NWPA allows the government to construct one consolidated storage facility with limited capacity, but only after construction of a nuclear waste repository has been licensed. One or more consolidated storage facilities should be established, independent of the schedule for opening a repository. The Act should be modified to allow for a consent-based process to site, license, and construct multiple storage facilities with adequate capacity when needed and to clarify that nuclear waste fee payments can be used for this purpose.

3. Broadening support to jurisdictions affected by transportation – The NWPA provides funding and technical assistance for training public safety officials to states and tribes whose jurisdictions would be traversed by shipments of spent fuel to a storage or disposal facility. The Act should be amended to give the waste management organization the broader authorities given to DOE in the WIPP Land Withdrawal Act that supported the successful large-scale transport of transuranic waste to WIPP (including a public information program, support for the acquisition of equipment to respond to transportation incidents, and broad assistance for other waste-related transportation safety programs).
4. Establishing a new waste management organization – Responsibility for implementing the nation's program for managing spent nuclear fuel and high-level radioactive wastes is currently assigned to the U.S. Department of Energy. Legislation will be needed to (1) move this responsibility to a new, independent, government-chartered corporation focused solely on carrying out that program and (2) establish the appropriate oversight mechanisms.
5. Ensuring access to dedicated funding – Current federal budget rules and laws make it impossible for the nuclear waste program to have assured access to the fees being collected from nuclear utilities and ratepayers to finance the commercial share of the waste program's expenses. We have recommended a partial remedy that should be implemented promptly by the Administration, working with the relevant congressional committees and the Congressional Budget Office. A long-term remedy requires legislation to provide access to the Nuclear Waste Fund and fees independent of the annual appropriations process but subject to rigorous independent financial and managerial oversight.
6. Promoting international engagement to support safe and secure waste management – Congress may need to provide policy direction and new legislation to implement some measures aimed at helping other countries manage radioactive wastes in a safe, secure, and proliferation-resistant manner, similar to the expired NWPA provisions for technical assistance to non-nuclear weapons states in the area of spent nuclear fuel storage and disposal. (Blue Ribbon Commission viii)

Of these five legislative actions, the results of the study are readily applicable to the first two items related to the siting process and interim storage facilities. The creation of a new waste management organization is not readily applicable to the study, but would rather benefit if the new organization took into account the results of the study conducted in this thesis. Ensuring access to funding and international engagement would more than likely follow from the actions of the organization to the findings of this study and not be directly affected by the study's findings.

The following results of the study conducted in this thesis can be made when compared to the Blue Ribbon Commission recommendations:

1. Geologic storage facilities are a divided issue in the houses of Congress. Approval is positive in the House, but negative in the Senate, as demonstrated by the results in the results section. This recommendation by the BRC of a geologic repository for the final disposal of nuclear waste could encounter a great deal of resistance in the passage of legislation.
2. According to the results of the study, interim storage facilities receive a negative view in both the House and the Senate. This observation would indicate difficulty in the enacting of legislation to implement this recommendation.
3. As was seen in the historical overview, it is difficult to meet the needs of a consent-based approach to siting a repository. The Blue Ribbon Commission uses the Waste Isolation Pilot Plant (WIPP) in New Mexico as an example of consent-based cooperation in a community for the storage of nuclear waste. The facility, while approved by the local citizenry and state and local government, only stores low-to mid-level nuclear waste products. The community and Congress, however, have rejected the possibility of having high-level nuclear waste, the same waste that has been at the heart of the discussion of this thesis, stored at WIPP. The example of WIPP's acceptance in a community is a moot point because of this resistance to the storage of nuclear waste. An observation would be that resistance to nuclear waste storage will still be difficult to overcome in a consent-based approach.
4. There is recognition of the potential for alternative methods of waste disposal by the Blue Ribbon Commission, and this could find support in both houses of Congress, given the mutual support given to Reprocessing in the study conducted in this thesis.

**Ethical Considerations**

The results of the study conducted in this thesis yield some interesting results. As was previously mentioned, there is an agreed negative view in the House and Senate on the issue of Interim Storage. There is also disagreement over Repository Storage in both houses of Congress; the Senate indicates a negative view of the method while the House indicates a positive view. These findings call into question the recommendation of the Blue Ribbon Commission to pursue geologic disposal and a simultaneous interim storage program. If the President decides to pursue the BRC recommendations, there is a strong possibility, given the history of nuclear power and the results of this study, that there will be the same legislative resistance that these disposal methods have faced in the past. Such a pursuit, even with a consent-based approach to repository siting, has a strong chance of continuing the delays that have plagued nuclear waste disposal for over 30 years. There is no reason to show that, given this evidence, the pursuit of the status quo of a geologic repository should continue.

While the consent-based approach is emphasized by the Blue Ribbon Commission with reference being made to the success of the Waste Isolation Pilot Plant in Carlsbad, New Mexico, this is not the full story. The October 1992 bill passed by Congress authorizing the construction and implementation of WIPP specifically stated that no high-level waste (the kind of waste bound for Yucca Mountain) would be stored in the facility. Carter in *Nuclear Waste Imperatives* also makes reference to this when discussing the surrounding community's disapproval of any considerations by the government of storing high-level waste (Carter 185-186). The BRC report, while correct that consent of the community should be sought in siting a facility, does not take into account what the community has approved and not approved for storage in their community. Again, this could help prolong the delay of a solution to the nuclear waste problem by implementing an approach that has a strong possibility of being ineffective in the face of the historical record.

With the limitations of repository storage known, it is time to pursue an alternative disposal method. This study points to the possibility that reprocessing nuclear waste is a politically viable alternative. While history has shown that it is a costly method with unproven technology, it has been seen in this study that there is a stronger degree of political acceptance in the House and Senate energy committees of the reprocessing method when compared to repository storage. In addition to this, while there is disagreement over the status of transmutation, politically, this technology should be given some consideration as well.

A reprocessing-transmutation scheme has been seen, theoretically, to be useful in decreasing the amount of waste generated by nuclear power plants and rendering inert long-lived radioactive actinides like plutonium 239 (Vandenbosch 25). There is the problem of maintaining an accounting of fissile nuclear material in the separation processes in these disposal methods and ensuring that these materials are secured. But, unlike the time devoted to repository storage, reprocessing and transmutation have not been given the same serious consideration. The limited amounts of data collected for this study for reprocessing and transmutation and the larger amounts of data collected in statements about repository storage reflect this imbalance of focus. There should be a greater amount of study of these two methods to increase knowledge of their potential to the level that repository storage is understood. The positive agreement of both houses of Congress on Reprocessing warrants the need for more intensive study for, at least, this method of nuclear waste disposal.

**The Need for More Research**

As was stated in the analysis section, the results yielded by the study, while informative, are admittedly weak. Also mentioned was the weakness of the results due to the scarce availability of data to analyze. These problems prevent us from establishing strong, well-reinforced conclusions about politically viable nuclear waste disposal methods. While these are valid points, they should not preclude further study. Rather, they should encourage greater study of the preferences of senators and representatives using the content analysis method. The data gathered here was the result of a single individual coding data from a limited number of transcripts. Still unexplored is the use of multiple coders to ensure data collected is relevant to the study or even the use of computer programs that have the potential to more accurately extract data for analysis.

More data, as it becomes available in the future, would greatly assist in understanding Congressional preferences for nuclear waste disposal methods. This study, with its flaws, is more of a guideline for future analysis of these preferences. The content analysis method employed in this study eliminates the need for time-consuming surveys or interviews of all 535 members of Congress. Greater access to technology for data collection would allow for the potential of greater understanding of the preferences of members of Congress for nuclear waste disposal methods.

As was found in this study, nuclear waste policy is a seldom discussed issue in the Senate and House. But, nuclear waste policy is an issue that has the potential to greatly affect millions of Americans as Figure 1 in the introduction illustrates. A disaster at any number of nuclear waste storage sites could be devastating to a region for many years to come. This is why more study is needed in this area of public policy. A greater understanding of Congressional preferences for nuclear waste disposal methods would greatly contribute to more definitive conclusions. This may provide even more accurate guides that may lead to a political solution to the final disposal of the nation's nuclear waste.

## The Need for a Solution

The ethical question that faces the president and Congress, given the results of this study, is this: Should the United States commit itself to the disposal of nuclear waste using a historically unpopular method that has encountered strong resistance to its implementation or should the country give serious consideration to an alternative like the reprocessing of nuclear waste and develop the safeguards needed for this more politically acceptable method of nuclear waste disposal?

Nuclear power plants in the United States have stored nuclear waste on site since the beginning of nuclear power. Power plant operators were promised by the United States government that a solution would be found and are continuing to be billed for contributions into the Nuclear Waste Fund for the purposes of constructing a facility to store their nuclear waste.

President Obama in 2010 called for the construction of new nuclear power plants in the United States to help reduce carbon emissions in the United States. Nuclear power, while generating nuclear waste, does not produce the kind of carbon emissions that a coal-fired plant produces. Nuclear power could become the sole source of energy in the United States. And if not the sole source, it could serve as a buffer technology between coal-fired plants and future renewable technologies like solar and wind power that are more cost-effective and efficient.

If a solution to nuclear waste is not implemented, waste will continue to accumulate at power plants and remain highly radioactive for many generations to come.

In addition to this, the continued use of nuclear power, without a solution, means even more waste generated and stored for generations to come.

The results of this study provide a foundation for future studies of Congressional preferences for various disposal methods. It reveals the potential of Reprocessing to be more politically viable than the status quo of Repository Storage. The political environment is the crux of the matter when discussing nuclear waste disposal. Technology can improve and adapt, but it is the human factor, in this case the members of Congress approving funding of innovation, that ultimately decide to stall innovation or allow it to progress.

Nuclear waste is a very dangerous and long-lived substance and the future of nuclear waste stored around the United States lies in the decision of the president and Congress on what disposal route to take. The ultimate question the study's results lead to is: Will the president and Congress make the right decision and adopt an alternative disposal method?

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